Phylum-Annelida

General Characters

Annelida consists of bilaterally symmetrical, true coelomate, triploblastic, metamerically segmented worm-like animals. Eg. Nereis, earth worm, leeches, etc. They have the following general characters:

- Annelids have a soft, elongated and cylindrical body.
- Annelids are b**ilaterally symmetri**cal animals.
- They have **organ-system grad**e of organization.
- They are the firs**t true coelomate anim**als.
- They have triploblastic body wall.
- The anterior end has a head in some forms.
- The muscle layers are thick in the body wall. Hence the body wall is said to be **dermomuscular.**
- The body is divided into a number of segments called **the metameres**. The segmentation is k**nown as metamerism**.
- The body is covered with a thin cuticle.
- Locomotory organs are setae.
- Digestive system is well developed.
- Blood vascular system is a closed type.
- Excretory system is formed of segmentally arranged nephridia.
- Nervous system is formed of a pair of cerebral ganglia (brain) and a double ventra**l nerve cord**.
- Mostly annelids ar**hermaphrodités.**
- The gonoducts are formed from **coelom (coelo** moducts). The coelomoducts have connection with nephridia.
- Regeneration is a common character in thphylum.
- Their development is **direct or indi**rect. Trochophore is a typical larva.

Classification

Phylum *Annelida* is divided into *eight classe*s. They are the following:

Class 1. Polychaeta

Order 1 Errantia

· Order 2.Sedentari

Class 2. Oligochaeta

Order 1 Archioligochaeta

Order 2 Neooligocha

Class 3. Hirudinea

Order 1 Acanthobdellida

Order 2. Rhynchobdellida

Order 3. Gnathobdellid

Class 4. Archiannelida

Class 5. Echiuroidea

Class 6. Sipunculoidea

Class 7. Priapulida

Class 8. Myzostomaria

Nereis

Phylum: Annelida
Class : Polychaeta
Order : Errantia

- ✓ Nereis is a marine worm commonly known as **clam-worm or rag-worm or sand-worm.**
- ✓ It has several species. The common and important species is N.diversicolor.
- ✓ It is a true coelomate worm with segmented body. Hence it is included in the phylum Annelida.
- ✓ The loco**moto**ry organs are setae and the setae are arranged in groups. Hence Nereis is included in the class Polychaeta.
- ✓ It is **cosmopolitan** in distribution. It is **a marine an**nelid and it lives in th**e sea shore b**etween tide marks.
- ✓ It is also found among the sea weeds and under stones. Normally it' lives in **burrows.**
- ✓ **It** is a free living, predaceous and nocturnal animal.
- ✓ The body is long, narrow, slender and bilaterally **symm**etrical tapering posteriorly.
- ✓ The length varies with species. Nereis virens is 40 to 45cms long.
- ✓ The upper surface of the body is convex while the lower surface is flat.
- ✓ The colour may be brown, dark brown, reddish brown or blue green.
- ✓ The body consists of two regions, namely *head a*nd *trunk.*
- ✓ The head consists of an anterior ***prostomium*** and a posterior ***peristomium.***
- ✓ Prostomium lies infront of the mouth and it is a ***triangular*** lobe.
- ✓ It bears dorsally two pairs of simple eyes, a pair of *prostomia* ***tenta****cles* at its anterior tip and a pair of short, fleshy and two joined *palps* on the ventral side.
- ✓ On each side of prostomium there is a ciliated pit which is called nuchal organ.
- ✓ Peristomium has a mouth and two pairs of slender cylindrical tentacles called **peristomial tentacles.**
- ✓ The trunk is divided into a number of segments or **metameres** which may be 200 or more. Each metamere bears a flat, paddle like fleshy and hollow outgrowth on either side known as parapodium.

