Set II

MJ-I (Zoology)

Full Marks : 60 **Time: 3 hrs**

Answer the following question as per instruction mentioned.

Respective marks are given in parentheses on right side.

Candidates are advised to give answer in their own words where group A is compulsory and three from the group B selecting one from each unit .

Group A

(Compulsory)

1. **Give answer as per instruction** **1X5=5**

1. Name one parasitic protozoa with locomotors and without locomotors organelles

   Ans- Parasitic protozoa with locomotors –*Trypanosoma* , *Leishmania*

   Parasitic protozoa without locomotors organelles-*Plasmodium vivax*

2. Name Coelenterates with polymorphic organizations

   Ans- Obelia, Physallia

3. Name Acoelomate with dorso-ventrally and monogamous parasite

   Ans- Schistosoma

4. Name Nephridia located behind 15^{th} segment in earthworm

   Ans-Septal nephridia

4. Name the larvae that emerge from egg in squilla

   Ans- Alima

2. **What is Torsion & Detorsion in Mollusca**

TORSION

It is the developmental events which occurs in early development of the gastropods. It is one of the most important changes in the Mollusca body morphology in which the mantle, mantle cavity and visceral mass are rotated 180° in a counter clockwise direction. As a result,the mantle cavity and the anus are positioned anteriorly above the skull due to this rotation. The digestive tract is also twisted into a U shape together with the gills, anus, and apertures form the excretory and reproductive systems. They are positioned right below the brain and nerve cords. Thus torsion or twisting is a significant process in three ways .

a**.Protection** -If there were no torsion, the foot would withdraw into the shell first and the more vulnerable head would withdraw last. An operculum, a proteinaceous coating on the dorsal, posterior border of the foot in some snails, improves defence. The operculum covers the entrance of the shell as the gastropod pulls the foot into the mantle chamber, protecting the snail from desiccation in dry environments.

Secondly , the mantle cavity has an anterior aperture that permits pure water from the front of the snail to enter, rather than water that has been tainted with silt from the snail's movement. direction in which it moves by twisting the sense organs of the mantle around the head region.

The third benefit of torsion is that it increases the snail's sensitivity to stimuli .

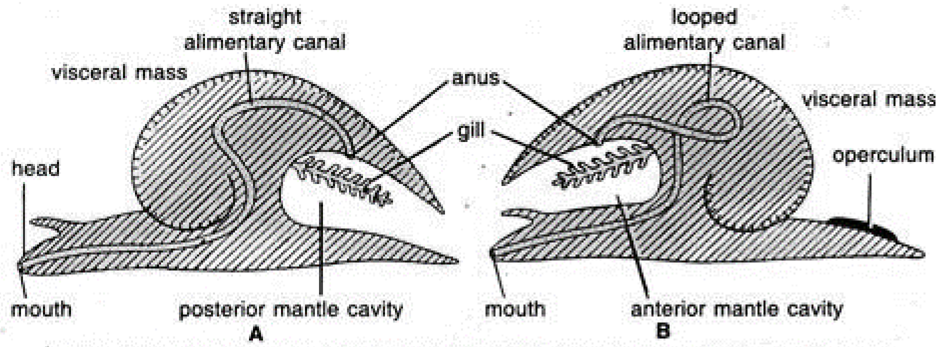


Fig.63.2. A gastrpod showing torsion. A—Before torsion; B—After torsion.

Detorsion

Detorsion is the reversion to a certain amount during the larval stage. Detorsion takes place during the larval stage and the animal again becomes bilaterally symmetrical. Nervous system becomes symmetrical and not twisted in the shape of 8. Pallial complex travels backwards. Ctenidium travels backwards or to the lateral side. Auricle moves behind the ventricle. Visceral loop and intestine become straightened. For Example Aplysia . Doris etc

3. Differentiate exo & entero nephridia . 05

Exonephridia	Enteronephridia
Directly open to the body surface or exterior	Opens into excretory canals/ alimentary canal
Nephridipore present	Nephridiopore absent
Example- Meganephridia of neries , Hiridinaria & Lumbricus , Integumentary nephridia of pheretima	Sptal and pharyngeal nephridia of pheretima

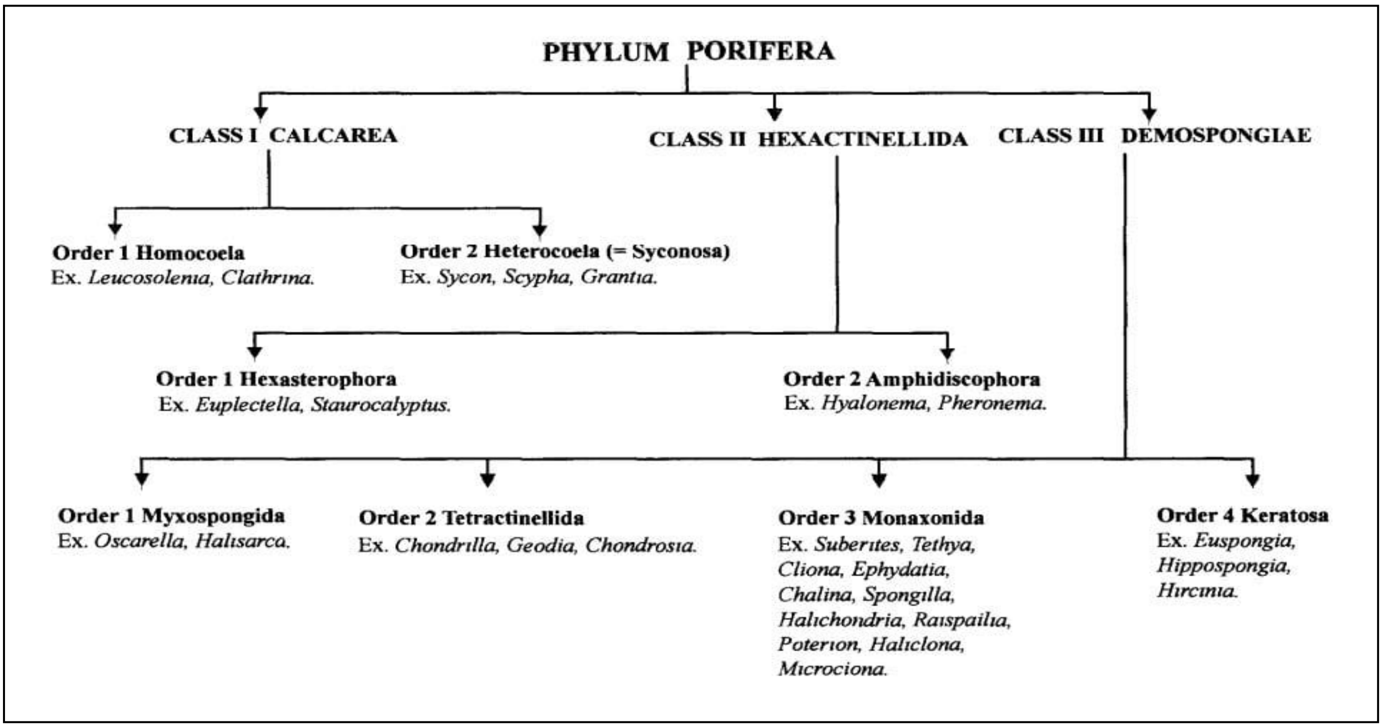
Group B.

Unit I

1. Mention the general characters of phylum porifera and classify upto class with distinct characters and examples. 15

Answer – **Features of Phylum Porifera**

- They are for the most part marine sea-going creatures, with a couple of freshwater animal types.
- Their bodies are uneven.
- Body shape can be tube-shaped, jar-like, adjusted, or sac-like.
- They are diploblastic creatures with two layers, the external dermal layer, and the inward gastral layer. There is a thick, non-cell, in the middle of between these two layers.
- This contains many free amoebic cells.
- The body has many pores called the Ostia and a solitary huge opening called the osculum at the top.
- Spongocoel is the body hole that is available.
- They have the trademark trench framework for the progression of water through the body.
- Receptors are missing.
- There is an endoskeleton present with calcareous spicules (calcium carbonate) or siliceous spicules (silica) or wiping strands (protein).
- Genders are not discrete.
- Asexual proliferation is seen through sprouting and fragmentation. Sexual proliferation is found in specific species, through gametic combinations.



