

MZ – 105 GENERAL ZOOLOGY

UNIT – I

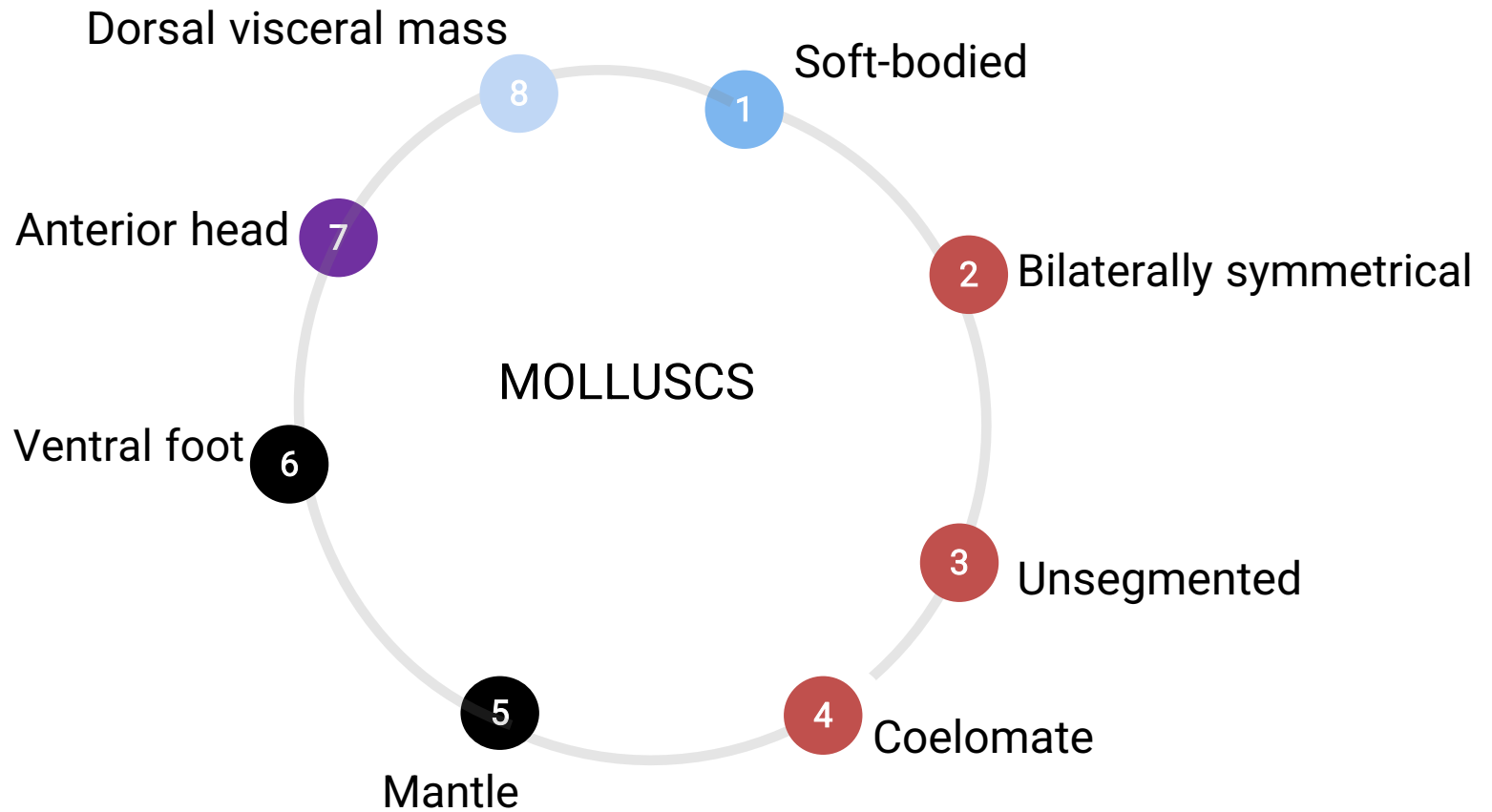
TOPIC:

“NERVOUS SYSTEM, MODIFICATIONS OF FOOT, AND
USEFUL AND HARMFUL MOLLUSCS”



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Characteristics



Systematic Classification of Molluscs:

There are seven classes of phylum Mollusca

Class 1. Aplacophora (shell less deep sea marine molluscs)

Order 1: Neomeniooidea e.g. *Neomentoia*, *Lepidomenia*

Order 2: Chaetodermatoidea e.g. *Chaetoderrma*, *Prochaetoderma*

Class 2. Polyplacophora (elongate oval with dorsal shell of eight plates)

Order 1: Lepidopleurida e.g. *Lepidopleurus*, *Hanleya* etc.

Order 2: Chitonina e.g. *Chiton*, *Choneplex* etc.

Class 3. Monoplacophora (one plate shell) e.g. *Neopilina*

Class 4. Gastropoda (Gr. gaster=belly+podos= foot, coiled shells) e.g. *Pila*, *Bulla*, *Clione*

Class 5. Scaphopoda ((tusk shells)e.g. *Dentallium*

Class 6. Pelecypoda (having two shells) e.g. *Mytilus*, *Arca*

Class 7. Cephalopoda (completely merged head and foot with rings of arms surrounding head) e.g. *Sepia*, *Loligo*, *Spirula*, *Octopus*, *Nautilus*



Fig 1: *Chiton*



Fig 2: *Neopilina*



Fig 3: *Patella*



Fig 4: *Asteraea*



Fig 5: *Pila*



Fig 6: *Terebra*



Fig 7: *Acteon*



Fig 8: *Bulla*



Fig 9: *Clione* (Sea angel)



Fig 10: *Limnaea*



Fig 11: *Helix*



Fig 11: *Mya*

PARTS NERVOUS SYSTEM

❖ Nervous system in molluscs is made up of

1. Ganglia,
2. Commissures and Connectives
3. Nerves

1. Ganglia - A ganglion is a collection of neuronal bodies found in the voluntary and autonomic branches of the peripheral nervous system (PNS). It is of three different types
 - a. Cerebral - pleural ganglia – one each such ganglion is present near anterior abductor muscle impression at the base of labial palps.
 - b. Pedal ganglia – It is bilobed(x- shaped) mass situated inside the foot.
 - c. Visceral ganglia – it is also a bilobed ganglion situated below the posterior abductor muscles.

2. Commissures and Connectives

- a. Cerebral commissures joins the two cerebrals
- b. cerebro-pedal connective connects cerebral with pedal ganglion
- c. Cerebro-visceral connective joins cerebral with visceral.
This connective passes through kidney and above supra-branchial chamber.

3. Nerves - They come out from the ganglia. Some of them are

- a. Anterior part of mantle and labial palps are supplied with nerves coming from cerebral ganglia
- b. Pedal ganglia gives out nerves to foot musculatures
- c. Visceral ganglia gives out pallial nerves to mantle, branchial nerve to ctenidium and renal nerve to kidney. it also supplies nerves to posterior adductor muscles and alimentary canal.