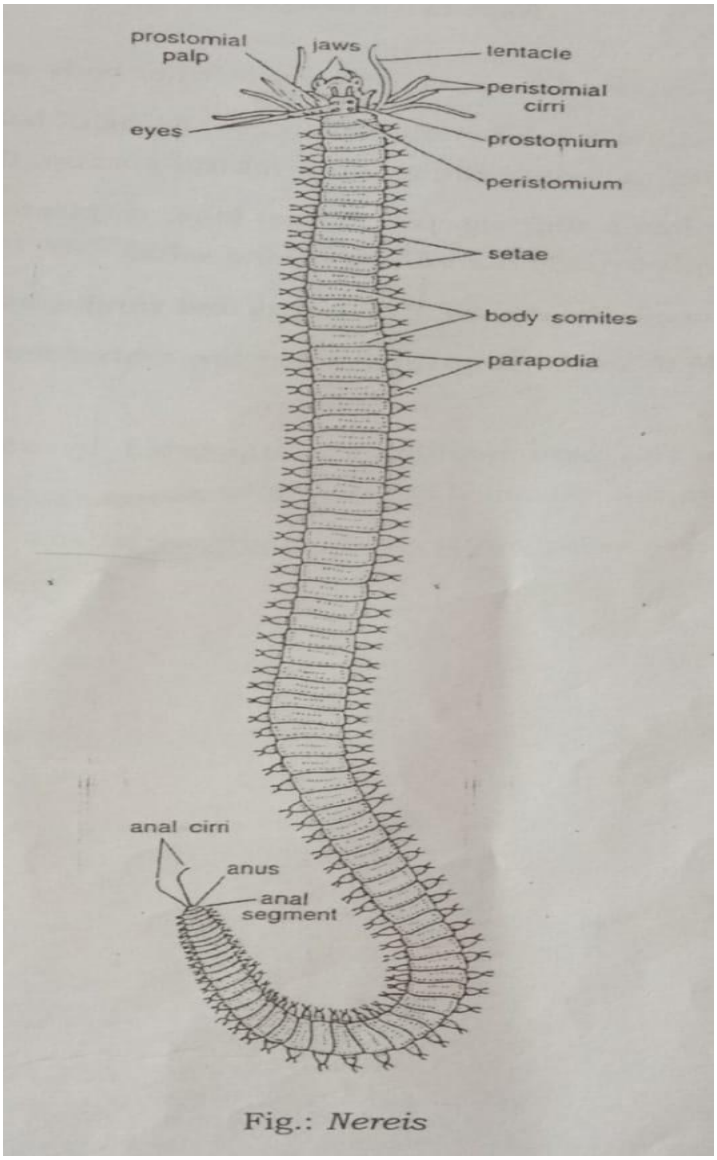


Fig.: *Nereis*

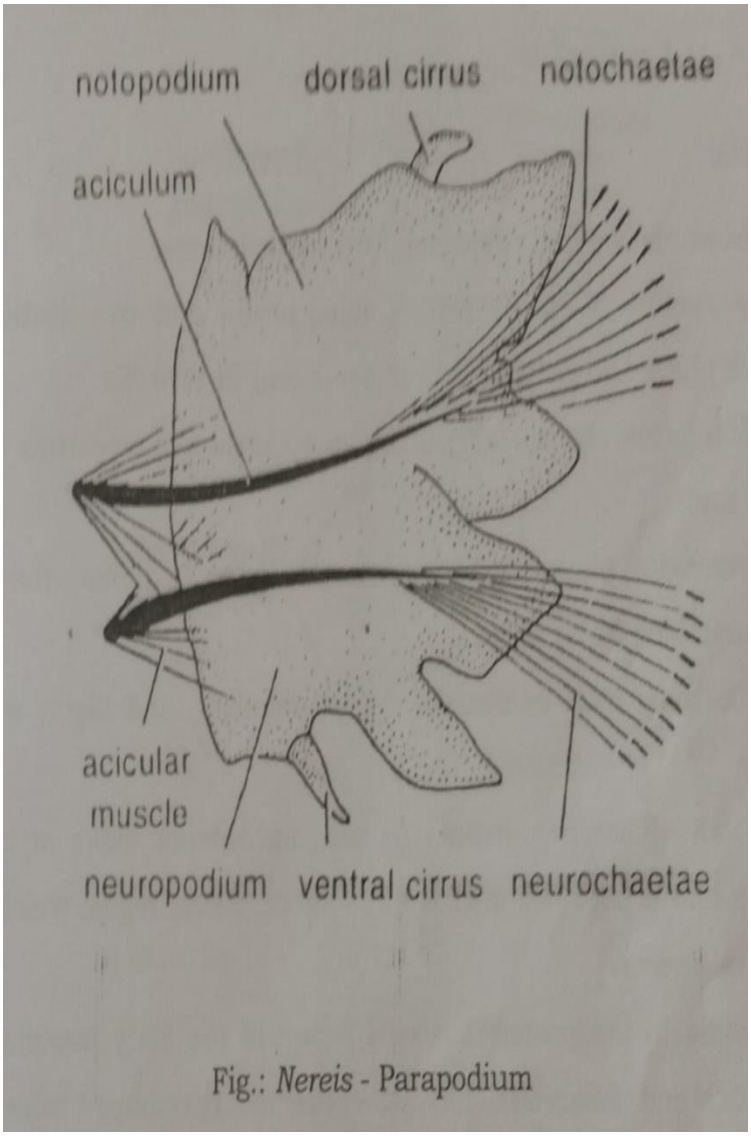


Fig.: *Nereis* - Parapodium

Parapodium

- ✓ Parapodium is a *side-foot o*f *Nereis.* It is a hollow lateral outgrowth of the body. Each segment has a pair of parapodia. They are absent from the first and last segment. Each parapodium is **a *biramous*** structure because it is formed of two lobes **or *rami.***
- ✓ The parapodium has *a basal region* and *a distal region.* The parapodium is attached to the segment by the *basal region.* The *distal region* has two parts,namely a dorsal *notopodium* and a ventral ***neuropodium.***

- ✓ The notopodium and neuropodium are bilobed and bear a bundle of setae embedded in a sac, the *setigerous sac.* One of the setae in each bundle is dark coloured and thicker than the rest. It is known a*s aciculum.* It forins a kind of internal skeleton to the para*podi*um an*d al*so provi*des* the attachment of setal muscles.
- ✓ A short filamentous appendage is present on the of the notopodium an it is called *dorsal cirr.* neuropodium bears a similar process, the ventrai its ventral side.
- ✓ The seta is made up of a basa*l shaft a*nd a distal blade. The blade can be retracted into the shaft. There are three types of setae.
- ✓ One has a fine shaft and the terminal blade i*s long, slender, straight a*nd *pointed.* In the second type the shaft is stout and the blade is short and slightly *hooked.* In the third type the blade is ***oar-shaped.***

Functions

The parapodia has the following functions :

1. Locomotion
2. Respiration and
3. Offense and defence.

Body Wall

- ✓ The body wall i*s triploblastic* and ***dermo-muscular.*** **It** consiscuticle, epidermis, muscles and peritoneum.
- ✓ Cuticle : It is a thin, non-cellular, irridescent outer covering. It is secreted by the underlying epidermis and is *chitinous* in nature. It is perforated by numerous minute pores through which the epidermal glands open out.
