host to another easier and safer.

PHYLUM ANNELIDA (THE SEGMENTED WORMS)

- The **annelids**, collectively called **annelida** (from Latin *annelus* "little ring"), are a large phylum of segmented worms, with about 17,000 modern species including ragworms, earthworms and leeches. They are found in marine environments from tidal zones to hydrothermal vents, in freshwater, and moist terrestrial environments.

GENERAL CHARACTERS

- **Habitat :** Annelids occur in fresh water, sea water or moist soil. Some are free living, some are burrowing and a few are parasitic.
- **Metameric segmentation :** The annelids are characterised by metameric segmentation, *viz.*, the body is divided externally by ring like grooves the **annuli** (Latin *annulus* : little ring) and internally by transverse **septa.** The segments are called **metameres.** The first segment is called **peristomium.** An outgrowth, known as **prostomium,** arises from the peristomium.
- **Symmetry :** They show bilateral symmetry.
- **Germ layers :** Annelids are triploblastic animals.
- **Level of organization :** They have **organ-system** level of organization.
- **Setae and parapodia :** Except leeches, unjoined chitinous **setae** are often present. Some annelids such as *Nereis* have unjoined, locomotory structures, the **parapodia** (*para*-parallel, *podia*-feet).
- **Body wall :** The body wall consists of thin, and moist noncellular **cuticle,** single layered **epidermis** and **circular** and **longitudinal muscles.** The muscles are smooth which are highly contractile and help in locomotion.
- **Coelom (Body cavity) :** A true coelom is present. From evolutionary point of view, annelids are, perhaps, the first

animals to have a true **schizocoelic coelom.** In most annelids coelom is divided by septa into compartments. The coelom is filled with **coelomic fluid** which contain cells.

- **Hydrostatic skeleton :** The coelomic fluid serves as a hydrostatic skeleton.
- **Digestive tract :** It is complete.
- **Respiratory organs :** Exchange of gases usually occurs through the skin (cutaneous respiration). In some annelids gaseous exchange also occurs through gills **(branchial respiration).**
- **Blood vascular system :** It is usually **closed type.** Blood is red due to the presence of respiratory pigment **haemoglobin** or **erythrocruorin,** found dissolved in the plasma. Free **amoeboid blood corpuscles** are present, but there are no red blood corpuscles. In leech, there in no true blood vascular system. The coelomic space and fluid have been modified to form the circulatory system. It is called **haemocoelomic system** and red coelomic fluid is called **haemocoelomic fluid.**
- **Excretory system :** It consists of coiled tubular structures, called **nephridia** which helps in osmoregulation and excretion. Ammonia is chief excretory waste.
- **Nervous system :** The nervous system consists of a **nerve ring** and a solid, double, mid ventral **nerve cord** with **ganglia.** A ganglion is an aggregation of nerve cells.
- **Receptors : Tactile receptors** (sensitive to touch), **gustatoreceptors** (receptors of taste) and **photoreceptors** (sensitive to light) are usually found. Some forms have **statocysts** (balancing organs).
- **Sexes :** Both unisexual or dioecious (*e.g., Nereis*) and bisexual or monoecious (*e.g.,* earthworm, leech) forms are found.
- **Development :** It is mostly direct. If there is indirect development (*e.g., Nereis*), it includes a **trochophore larva.**

Nephridia

- Nephridia are segmentally arranged coiled tubes of ectodermal origin developed as invaginations from ectoderm into coelom.
- They communicate with the exterior through laterally placed small apertures called **nephridiopores.**
- Nephridia are of two types, **protonephridia** and **metanephridia.**
- Protonephridia are **closed nephridium** as they terminate in the coelom as a blind tube. The closed end of protonephridium are provided with peculiar specialized excretory **tube cells** or **solenocytes. These are similar to flame cells of platyhelminthes.**
- Protonephridia is found in all larval polychaetes and some adult polychaetes such as *Vanadis, Phyllodoce,* etc.
- Metanephridia are open nephridium, as instead of solenocyte, the inner end of metanephridium opens into coelom by a ciliated funnel or **nephrostome.**
- Metanephridia are more advanced and found in the majority of polychaetes, all oligochaetes and leeches.
- Nephridia may be **micronephridia** or **meganephridia** on the basis of their size and number. Micronephridia or meronephridia are smaller in size and found in oligochaetes. Micronephridia or holonephridia are larger in size and found in polychaetes and leeches.
- Nephridia are termed **exonephric** or **ectonephric** when they directly open to the exterior through **nephridiopores,** *i.e,*

CLASSIFICATION

- Phylum annelida is divided into four main classes, primarily on the basis of the presence or absence of parapodia setae, metameres and other morphological features.