Calcarea spicules form a skeleton that results in the cylindrical shape of the body for which the animal is symmetrical. Coeloblastula or amphiblastula helps in the development and the body may be organised like the asconoid or conoid type. In this, large cells are known as Choanocytes. Again these Choanocytes are sub-classified into two orders based on the structures. They are Homocoela and Heterocoela.

- **Hexactinellida**

  Large sponges are present in this. As the name itself says that it has six-rayed glossy spicules which can help to grow long from 10 to 30 cms. They are mostly found in deep layers of the sea. They have finger-like canals and possess some inorganic elements. Its shape seems to be like a cup or vase. Euplectella and Hyalonema are some examples.

- **Demospongiae**

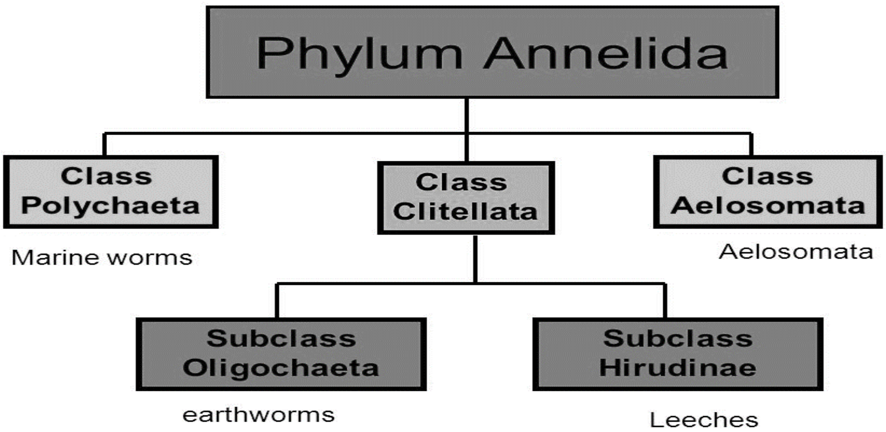
  These sponges may be found from shallow to the depth of the sea in different colors with the presence of pigment granules. Most available species are of this category. The skeleton may or may not be present, and the body will be either in a round shape or flattened shape. Pascarella, Platina, and Geodia are some of examples.

2. State the salient features of phylum Annelida and give its classification up to class along with important characters of each class and suitable examples 15

Answer- Characteristics of Annelida

The characteristics of the organisms present in the Phylum Annelida are as follows:

1. The Annelids are coelomate and triploblastic.
2. They exhibit organ system level organization.
3. Their body is segmented.
4. They respire through their body surface.
5. Nephridia are the excretory organs.
6. They have a well-developed circulatory and digestive system.
7. Their body contains haemoglobin, which gives them a red colour.
8. Regeneration is a very common characteristic of the Annelids.
9. Setae help them in movement.Most of the Annelids are hermaphrodite, i.e., male and female organs are present in the same body. They reproduce both sexually and asexually. The others reproduce sexually.Eg., Earthworms, and leeches
10. Classification of Annelida



Following are the different classes of Annelida:

- **Polychaeta**
- **Oligochaeta**
- **Hirudinea**
- **Archiannelida**

Polychaeta

- The body is elongated and divided into segments.
- They are found in the marine environment.
- These are true coelomates, bilaterally symmetrical worms.
- They excrete through metanephridia and protonephridia.
- Fertilization is external.
- They have a well-developed nervous system.
- The circulatory system is closed type.
- They are hermaphrodites.
- They might possess fin-like appendages called parapodia.
- The organisms belonging to this group lack clitellum and are dioecious.
- Eg., Nereis, Syllis

Oligochaeta

- They are mostly freshwater and terrestrial organisms.
- The body is segmented metamerically.
- Head, eyes and tentacles are not distinct.
- They are hermaphrodites, but cross-fertilization takes place.
- Fertilization is external.
- Cocoon formation occurs.
- Setae are segmented.
- They do not possess parapodia but clitellum is present.
- The organisms belonging to this class are monoecious.
- They exhibit no free larval stage and the development takes place inside the cocoons.
- Eg., Pheretima, Tubifex

Hirudinea

- Most commonly found in freshwater. Some are marine, terrestrial, and parasitic.
- The body is segmented.
- The tentacles, parapodia, and setae are not present.
- The animals are monoecious.
- The body is dorsoventrally or cylindrically flattened.

- They have an anterior and posterior sucker on the ventral side.
- The organisms lay eggs in cocoons.
- There is no larval stage during the development of the organism.
- The mouth is located ventrally in the anterior sucker, while the anus is present dorsally in the posterior sucker.
- Fertilization is internal.
- They are hermaphrodites.
- Eg., Hirudinaria

Archiannelida

- They are found only in the marine environment.
- The body is elongated without setae and parapodia.
- They are unisexual or hermaphrodite.
- Tentacles are present on the prostomium.
- Eg., Dinophilus, Protodrilus

Unit II

2. What is metagenesis .describe the life cycle of obelia in details with a labeled diagrams 5+10

Answer-

Metagenesis is the process through which one generation of plants and animals reproduced asexually before giving birth to a sexually reproducing generation. It is the transition between sexual and asexual phases of an organism in its lifecycle. Both the sexual and asexual phases are diploid (two sets of chromosomes).

Description of Obelia:

1. It is a branched, fixed colony .Some of the horizontal branches anchoring the colony on some support are called Hydrorhiza while other branches are vertical and known as Hydrocaulus.

2. Each branch consists of a granular coenosarc made of two cell layers enclosing the coelenteron and surrounded by a thin transparent horny perisarc.

3. The vertical branches towards the base are further branched and all the branches end in zooids.

4. Zooids are of three types:

a. Polyps or gastro zooids (vegetative zooids). Barrel-shaped and responsible for the nutrition of the colony.

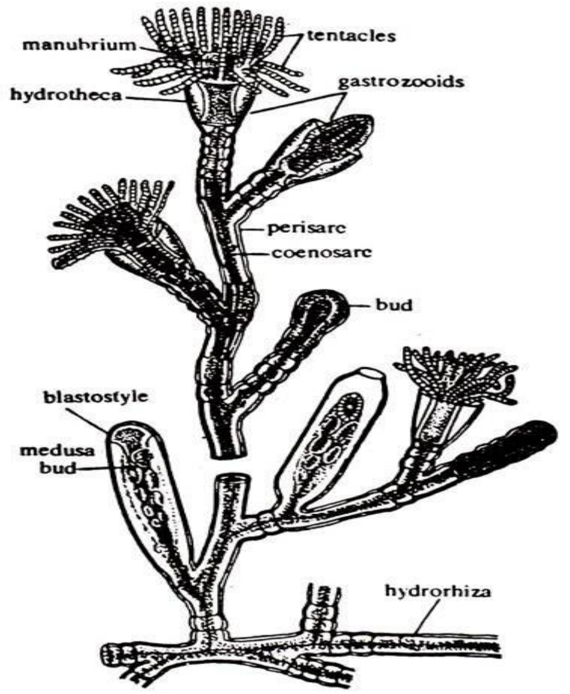


Fig. 20.12. Obelia geniculata

The perisarc enclosing the polyp is termed hydro theca.

b. Blastostyles. or gonozooids. Club- shaped zooids, bearing the medusae buds.

c. Medusae buds. Umbrella-like reproductive zooids bearing gonads, enclosed in a gonotheca.

5. Medusae buds are unisexual and free- living at maturity. One medusa bears either four testes or four ovaries close to the four radial canals.

6. The tentacles in all cases are solid; the solid core or endoderm surrounded by a layer of ectoderm cells.

7. The larvae are ciliated and free-swimming.

8. By repeated branching of the simple polyps colony is formed.

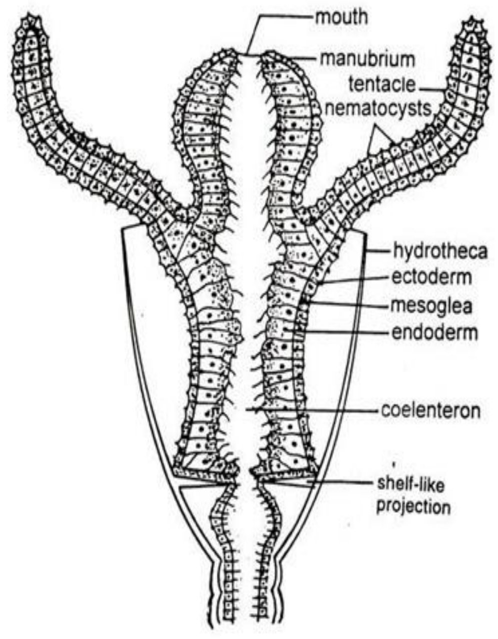


Fig. 20.13. Obelia sp. Vertical section of a polyp (magnified)

Polyps or Gastro zooids or Nutritive Zooids:

1. The zooid is barrel-shaped, partially enclosed by a cup-shaped hydro theca, a continuation of the perisarc.

2. At the distal end a conical projection the hypostome or- manubrium, bearing a mouth is present .

3. A circlet of about twenty-four tentacles are present around the hypos tame. The tentacles are solid with a core of endoderm cells surrounded by a layer of ectodermal cells.