- ✓ **Epidermis** : It is thin. It consists of a single layer of columnar s***upporting*** *cells* resting on *a* ***basement membrane.*** In between, *sensory cells* an*d gland cells* are found.
- ✓ Muscles : Muscles are formed by ***mesoderm*** **a**nd they are situated below the *epidermis.* Muscles are of three types, *circular, longitudinal a*nd *oblique.*
- ✓ The circular muscles lie next to the epidermis and form a complete layer, which is thicker on the ventral than on the dorsal side.

- ✓ Longitudinal muscles are not continuous but are arranged into four longitudinal bundles, out of which two bundles are *dorsolateral* and the other two are *ventrolateral.*
- ✓ There are two pairs *of oblique muscles* in each seg One pair is inserted in th*e anterior face* and the other in ***post****erior face o*f the bases of th*e parapodia.* Besides parapodium has a complicated system of parapodial muscle which are responsible for the movements of the various loh and setae.
- ✓ **Peritoneum** : This is the inner most layer of the body, wall. It covers the muscles internally and forms the linino of the body cavity. The layer of peritoneum lining the body cavity is called *parietal or coe****lomic epithelium.***

Body Cavity

- ✓ The body cavity extending between the body wall and the alimentary canal is a *coelom.* It is lined by the ***peritoneum* or *coelomic epithelium.*** **I**t is divided into two layers,a. ***parietal l****ayer* lining the body wall and b. ***splanchni****c o*r ***visceral layer.***
- ✓ There are tw***o mesenteries*** in each segment on the median side 1. ***dorsal*** **and 2.** ***ventral.***
- ✓ The body cavity is filled with a colourless *coelomic fluid* containing amoeboid corpuscles and numerous reproductive cells in various stages of development

