

(6) Molting - for growth or disease. as in snake

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Phylum Arthropoda

Arthro - Jointed

Poda - appendages.

- Largest phylum of animal Kingdom.
- 83% population of invertebrates.
- 53.6% are insect.
- Evolutionary → From annelida Metameric segmentation
- Habitat - both terrestrial & aquatic, Cuticle, appendages.
- Organ System level of body organisation.
- (2) Triploblastic, bilaterally symmetrical body.
- Mainly two regions -
Head, thorax, abdomen
Cephalothorax + abdomen.
- Exoskeleton - chitin.
- Blood vascular system is open type & blood pigment is haemolymph.
- Complete digestive system i.e open from mouth & ends in anus.
- Respiration through trachea gills, trachea & book lungs in case of spider.
- Excretory system. through green gland and malpighian tubules.
- Excretory product is uric acid.
- Nervous system well developed & simple ganglion, brain & ventral nerve chord.
- Sensory organs are antenna, antennae or statocyst (statocyst - balancing organ)
- Reproduction - sexes are separate.
Internal fertilisation, Indirect development except Ascaris (viviparous)
- Development ← Incomplete - Direct
complete - Indirect

→ Parienta

Classifi

→ 7 class

→ Insect

Insecta	Mostly terrestrial and some aquatic
Diplopoda	Terrestrial
Chilopoda	Terrestrial
Arachnida	Terrestrial
Crustacea	Mostly aquatic
Orychophora	

→ Parental Care is also seen in some arthropods.

Classification

→ 7 classes.

→ Insecta + Hexapoda = Insecta.

	Orychophora	Crustacea	Arachnida	Chilopoda	Diplopoda	Insecta
Habitat	Terrestrial	Mostly aquatic and some are terrestrial	Terrestrial	Terrestrial	Terrestrial	Mostly terrestrial and some are aquatic
Body regions	Not distinct	Cephalothorax and abdomen	3 regions Head Thorax abdomen epistoma	2 head with multisegmented trunk centipede	2 head with multisegmented trunk millipede	3 regions Head thorax abdomen Housefly & Cockroach
Antenna	1 pair	2 pair — one pair antenna & one antennule	no antenna	1 pair	1 pair	1 pair
Eyes	Non distinct	1 pair stalked compound eye	1 pair simple eye	1 pair simple eye	1 pair simple eye	simple & compound eye both are present
Locomotory organ	many pairs of legs	minimum 3 pairs of legs Bisexual appendages	4 pair	1 pair in each segment & poisonous claws	2 pair in each segment no poisonous claws	3 pairs of legs — prothoracic — mesothoracic — metathoracic
Mouth part	Non mandibulate	Mandibulate	Non mandibulate except scorpion	Mandibulate	Mandibulate	Mandibulate
Respiration	Cutaneous	Gills	Tracheal	Trachea	Trachea	Trachea
Body fluid	Haemolymph	Haemolymph	Haemolymph	Haemolymph	Haemolymph	Haemolymph
Circulation	Heart & Ostea					

Development	Anamorphosis	Anamorphosis	Metamorphosis		
Habit / Food	Feed on organic matter	Omnivorous	Hytophagous & predators	Carnivores	Herbivorous
Special character	connecting link btw annelids & arthropoda	presence of exoskeleton	incomplete metamorphosis	Genital organ on feet coprothecogenital	Progenital
					Genital organ + 1st seg 8 & 9 segment

Class Crustacea

Order - 1 Anostraca
Eg - Artemia

2 - Notostroaca

3 - Diplostroaca Eg - Deafnea

4 - Decapoda Eg - Prawn

Class Arachnida

Order - 1 - Scorpionida Eg - Buthus

2 - Pseudoscorpionida Eg - Chelifer

Class Insecta

Subclass - Apterlygota (absence of wings)

order - Thysanura Eg - Silver fish (Lepisma/Book lice)

Subclass - Pterygota (presence of wings)

order 1 - Lepidoptera Eg - Butterfly

2 - Odonata, Eg - Dragonfly

Slipper animal cell due to
2 ha-

{ Digestive, Nervous & Excretory system } - imp.
(Excretory gland)

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Fresh water Prawn
(Macrobrachium/Malcolmsonii)

Important species -

M. carcinus → 30cm length

M. rosenbergii → 25-32cm length

M. malcolmsonii → 28-34cm

M. lamellii → 2.5cm

M. chopraii → 5cm

Systematic Position -

Phylum - Arthropoda

Sub phylum - Mandibulata

Class - Crustacea

Sub class - Malacostraca

Order - Decapoda

Genus - Macrobrachium

Species - Malcolmsonii

Habit & Habitat

Both terrestrial & aquatic, Omnivorous, found in
Ditches, canal, fresh water river.