4. The tentacles and the hypostome bear cnidocytes.

5. At the proximal end, the zooid is continuous with the coenosare.

Blastostyle or Gonozooid or Reproductive Zooid:

1. These are a few in number and restricted to the basal end of the hydrocaulus.

2. The blastosyle is long, cylindrical and devoid of mouth and tentacles and enclosed in a transparent gonotheca, modified perisarce .

3. A number of small buds—the medusae buds develop on the walls of the blastostyle.

Medusa in Obelia:

1. At maturity, small umbrella-like me dusae buds get detached from the blastostyle and escape to the sea water through an aperture at the free end of the gonotheca. A hydro-medusa is a solitary and free-swimming modified zooid.

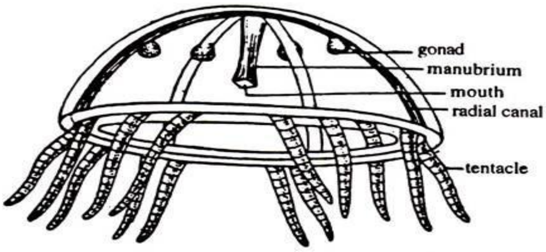


Fig. 20.14. Obelia sp. A medusa

2. A typical medusa consists of a bowl- shaped gelatinous disc or umbrella, the concave surface of which is described as sub-umbrella and the outer convex surface as ex-umbrella.
3. A cylindrical projection, the manubrium, hangs from the middle of the subumbrellar surface. A square mouth is present, at the apex of the manubrium.
4. The mouth leads to a small, central, rounded or quadrangular chamber known as gastric cavity or stomach.
5. From gastric cavity four gastro dermal canals radiate to the margins of the bell. These are radial canals, opening into a ring canal or circular canal running in the margin of the bell. The radial canals mark out four principal radii.
6. From the middle of the radial canal four gonads project. Since sexes are separate, these are either testes or ovaries.
7. The gonads mature after the medusae escape from the gonotheca.
8. The edge of the bell is produced inwards as a thin fold called velum. The medusae with a velum are known as craspedote and those without a velum are acraspedote. The hydromedusa is craspedote.
9. From the edge of bell numerous small solid tentacles hang downwards.
10. The tentacles have swollen bases of accumulated interstitial cells, called vesicles or bulbs. Cnidocytes are formed continuously in the bulb and migrate to the tentacles. They are confined to manubrium and tentacles and a few on the bell margin.
11. Near the bulbs the ectoderm has pigment granules and nerve cells called ocelli. The pigments are accumulated excretory products.
12. Marginal sense organs, statocysts or lithocysts are eight in number and attached at regular intervals on the subumbrellar side to the bulbs of the tentacles.
13. A statocyst is a tiny, circular, closed vesicle lined with ectoderm and filled with a fluid containing calcareous granules called otoliths.
14. Otolith produces a stimulus on thin sensory processes of the sensory tells of ectodermal lining which are transmitted to the muscles. The muscles coordinate the snake-like swimming movements of the medusa.

Histology of Hydromedusa :

1. Both exumbrellar and subumbrellar surfaces of medusa are covered by ectoderm cells.

2. The whole canal system is lined by endoderm cells, continued, at the lip of the mouth, into the surface ectoderm.

3. A thin sheet of endodermal lamella, presumably formed by the fusion of an upper and a lower layer of endoderm, lie between the radial canals and between the ex- and subumbrellar layers of ectoderm.

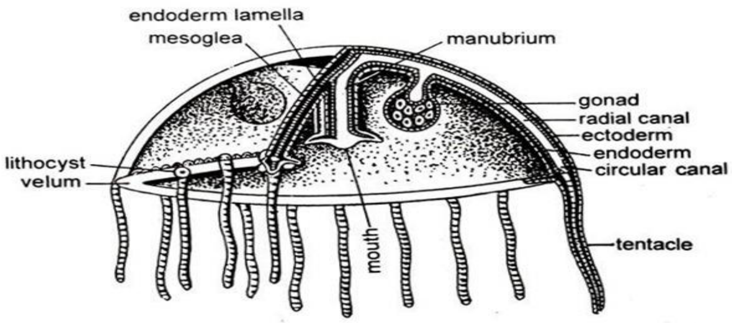


Fig. 20.15. Obelia sp. Medusa (more than one-quarter of the umbrella and manubrium removed)

4. The velum is composed of a double layer of ectoderm enclosing a ring canal and a strip of narrow mesoglea in between the canal and ectoderm.

5. The tentacles are solid, each containing a core of vacuolated endodermal cells covered by ectoderm.

6. The gelatinous mesoglea form the main bulk of the body and contains certain non-cellular fibres.

7. Well-developed musculature with regularly arranged circular, longitudinal and radial tracts is present.

8. The interstitial cells are mainly accumulated at the bulbs or vesicles of tentacles and give rise to cnidocytes of only one type.

Gonads:

1. The medusae are sexual reproductive zooids or gonozooids possessing gonads.

2. They are dioecious—testes and ovaries are borne by separate individuals.

3. Each medusa bears only four gonads situated on the subumbrellar surface, one on the middle of the course of each radial canal.

4. The gonads mature after the medusae escape from the gonotheca.

5. Each gonad (testis or ovary) is an ovoid, knob-like body; it has an outer covering of ectoderm, continuous with that of the sub-umbrella, and an inner lining of endoderm continuous with that of the radial canal (Figs. 20. 14, 20.15)

6. The space between the two layers is filled with a mass of interstitial cells which become differentiated into ova or sperms, as the case may be.

7. The germ cells originate in the ectoderm of the manubrium quite early when the medusa itself remains attached to the blastostyle.

8. Subsequently, they migrate to the gonads to lie between the mesoglea and the subumbrellar ectoderm and undergo maturation.

9. When the gonads are ripe, ectodermal covering ruptures and the germ cells are shed in water.

10. The ova are large rounded cells.

11. The sperms are minute, actively swimming flagellated cells.

12. The medusae die soon after liberating the gametes.

Fertilization and Development in Obelia:

1. Fertilization occurs either in the sea water where the germ cells are set free, or the spermatozoa may be carried by water currents to the female medusae and fertilize the ova in situ. Zygote formed after fertilization, immediately undergoes cleavage.

2. The cleavage is holoblastic and a blastula is formed .

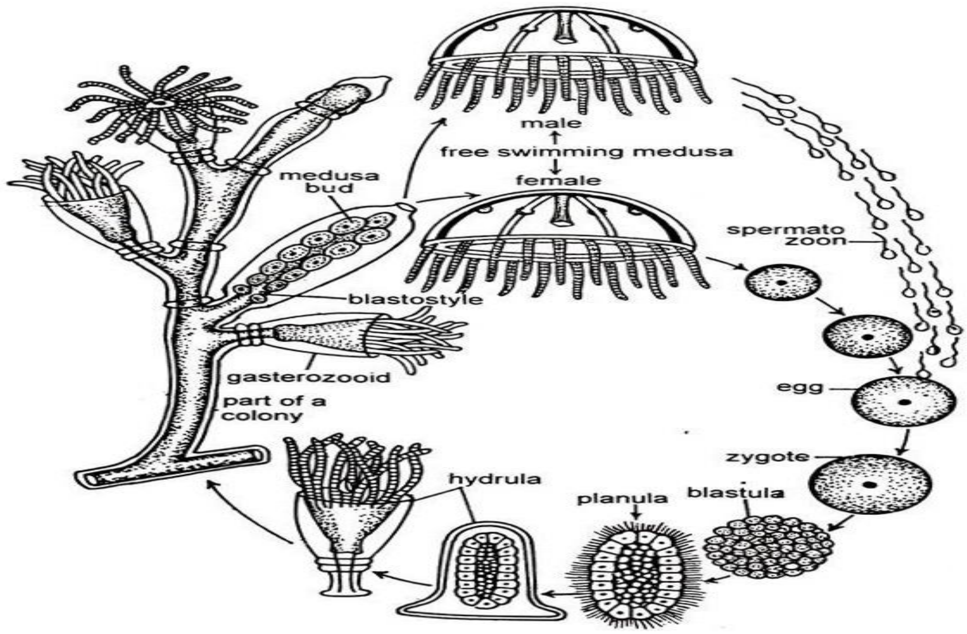


Fig. 20.16. Obelia sp. Life cycle

3. By invagination the blastula is converted into an oval, ciliated planula larva.

4. The planula consists of an outer layer of ciliated ectoderm and an inner mass of endoderm cells enclosing a space, the rudiment of coelenteron.