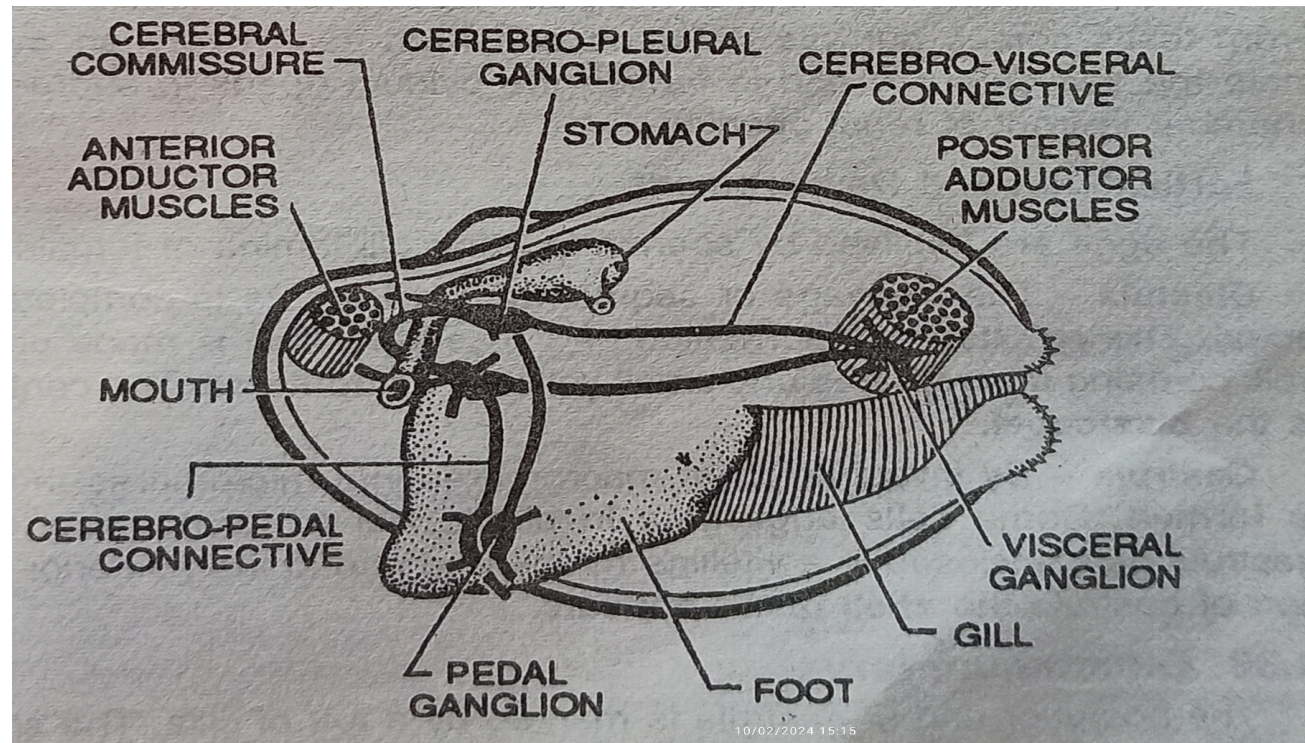


Fig13: Nervous system of *Unio*

NERVOUS SYSTEM IN GASTROPODS

- ❖ Molluscs can also be classified or grouped on the basis of foot and the type of nervous system present.
- ❖ Nervous system in gastropods shows great variation due to different arrangement of ganglia, connectives and commissures.
- ❖ Central nervous system in gastropods includes three typical ganglia in the head region. They are
 - Cerebral ganglia – supplying nerves to head and sense organs
 - Pedal ganglia – supplying the foot
 - Pleural ganglia – which innervates the mantle and spindle muscles

Types of commissure in gastropods

1. Anterior commissure (stomagasteric) – connecting cerebral ganglia.
2. Posterior (visceral) commissure – connecting the pleural ganglia. It is asymmetrical and on this are developed the
 - Supra- and Infra-intestinal ganglia lying above and below intestine supply nerves to mantle, ctenidium and osphradium.
 - Abdominal ganglia are also found supplying nerves to excretory, reproductive and other intestinal organs.

Arrangement of Primitive nervous system in Gastropods:

- ❖ Cerebral ganglia lie on both sides of oesophagus and are connected by cerebral commissures
- ❖ Pedal ganglia are drawn out into long ganglionic cords on ventral surface and are connected in a ladder – like manner
- ❖ Pleural ganglia lie closely to pedal
- ❖ Visceral commissures are long and ganglia on them are widely separated

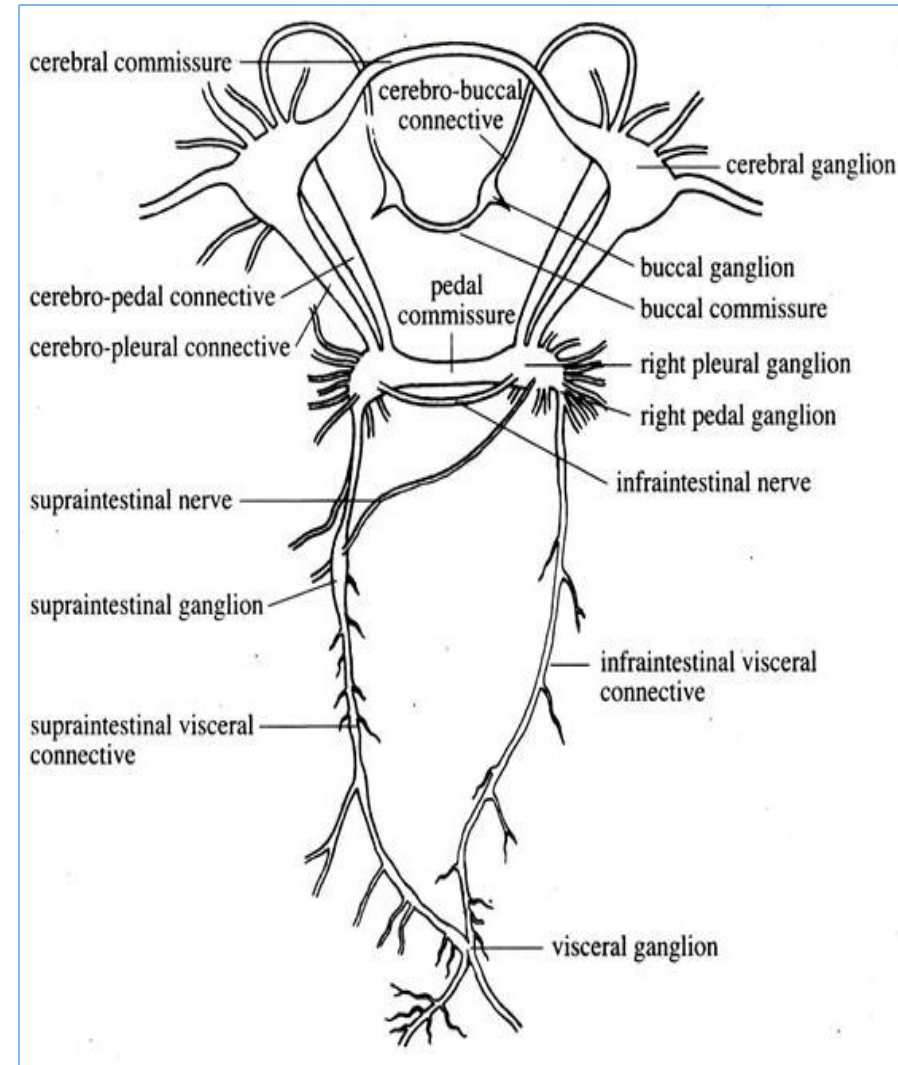


Fig 14: Nervous system of *Pila*

TYPES OF NERVOUS SYSTEM:

The nervous system present in three great sub-divisions of gastropods namely – Prosobranchia, Opisthobranchia and Pulmonata are broadly placed in two distinct types -

1. Streptoneurons where visceral nerve cord is twisted like a figure of "8". e.g. Prosobranchiata
2. Euthyneurons where visceral nerve cords are straight without any crossings. e.g. Opisthobranchiata and Pulmonata.

Streptoneurous type of Nervous System

Streptoneurous type of Nervous System is characteristic of Prosobranchiata molluscs like -

Haliotis,

Patella,

Triton,

Paludrina, etc.