Locomotion

- ✓ Locomotion takes place with the help of *parapodia, body muscles* and the ***coelomic fluid.***
- ✓ *Nereis* shows three types of locomotion: *slo*w *creeping, fast creeping* and sw***imming.***
- ✓ S*low creeping* involves the action of parapodia only. parapodia perform a circular movement involving an *effective or backward stroke* and *recove*ry or *forward stroke.* In the effective stroke the parapodium is protruded and moved backward and downward on the substratum.
- ✓ *Fast creeping* involves slow, lateral undulations of the body, in addition to the parapodial activity. The lateral undulations of the body are caused by wave-like contraction of longitudinal muscles.
- ✓ **S*wimming*** involves lateral undulations of muscles along with the action of parapodia.

- ***Bu****rrowing d*epends mainly upon the thrust exerted by the proboscis, comprising the buccal cavity and pharynx.

Digestive System

- The digestive system is formed of two components, namely ***alimentary canal*** and *digestive g****lands.***

Alimentary Canal

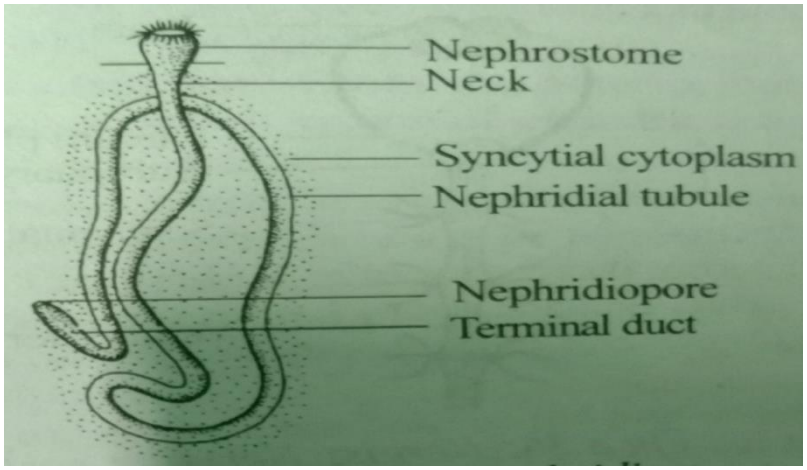
- Alimentary canal is straight tube. It starts from the *mouth* and ends with *anus.* It consists of three main regions, namely *fore-gut, mid-gut and hind-gut.*
- The fore-gut includes *mouth, buccal cavity* and *pharynx.* The mid-gut is formed of *oesophag****us*** **and** ***stomach-intestine.*** The hind-gut is formed of *rect****um*** **and** ***anus.***
- *Mouth* leads into a *buccal cavity* which opens into the *pharyn*x. The buccal cavity and pharynx extend through the peristomium and the succeeding four segments of the body. They are lined with *cuticle.*
- The cuticle is thickened at various places to form small dark brown *denticles.* They are also known as *cuticular teeth* or *pharyngeal teeth.* A pair of these cuticular teeth is greatly enlarged and these **teeth are c*alled jaws.* Each jaw is an *el*ongated structure po*i*nted *an*teri***o***rly an*d* roun posterior end. The inner margin of each jaw bears several strong teeth. Each jaw is connected to the posterior part of th **by muscles. These muscl**es help in the move*me*nt of jaws.
- The buccal cav**ity is ev*ersibl****e*** and the pharynx is ***protrusible****. E*version is brought about partly by the contraction of a set of muscles, the ***protractor mus****cle*s and partly by the pressure of the coelomic fluid. Retraction is effected by a pair o**f** ***retractor muscles*** **w**hich extend between the hinder end of the pharynx and the body wall.
- **The** ***oesophagus*** is a short tube occupying five segments behind the pharynx. A pair of ***oesophageal glands*** lies on the sides of the oesophagus and opens into it. The oesophagus is followed by the ***stomach-intestine.***
- Behind the stomach-intestine, a very short chambet, is ***rectum*** **is p**resent. It occupies the last segment and o*p* posteriorly by the ***anun.***

Respiratory System

- ✓ In *Nereis,* respiratory organs are lacking. Respiration occurs by *diffusion* through body surface. The parapodia are highly involved in this process. Each parapodium has a capillary network and is richly supplied with blood. The body walls of the dorsal and ventral sides are supplied with a network of blood capillaries.
- ✓ When the blood passes through these networks, it obtains oxygen from the surrounding water and gives out carbon-di oxide. The respiratory pigment, ***haemoglobin*** present in the blood greatly increases its capacity for oxygen absorption.

