3 Agnatha

General Characters

(Gk. ***a***, not + ***gnathos***, jaw)

1. Agnatha is a superclass of Vertebrata that includes jawless forms, viz., the extinct ***ostracoderms*** and the extant (surviving) ***cyclostomes.*** Eg. *Petromyzon.*
2. Ostracoderms are the fossil agnathans, characterized by a bony ***external skeleton.*** They lived in the freshwater of ***Silurian*** and ***Devonian*** periods. Eg. *Jamoytius.*
3. Cyclostomes are the living agnathans but they have no bony external skeleton. They might have lost the bony armour by ***mutations*** (***Kent***, 1967). Eg. *Petromyzon.*
4. Agnathans do not possess jaws.
5. The extinct forms were freshwater forms.
6. The extinct forms were covered by a ***bony external skeleton.***
7. Paired fins are absent.
8. A distinct head is present.
9. Gills are 6 - 14 pairs.

Comment

1. Bony armour may have been a defence against the ***eurypterids*** (aquatic scorpions) of Devonian (***A.S. Romer***, 1962). Another view is that it may have offered some protection against an excessive inflow of water from the freshwater environment in which the ostracoderms lived (***Villee***, *et al.*, 1978).
2. Cyclostomes might have lost the bony armour by ***mutations*** (***Kent***, 1967).

Classification

Superclass Agnatha is divided into two classes, namely

Class 1. Ostracodermi

Class 2. Cyclostomata

Class 1. Ostracodermi

(Gk. ***ostrakon***, shell + ***derma***, skin)

Ostracoderms are the fossil agnathans, characterized by a bony ***external skeleton***.

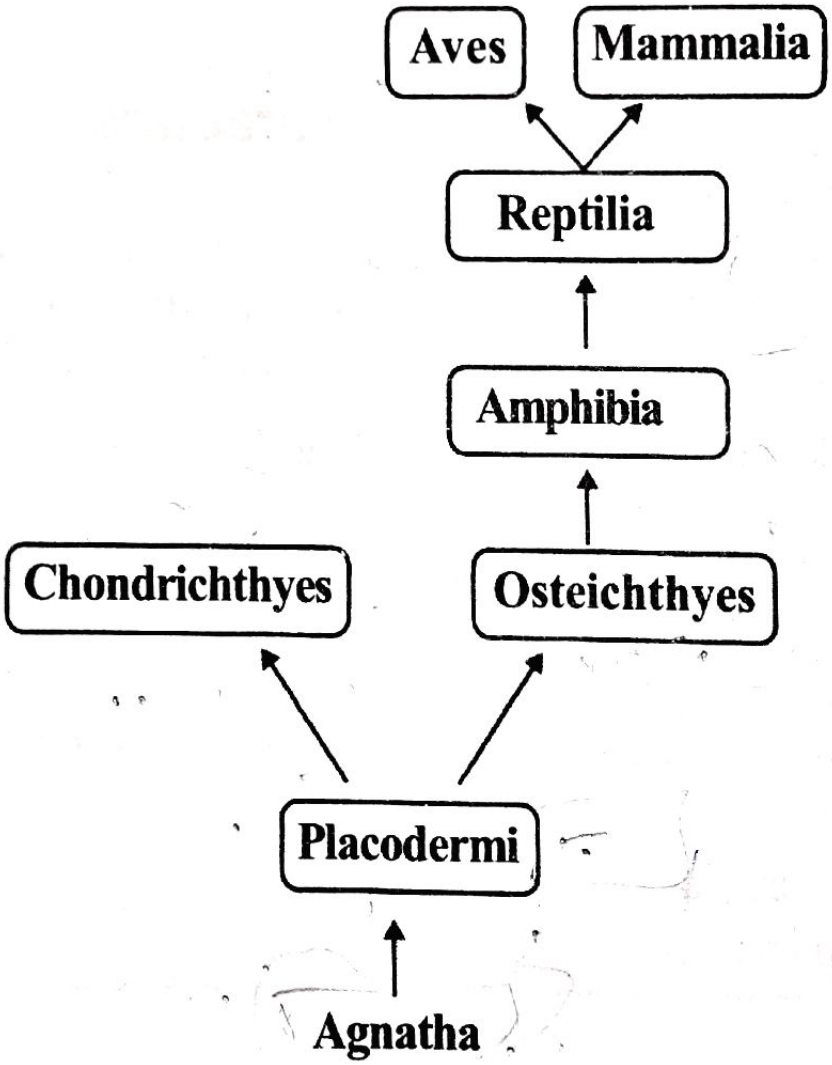

Fig.3.1: Phylogenetic tree of Agnatha.