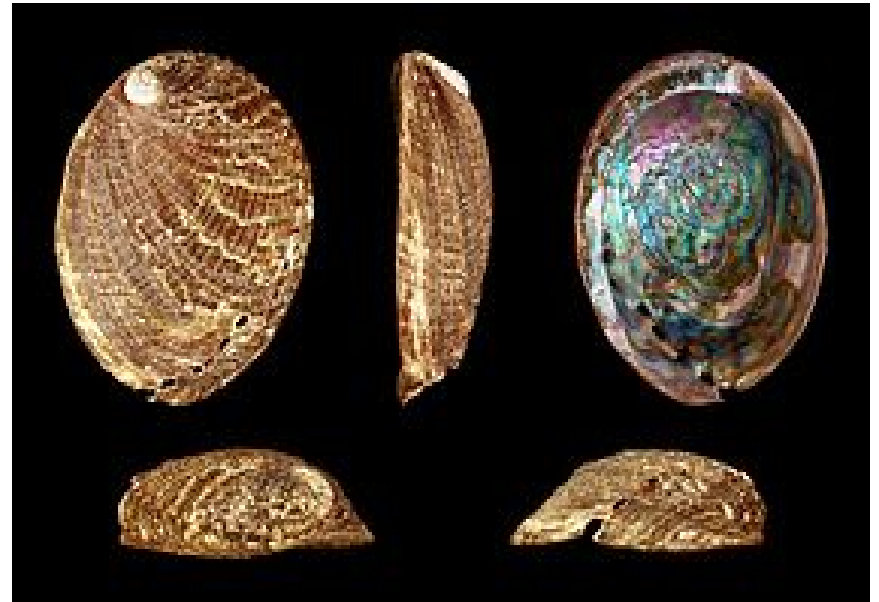


Fig15 : *Haliotis*

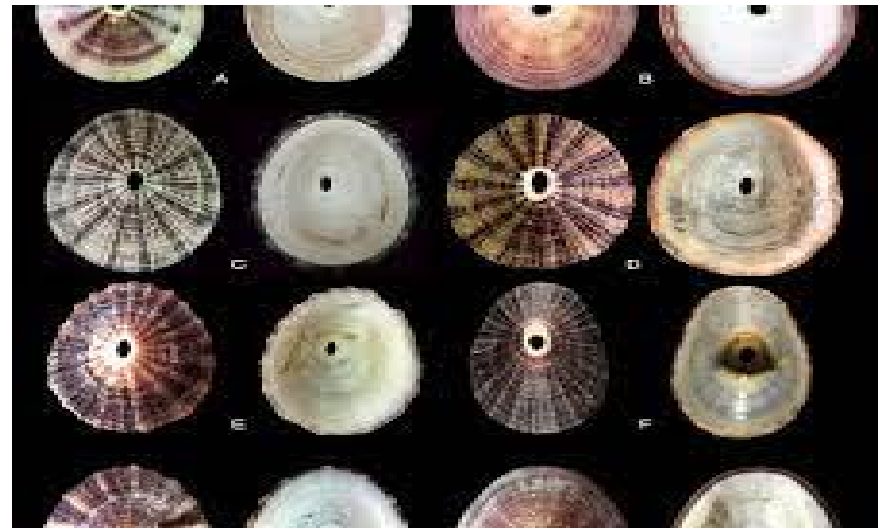


Fig16 : *Fissurella*

- A pair of cerebral ganglia situated over gullet are closely united giving out a pair of nerve cords which extend behind
- A pair of laterally placed pleural ganglia which are united behind with one or a pair (in *Triton*) of visceral ganglia
- A pair of parietal ganglia is encountered during the course of nerve cord
- A pair of pedal ganglia joined to cerebral and pleural ganglia by connectives and gives off posteriorly pedal nerves
- A pair of buccal ganglia are connected by slender nerves with cerebral
- A small osphradial ganglion at the base of each osphradium. Each is connected by thin nerves with parietal
- In *Haliotis* and *Fissurella*, the pleural and pedal are fused.
- From this arise a pair of elongated pedal nerve cord which are connected by several transverse commissures. In *Fissurella* these two cords join are another posteriorly.

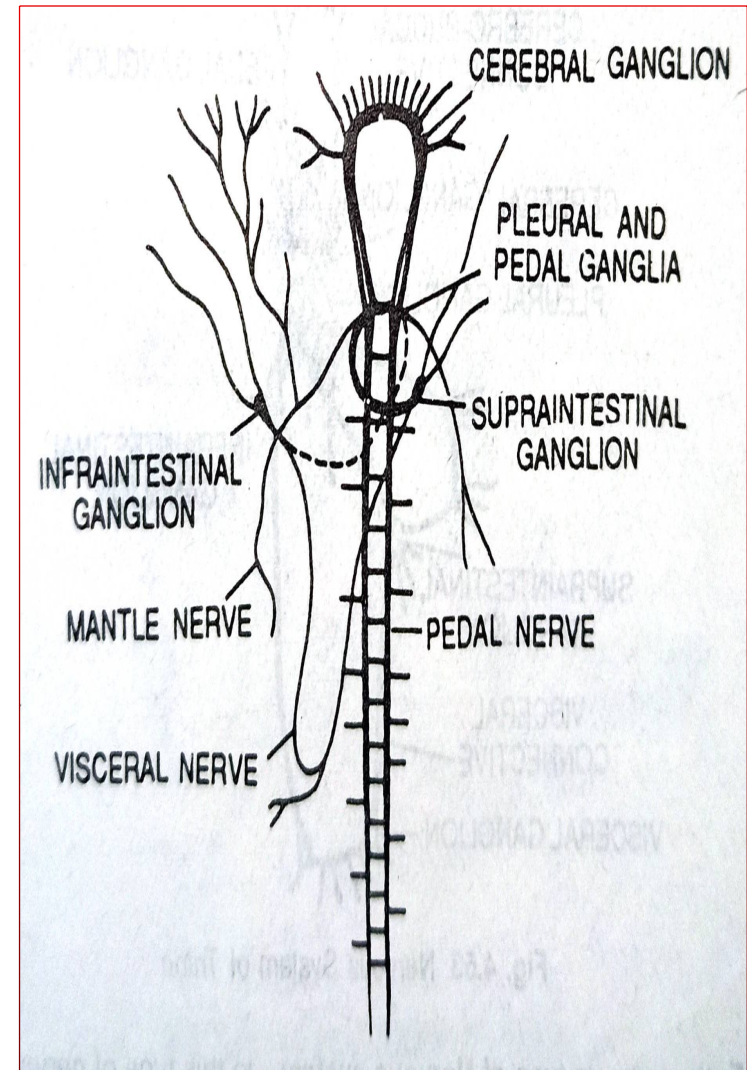


Fig 17: Nervous system of *Haliotis*

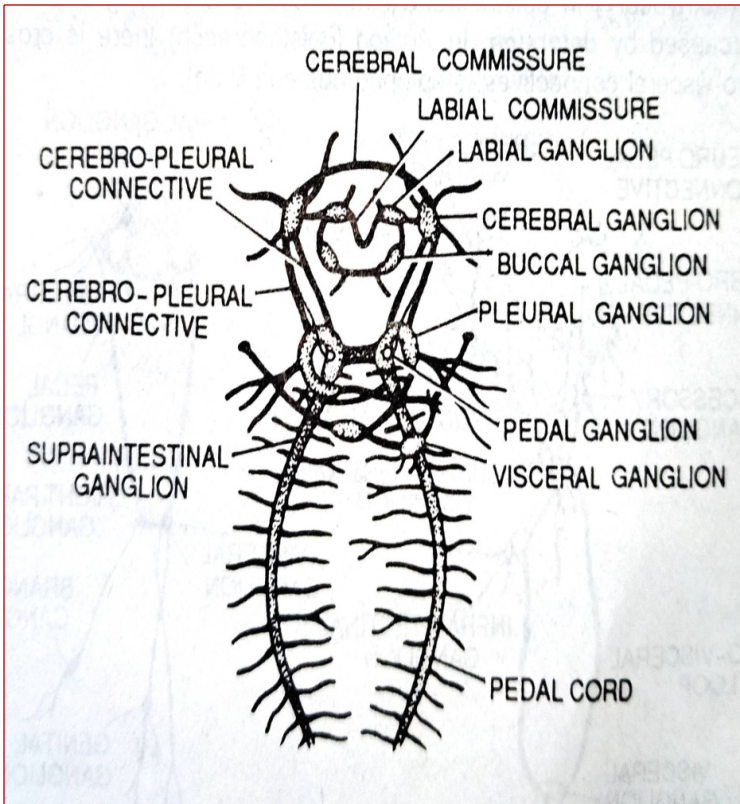


Fig18: Nervous system of *Patella*

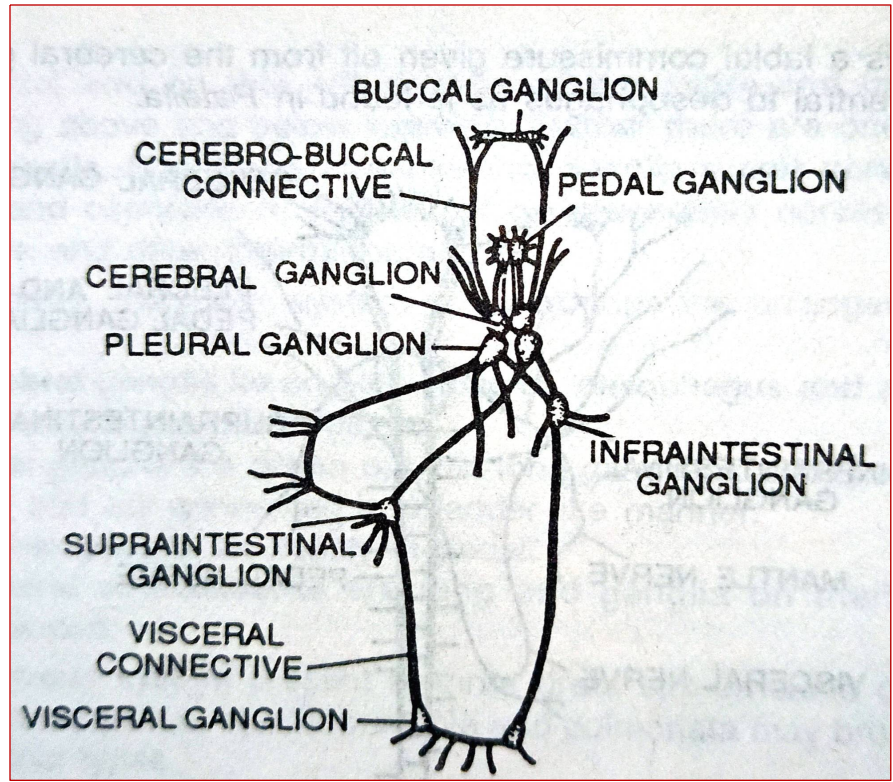


Fig19: Nervous system of *Triton*



Fig20: *Patella*



Fig 21: *Triton*

Euthynuerons types of Nervous system

- ❖ This type of nervous system occurs in Opisthobranchiata and Pulmonata, except in a few, the visceral loop does not show twisting.
- ❖ This secondary symmetry of nervous system (euthyneury) in Opisthobranchiata is due to twisting of the visceral loop caused by detorsion.
- ❖ In *Acteon* (opisthobranch) there is crossing of pleura-visceral connectives (streptoneurous condition).
- ❖ In *Aplysia*, the nervous sytem is characterized due to small connective between visceral ganglion and supra-intestinal (originally right) parietal ganglion. The infra-intestinal (originally left) parietal ganglion has disappeared.