External features

19 appendages

Head - 5

Thorax - 8

Abdomen - 6

5 appendages
5 appendages

5 → Antenna

2. Antennule

3. Mandible

4. Maxillare

5. Maxilla

slipper animal cell due to
24 ha

{ Digestive, Nervous & Excretory system } - Imp.

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Fresh water Prawn
(Macrobrachium / Malcolmsonii)

Important species -

M. Carcinus → 90cm length

M. rosenbergii → 25-32cm length

M. malcolmsonii → 28-34cm

M. lamerii → 2.5cm

M. chopraii → 5cm

Systematic Position -

Phylum - Arthropoda

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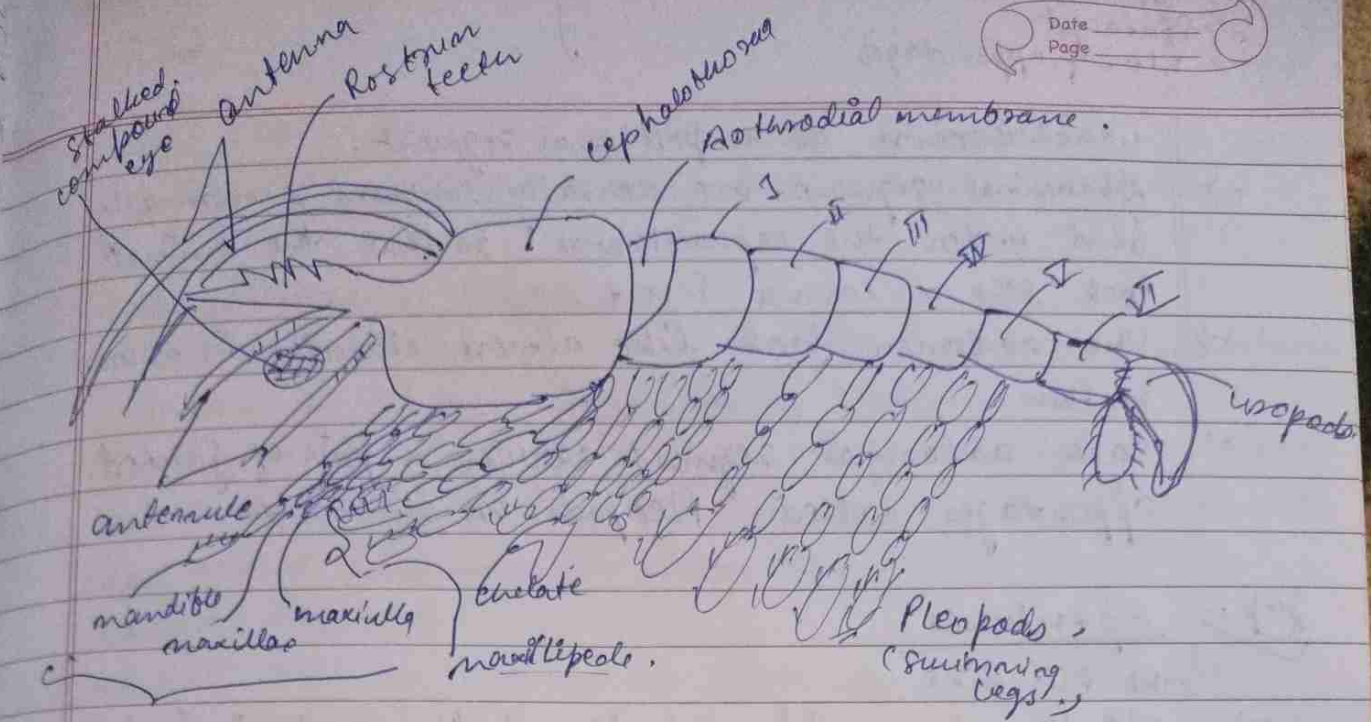
Head - 5

Thorax - 8

Abdomen - 6

3 pairs of
limbs

5 → 1. Antenna
2. Antennule
3. Mandible
4. Maxillae
5. Maxilla.



Thorax - Maxillipedes - 3

- Body of adult prawn is divided into 19 segment or somites, all bearing jointed appendages, the segment are arranged into 2 region - anterior cephalothorax & posterior abdominal region.

Cephalothorax

- It is large, rigid, unjointed & more or less cylindrical in shape.
- It consist of 13 segment.
- It is formed by the union of 2 region head & thorax.
- Head consist of 5 segment & thorax include 8 segment all bearing jointed appendages.

Abdomen

- Well developed abdomen is present in prawn.
- It is composed of 6 distinct movable segment & a terminal conical segment which is called tail telson.