They lived in the freshwater of ***Silurian*** and ***Devonian*** periods.

1. Bony external skeleton i.e., ***plates*** and ***scales*** were embedded in the dermis.
2. No axial skeleton or vertebrae.
3. Mouth jawless and ventral but not suctorial.
4. Paired nostrils were present (Diplorhina).

Class 2. Cyclostomata

(Greek.***kyklos***, circular + ***stoma***, mouth)

Cyclostomes are the living agnathans but they have no bony external skeleton. They might have lost the bony armour by ***mutations*** (***Kent***, 1967).

Table 3.1: Key characters of Ostracodermi and Cyclostomata by way of comparison.

Sl.No.	Ostracodermi	Cyclostomata
1.	Bony external skeleton, ie., plates and scales were embedded in the dermis.	Bony external skeleton is absent. Skin is smooth and scaleless.
2.	No axial skeleton or vertebrae.	Notochord ***persistent.*** Skeleton is ***cartilaginous.***
3.	Mouth jawless and ventral but not suctorial.	Mouth ventral, circular and ***suctorial.***
4.	Paired nostrils were present (Diplorhina).	A ***single*** nostril is present (Monorhina).
5.	Paired fins absent but some had paired spines or flippers.	Paired fins (pectoral and pelvic) absent.
6.	Ten pairs of gills.	6 to 14 pairs of gills.

1. Bony external skeleton is absent. Skin is smooth and scaleless.
2. Notochord ***persistent.*** Skeleton is ***cartilaginous.***
3. Mouth ventral, circular and ***suctorial.***
4. A ***single nostril*** is present (Monorhina).
5. Paired fins (pectoral and pelvic) absent.
6. 6 to 14 pairs of gills. Eg. *Petromyzon.*

The Cyclostomata is divisible into two orders as follows:

6. Gill openings are circular and 6 to 14 in number. Behind the last gill opening is the ***aperture*** of pharyngocutaneous duct. This serves for the expulsion of very large inhaled particles (***Parker*** and ***Haswell***, 1962).

7. The only fin is a ***caudal fin.***

4. Petromyzon

1. *Petromyzon* is popularly known as ***sea lamprey***.

2. *Petromyzon marinus* is marine. It is an ***ectoparasite***. It sucks the blood of fishes and turtles.

3. It has an elongated cylindrical and ***eel***-like body.

4. The body consists of 3 regions, namely ***head, trunk*** and ***tail***.

5. The head is cylindrical and has a ***buccal funnel,*** a ***mouth***, a single ***naris***, a pair of eyes and seven pairs of ***gill slits***.

6. The mouth is surrounded by a ***cup***-like structure called ***buccal funnel***.

7. The centre of the buccal funnel has a circular ***mouth***. A ***tongue*** protrudes through the mouth.

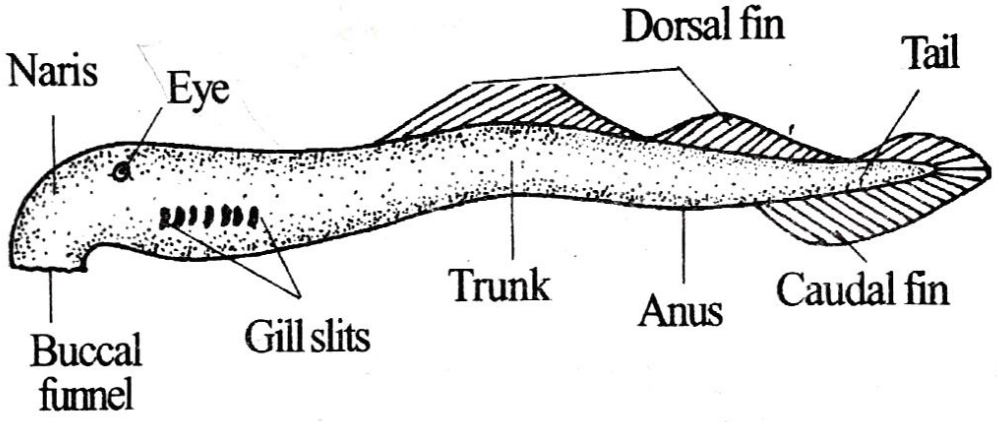

Fig.3.6: Petromyzon.