Excretory System

- ✓ Excretory organs consist of a series of segmentally, arranged pairs of coiled and ciliated tubes called s*egmental organs* or *nephridia*. There is a pair of nephridia in ea segment except the peristomium and the anal segment. La nephridium is formed by a s*yncytial mas*s of protoplası containing a long convoluted and ciliated canal call *nephridial tubule.*
- ✓ The nephridial tubule passes through the septum int anterior segment where it opens by a ciliated funnel call *nephrostome*. The nephridium with a nephrostome is calle ***metan****ephridium.*
- ✓ Posteriorly it opens to the exterior at the base of the parapodium near its ventral cirrus by a fine pore called ***nephridiopore.***
- ✓ The chief excretory product i***s ammonia."***
- ✓ In each segment on the dorsal side adjacent to the longitudinal muscle bundles, there is a dorsal *c****iliated organ.*** It also seems to be excretory in function.



Sense Organs

*Nerei*s has well developed sense organs**.**

- ✓ Pros**tomial tentacle**s: From the anterior borders of prostomium project a pair of small cylindrical tentacles. These are tactile in function.
- ✓ **Prostomial pal**ps: On either side of the prostomium from ventro-lateral surface originate a pair of short, thick and muscular palps. Each palp is made up of two pieces, the basal piece is large, while terminal piece is small and is capable of retraction into the basal piece. They are also regarded as tactile in function.
- ✓ **Nuchal organs**: On each side of the prostomium there are ciliated pits. Though doubtful in function, they are supposed to be *olfactory* or *chemoreceptive.*
- ✓ **Peristomial cirri: T**wo pairs of cirri are situated at the anterior end of peristomium; they serve as tactile organs.
- ✓ **Ey**e: On the dorsal surface of the prostomium there are four simple eyes.

R*eproduc*tive System

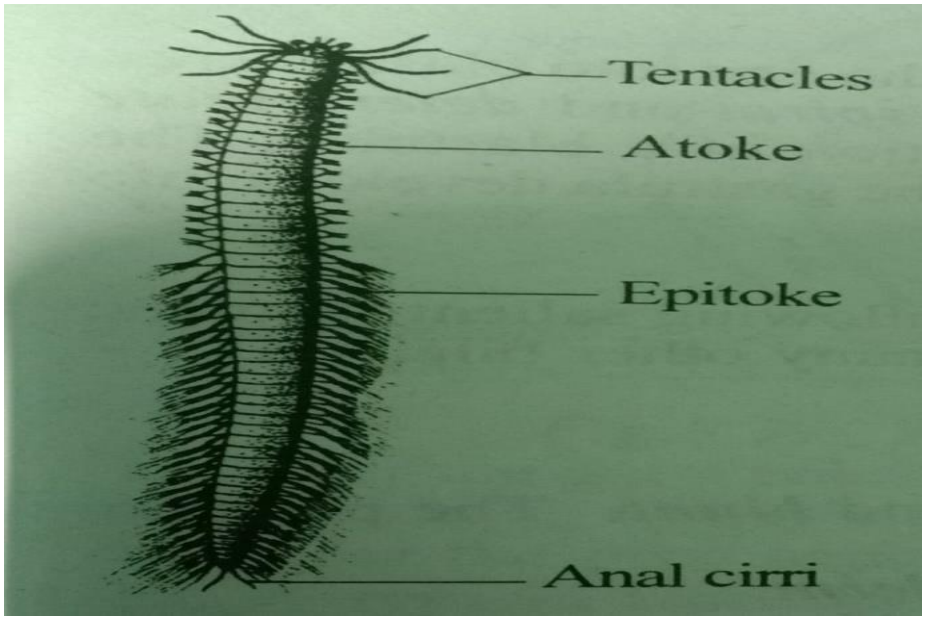
- ✓ *Nereis is dioecious o*r unisexual i.e., sexes are Gonads are temporary organs appearing only during in breeding season (summer months). Gonads i.e. te ovaries develop by rapid pro*lifera*tion and m*o*dification ventral coelomic epithelial cells.
- ✓ Reproductive cells are found in each segment except nem the anterior end. But in male *N.dumerilli, a* single pair in testis develops in one of the segments of the body between 19th to 25th segments. Testis produces the sperm with a rod shaped head and a vibratile tail. : In the female the ovaries lie in many segments around blood vessels.
- ✓ Gonads have no gonoducts. Sex cells are discharged into the coelom and the sex cells mature while floating in the coelomic fluid.
- ✓ Ripe ova and sperm escape through nephridiopores and by the rupture of the body. Fertilization takes place externally in the seawater.
- ✓ Sexually mature *Nerei*s of certain species show variations and modifications. Such species exhibit two distinct phases in the life cycle, *a* ***non-sexual or nereis phase*** and s*exual* **or *heteronereis phase.***