- Where is ♀ & ♂ genital pore
- Green island
- Statocyst
- No. of appendages

- which consist as a post anal segment.
- Abdominal segments are dorsally rounded & normally bend under the cephalothorax so that the animal look like a comma insect.
- The abdomen look like almost circular in a cross section.
- Each abdominal segment carries a pair of jointed appendages called Pleopods or swimmerets.

Imp. Apertures

The slit like

- Mouth open mid ventrally at the anterior of cephalothorax.
- Anus is a longitudinal aperture lying ventrally at the base of telson.
- Paired renal aperture open on the inner surface of coxae of antennae. (base of antennae)
- Paired female genital aperture in female open on the third pair of walking leg
- Paired male genital aperture in male are situated on the inner surface of 5th pair of walking leg.
- There are 2 minute opening of statocyst one lying in deep depression dorsally on the basal segment of each antennule.
- Body & appendages are cover

Exoskeleton

- Body & appendages are covered by hard protective calcareous shell or exoskeleton, it is composed of chitinous cuticle.
- The exoskeleton comprises several hundred plates called sclerites & adjacent sclerites are connected by

thin, soft, uncalcified cuticle which is called arthrodial membrane making the movement feasible.

Cephalothoracic sclerites

All the sclerites of dorsal & lateral side of cephalothorax to form a single large dorsal shield. The anterior and somewhat triangular region of dorsal shield is termed dorsal plate, it extends forward over the head and a laterally compressed & cervicated process called Rostrium.

At the base of rostrum on either side is orbital notch which accommodates or stalked jointed and movable compound eye.

Just behind and below each orbital notch are two spine-like outgrowths, the anterior antennal spine & the posterior hepatic spine.

The posterior region of dorsal shield is termed ~~Carapace~~ Carapaci.

On the either side of the thorax it hangs down freely as gill cover or branchiostegite which enclose a gill chamber.

Abdominal sclerites

The sclerites of each abdominal segment is separate ring like structure which is called arthrodial membrane providing movable joints.

In each abdominal sclerite its dorsal plate is called tergum & the ventral plate is called sternum.

Appendages

Each segment of body bears a pair of joined appendages. In Pelican thus there are 19 pairs of appendages & they are built on the same fundamental plan.

- Each appendage consists of common base which is k/a Protopodite bears 2 rami & inner endopodite & outer exopodite.
- An appendage consists of 2 branches so it is called biramous.
- Typically the basal protopodite composed of 2 segments coxa and basis.
- In prawn there are 19 pairs of appendages 13 in cephalothorax.

2 Page Appendages

Cephalic appendages

Cephalic appendages are 5 pairs beginning from the anterior end of the head they → antennules, antennae, mandibles, maxillule & maxillae.

- Antennules & antennae are preoral while mandibles, maxillule & maxillae are post oral.

Antennules

The antennules are present on the either side below the bases of eyes stalk.

The protopodite consists of 3 segments - a large pre-coxa, coxa & basis.

Pre-coxa bears a depression containing the opening of statocyst on its dorsal side. It also bears a basal

Appendix maxillina is present in 2nd abdominal appendages of male prawn.

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spiny lobe called Stylocerite on its outer margin. Basis carries 2 long fillers these fillers have sensory setae & are tactile in nature.

Antenna

Lies on either side just below the antennules. The protopodite is greatly swollen due to the presence of excretory organ within which opens by a minute renal aperture on the inner margin of the coxa. Thus the antenna are sensory, excretory & balancing in function.

Mandible

The 2 mandibles are strong calcified bodies lying on either side of mouth. Almost the entire mandible consist of coxa which is differentiated into proximal triangular & hollow apophysis and a distal swollen solid head. The head form 2 process a molar process bearing 5-6 dental plate & a plate like incisor process ending in 3 teeth.

The proximal segment represent the basis while the distal segment represent the endopodite. The exopodite is absent - Mandible contribute the biting jaw & are masticatory in function.

Maxilluli

Are small, thin & leaf like appendages. Free border of coxa & basis are covered $\bar{c}$ pointed spines and project forwards Jaw & Gnathopod. Gnathopod bone.