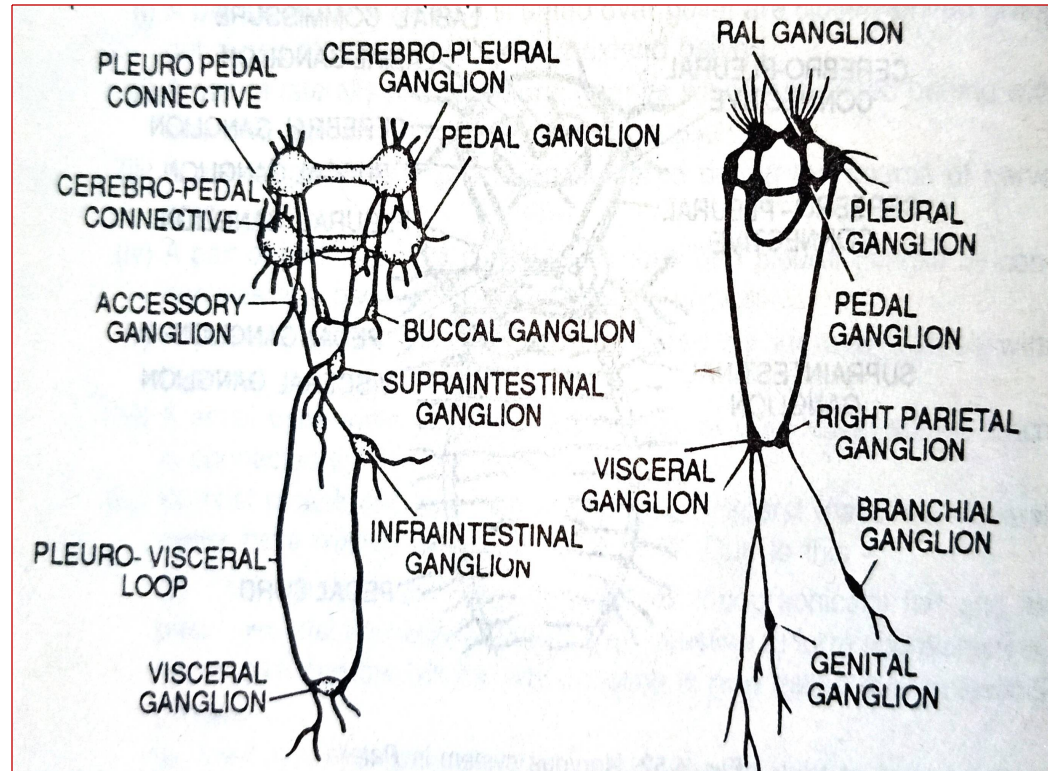


Fig 22: Nervous systems in *Acteon* and *Aplysia*



Fig23 :*Acteon*



Fig 24: *Aplysia*

In pulmonata the secondary symmetry in nervous system is due to shortening of visceral loop.e.g in *Limnaea*-

1. A pair of cerebral ganglia lie above oesophagous pairs
2. Below it lie pedal, pleural and parietal ganglia along with a visceral ganglion



Fig 26: *Limnaea*

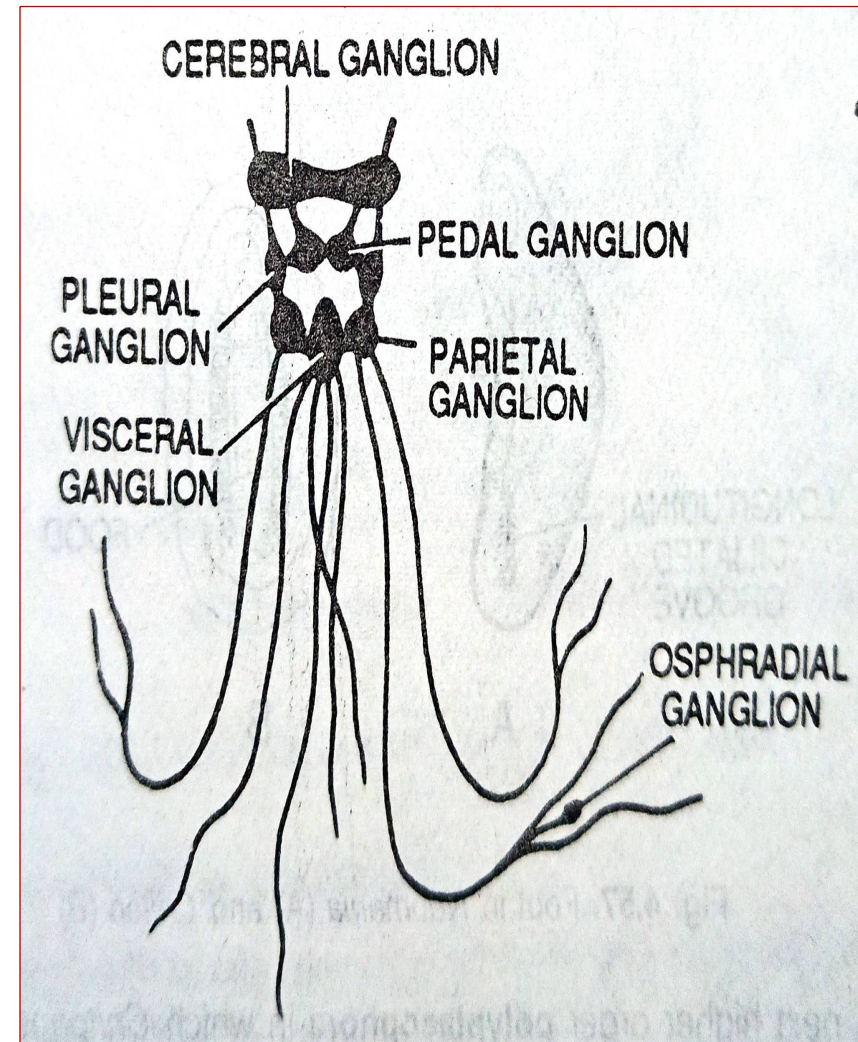


Fig25 : Nervous system in *Limnaea*

Significances of Eurythermous nervous system:

- ❖ The variation in nervous system exist in gastropods.
- ❖ The asymmetry is due to torsion in Prosobranchiata and
- ❖ The secondary symmetry is due to either detorsion or concentration of ganglia in Opisthobranchiata and Pulmonata.

Classification of Gasropods based on Nervous system

Order 1. Prosobranchiata (Streptoneura) – In these individuals the visceral loop is twisted in the form of “8” e.g. *Patella*, *Halliotis*, *Fissurella*, *Triton* etc.

Order 2. Opisthobranchiata (Euthyneura I)

Secondary symmetry of nervous system is due to detorsion. e.g. *Aplysia*, *Doris*, *Eolis* etc.

Order 3. Pulmonata (Euthyneura II)

Secondary symmetry of nervous system is due to shortening of connectives and concentration of ganglia forming a complex of circum – oesophageal ganglionic ring. E.g. *Limnaea*

FOOT IN MOLLUSCA

- ❖ The chief function of foot in mollusca is locomotion.
- ❖ It is an important muscular organ.
- ❖ It has undergone various types of changes and form for different habitats.
- ❖ Various shapes of the foot is the basis of classification of mollusca.

1. FOOT IN CLASS AMPHINEURA

❖ The foot in its vestigial form is found in primitive mollusks like *Neomenia* and *Chaetoderma* of order Aplacophora.