8. The tail is laterally compressed. It has a ***caudal*** or ***tail fin***. The tail fin is also supported by fin rays.

9. The skeleton is ***cartilaginous*** and not bony. It is made up of ***skull, vertebral column*** and a set of ***rods.***

10. The circulatory system is a ***closed type***.

11. The excretory system is made up of a pair of ***mesonephric kidneys***.

12. The development is ***indirect***. It includes a larva called ***ammocoetes***.

Detailed Study

1. Petromyzon

Petromyzon is popularly known as ***sea lamprey***. It is the most ***primitive living vertebrate***. It has no jaws and hence it is included in the superclass ***Agnatha***. It has a single nostril and hence it is included in the subclass ***Monorhina***. It has a circular mouth and hence it is included in the class ***Cyclostomata***.

Petromyzon marinus is marine. It is an ***ectoparasite***. It sucks the blood of fishes and turtles.

It has an elongated cylindrical and eel-like body. It is about one foot long. The body consists of 3 regions, namely ***head, trunk*** and ***tail***.

The head is cylindrical and has a ***buccal funnel,*** a ***mouth***, a single ***naris***, a pair of ***eyes*** and seven pairs of ***gill slits***.

The mouth is surrounded by a cup-like structure called ***buccal funnel***. The buccal funnel is a cup-like structure situated at the anterior end of the head. It is directed downwards. It functions as a ***sucker***. It is ***circular*** in shape. It is surrounded by a marginal membrane. This membrane is beset with numerous soft projections called ***oral papillae*** or ***oral fimbriae***.

In between, the oral papillae many ***sensory cirri*** project out. The inner surface of the buccal funnel is beset with radiating rows of conical, yellowish, horny teeth.

The centre of the buccal funnel has a circular ***mouth***. A ***tongue*** protrudes through the

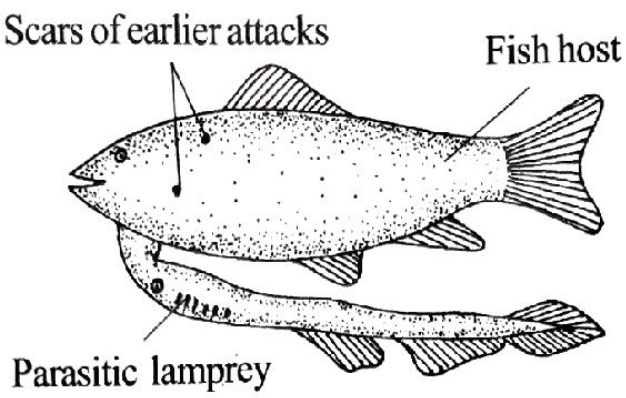

Fig.3.8: Petromyzon attached to its host.

mouth. It is also beset with teeth. The tongue makes a hole on the skin of the victim by moving forwards and backwards.

A ***naris*** is present on the dorsal surface of the head. It leads into an ***olfactory sac***. The olfactory sac is an organ to smell.

Behind each eye, laterally there are seven pairs of ***gill apertures***.

The trunk is also cylindrical. It has two ***median dorsal fins***. The fins are supported by cartilaginous rods called ***fin rays***.

At the junction of the trunk and tail, the ***anus*** and the ***urinogenital aperture*** are present on the ventral side.