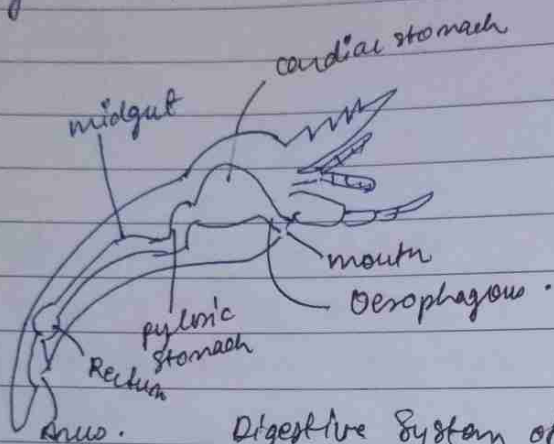
Gnathopodite is also absent in maxilluli.

is also a supper animal cell due to of its shape. It has a mouth - a slit like mid ventral opening.
 Mouth - a slit like mid ventral opening.
 → Hepatopancreas & Gonads are almost similar.
 → Labrum & Labium.

Digestive System of Praon

- ① Alimentary Canal
- ② Digestive gland - Hepatopancreas

- Foregut - Mouth, Buccal cavity, Oesophagus, stomach
- Midgut - Intestine
- Hindgut - Rectum & anus



Digestive System of Praon

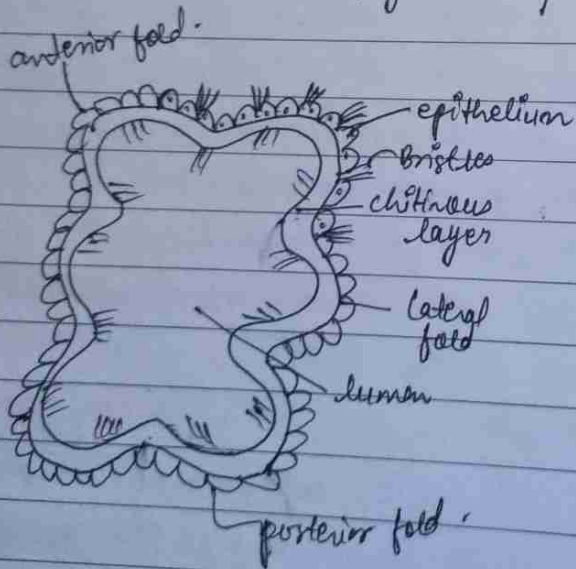


Fig - T.S of ~~the~~ Oesophagus.

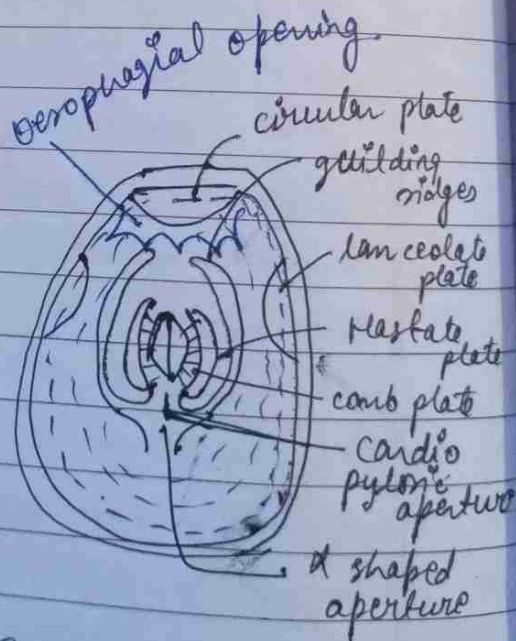


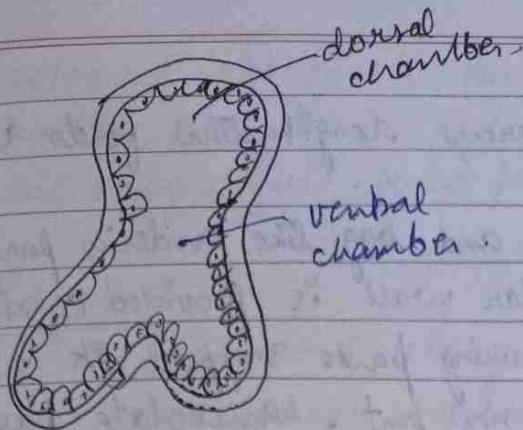
Fig - Floor of Cardiac Stomach



T.S of hepatopancrea



T.S of ovary



T.S. of Pyloric

(A) Alimentary Canal

Foregut

Mouth -

Situated mid ventrally & a large slit like aperture inside the anterior end of

Buccal Cavity

Anterior posteriorly compressed has a thick cuticular lining which is irregularly folded. Mandibular process of mandible lies opposite for crushing the food.

Esophagus

Ventrally upward from buccal cavity to floor of cardiac stomach

Stomach

Occupies most of the cephalothoracic cavity. It remains buried laterally, ventrally, posteriorly in the hepatopancreas. It is the thin walled and double chambered. Consist of 2 parts - a large anterior bag like str. cardiac stomach & smaller posterior pyloric stomach.