❖ In such cases foot is represented by a mid-ventral ciliated longitudinal groove.

❖ In the next higher order Polyplacophora in which *Chiton* is included, the foot is represented by a broad muscular foot on the ventral surface.

❖ The foot produces muscular waves from anterior to posterior end which help the animal in creeping movement. It also helps the animal to adhere any object firmly.

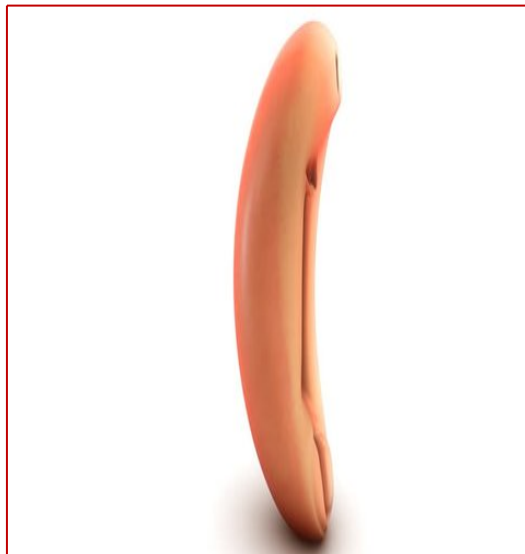


Fig 27: *Neomenia*

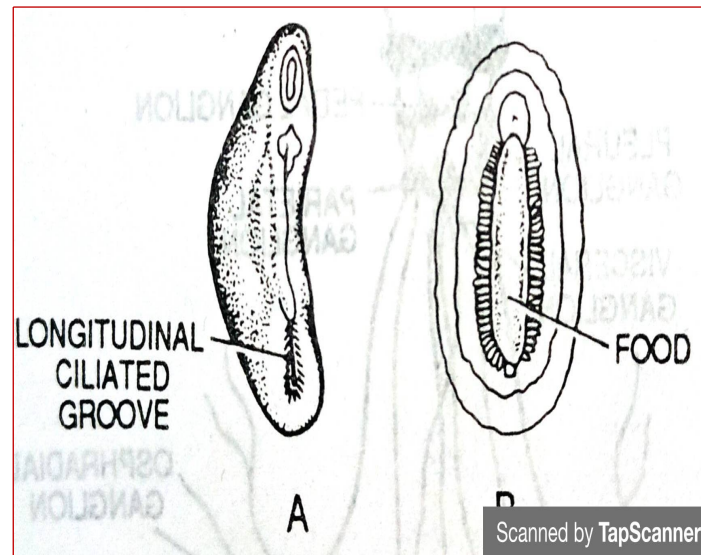


Fig 28: Foot in *Neomenia* (A) and *Chiton* (B)



Fig 29: *Chiton*

2. FOOT IN CLASS SCAPHODA

- ❖ The foot in scaphoda is meant for burrowing purpose.
- ❖ The shell of a typical scaphoda like *Dentallium* is like the tooth of an elephant.
- ❖ Through its oral opening comes out a narrow foot which is directed forward.
- ❖ The end is generally conical but trilobed in *Dentallium*.



DENTALIUM

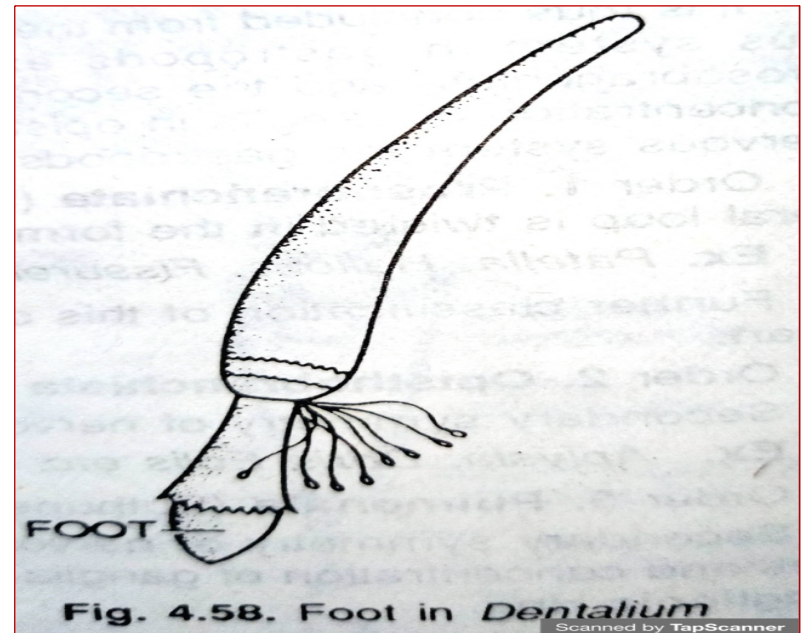


Fig 30 & 31: Foot of *Dentallium*

3.FOOT IN CLASS GASTROPODA

- ❖ Gastropoda means gaster = belly and podos = foot i.e. belly footed animals.
- ❖ The foot in gastropods is thick muscular fold lying generally on the ventral surface beneath head and digestive tract.
- ❖ By means of this the animal can creep by wave-like contraction of muscular tissue
- ❖ In gastropods the foot is generally divided into three parts. These are –
 - Propodium is the anterior part of the foot and is well developed in forms which crawl on wet sand. E.g. *Sigaretus*, *Natica* etc. By it the animal pushes the sand away on both sides of its path
 - Mesopodium is the middle large portion of the foot.
 - Metapodium is the posterior part of the foot bearing the calcareous operculum.

