**Prof N.P.Tiwary For Students of B.sc, Zoology, Part II, Paper II**

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**Topic**

**Describe the characteristic features of Cylostomes and also discuss the habit, habitat and external features of Petromyzom**

**Cyclostomata**

Cyclostamata comes under the superclass agnatha. The Agnathas are charecterized by the absence of true jaws and paired appandages.The lamprey and the hagfishes show a great advance in the vertebrate series, but are different from other fishes and that is why it is placed in a separate class

They are called “cyclostomes” (cyclo, round; stoma, mouth) for the reason that, instead of typical vertebrate jaws, they have round jawless sucker-like mouths by which they attach themselves to the sides of fishes or to other objects. They are more committed to a life of parisitism and when one fastens to a fish, it may make a hole with its filelike horny teeth that are attached to its muscular “tongue,” through the skin of the host who eventually dies.

Morphologically, they resemble eels. They are known to be the only living vertebrates without true jaws, hence called Agnatha. Cyclostomata includes hagfishes and lampreys.

**Habit and Habitat:** Cyclostomes are usually marine in habitat although they frequent fresh waters to breed, and some species are permanent fresh-water inhabitants. Lampreys scoop out a nest in the sandy bottom of a flowing stream to deposit their eggs, meanwhile fastening themselves by means of their suctorial mouths to a stone in order not to be carried down stream. This habit has given rise to their genus name of Petromyzon (petros, rock; myzon, sucker)

GENERAL CHARACTERISTICS OF CYCLOSTOMATA Gr.,cyklos=circular, stoma=mouth

* May be marine or fresh water in habitat.
* The body is round and elongated like an eel.
* Mouth without jaws, so grouped under Agnatha.
* Mouth is ventral, suctorial and is circular surrounded by tentacles.
* A median nasal chamber is found with a single nostril.
* Respiration by pouch like gills
* Paired fins are absent.
* Median fins are supported by cartilagenous fin ray.
* Skin is smooth, soft and slimy. Scales are absent.
* Notochord is persistent through out the life. Vertebrae are represented by imperfect neural arches (arcualia) present surrounding the notochord.
* Pharyngeal gill-slits are found in which about 6-15 paires of gills are present.
* Digestive system lacks stomach. Esophagus directly opens into intestine. Cloaca is absent,.
* Excretion takes place by 2 mesonephric kindneys.
* Nervous system includes a brain and a dorsal nerve cord.
* 8-10 cranial nerves are present
* . The lateral line acts as a sense organ.
* The sexes are separate. Some hagfish species are believed to be hermaphrodite.
* Reproduction is sexual. Fertilization is external.
* Development direct or by prolonged larval stage.
* The larval lamprey is so different from the adult that it was formerly assigned to a distinct genus and named Ammocoetes before its whole life history was known. In its early stages an endostyle-like groove is present in the pharynx. Later this groove pinches off and gives rise to a subpharyngeal gland believed by some to be homologous with the thyroid gland of other vertebrates.

Eg., Petromyzon and Maxine.

**PETROMYZON**

**Distribution:** almost worldwide in distribution found in the sea of North America, Europe Japan AustraliaTasmania west Africa.

The common marine sps are Petromyzon marinus and fresh water is represented by Petromyzon fluviatilis found in European rivers.

**External Features**:

1. Body long, cylindrical eel like.
2. Tail laterally compressed
3. Skin slimny and scaleless
4. At the anterior end on the ventral aspect of the head is a depression the Buccal funnel
5. Mouth situated at the base of the center of the funnel.
6. There are numerous soft papillae on the margin of the funnel whereas on its inner surface there are many horny epithelial teeth present in definite rows.
7. A tongue is situated just below the mouth and acts as a rasping organ
8. Single median nasal aperture present
9. Pineal eye present
10. Behind the eyes are seven pairs of gill openings
11. Paired fins are absent
12. A median dorsal fin which are divided into two unequal notch is present
13. The posterior part of the+dorsal fin is continuous with the caudal fin.
14. Anus present on the ventral side between the trunk and tail.
15. Urinogenital aperture immediately behind the anus
16. Lateral line system present.

**Digestive system:**

* Sectorial buccal funnel with horny teeth is present.
* Presence of buccal gland which prioduces lamphedrin . This prevents the clotting of blood.
* Mouth situated above the tongue which opens in the buccal cavity.
* Buccal cavity opens in two tubes; the dorsal oesophagus and a ventral pharynx or respiratory tube which is guarded by velum.
* Stomach is absent.
* Intestine straight with spiral valve

**Respiratory system:**

* Presence of seven pairs of gill pouches which opens separately to the exterior by short passages
* Water enters the pouch through external gill apertures and passes out through the same route.
* The branchial baskets are responsible for the respiratory movements.

**Branchial basket:**

It’s a peculiar cartilaginous structure developed to support the branchial passage.

**Blood vascular system:**

* The heart consists of a sinus venosus , large thin walled auricle and a muscular ventricle.
* Heart is enclosed in a pericardium made up of cartilage.

**Nervous System:**

* Presence of a primitive brain.
* 10 pairs of cranial nerves present.