Cardiac stomach

The inner lining is numerous longitudinal folds covered by minute bristle.

It is a large spacious and bag like anterior part of the stomach, its inner cuticular wall is provided 3 ridges having minute bristle. Following parts support its wall circular plate in the anterior part. Lanceolate part and a hastate plate in the mid ventral region. The posterior part of hastate plate is dippered & reaches upto the cardio pyloric aperture.

The inner wall of the cardiac stomach on the side of each comb plate is folded to form longitudinal channel called the guiding ridges.

Guiding ridges

The 2 guiding ridges forms the border of cardio-pyloric aperture.

Pyloric stomach

The cardiac stomach opens in pyloric stomach through a narrow x-shaped cardio pyloric opening. The opening is guarded by 1 anterior, 1 posterior & 2 lateral walls.

The anterior wall is the posterior extension of hastate plate, posterior one is the fold of stomach wall & the two lateral wall are projection of guiding ridges.

The pyloric stomach is much smaller in comparison of cardiac stomach, it is incompletely divided into a small dorsal chamber & a large ventral chamber. The ventral chamber receive the duct from the digestive gland, hepatopancreas.

The floor of ventral chamber has a rectangular filter plate having alternate ridges & groove. The filter plate

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together & the bristle on the lateral wall of ^{ventral} lateral chamber acts as a pyloric filtering apparatus. The filter permit only liquid food particle enter into the intestine.

Midgut

It is a narrow & elongated part of the intestine which begins from dorsal chamber of pyloric stomach & runs along the mid dorsal line upto the 6th abdominal segment.

→ hindgut

It is also lined by thick cuticle and consists of following parts - Rectum & Anus.

Rectum - It is a smaller muscular region of the last part of intestine having no. of internal pore.

Anus - This is the aperture through which alimentary canal open to the exterior. It is a ventrally placed longitudinal slit like opening present near the base of telson.

→ Digestive gland

(B) Hepatopancreas Only one digestive gland is present

It is an orange yellow coloured, loosely arranged, bilobed organ which encircles the completely the pyloric stomach, part of intestine and the cardiac stomach.

One Hepatopancreatic duct originates from each lobe & open separately within the pyloric stomach immediately after the pyloric filter plate.

Hepatopancreas play a role of digestive gland such as liver, pancreas & intestine of higher animal, in addition it absorb digested food & can store it for future use thus this organ serves dual functions i.e digestion & storage.

Mechanism of Nutrition

- Ingestion
- Digestion
- Egestion

Ingestion - Praon is omnivorous ~~he~~ ^{eat} all kind of food it feed actively at dusk & in the morning on it and on decaying vegetable & insects. Food is captured by the chelate legs & brought near the mouth cavity by following appendages - maxillipedes, maxilluli & maxilli.

Mandibles help to fragment the food into smaller particles or small bites & the molar process of the mandible inside the buccal cavity crush the food.

Entrance of food within the cardiac stomach is assisted by the peristaltic motion of the Oesophageal wall.

Digestion

Within the cardiac stomach the food is churned by the action of cuticular plates on the inner wall. ~~Food~~ ^{Food} particles of food filtered by ventral chamber of pyloric stomach.

Digestion takes place within the pyloric stomach by the action of digestive juice which come from the hepatopancreas. All the enzyme for the breakdown of carbohydrate, protein, lipid are present in this juice.

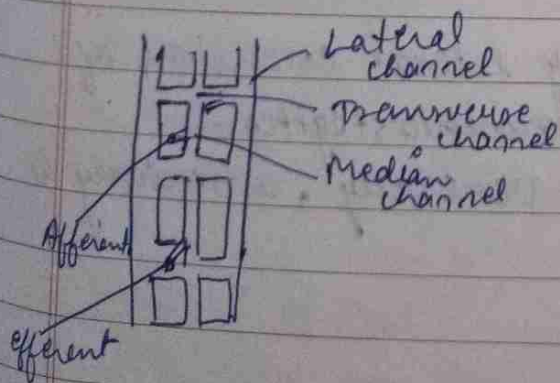
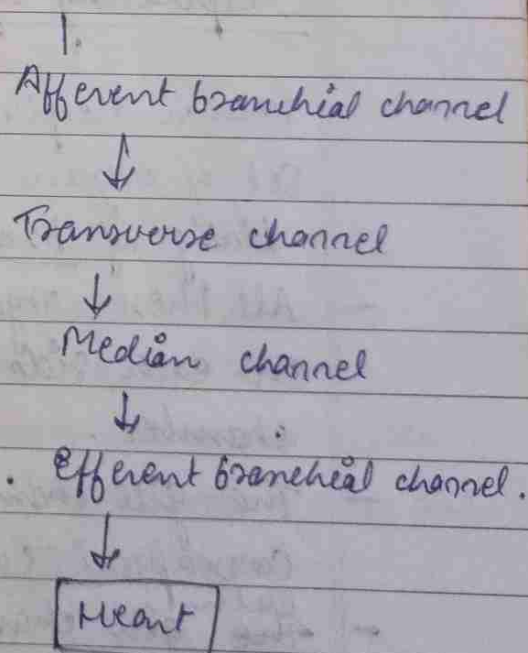
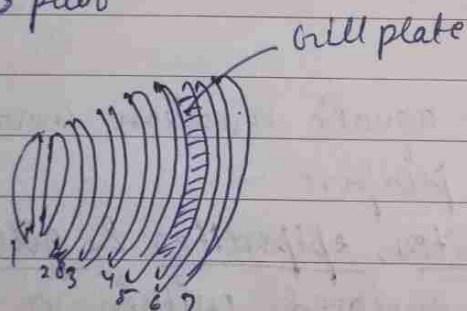
Certain amount of absorptⁿ takes place & the residual part of food passes within the hindgut.