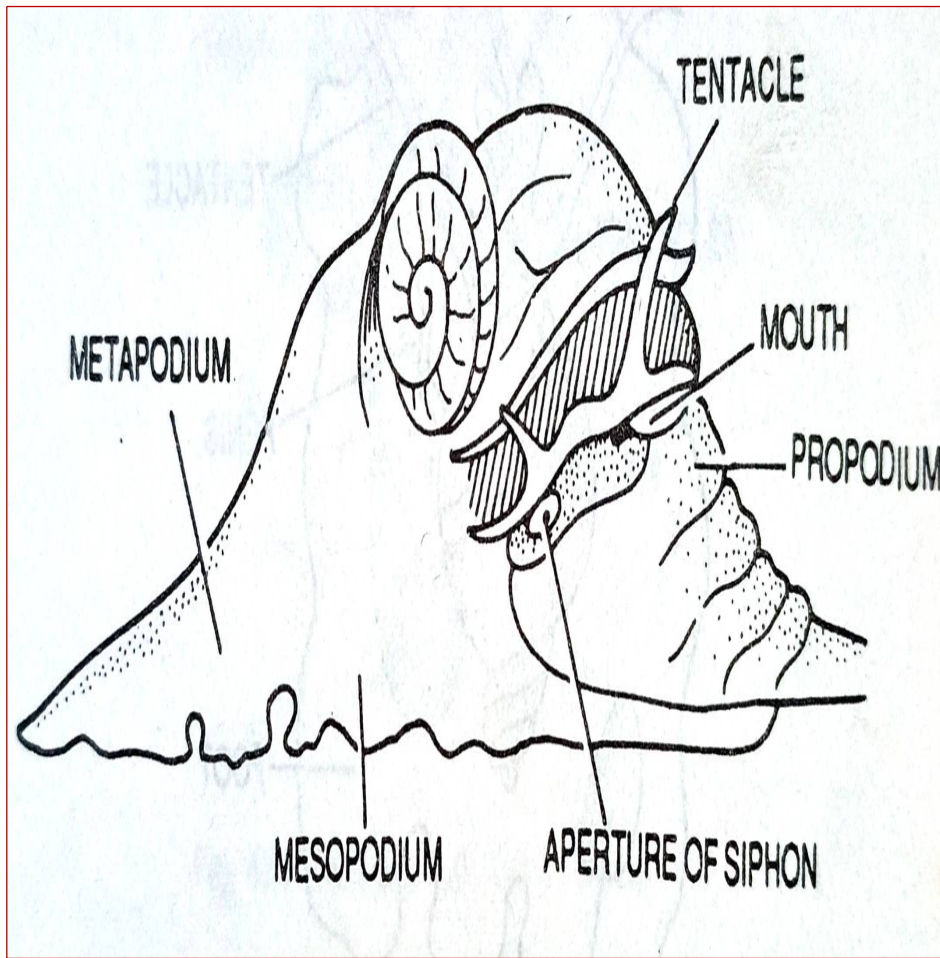


Fig 32: Foot in *Sigaretus* showing different parts

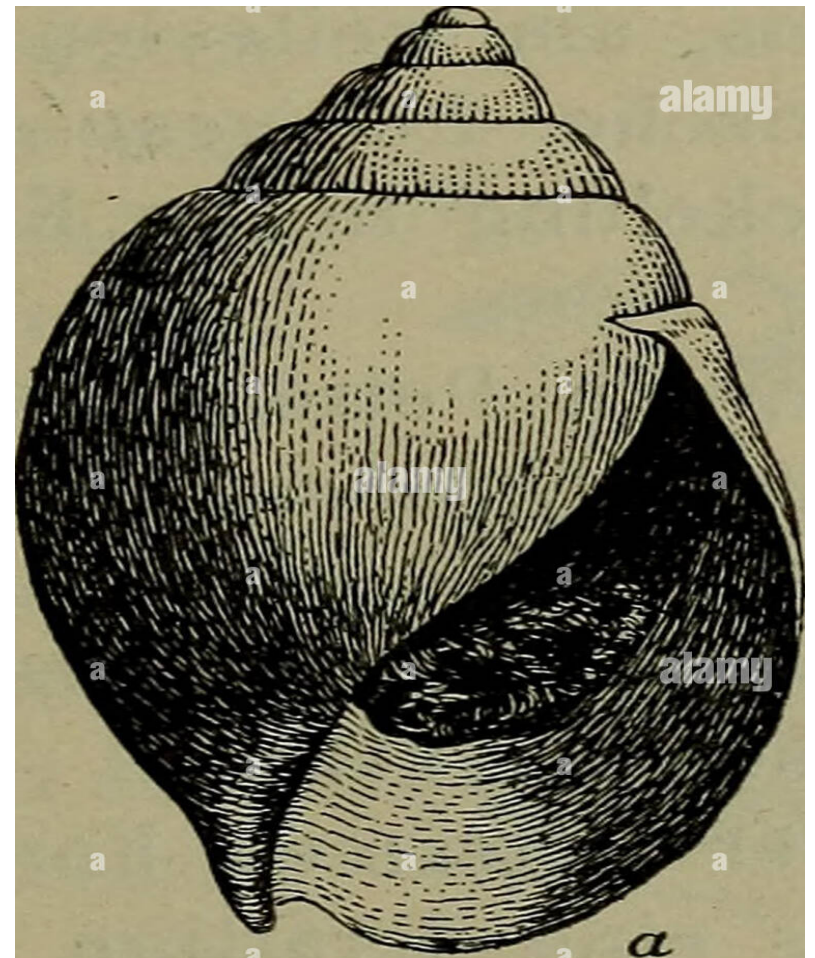


Fig 33: *Sigaretus*

Modifications of foot in Class Gastropoda

- A. The foot in gastropods has undergone peculiar modifications due to different conditions of life
1. In sedentary gastropods, like *Vermetus* foot has been reduced to a simple small disc
 2. In clinging gastropods like *Bathysciadium*, the ventral surface of the foot functions as a sucker to cling to any object
 3. In parasitic gastropods like *Stylifer* foot has atrophied and is represented only by a small ventral appendage
 4. In crawling gastropods like *Bullia*, the foot has extended on all sides of the body and it slides over the sand in order to progress forward

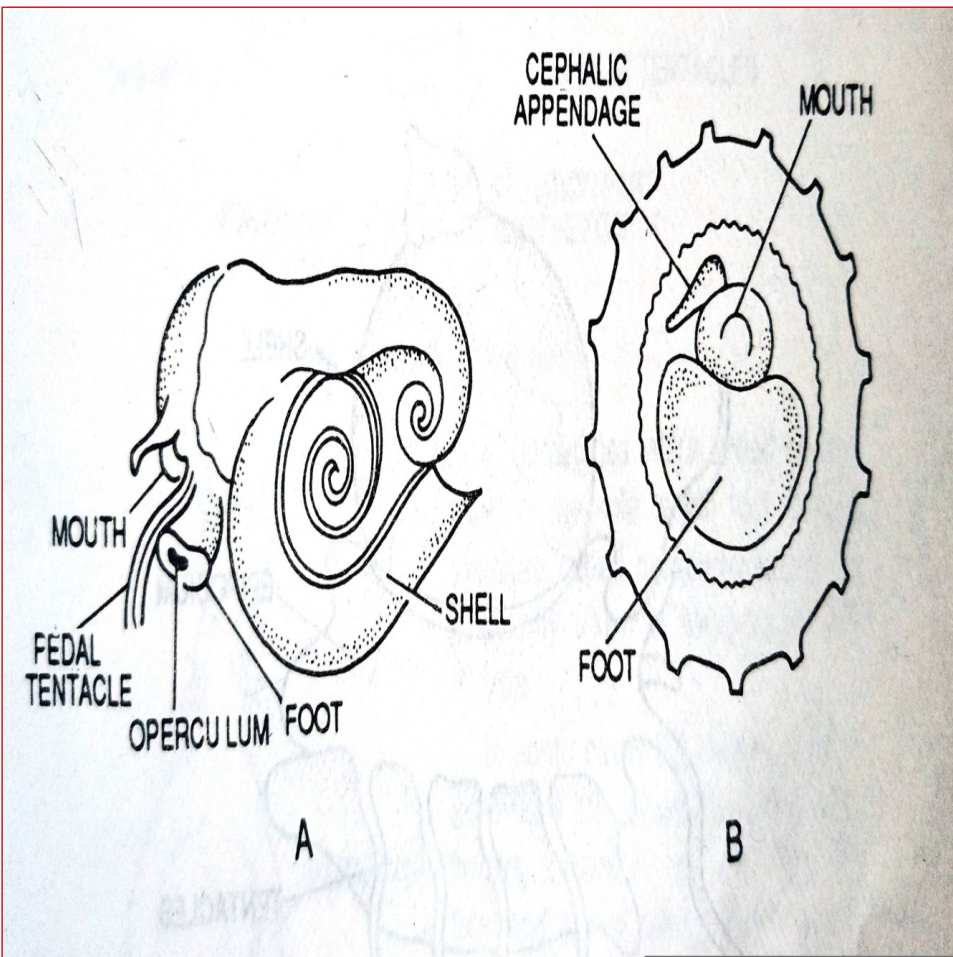


Fig 34: Foot in *Vermetus* (A) and *Bathysciadium* (B)



Fig 35: *Vermetus*



Fig 36: *Bathysciadium*

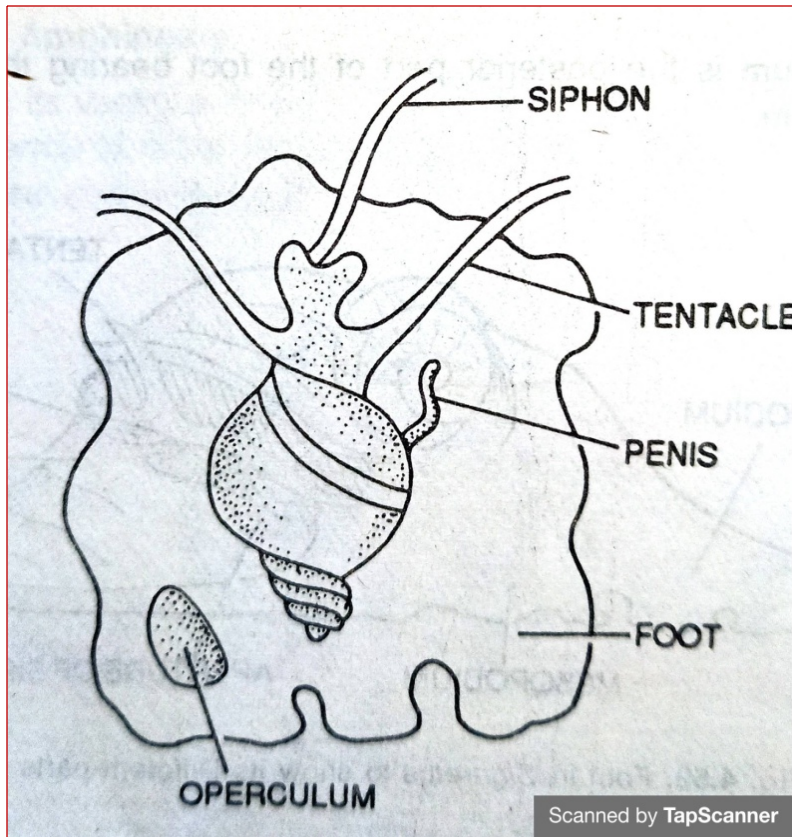


Fig 37: Foot in *Bullia*



Fig 38: *Bullia* (Plough snail)