5. The planula swims freely for a brief period and settles down on some submerged substratum by one end.

6. The proximal end gradually narrows down and a disc appears for attachment. The distal end expands and by developing a manubrium and a circlet of tentacles, it turns to a hydrula or simple polyp.

7. The hydrula sends out lateral buds and, by a repetition of this process, it is converted into a complex obelia colony.

3. Which group of animal forms coral reef ? Give an account of types, distribution and their formation

5+10

Answer: Corals are invertebrate animals belonging to a large group of colourful and fascinating animals called Cnidaria

Types of Coral Reefs:

On the basis of structure and the underlying substratum Charles Darwin (1831) classified 3 types of coral reefs.

They are as follows:

(1) Fringing reef or Shore reef,

(2) Barrier reef, and

(3) Atoll.

1. Fringing reef or Shore reef:

(i) The fringing reef or shore reef (Fig. 12.40A, B) is extended from the sea shore to the seaward directly and surrounds the shores of tropical islands or may be a stretch of continental coast line.

(ii) It extends from the coast a few meters to 400 meters as bench or platform and takes the contour of the shore.

(iii) The fringing reef consists of mainly 3 regions, namely (i) reef front or fore reef slope, (ii) reef crest, (iii) and the back reef, sometimes referred to as the reef lagoon or reef flat area.

(iv) The seaward side of the fringing reef has a reef edge, called reef front or fore reef slope where the most active coral growth occurs.

(v) The coral growing areas represent a narrow belt-like structure and is about 20 to 40 m wide and subject to continuous surf and below to this zone is usually a lot of dead corals, rubble and sand.

(vi) The reef front varies from gentle to steep and in some reefs the lower part of the reef front is nearly vertical and is called drop off.

(vii) The reef front is often interrupted by terraces or shelves. Sand and sediment will collect in terraces.

(viii) At the upper part of the reef front there is an emergent portion, called reef crest. The seaward side of the reef crest takes the brunt of the wave action. The reefs can reduce the wave action up to 97% and the rest of the waves break across the reef crest.

(ix) Between the reef crest and the shore there lies a more or less flat area often eroded and uncovered at low tide, called back reef area or reef flat area.

(x) The back reef area or reef flat area is shallow and is usually 50 to 100 metres or more broad (It may be a few kilometer).

(xi) Sediment, rubble, coral masses and reef fragments torn off by the breakers and are dumped behind the crest and widen the back reef flat. This zone is sometimes called boulder zone.

(xii) The reef flat area remains submerged at high tide but at low tide the water seems to run rapidly exposing more or less the whole surface.

(xiii) The zone between the boulder zone and shore is called inner flat which contains a shallow narrow channel, sometimes deep enough for the passage of local boats but not ships (Fig. 12.40).

(xiv) The reef flat ends at the shore in fringing reefs and descends into the lagoon to atolls and barrier reefs.

(xv) It is the simplest and relatively young type of all reefs and is common in the tropical seas. It is seen in the Gulf of Mannar, Palk Bay, and in the western part of Andaman and Nicobar islands. In the west coast of India fringing reefs are seen in the Malvan coast and in the Gulf of Kachchh including Pirotan island.

Other areas of fringing reef may be mentioned in the Barbados, Sri Lanka, east African coasts, Indonesia, South-eastern coast of Curacao, Islands of Tarutao group (Thailand) and South Pacific Hawaiian islands.

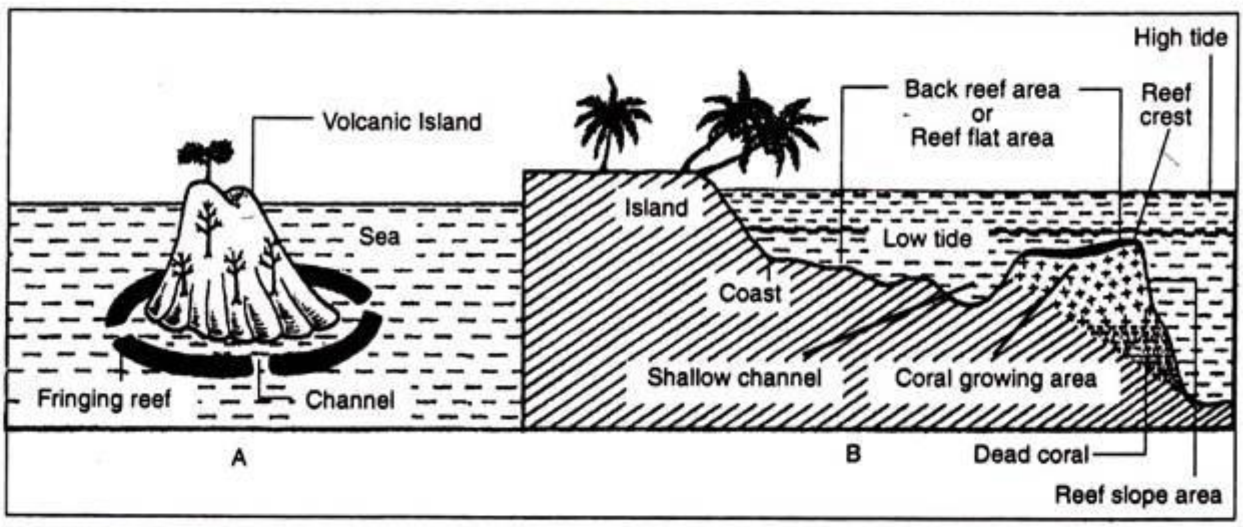


Fig. 12.40: A. Fringing reef, B. Sectional view of fringing reef.

2. Barrier reef:

(i) The barrier reef resembles the fringing reef but grows in deep water than the fringing reef (Fig. 12.41A,B).

(ii) It develops around islands or along the edges of continental shelves and is separated by a wide a relatively deep channel, called lagoon, which is 20 to 100 metres deep and 1/2 to 10 miles wide through which ships can easily navigate.

(iii) The largest barrier reefs which lie on the edge of continental shelves and over 160 km distant from the mainland (e.g., Great Barrier Reef of Australia) are sometimes referred to as shelf barrier reefs to differentiate them from the much smaller barrier reefs surrounding the islands.

(iv) Like the fringing reefs the barrier reefs are divided into (i) reef front area (ii) Reef crest and (iii) back- reef area or flat reef area containing lagoon.

(v) The place of inner reef of the back reef area is taken by a lagoon.

(vi) Towards the lagoon side of the barrier reef there grow more fragile corals than the outer slopes which descend to great depths of hundreds and thousands of fathoms, and tolerate more violent waves.

(vii) The lagoon flat is covered by a thin layer of sand and has a luxuriant coral growth. If there is a good circulation of water there may be the growth of patch reefs.

(viii) A number of small channels which cut across the barrier reefs and connect the lagoon with the open sea. Through these channels fresh and colder waters pass into the lagoons.

The typical example of the barrier reef is the Great Barrier Reef of Australia which is the largest reef in the world, stretching over 2600 km, off Queensland, Australia. Another relatively short barrier reefs are New Caledonia Barrier Reef (1000 km), the Bahama Barrier Reef between Andros and Nassau.