Egestion

The food particle from the intestine to the rectum & here it is temporarily stored for sometime and finally ejected through the anus.

Respiratory System

- 1) Epipodites - manipulators
- 2) Branchio stegites - highly vascularised
- 3) Gills - 8 pair



Blood Vascular system

Type - Open

- ① Blood - haemocyanin (copper containing pigment)
- ② Heart (triangular) situated, attached to ~~cardiac~~ ^{pyloric} stomach by cardio pyloric strand
- ③ Pericardium
- ④ Blood vessels (No. of arteries)
- ⑤ Sinus. - deoxygenated blood is collected & goes to efferent branchial channel,

Heart is attached to strands.

Arteries going inside antennal system is antennal artery.
Ophthalmic.

Respiratory System

Præon respire in the aquatic medium and it carries 3 set of organ for the purpose -

Lining of branchiostegites, epipodites & gills.

- All these organs are enclosed within a special chamber on each side of cephalothorax which is called gill chamber.
- The gill chamber is covered by lateral extension of carapace called gill cover/branchiostegites.
- ^{Each} the gill chamber thus open ventrally, anteriorly & posteriorly.

(A) Lining of branchiostegite.

The richly vascularised membrane of branchiostegite serve of respiratory surface through which gaseous exchange takes place.

due to
body whorls

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cardio
pyloric

branchial
channel,

(b) Epipodites -

These are small, highly vascularised leaf like membranous structure. One on the coxal segment of each maxillipedes. These epipodites being present in the anterior part of the gill chamber carry out respiratory function.

(c) Gills.

Among the 3 shapes of respiratory organ, the gills are regarded as primary respiratory organ on each lateral side of the cephalothorax & beneath the branchiostegite. There are 8 gills. Each attached with the thoracic wall by a gill root. 7 of these 8 gills are serially arranged with the 8th gill remains concealed under the 2nd gill.

Structure of gill

The gills are crescent shape and their sizes increased gradually from anterior to posterior direction. Each gill consist of a axis or base on which double row of leaf like gill plates are arranged like pages of a book.

Types of Gills -

3 types -

- 1) Podobranch - attached to 2nd maxillipede
- 2) Arthrobranch - 3rd maxillipede
- 3) Pleurobranch - attached to thoracic

Podobranch - 1st gill

Attached to the coxa of 2nd maxillipedes.

Arthrobranch - 2nd & 8th gill

Attached to the arthrodial membrane of 3rd maxillipedes.

Pleurobranch - 5 gills.

Attached to the lateral of thoracic segments over the articulating surface of walking leg.

Blood Supply

Two lateral and 1 median longitudinal blood channel pass throughout the length of gill base.

The two lateral channels are interconnected by transverse channel.

- From each lateral channel a marginal channel is given to each plate after covering the entire margin of the plate the marginal channels open into the median channel. The gill receives deoxygenated blood from afferent branchial channel.

- Each branch of afferent branchial channel opens within the transverse channel. From transverse channel the blood pass to the lateral longitudinal channel through the marginal channel.

Renal sac is collecting duct.