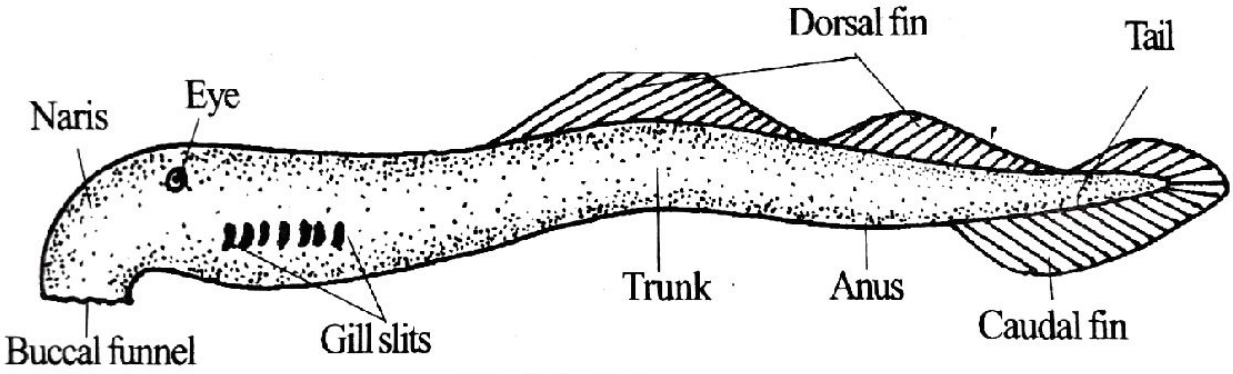

Fig.3.9: Petromyzon.

The tail is laterally compressed. It has a ***caudal*** or ***tail fin***. The tail fin is also supported by fin-rays.

Respiration is carried out by 7 pairs of ***gill pouches***.

Alimentary canal is straight with ***mouth*** and ***anus***.

Two mesonephric ***kidneys*** with ***ureters*** are present.

The brain consists of ***olfactory lobes***, ***cerebral hemispheres***, ***diencephalon***, ***optic lobes***, ***cerebellum*** and ***medulla oblongata***.

Ten pairs of ***cranial nerves*** are present.

The skeleton is ***cartilaginous*** and not bony. It is made up of ***skull***, ***vertebral column*** and a set of ***rods***.

The circulatory system is a ***closed type***. The heart is made up of ***2 chambers***, namely an ***auricle*** and a ***ventricle***. A ***hepatic portal system*** is present.

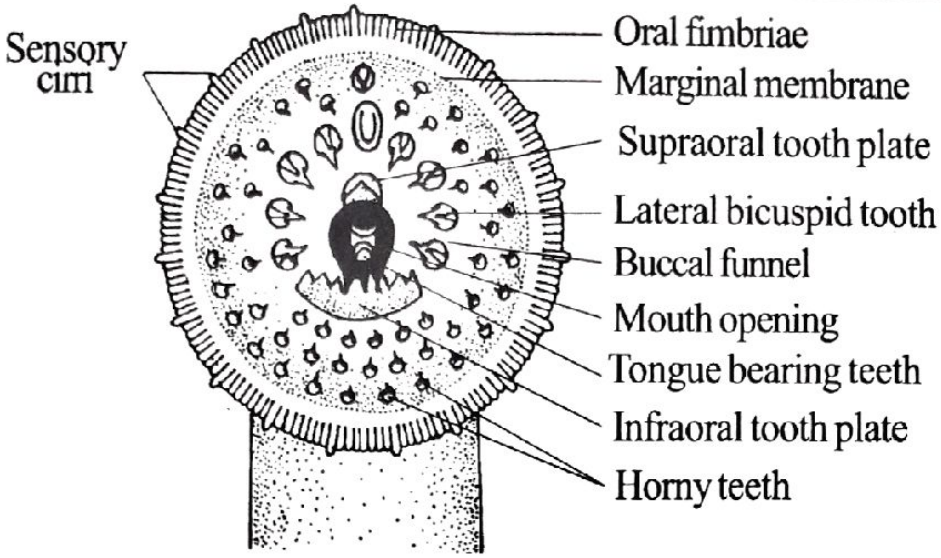

Fig.3.10: Petromyzon - Buccal funnel.