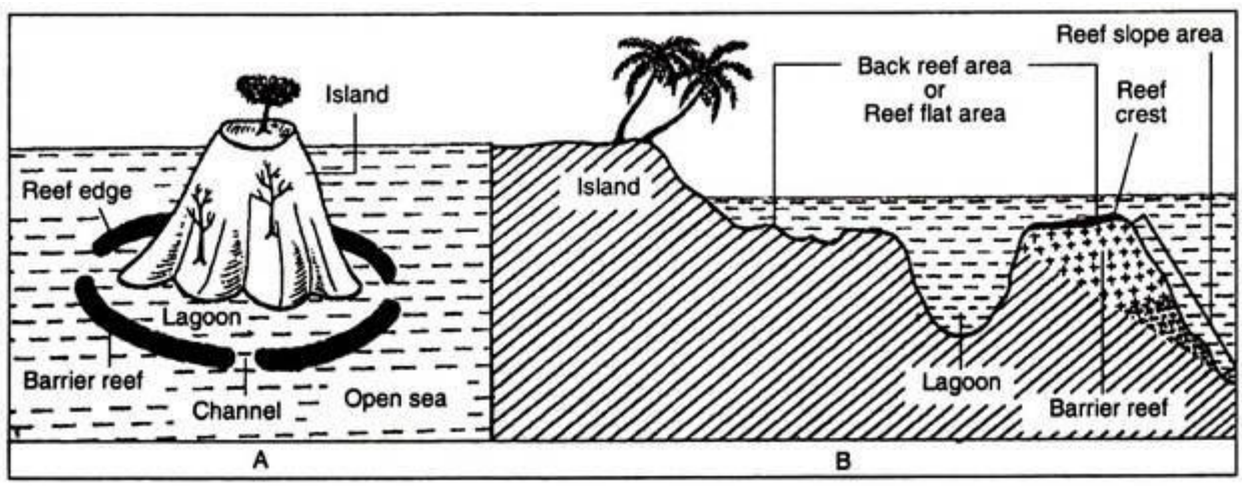


Fig. 12.41: A. Barrier reef, B. Sectional view of a barrier reef.

3. Atoll:

(i) The atoll (Fig. 12.42A, B) is more or less circular or horse-shoe shaped coral reef, enclosing a central area of water, called the lagoon.

(ii) The lagoon varies from a few hundred meters to 90 kilometres in diameter and 20 to 90 metres in depth.

(iii) Atoll generally arises first as a fringing reef around volcanic islands. As the volcanic island subsides because of the seafloor sinking or seafloor rising, the atoll rests on the summit of the submerged volcanoes.

(iv) The lagoon usually contains inner islands and reefs.

(v) Atoll is not connected with the mainland and is separated by hundreds or thousands of kilometres from the land.

(vi) The atoll reef may be complete or broken by a number of channels of which a few are navigable in between lagoon and outer seas.

(vii) There is a seaward slope to the outer-side of the atoll reef and inner side of the reef descends as the lagoon slope (Fig. 12.42).

(viii) The sediment of the lagoon floor consists coral sand and mud.

(ix) Atoll is also called coral island and the term 'atoll' is derived from the language of Maldives where a district is called atolu.

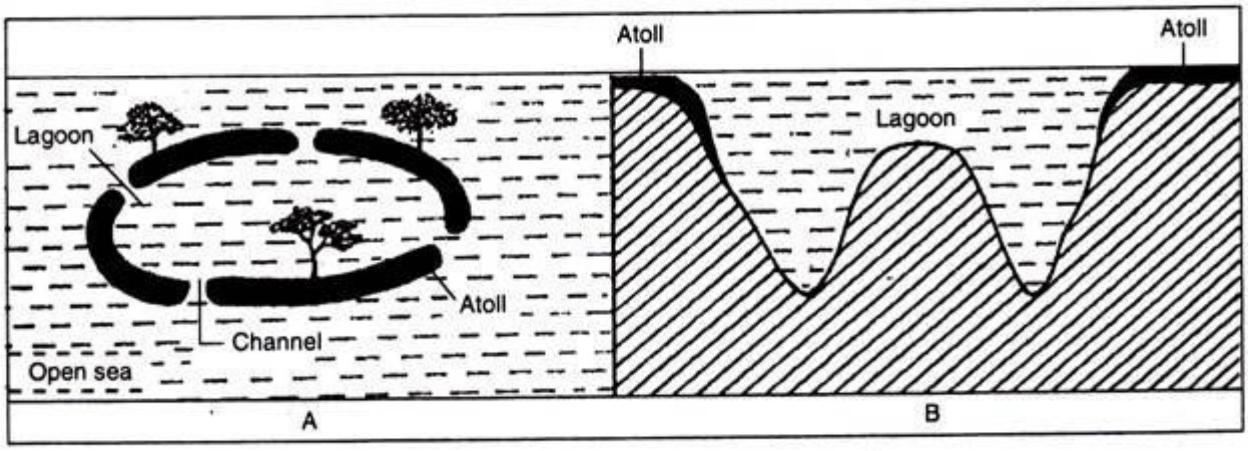


Fig. 12.42: A. Atoll, B. Sectional view of an atoll.

More than 300 atolls are present in the Indo-Pacific region and the largest atoll of the world is Kwajalein in the Marshall island of the Pacific Ocean that surrounds a lagoon over 97 km. Lakshadweep islands are an example of Indian atoll.

Unit III

4. Give an account of larval forms of crustacean and its evolutionary significance 15

Answer-

LARVAL FORMS OF CRUSTACEA

INTRODUCTION

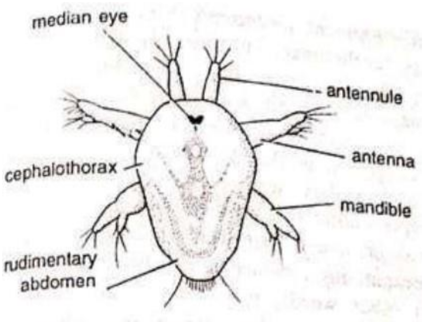
- Crustaceans show both direct and indirect development. In direct development (e.g,, Palaemon, crayfish), the adult is attained by progressive growth and differentiation of the embryo, so that the newly hatched young resembles the parents in general structure. In indirect development, there is a larval stage which differs from the adult in many features and acquires adulthood through metamorphosis.
- Many of the crustaceans undergo indirect development, involving a wide variety of larval forms. Of these 3 main larval forms are nauplius, zoaea and megalopa. Intermediate stages receive different names such as metanauplius, cypris and protozoaea. Modified and

distinctive forms of zoaea are given special designation, such as mysis of lobsters, phyllosoma of spiny lobster, and allima of squilla.

LARVAE OF CRUSTACEA

Nauplius

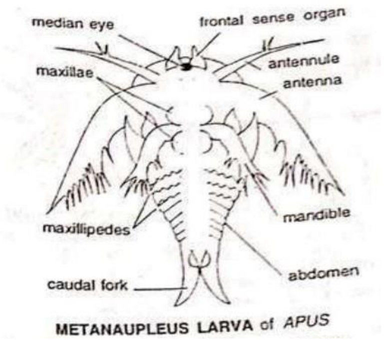
- Characteristic of the class, nauplius is the simplest and commonest type or larva, found in most marine crustaceans and a few malacostracans.
- When development proceeds through many larval forms, the nauplius is the earliest and the basic larva.
- It is free swimming larvae.
- The body is minute with 3 indistinct regions, a single median eye and three pairs of jointed appendages — the uniramous antennules, mainly the balancing organ; biramous antennae, principal locomotor organs and mandibles, which along with antennae may share for food collection.
- In branchiopods the nauplius develops straight away into the adult, but in mostly other crustaceans it may give rise to other intermediate larval forms, such as metanauplius, protozoaea, zoaea, mysis, etc.



NAUPLEUS LARVA of CYCLOPS

Metanauplius

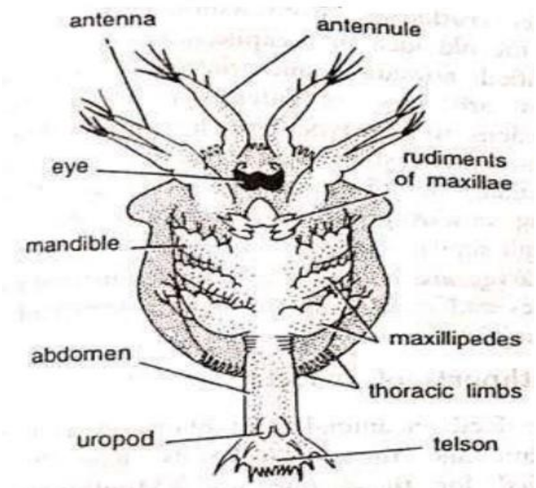
- Metanauplius is the later nauplius instar and results by the process of moulting and growth.
- Its body is divisible into a broad cephalothorax and an elongated abdomen. terminating into a pair of caudal forks.
- Besides the three pairs of nauplius appendages, it also bears the rudiments of four pairs of appendages, which are two pairs of maxillae and two pairs of maxillipedes of the adult.
- Some decapods, stomatopods and some notostracans (e.g., Apus) begin their life history with the free-swimming metanauplius larva.