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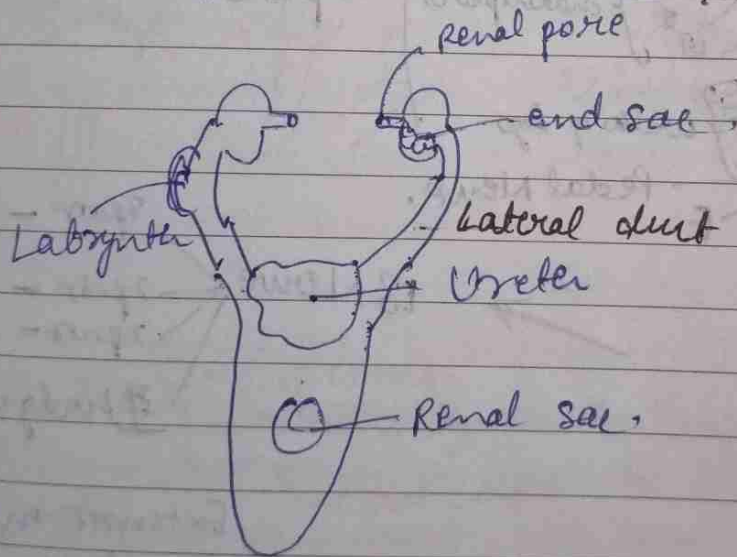
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After oxidation the blood from the marginal channel return to the median channel & then to the efferent branchial channel which convey it to the heart.

Excretory System

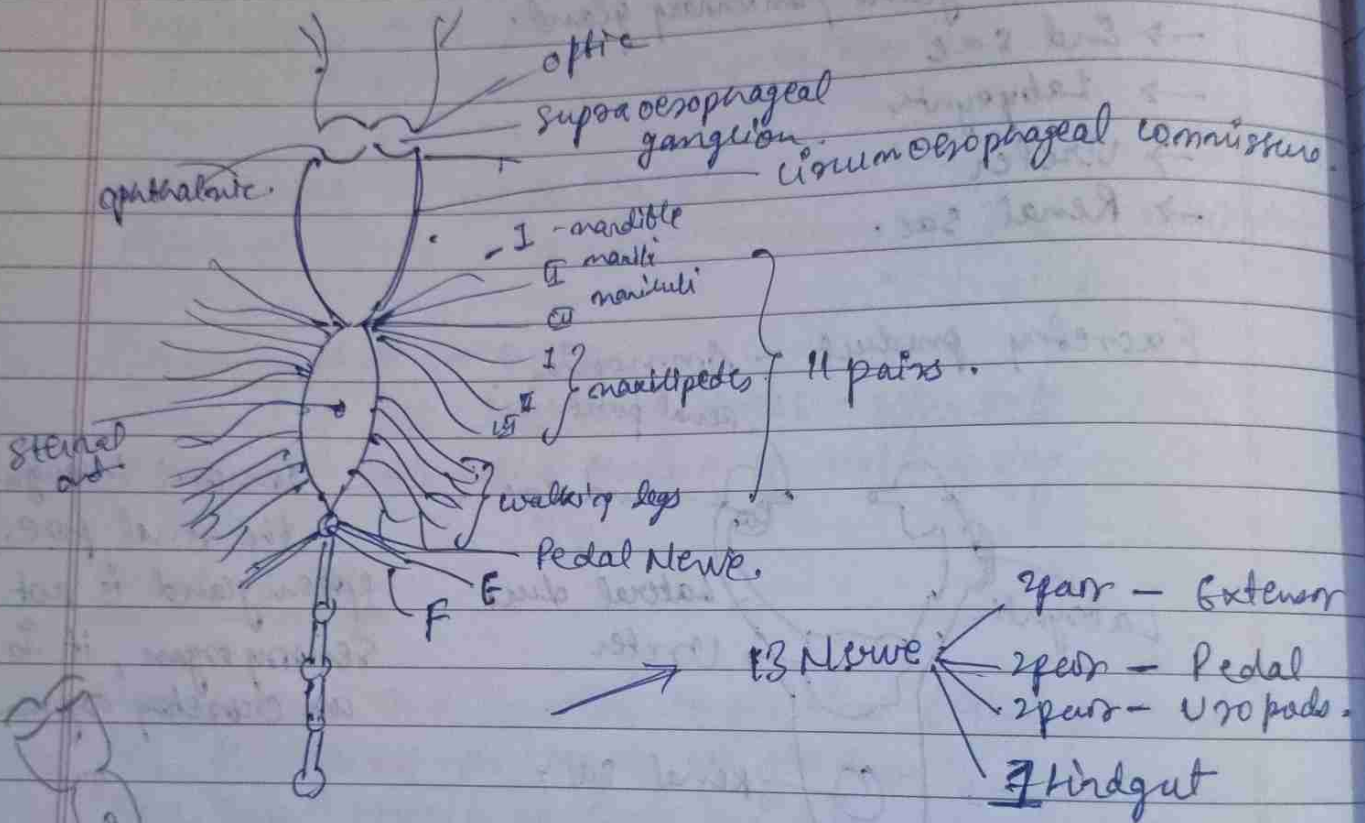
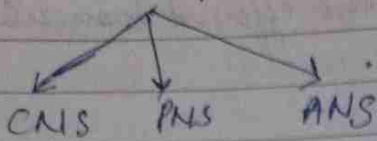
- Green gland / antennary gland.
- End sac
- Labyrinth
- Ureter
- Renal sac.