B. Foot modifications with habitat

1. Epipodia is a distinct fold extending from head to the posterior end of the foot. Eg. *Haliotis*, in some cases epipodia is well developed and gives out lateral tentacles as is found in *Monodonta*

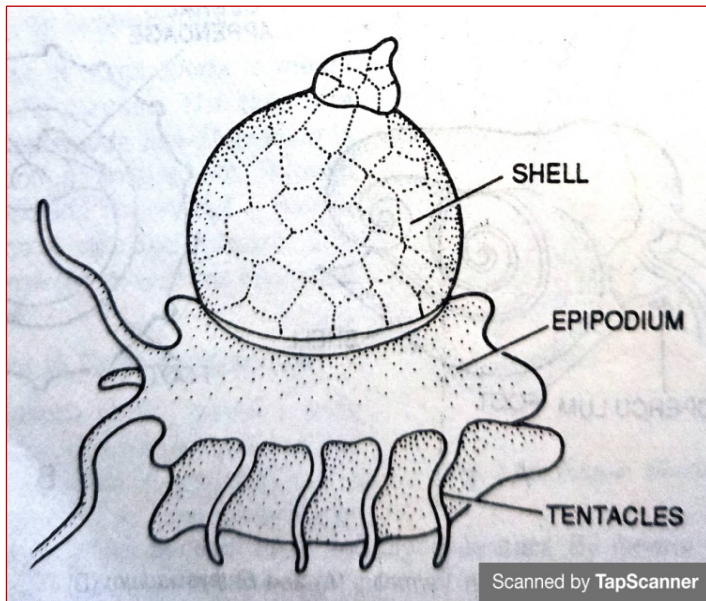


Fig 39: Epipodia with tentacles in *Monodonta*

Fig 40: *Monodontas*

2. Sometimes the two anterior angles of foot are prolonged as tentacles which is found in *Valvata*

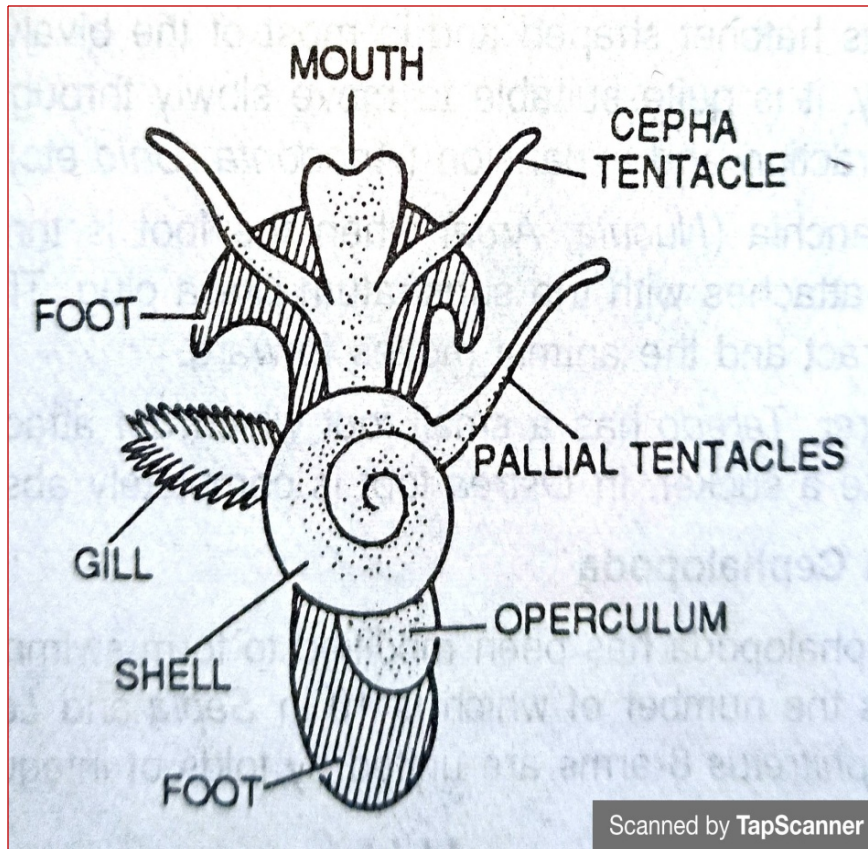


Fig 41: Tentacles from foot in *Valvata*



Fig 42: *Valvata*

3. In some forms like *Atlanta* and *Rostellaria* the posterior part of the foot is separated from the rest to form a lobe bearing the operculum

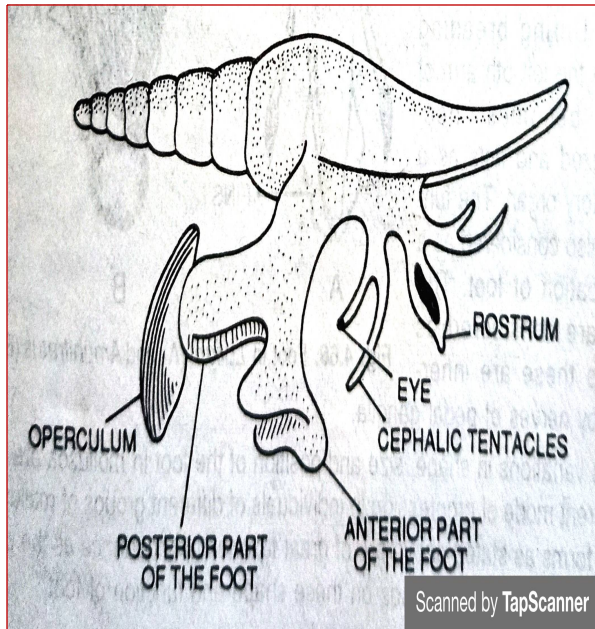


Fig 43: foot in *Rostellaria*



Fig 44: *Rostellaria*



Fig 45: *Atlanta*

4. Sometimes lateral broad fin-like lobes of the sole of the foot form a structure called parapodia which is generally used in swimming Eg. *Aplysia*

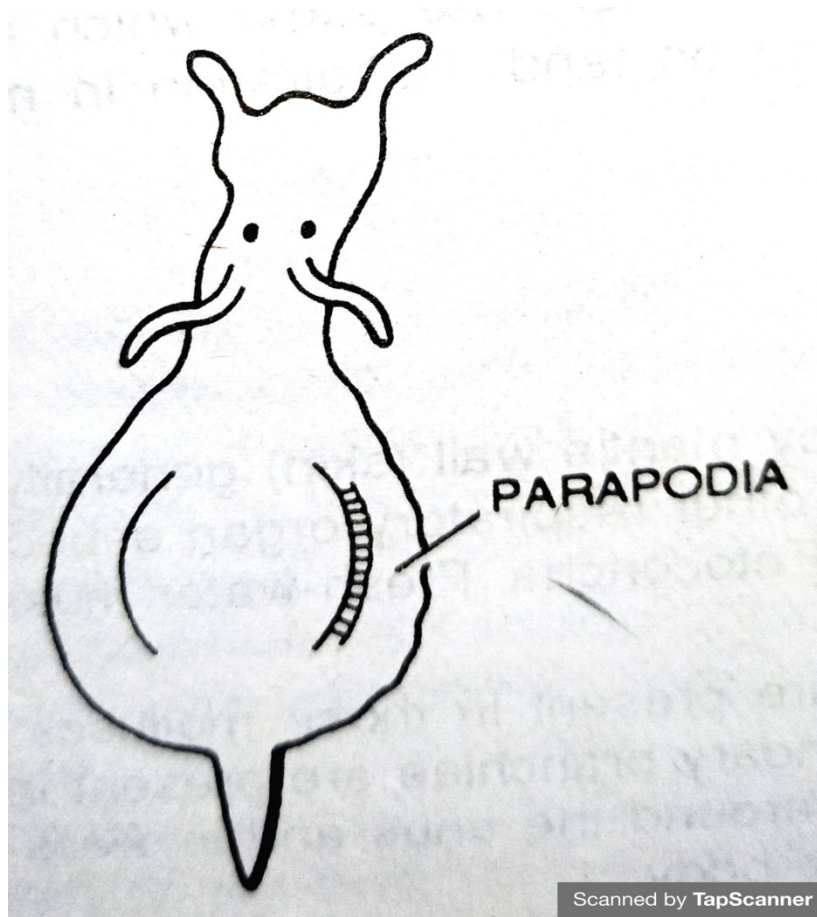


Fig 46: Parapodia in *Aplysia*



Fig 47: *Aplysia*

5. In some cases like *Notarchus*, the extensions are united above the body forming a muscular sac. It is open in front and closed behind and at sides. By forcing water through anterior aperture the animal moves using the sac as organ of locomotion



Fig 48: *Notarchus*

4. FOOT IN PELECYPODA (BIVALVIA)

- ❖ The foot in pelecypoda is used as a burrowing organ like the foot in *Dentalium*.
- ❖ It is hatchet shaped and in most of the bivalvia it protrudes out anteriorly.
- ❖ It is quite suitable to move slowly through sand or mud by alternate contraction and expansion.
- ❖ In Protobranchia (*Nucula*, *Arca*) when the foot is thrown forward on a substratum, it attaches with the substratum like a plug.
- ❖ Its longitudinal muscles contract and the animal moves forward.
- ❖ In ship borer, *Teredo* has a small foot which get attached to the end of the burrow like a sucker.
- ❖ In *Ostrea* foot is completely absent.