METANAUPLEUS LARVA of *APUS*

Protozoaea

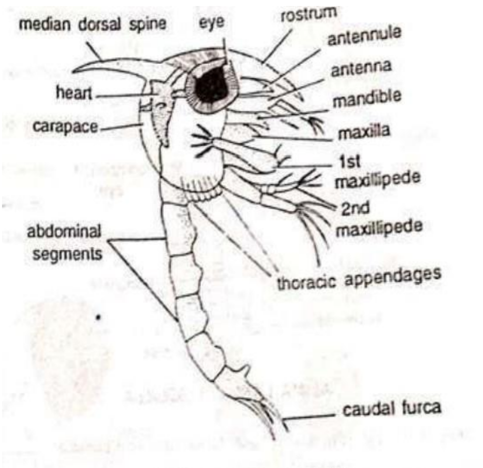
- In case of marine prawns (e.g., Penaeus), and sergestid decapods, the earliest nauplius, by growth and moulting, develops into a protozoaea larva.
- Its body is divisible into a broad segmented cephalothorax covered with a small carapace and a slender abdomen which is unsegmented and bear no appendages terminating in a forked telson.
- There is a single median nauplius eye and the appendages comprise of the antennules, antennae, mouthparts and first and second maxillipedes, The protozoaea later modifies into the zoaea.



PROTOZOAEA LARVA of *EUPHAUSIA*

Zoaea

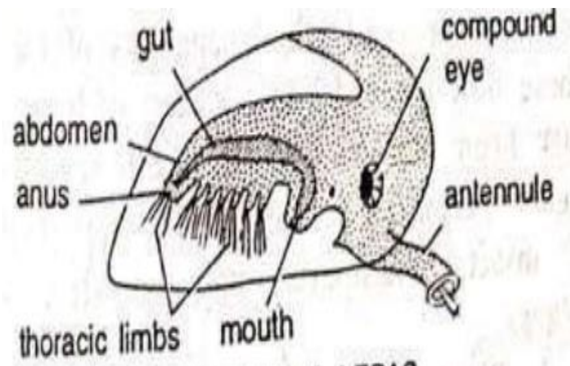
- In almost all marine decapods, except peneids and sergestids, hatching takes place at the zoaea stage (as in true crabs).
- Zoaea has a broad cephalothorax and a curved abdomen. which assists in swimming is provided with a forked telson.
- Helmet-like carapace bears two long spines, a median dorsal and a median rostrum, two lateral spines are often met with.
- A pair of large stalked movable compound eyes are present.
- In addition to protozoaeal appendages there appear rudiments of thoracic appendages.
- Biramous maxillipedes are used for swimming.



ZOAEA LARVA of CRAB

Cypris

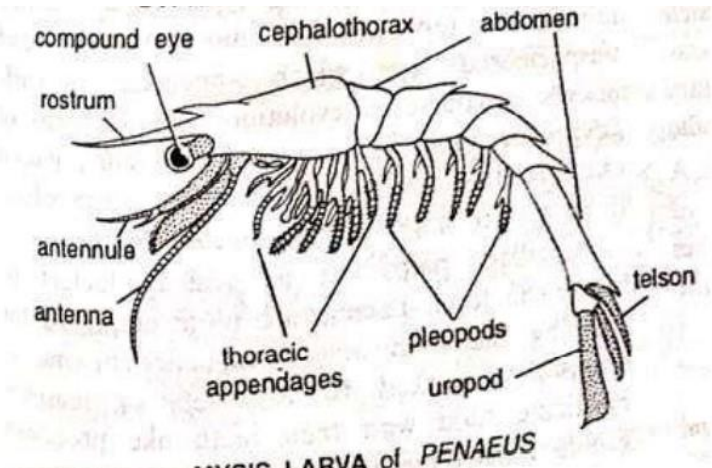
- In Cirripedia (e.g. Lepas, Sacculina), the nauplius larva passes into the Cypris Stage.
- In this form the body and appendages are enclosed within a bivalved shell provided with adductor muscle as is seen in an ostracod adult, Cypris.
- Its modified antennules have cement glands at their bases.
- All Other cephalic appendages with a compound eye only, except antennae, are present.
- Six pairs of biramous thoracic limbs are formed.
- It has abdomen with 4—5 segments.



CYPRIS LARVA of LEPAS

Mysis

- Mysis or Schizopod. In peneid decapods (e.g. penaeus) and lobsters zoaea is modified into Mysis; or Schizopod larva.
- It bears 13 pairs of appendages and resembles adult Mysis.
- It has 5 pairs of posterior biramous thoracic appendages.
- Abdomen is posterior similar to that of adult with 5 pairs of biramous pleopods and a pair of uropods and telson.
- In some lobsters mysis marks the begining of the life history as the naupleus and zoaea are passed within the egg but at the same time it marks the end of the life history of a prawn.

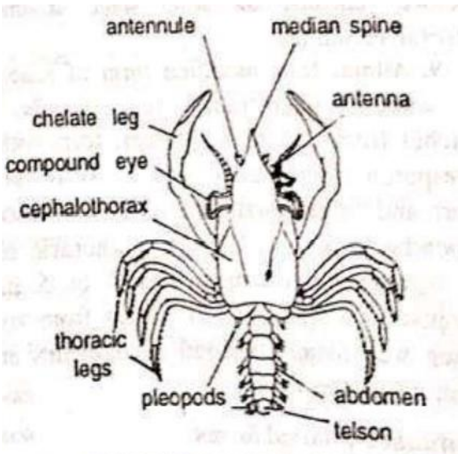


MYSIS LARVA of *PENAEUS*

Megalopa

- In brachyuran decapods (true crabs), zoaea metamorphoses into the megalopa larva.
- It resembles, to some extent, the adult crab and possesses all 13 pairs of appendages.
- Abdomen bears 6 pairs of pleopods and is placed straight in line with cephalothorax.
- In crabs nauplius Stage is passed within egg which hatches as zoaea.
- It then by moulting forms megalopa to be metamorphosed into adult.

In hermit crabs, the glaucothoe corresponds to a megalopa with symmetrical abdomen and swimming pleopods.

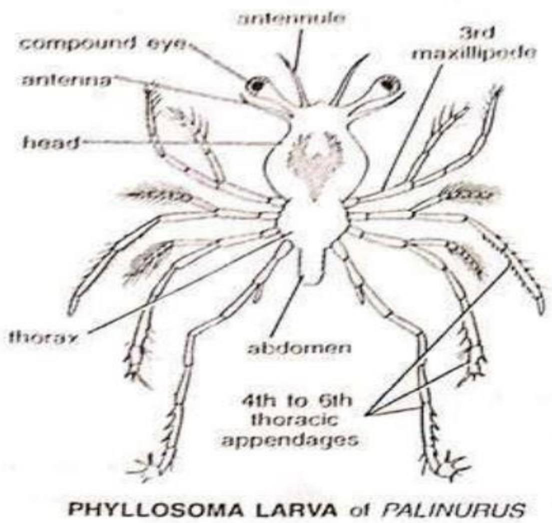


MEGALOPA LARVA of *CRAB*

Phyllosoma

- Larva of Palinurus, the spiny crab or rock lobster, is called Phyllosoma or glass crab.
- It is a modified mysis stage. It is remarkably large, flattened, leaf like, delicate and glassy.
- Body is distinguished into head, a transparent thorax and abdomen.
- Eyes are compound and stalked.
- Out of six pairs of thoracic appendages, the first or maxillipedes are rudimentary, second are uniramous, third well formed biramous succeeded by rest 3 (4^{th}, 5^{th} and $6^{th)}$ pair of long biramous legs.

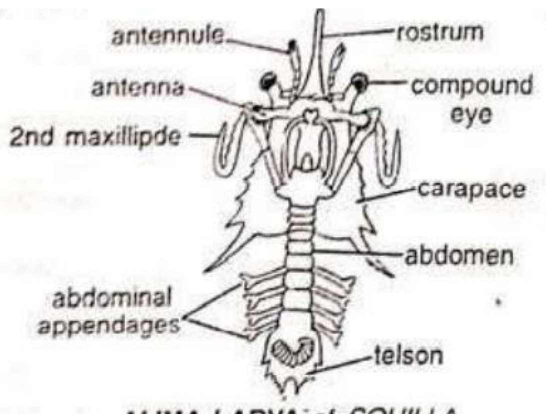
- A segmented but limbless abdomen is present.
- Before reaching an adult Stage, it undergoes several moultings.