Heteronereis

- ✓ The sexually mature Nereis is called heteronereis. The heteronereis is so different from the Nereis that for a long time, heteronereis was considered as a separate species. buy it was Malamgren who proposed that heteronereis was my a separate species but it was the sexually matured phase the Nereis.

The heteronereis has the following salient features:

- ➢ It swims actively on the surface of the sea.
- ➢ The eyes become large.
- ➢ The peristomial tentacles are elongated.
- ➢ Anal cirri are elongated.
- ➢ The pygidium develops special sensory papillae.
- ➢ Intestine becomes dorsoventrally flattened, reduced and functionless.
- ➢ The body is divided into an anterior non-sexual part, the **atok**e and the posterior sexual part, the epitoke. The epitoke is - Atoke filled with gametes.
- ➢ The parapodium develops leaf-like outgrowths. It is Epitoke supplied with large amount of blood to increase the respiratory rate. The dorsal cirrus is altered. The old setae are replaced by new setae. The setae become **oar-shaped. Parapo** dium is 'actively used for swimming.
- ➢ The male heteronereis is. smaller than the female. So they **exhibit sexual dimorphism.**
- ➢ The heteronereis stage is brought about by the action **of hormones.**



Significance of Heteronereis

The heteronereis swims in large numbers. During this mass movement the sperms and ova are liberated into the sea where fertilization takes place. This process is called s**warming or spawning. S**warming facilitates wide dispersal of the species.

Development

In Nereis, the development is indirect. The life cycle includes a trochophore larva.

Egg

The egg is spherical in shape. It is covered by three membranes, namely an outer jelly coat, a middle " **membrane** and an inner **zona radiata.**

Fertilization

Fertilization is external. It occurs in wate egg is called zygote.