Class 1. Polychaeta

(Gr., *polys*, many + *chaite*, hair)

- Chiefly marine, some in fresh water.
- Segmentation internal and external.
- Head distinct with eyes, palps and tentacles.
- Setae numerous, on lateral parapodia.
- Clitellum absent.
- Sexes separate. Gonads temporary and in many segments.
- Trochophore larva present.

Subclass 1. Errantia

- **Examples :** *Aphrodite* (sea mouse), *Polynoe, Phyllodoce, Tomopteris, Syllis, Nereis, Glycera, Eunice, Diopatra, Histriobdella.*

Subclass 2. Sedentaria

- **Examples :** *Chaetopterus, Arenicola, Owenia, Sabella, Sabellaria, Terebella, Amphitrite, Pomatoceros, Spirorbis, Serpula.*

Class 2. Oligochaeta

(Gr., *oligos*, few + *chaite*, hair)

- Mostly terrestrial, some in fresh water.
- Segmentation external and internal.
- Head indistinct, without sensory organs.
- Setae few, embedded in skin. Parapodia absent.
- Glandular clitellum present for cocoon formation.
- Hermaphroditic. Testes anterior to ovaries.
- Fertilization external (in cocoon), development direct, no larval stages.

Order 1. Plesiopora plesiothecata

- **Examples :** *Aelosoma, Nais, Dero, Chaetogaster, Tubifex.*

Order 2. Plesiopora prosothecata

- **Example :** *Enchytraeus.*

Order 3. Prosopora

- **Example :** *Branchiobdella* (parasitic).

Order 4. Opisthopora

- **Examples :** *Lumbricus, Eisenia, Pheretima, Megascolex, Allolobophora, Dendrobaena.*

Class 3. Hirudinea

(L., *hirudo*, leech)

- Freshwater, marine or terrestrial. Generally ectoparasitic, blood-sucking or carnivorous.
- Body with fixed number of segments (33). Each segment subdivided externally into annuli.
- Segmentation external without internal septa. Parapodia and setae absent.
- Both anterior and posterior ends of body with suckers.
- Coelom much reduced due to its filling by botryoidal tissue, and forms haemocoelomic sinuses.
- Hermaphroditic with one male and one female gonopore. Fertilization internal. Development in cocoons, direct without larval stages.

Order 1. Acanthobdellida

- **Example :** A single Russian genus and species (*Acanthobdella*) parasitic on salmon.

Order 2. Rhynchobdellida

- **Examples :** *Glossiphonia, Placobdella, Helobdella, Piscicola Pontobdella, Branchellion, Ozobranchus.*

Order 3. Gnathobdellida

- **Examples :** *Hirudo, Hirudinaria, Haemadipsa.*

Order 4. Pharyngobdellida

- **Examples :** *Erpobdella, Dina.*

Class 4. Archiannellida

(Gr., *arch.* first)

- About one dozen genera of small, marine worms of unknov affinities.
- Segmentation chiefly internal. No parapodia and setae.
- Sexes usually separate.
- Usually trochophore larva.
- **Examples :** *Polygordius, Dinophilus, Protodrilus.*

EXCRETORY SYSTEM

- Earthworms are both **ammonotelic** and **ureotelic.** The main excretory organs in them are **nephridia** which consists of slender and coiled tubules which perform the function of **excretion** and **osmoregulation.**
- The nephridia occurs in all segments except in the first two segments and are of three types according to their location :
  - Septal nephridia } enteronephric *i.e.*, nitrogen
  - Pharyngeal nephridia } products are expelled in gut.
  - Integumentary nephridia (exonephric *i.e.*, nitrogen waste products are directly discharged outside).

Septal nephridia

- They show complete organization (holonephridia). They are present attached to the septa behind the **fifteenth** segment and each septa bears **40 – 50 septal nephridia**, thus acquiring

80 to 100 septal nephridia in each segment.

It is made up of four components : Nephrostome, neck, body and terminal duct.

Nephrostome is a flat, funnel-like, ciliated and collects excretory matter from the coelomic fluid and the blood.