PHYLLOSOMA LARVA of *PALINURUS*

Alima

- It is modified form or zoaea found in some malacostracan (e.g. Squilla) which hatches from egg.
- It is a pelagic form with glassy transparency having a slender body.
- It bears short and broad carapace.
- It has all the cephalic appendages but only first two thoracic ones.
- A six segmented abdomen with 4 or 5 pairs of pleopods, is present.
- It differs from zoaea in having well formed second maxillipedes and the armature of the telson.



ALIMA LARVA of *SOUILLA*

Significance of larval forms of Crustacea

According to the biogenetic law or recapitulation theory of Haeckel, every organism during its development (ontogeny), repeats to some extent its evolutionary history (phylogeny). In other words, successive stages of individual development correspond with successive adult ancestors in the of evolutionary descent. Due to its occurrence in the development all

Crustacea, the nauplius was previously regarded to be representing the ancestral form of Crustacea.

It was presumed that from this ancestral form the present day crustaceans evolved phylogenetically. In the other words, the other larval forms (zoaea, megalopa, etc.) show stages of evolution of the higher crustaceans from nauplius-like ancestors. But the old idea of recapitulation stands greatly modified nowadays and the crustacean larval forms are now regarded to be the larval reversions to the types much simpler than the crustacean ancestors. The larval stages arc useful for finding out the homologies and the affinities among various groups. The animals which pass through similar stages are closely related.

Larvae are helpful in the wide distribution of species and in keeping the food reserves of eggs to a minimum.

Q.5 What do you mean by torsion and detorsion. Describe the mechanisms and consequences of this events 5+10

Answer-

Definition: Torsion (twisting) is the rotation of visceral organs in anticlockwise direction through an angle of 180° on the rest of the body during larval development. The phenomenon takes place in the free swimming (veliger) larva of gastropods and converts the symmetrical larva into an asymmetrical adult.

Torsion in Gastropoda:

Mollusca are typically bilaterally symmetrical animals but this symmetry is lost in Gastropoda due to two processes called coiling and torsion. There is a tendency for digestion and resorption to be confined to a dorsal digestive gland or liver, the liver undergoes growth to form a projection which grows so much that it falls over to one side causing a coiling of the alimentary canal into a visceral hump.

The visceral hump grows faster on one side than on the other, so that it is twisted into a compact spiral which is directed posteriorly to keep the balance of the animal, the shell is also coiled. With this spiral coiling one may confuse another process called torsion of the visceral mass, but this coiling evolved before torsion.

The visceral hump behind the head includes the visceral mass, mantle, mantle cavity, and foot; it rotates in a counter-clockwise direction through an angle of 180° on the rest of the body by contraction of an asymmetric retractor muscle which arises from the right side of the larval shell, passes over the body and gets inserted to the left side of the head.

This rotation is known as torsion which is distinct from coiling and is a much more drastic change, it occurs after coiling of the visceral hump.

In torsion only a narrow part of the body and the organs which pass through it are twisted, it is that small part which lies between the visceral hump and the rest of the body. Torsion changes the orientation of the mantle cavity and its organs, and the organs of the left side tend to be reduced or even lost.

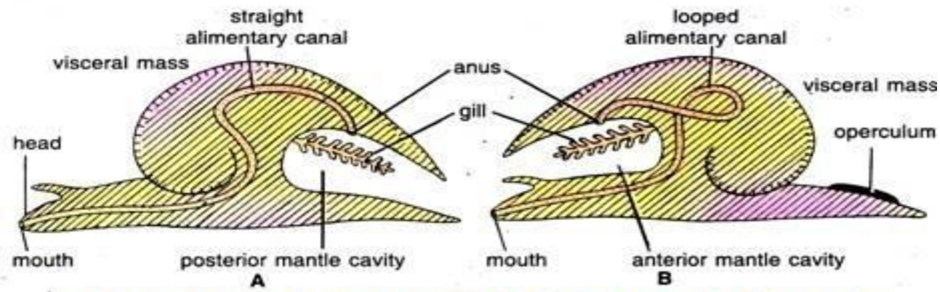


Fig.63.2. A gastrpod showing torsion. A—Before torsion; B—After torsion.

Before torsion the mantle cavity opens posteriorly, ctenidia point backwards, the auricles are behind the ventricle, the nervous system is bilaterally symmetrical, and the mouth and the anus are at opposite ends.

After torsion the mantle cavity opens in front just behind the head, ctenidia come to lie in front and point anteriorly, the ctenidium of the right side comes to lie on the left and that of the left side on the right, the auricles become anterior to the ventricle, the auricle of the right side comes to lie on the left and vice versa, the nervous system is twisted into a figure of 8 by the crossing of the two long nerve connectives running to the viscera, and the digestive system becomes U-shaped so that the anus comes to lie in front near the mouth.

The entire process of torsion generally takes only a few minutes.

In primitive Gastropoda there are two ctenidia, two auricles and two kidneys, but in more specialised forms the real left but topographically right ctenidium, right auricle and the right kidney fail to form; this absence of organs of the right side is a consequence of torsion.

The number of auricles is directly related with the number of ctenidia present, and the loss of one gill leaves only one auricle.

It is not clear whether torsion is an advantage or not to the animal, or if it has any evolutionary significance, but it takes place during the embryological development of gastropods, the larva is a first bilaterally symmetrical, then quite suddenly it undergoes torsion. In some forms after the coiling of the visceral hump, torsion occurs by rotation only through 90°, so that the ctenidia and anus point laterally.

Detorsion in Gastropoda:

In some forms the changes brought about by torsion are reversed to a certain extent, while in others, e.g., Aplysia a complete reversal of torsion takes place which is known as detorsion, this occurs when the shell is lost or much reduced, the ctenidia liberated from their enclosing case point posteriorly again, their anterior position being of no advantage, and the visceral hump gets completely untwisted.

In Cephalopoda the body has become greatly elongated along the dorso-ventral axis, and as a result of change in the method of locomotion this axis has become the functional anteroposterior axis. A ring of tentacles lies at the anterior end of the body and the visceral hump is posterior, the original mantle cavity has become ventral.

6. Write notes on any two 7.5X2=15

a. Septal nephridia

Answer- **Septal Nephridia:**

These are found situated on the inter-segmental septum between 15th and 16th segments to the posterior side of the body.

Each septum bears nephridia on both the surfaces arranged in semicircles around the intestine, two rows in front of the septum and two behind it. Each septum has about 40 to 50 nephridia in front and the same number behind, so that each segment possesses 80 to 100 septal nephridia except the 15th segment which has only 40 to 50 nephridia. These are not found in the segments up to 14th.

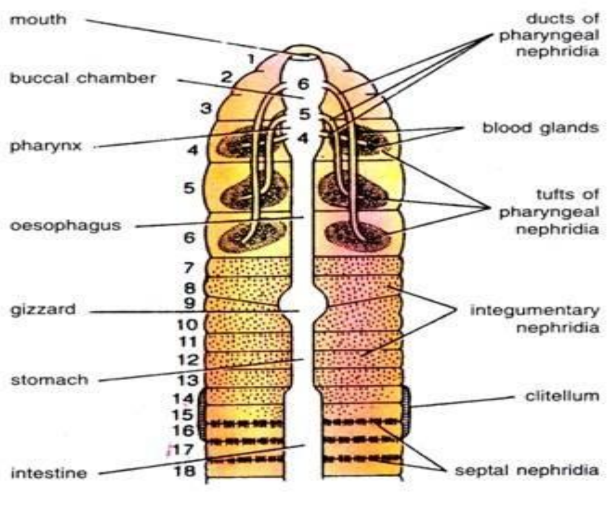


Fig. 66.21. *Pheretima*. Different types of nephridia and general plan of their distribution.

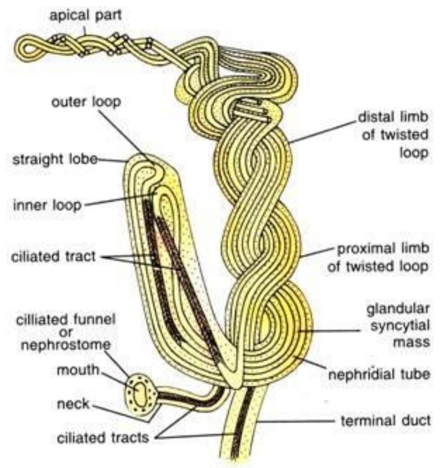


Fig. 66.22. *Pheretima*. A septal nephridium.