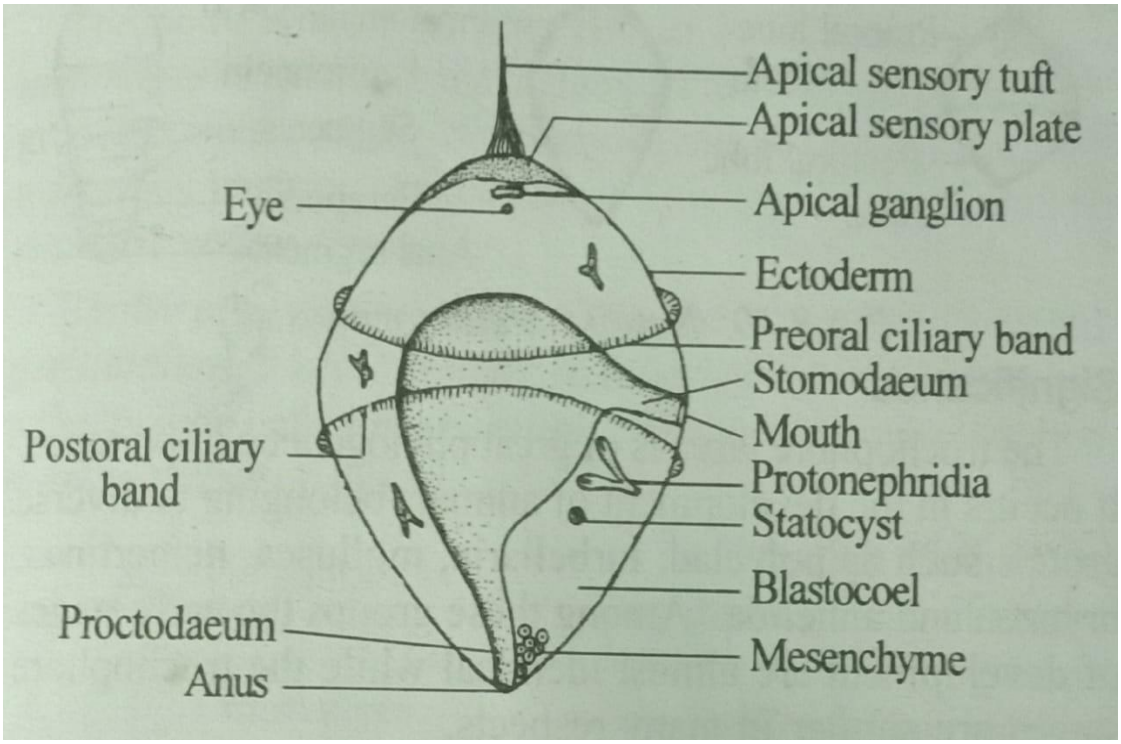
Cleavage

Cleavage is the segmentation of the egg into blostomeres.Cleavage is **holobiustic,**, **unequal, spiral** and determ type. Cleavage leads to the formation of a blast blastula develops into a gastrula. The gastrula devel a larva called trochophore larva.

Trochophore larva

The trochophore larva has the following salient featurec.

- It is the larva of Nereis and many other bilateria.
- It is a **free-swimming larva.**
- It is **microscopic.**
- It is top-shaped.
- The anterior end is broader and blunt. The posterior end is **narrower and pointed.**
- The body is covered by e**ctoderm.**
- The ectoderm at the anterior end becomes thickened and forms a plate called apical sensory plate. –
- The apical plate bears an apical ganglion and a pair of **eyes.**
- The apical plate bears a tuft of cilia called apical **sensory tuft.**



- On the ventral side the **mouth i**s present. The mouth leads to the **stomodaeum** which is followed by stomach. The stomach leads into the **proctodaeum w**hich opens outside by the **anus.**
- The body has two regions, namely an anterior preo lobe and à posterior postoral lobe. The preoral lobe is located in front of the mouth and the postoral lobe is locate behind the mouth.
- The body cavity lying in between the gut wall and the body wall is called blastocoel. The blastocoel contains **mesenchym**e cells. **n.**
- Near the gut a pair of protonephridia is present. They open outside by a sing**le excretory pore.**
- Near the protonephridia **a statocyst** is present.
- A typical trochophore larva is surrounded by two **girdles of cilia, one in front of the mouth called preoral circlet or prototroch** and the other behind the mouth called **postoral circlet or metatr**och. In some cases there is a girdle of cilia around the anus called p**erianal circlet (telotroch).**
- In some cases there will be a single circlet of cilia in the middle of the body called **mesotroch.**
- In some larvae many circlets of cilia are present. They are called the **polytrochs.**

- In some other larva there will not be any girdles of cilia but the body is uniformly covered with cilia. Such a larva is called **atroch.**

Metamorphosis

- ✓ After some days of free swimming life, the larva undergoes metamorphosis. During this, the preoral lobe develops into **the prostomium** and the postoral lobe elongates and becomes segmented. The first segment develops into the perist and the last segment develops into the pygidium.

Significance

- ✓ The trochophore larva is of great phylogenetic importance It occurs in the development of animals belonging to diverse groups such as polyclad, turbellaria, mollusca, nemertinea. bryozoa and annelida. Among these groups the early stages of development are almost identical while the trochophore stages are similar in many respects.
- ✓ This led Hatschek to formulate a theory called trochophore **theory**. According tothis theory almost all the present day bilateral phyla are originated from a hypothetical ancestor called tr**ochozoon. I**t resembles the trochophore larva and the adult rotifers.