The excretory system is made up of a pair of ***mesonephric kidneys***. The brain has three main divisions, namely ***fore brain, midbrain*** and ***hindbrain.***

The sensory organs include an ***olfactory organ***, a pair of ***eyes***, a pair of ***ears*** and a ***lateral line sense organ***. The sexes are separate. The development is ***indirect***. It includes a larva called ***ammocoetes***.

Breeding and Migration

Petromyzon has a peculiar breeding habit and breeds only once in its life. Mature males and females migrate from sea to rivers for breeding. This type of migration is called ***anadromous migration***.

During migration the alimentary canal becomes non-functional. They do not feed. They use the fat stored in the muscles and beneath the skin. They travel hundreds of miles and reach the place where their parents and grand parents bred.

In the river, a male and a female select a site in a clear moderately fast-flowing water and they build a nest. The buccal funnel is used to remove the stones.

The nest consists of a rounded pit with sandy floor. The female gets fixed onto a stone by its buccal funnel near the nest.

The male attaches to the female by its buccal funnel near head. Both the female and the male wriggle forth and back and discharge eggs and sperms in the nest.

This mating is repeated many times. After each mating the eggs are covered with sand brought in by the tail. After spawning the parents leave the nest and die within a few days.

Fertilization is ***external***. The development includes a larva called ***ammocoetes***.

Ammocoetes Larva

Ammocoetes is the larva of *Petromyzon*. It has the following salient features:

1. *Ammocoetes* is a freshwater larva of the marine *Petromyzon*.
2. It looks like an *Amphioxus* in its morphology and habits.
3. It is a transparent larva.
4. It lives for 3 - 7 years.
5. In the beginning, it is about 7 mm in length and it can attain a length of 175 mm.

6. It lives inside a U-shaped burrow. At times it comes out of the burrow.
7. It is muddy brown in colour.
8. It has an ***eel***-like body.
9. The body is divisible into a ***head, trunk*** and a ***tail***.
10. The head has an ***oral hood*** and a pair of ***eyes*** hidden under the skin.
11. The oral hood surrounds the ***mouth*** in the place of the buccal funnel.
12. The trunk has a single ***dorsal fin***.

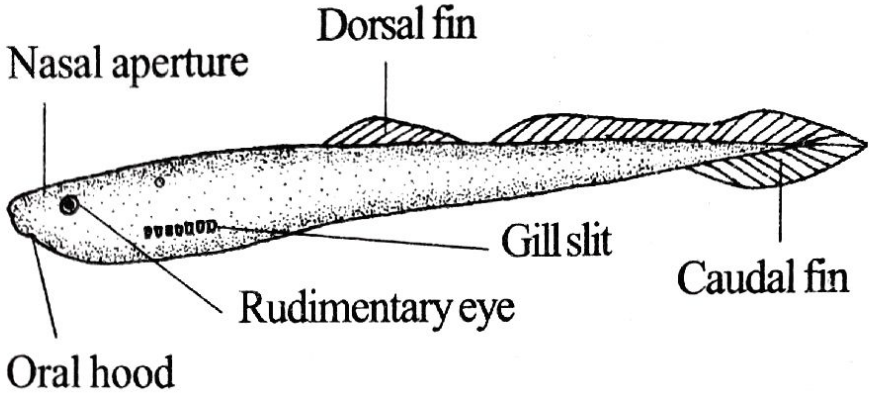

Fig.3.11: Ammocoetes larva of Petromyzon.

13. The tail has a ***caudal fin*** which is in continuation of the dorsal fin.
14. The trunk has 7 pairs of ***gill slits*** just behind the head.
15. The alimentary canal includes a ***mouth, buccal cavity, pharynx, intestine*** and ***anus***. A ***velum*** is present between the buccal cavity and the pharynx.
16. The pharynx has an ***endostyle***, a pair of ***peripharyngeal bands*** and a ***hypopharyngeal groove***.
17. Liver, bile duct and gall bladder are present.
18. The kidney is a ***protonephros***.
19. It exhibits ***filter feeding***. The water current is created by the muscular activity of branchial basket and not by the ciliary activity.
20. The respiratory current goes into the pharynx through the mouth and comes out through the gill slits. But in the adult it comes in and goes out through the gill slits.
21. A heart with ***pericardium*** is present.
22. The ***pineal eye*** is well developed.