Structure:

The septal nephridia may be considered typical of all the nephridia of Pheretima. Each septal nephridium (Fig. 66.22) consists of nephrostome, neck, body of nephridium and the terminal duct.

(i) Nephrostome:

It is also known as ciliated funnel or nephridiostome. It is the proximal flattened funnel-shaped structure of the nephridium lying in the coelom.

It has an elliptical mouth-like opening leading into an intracellular canal of the large central cell, the margins of the opening are surrounded by a large upper lip and a smaller lower lip.

The lips are provided with several rows of small ciliated marginal cells and the central canal is also ciliated.

(ii) Neck:

The nephrostome leads into a short and narrow ciliated canal forming the neck. It joins the nephrostome to the body of nephridium.

(iii) Body of Nephridium:

The body of nephridium has two parts a short straight lobe and a long twisted loop. The loop is formed by two limbs— the proximal limb and the distal limb.

Both these limbs are twisted spirally around each other, the number of twists varies from nine to thirteen. The neck of nephridium and the terminal duct join together and remain connected with the proximal limb of the twisted loop, while the distal limb becomes the straight lobe.

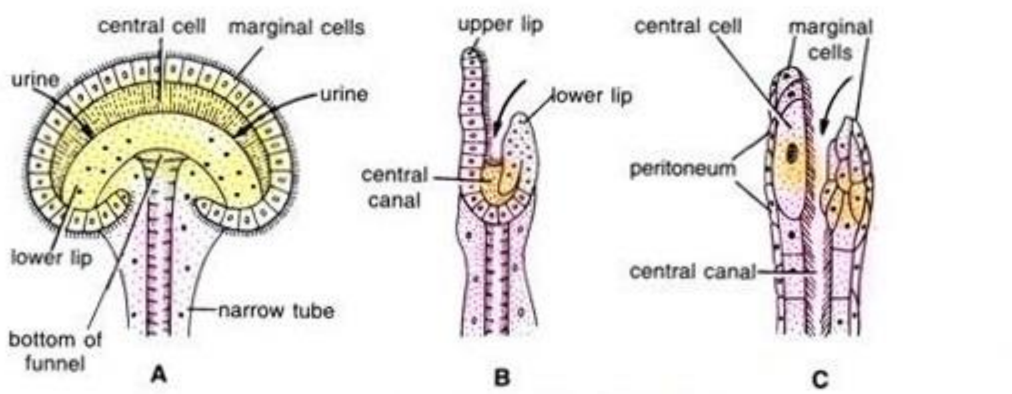


Fig. 66.23. A—Nephrostome of earthworm; B and C—L.S of nephrostome.

Internally the nephridium is made of a connective tissue matrix having long coiled nephridial duct forming loops. There are four such canals in the straight lobe, three in the lower part and two in the upper part of the limbs of twisted loop. Two canals of the straight lobe out of the four are ciliated like the ciliated canal of the neck.

(iv) Terminal Duct:

It is short and narrow with a terminal excretory duct. It joins the nephridium with septal excretory canal.

Relation of septal nephridia with intestine:

The nephridia hang freely in the coelom and are attached only by their terminal ducts. They open by their terminal ducts into two septal excretory canals lying on the posterior surface of the septum, one on each side of the intestine, each begins ventrally but dorsally it opens in the supra-intestinal excretory duct of its own side.

The supra-intestinal excretory ducts are two parallel longitudinal canals lying above the gut and below the dorsal vessel (Fig. 66.24). These excretory ducts begin from the 15th segment and run to the last segment, they communicate- with each other for a short space behind each septum, then either the right or the left duct opens by a ductule into the lumen of the intestine near the septum.

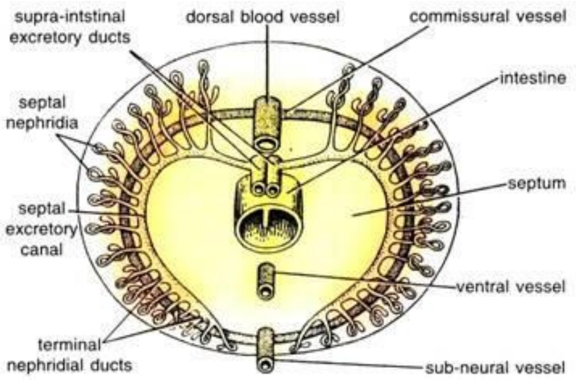


Fig. 66.24. *Pheretima.* The arrangement of septal nephridial system in relation to the intestine.

Thus, each segment has one such opening into the intestine of either the left or the right supra-intestinal excretory duct. The waste collected by the nephridia is discharged through the excretory canals and ducts into the lumen of the intestine. Such nephridia opening into the intestine are called enteronephric nephridia.

b. osphardaium

answer- Pila has a single gill-like osphradium in the left pulmonary area. It is used to detect materials entering gills and hangs from the roof of the mantle cavity. In mollusk, a single or paired sensory attachment to the visceral ganglia is called osphradium. The major function of osphradium is to test the incoming water for silt and food particles. The osphradium also acts as an olfactory organ in certain mollusks and is linked with the respiratory organ. Osphradium structure resembles the feather of a bird and is also called Bipectinate. Chemoreceptors are used to detect chemical changes in the surroundings. It is found in the genus Conus- the cone snails and the predatory sea snails.

c. Madreporite

d. The madreporite is a lightcolored calcareous opening used to filter water into the water vascular system of echinoderms.

e. It acts like a pressure-equalizing valve. The water vascular system of the sea star consists of a series of seawater-filled ducts that function in locomotion and feeding and respiration.

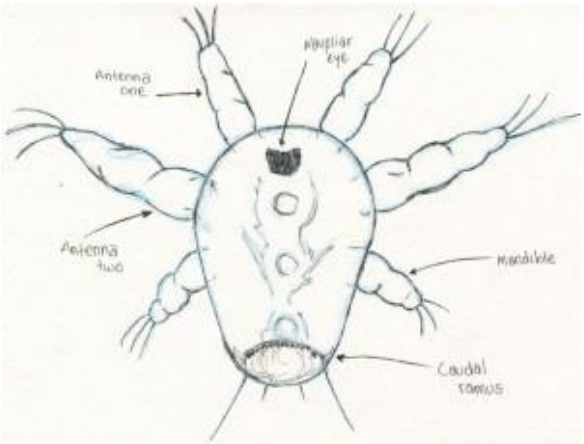
f. Its main parts are the madreporite, the stone canal, the ring canal, the radial canals, the lateral canals, and the tube feet.

g. The sieve-like madreporite allows entry of seawater into the stone canal, which connects to the ring canal around the mouth.

d Nauplius larva

answer-

he *Nauplius* larva is the first planktonic larval form of most marine and of some freshwater crustaceans, from barnacles to anostracans to decapods. Crustaceans may pass through a number of larval and immature stages between hatching from their eggs and reaching their adult form. Even so, many groups have bypassed this phase during their development. The larva bears little resemblance to the adult, and there are sometimes where is not known what larva will grow into what adult. A *nauplius* (plural nauplii) is the first larva of animals, classified as crustaceans. *Nauplius* larvae belong to the phylum *Arthropod*.
It body consists of a thorax and abdomen, head and telson*[1].
This organism has a single, median eye at the front of its head. This eye is referred to as the *Nauplius* eye or "naupliar eye", and is often absent in later developmental stages, but can be retained into the adult form in some groups, such as the Notostraca*[2].



With only three pairs of appendages, the first and second function as antennae, and the third function as mandibles; the antennae and mandible bear swimming setae which is a stiff, hair-like structure (A Dictionary of Zoology (4 ed.)). These appendages are usually feeding limbs and also aid in propulsion.

The body of the *Nauplius* shows no external sings of segmentation. During subsequent molts, the body adds new segments posteriorly, and new appendages that appear like buds. A shield covers the *naupliar* body in the earlier stages. At the posterior end of the body there are indications of caudal rami*[3] in later stages. The labrum*[4] originates as a lobate flap near the frontal margin of the head, between the bases of the first antennae, and extends posteriorly along the ventral surface of the body.