**Sense organs:**

* The eyes are well developed with more or less flattened cornea.
* The pupil is round.
* Single median nasopharyngeal sacs ends blindly at the posterior end.
* Inner lining of the nasal sac has folded wall containing olfactory receptors.

**Excretory system:**

* Presence of one pair of functional mesonephric kidney.
* The kidneys act as an organ of excretion and also as an haemopoietic organ.

**Reproductive system:**

* The sexes are separate
* Gametes pass out through the genital aperture.
* Fertilization is external.

**Development:**

* P.marinus leaves the sae and moves to freshwater river to spawn.
* A small nest is hollowed out in the river bed and eggs are laid in the nest.
* Soon after spawning the parents die and disintegrate.
* After sometimes the ammocoete larva hatches which after swimming for a short time burrows in the soft bed of the river.
* The larval life is long and metamorphosis occurs under favourable condition.

**CLASSIFICATION OF CYCLOSTOMATA**

The class Cyclostomata is divided into two orders:

1. PETROMYZONIA AND 2) MYXINOIDEA

**Order 1. Pefromyzonia**

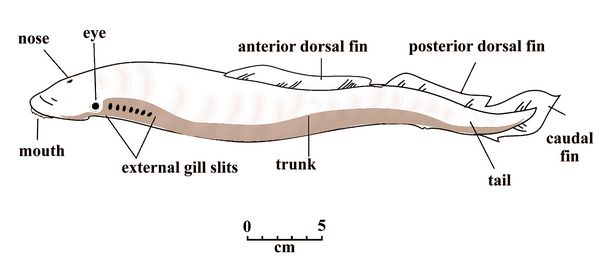
* Lampreys are included In this order.lamprey-petromyzon-cyclostomata
* The buccal funnel is suctorial and shows horny teeth.
* The mouth is present in the buccal funnel.
* The nasal sac is dorsal. It has no connection with the pharynx.
* Eyes are functional.
* Seven pairs of gill slits are present.
* A well developed dorsal fin is present.
* Branchial basket is complete.
* Brain is well developed.
* Pineal eye is well developed.
* Ear has two semicircular canals.

Ex: 1. **Petromyzon (Sea-lamprey) ) Lampetra fluviatilis.**

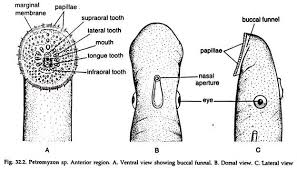
**Order 2: Myxinoidea** It includes the hag-fishes or slime eels. Myxine

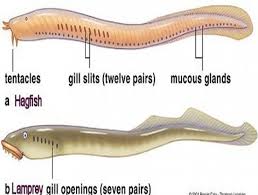
* Buccal funnel is absent.
* The nasal sac open into pharynx, through a canal.
* Eyes are vestigial organs.
* Dorsal fin is absent or very small.
* Branchial basket is poorly developed.
* Brain is primitive.
* Pineal eye is reduced.
* Ear has only one semicircular canal.
* The hag-fishes are all marine.

Eg Myxine glutinosa Hag-fish or slime eel). 2. Eptatretus (Bdellostoma)hagfish



Lamprey





Difference between Lamprey and Hag fishes

**Affinities of Cyclostomes:**

Cyclostomes are evidently chordate. They are primitive vertebrates. Their ammocoete larva resembles in most characters with that of Branchiostoma, which shows primitive relationship. Whereas, the adult cyclostomes possess specialised as well as degenerate characteristics.

I. **Primitive Characters of Cyclostomes:**

A.**Characters Resembling those of Amphioxus**:

1. Absence of jaws, exoskeleton and paired fins.

2. Continuous notochord (but with an added sheath).

3. Segmental musculature (myotomes) but little modified from head to tail.

4. Ciliated alimentary tract straight and without much regional specialisation.

5. Relatively large numbers of gill-slits.

6. Endostyle in lamprey larva.

7. Gonads without gonoducts.

Besides these, the ammocoete larva of lampreys resembles Amphioxus as follows:

1. Fish-like body.

2. Oral hood anterior to mouth.

3. Continuous dorsal and caudal fins.

4. Ciliated digestive tract.

5. Filter feeding habit and

6. Endostyle functions in feeding.

B.**Characters more Primitive than in Fishes (Differences from Fishes):**

1. No biting jaws, Scales, true teeth, true fin rays, girdles, ribs, stomach, spleen and gonoducts.

2. Continuous median dorsal fin.

3. Diphycercal caudal fin.

4. Single median nostril, instead of paired.

5. Cranium incomplete or poorly developed.

6. No vertebrae or poorly developed vertebrae.

7. Rudimentary pancreas.

8. No spinal valve, or only slightly developed spiral valve, in intestine.

9. Brain relatively small or generalised.

10. Ninth and tenth cranial nerves not enclosed in the cranium. Absence of medullated nerves.

11. Sympathetic nervous system very primitive and poorly developed.

12. Heart a rather loosely twisted S-shaped tube without conus arteriosus.

13. Lateral line organs poorly developed and in isolated pits.

14. Hypophysial duct rather large, open to the exterior and not connected with the pituitary body.

**C.Affinities with Ostracoderms:**

The fossil ostracoderms and present cyclostomes are kept in Agnatha due to the following similarities:

1. Presence of a median pineal eye.

2. Presence of velar pump-like lamprey.

3. Endostyle sac-like.

4. Single nasal opening though nasal sacs are paired.

5. Brain is like that of lamprey.

6. Two semicircular canals in the ear.

7. Dorsal and ventral nerve roots separate up to 15.

8. Pairs of branchial pouches surrounded by a branchial basket.

9. Continuous uncostricted notochord.

10. Absence of jaws.

The Agnatha were the first animals of the chordate type to become large. They feed on detritus on the bottom. The lampreys and hagfishes have been derived from early Agnatha by the evolution of a sucking mouth, perhaps with loss of the bony skeleton and paired limbs.

II. **Specialised Characters:**

1. Sucking mouth buccal funnel and horny teeth (in lampreys) for attachment.

2. Powerful tongue armed with sharp horny teeth works as a rasping organ.

3. Secretion of anticoagulants in saliva to feed on blood of prey.

4. Sac-like gill-pouches. Located far behind head. It is probably an adaptation to burrowing.

5. Complete separation of lower sac-like respiratory pharynx from upper digestive pharynx.

6. Water entering gill-pouches and also leaving them through external gill openings and not through mouth.

7. In hagfishes, presence of large mucus secreting mucous glands.

8. Dorsal position of nostril on head in lampreys.

9. Large, heavy-yolked egg, with meroblastic cleavage and no larval stage in hags.

III. **Degenerate Characters:**

1. Simple elongated eel-like body more marked in hags. Whereas ostracoderms body is broad fish-like.

2. Rudimentary paired eyes covered by thick skin in hags.

3. Lack of exoskeleton or bony armour.

4. Absence of paired fins and girdles.

5. Lack of ossification of endoskeleton, it is cartilaginous.

6. Reduced liver and lack of gall-bladder and bile-duct in adult lamprey.

**Ammocoete larva (Notes)**

**Development of Lamprey:**

The eggs are telolecithal, having a large amount of yolk. Cleavage is complete but unequal resulting in the formation of blastula. Blastula consists of micro and macromeres. Invagination in blastula gives rise to gastrula. After sometimes the embryo hatches out as an ammocoete larva.

Ammocoete Larva:

**Salient Features:**

* Ammocoete is a freshwater larva of Petromyzon.
* It is transparent.
* It looks like an Amphioxus in its morphology and habit.
* It lives for 3-7 years.
* In the beginning it is about 7 mm in length and attains a length of 165 mm.
* It lives inside U-shaped burrow. At times it comes out of burrow.
* Colour is muddy brown.
* Body is eel like.
* Body is divisible into head, trunk and a tail.
* Suctorial buccal funnel absent.
* Oral hood surrounds the mouth in the place of the buccal funnel.
* Trunk has a single dorsal fin.
* Tail has a caudal fin which is in continuation of the dorsal fin.
* Teeth are absent but several branched buccal tentacles surround the mouth.
* The alimentary canal includes a mouth, buccal cavity, pharynx, intestine and anus.
* A velum is present between the buccal cavity and the pharynx.
* The pharynx has an endostyle, a pair of peripharyngeal bands and a hypopharyngeal groove.
* Eyes are vestigial and concealed below the skin.
* Pineal eye is well developed.
* Trunk has 7 pairs of gill-slits just behind the head.
* Liver, bile duct and gall bladder are present.
* Protonephric kidney present.
* It exhibits filter feeding. It feeds on small food particles which are carried into pharynx by means of current of water maintained by the velum and the pumping movements of the pharynx.
* Respiratory current goes into the pharynx through mouth and comes out through gill-slits.
* Heart with pericardium is present.

**Metamorphosis:**

After a prolonged period of 3 to 6 years, the ammocoete larva undergoes metamorphosis. During metamorphosis, the following changes occur.

(1) The larva leaves the burrow and leads a free swimming life.

(2) It migrates from the freshwater habitat to the marine habitat.

(3) The filter feeding habit of the larva is changed in sanguivorous habit (blood sucking habit).

(4) The oral hood disappears and a buccal funnel with teeth and tongue appears.

(5) The continuous median fin breaks into two dorsal fins and a caudal fin.

(6) The paired eyes become uncovered and functional.

(7) The endostyle changes into the thyroid gland.

(8) The gall bladder and bile duct disappear.

(9) A respiratory tube develops from the pharynx.

(10) The velum is reduced.

(11) The pronephros is replaced by mesonephros.

(12) The spinal cord becomes flattened and neural arches appear in the trunk region.

(13) The rudimentary skull and branchial basket are fully developed.

(14) Supporting skeletal tissues of the upper lip and tongue is also formed.

(15) The pericardial cavity becomes completely separate from the general body cavity.

(16) The larval head muscles are reformed during metamorphosis.

(17) The colour of the skin changes from muddy brown to metallic.