Neck is a short, narrow, ciliated tubule and connects terminal duct with nephrostome.

Body is divisible into a small, straight lobe and a long twisted lobe which has one proximal limb and one distal limb. Both limbs are twisted 9 - 13 times around each other.

Terminal duct is short, narrow and consists of ciliated terminal part of nephridial duct enclosed in connective tissue matrix.

A pair of loop-like septal excretory canal in each segment receive the terminal ducts of their side. A pair of supra-intestinal excretory ducts are present on the dorsal surface beginning from segment 15 to the last and receive the segmental (= septal) excretory canal of their side. The former open into intestine and voids the N_2 waste in it. This is the reason why septal nephridia are called enteronephric.

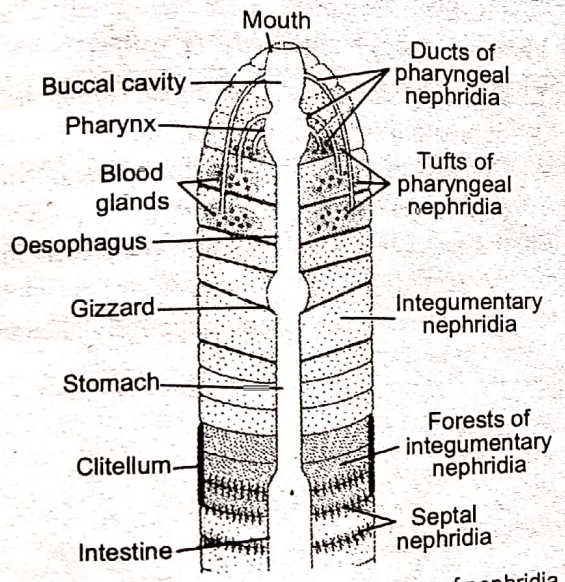

Fig.: Location of three types of nephridia

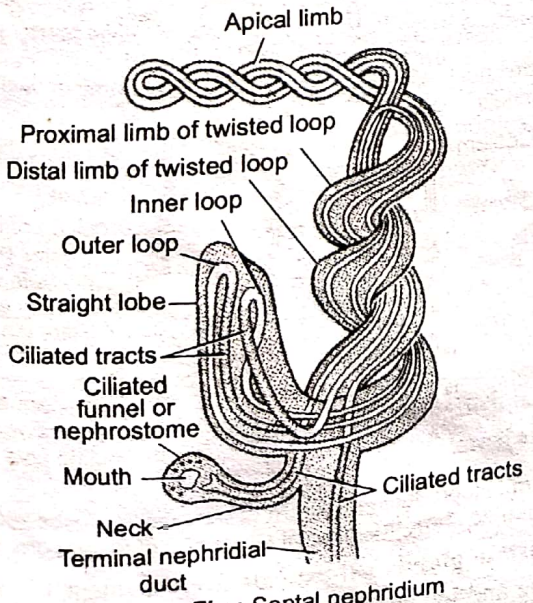

Fig.: Septal nephridium

Pharyngeal nephridia

- These are found in segments 4, 5, 6 along with blood-glands. They are as large as septal nephridia. Funnel and neck is absent. Terminal ducts of all nephridia unite to form a common duct (3 pairs). Of these 2 open into buccal chamber and the third in pharynx.

Integumentary nephridia

- They are found scattered on the inner surface of the body wall (integument) in each segment except the first two segments.
- In others except clitellar segments their number is 200 - 250 and in clitellar region (14 - 16) segment) their number is 2000 - 2500 (**Forest of nephridia).**
- They are smallest, lack neck and nephrostome and terminal duct is without cilia. They open directly to outside by nephridiopores hence are **exonephric** or **ectonephric.**

Physiology of excretion

- *Pheretima* is both **ammonotelic** and **ureotelic**. The urine is acidic and in addition has water and traces of creatinine. Chloragogen cells are the site of urea formation. These cells (a) deaminate amino acids and (b) absorb NH_3 from coelomic fluid and blood. Nephridia function differently in summer, winter and rainy season. In summer and winter they reabsorb much more water and conserve it, while in rainy season this reabsorption is less and the urine is dilute. Nephridia of earthworm are osmoregulatory in function.
- Excretory fluids contain 40% urea, 20% ammonia, 40% amino acids and other nitrogenous compounds but no uric acid or urates.