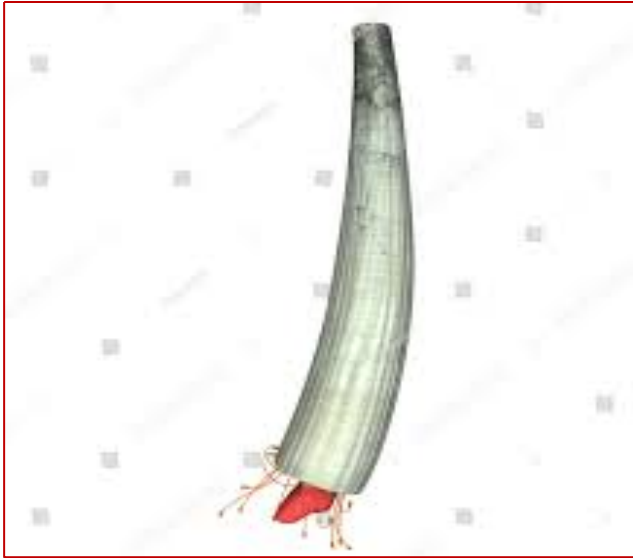


Fig 49: *Dentallium*



Fig 50: *Nucula*



Fig 51: *Arca*



Fig 52: *Teredo*



Fig 53: *Ostea*

5. FOOT IN CEPHALOPODA

- ❖ Foot in cephalopoda has been modified to form swimming organ.
- ❖ These are oral arms the number of which is 10 in *Sepia* and *Loligo*, but 8 in *Octopus*.
- ❖ In *Amphitretus*, 8 arms are united by folds of integument or web.
- ❖ Each arm of *Sepia* or *Loligo* bears suckers and the 4th pair on arms called tentacles are long bearing suckers only at the distal ends.
- ❖ During breeding season, the left 5th arm of *Sepia* becomes hectocotylised and acts as a copulatory organ.
- ❖ The funnel is also considered as a modification of foot.
- ❖ The arms are considered as foot as these are innervated by nerves of pedal ganglia.

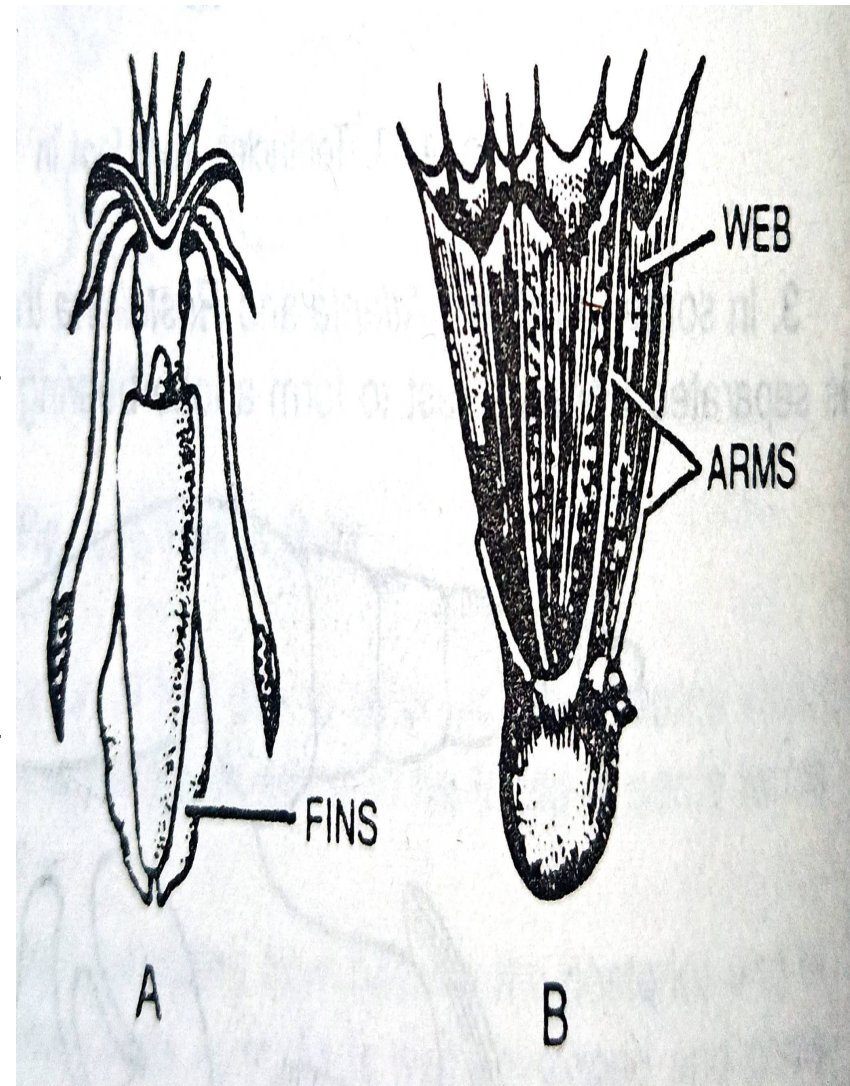


Fig 54: Foot in *Loligo* (A) and *Amphitretus* (B)



Fig 55: *Amphitretus*



Fig 56: *Sepia*



Fig 57: *Loligo*



Fig 58: *Octopus*

Significances of fooks

- ❖ The variation in shape, size and position of the foot in mollusca are due to different mode of progression in individuals of different groups of mollusca.
- ❖ These forms are of great taxonomic importance as the classification of mollusca depends on these shape and function of fooks.

ECONOMIC IMPORTANCE OF MOLLUSCS

Mollusc is one of the most important phylum of invertebrates because it includes numerous animals having either some useful or harmful characteristics.

Molluscs which are useful to man

1. As food:

- Bivalves are favorite food for people in Europe.
- Oysters like *Ostrea* are mostly used as food and so their culture is successfully done to solve food shortage in European countries.
- The mussel, *Mytilus edulis* is also used as food extensively in Europe and other countries.
- In many parts of the World, snails, squids, cuttle-fishes and devil- fishes (Octopus) are considered good dishes specially in South Europe.



Fig 58: Cuttle fish



Fig 59: Octopus

4. Other uses:

- By ingesting organic particles the fresh water clam purify the water and thus they act as Scavengers
- As cowries (*Cypraea*). They are found on coral reefs of India and Pacific oceans. These cowries are used as decoration purposes and to increase the beauty of ornaments.
- Different types of molluscs (*Pila, Unio, Sepia*) are used in the laboratories of different Universities and research centers for study purposes.
- Some are also used as medicines.

2. Pearls: pearls are valuable animal products. Bivalves like *Margaritifera vulgaris* (Ceylon pearl oyster), *Pteria vulgaris* (Indian pearl oyster) and *Pinctada margaritifera* (Found in Eastern Asia) are capable of forming pearls.

3. Pearl buttons: Pearl buttons of various shapes and size are cut from the fresh-water bivalves which are used in valuable dresses.



Fig 60: *Margaritifera*



Fig 61: *Pteria*



Fig 62: *Pinctada*

HARMFUL MOLLUSCS

1. Slugs are injurious to green- houses and gardens as they feed on green vegetables
2. *Teredo*, commonly known as ship-worm cause damage to our wooden boats and other vessels as they burrow into wooden portions of the boats and
3. Marine *Octopus* can even kill man in the sea.





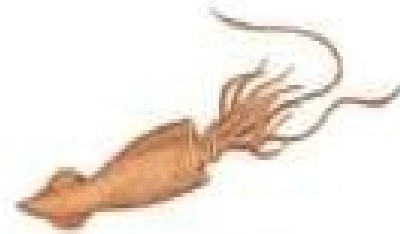
Slug



Cuttlefish



Oyster



Squid



Limpet



Snail



Scallop



Mussel

THANK YOU



Octopus



Nautilus



Clam



Winkle