Excretory product - Ammonia



Removal through the renal pore.
Green gland is not a sensory organ, it is an excretory organ.

Nervous System

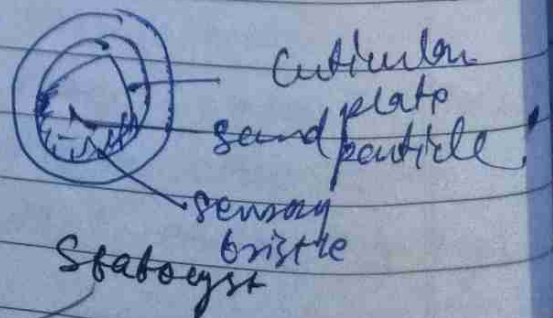
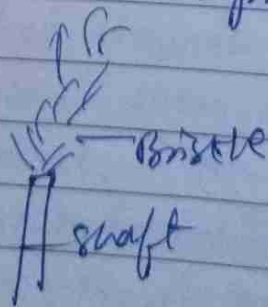


Extensor muscle
Flexor muscle
Pedal

5 segments - 1 pair each

Sense organ

- 1) Antenna - touch
- 2) Statocyst - balancing, precoxal region
- 3) Olfactory organ - smell
bristle absent
(antennules)
- 4) Eye - compound eye - unit - ommatidia



ommatidia, compound eye ..
mosaic formation.

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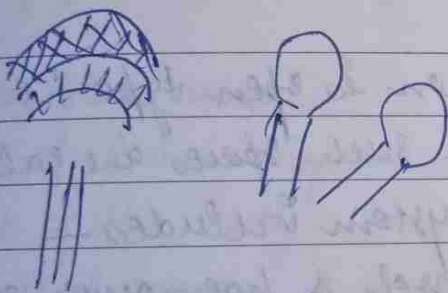
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Course of circulation of blood through the blood

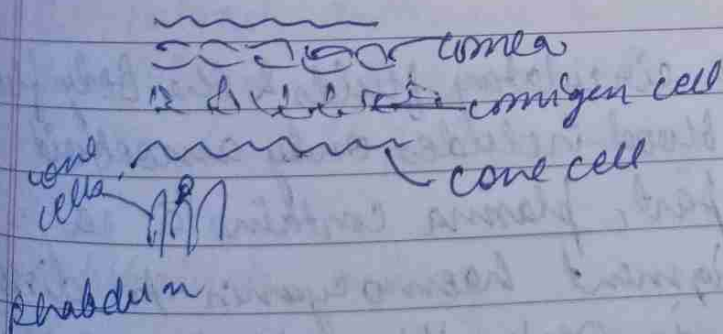
Afferent branchial channel - Transverse channel
- Lateral longitudinal channel
↓ Marginal channel

Heart ← efferent branchial channel ← Median longitudinal channel

Mechanism of Respiration



- 1) Apportion - In bright light
image - mosaic image
- 2) Superposition - In dim light
image - only one image is formed.



Mechanism of Respiration

The exopodite of maxillipedes are responsible for forcing the water rush inside the gill chamber through posterior & lateral side. This water passes out through the anterior end. During the flow of water the vascularised surface of Branchiostegites, gills & epipodites are bathed & gaseous exchange through these areas when dissolved O_2 is taken in and CO_2 passes from the from the body to the exterior.

Blood Vascular System

The blood circulation in Prawn is open type i.e blood flows through the body spaces. Such spaces are called haemocoel. The circulatory system includes—

Blood, Heart, two blood vessels & haemolytic space (sinus)

(A) Blood

Blood includes both the circulatory fluids & the body fluid. The cellular part of the blood includes only amoeboid leucocytes. The liquid part, plasma contains a copper respiratory pigment haemocyanin in dissolved state. This pigment is responsible for blue coloration of blood.

(B) Heart

It is more or less triangular organ in inner spongy cavity. It is placed beneath the carapace & above the gonads.

Heart is united to the pyloric stomach by a Cardio pyloric strand. The anterior end of the heart, called the apex is

pointed & broad end base is directed posteriorly.
The entire sb. is enclosed within a hemolytic space.

called pericardial sinus, the wall of which serve as tissue strands connect the heart to the body wall & thus fix it to its position inside the pericardium.

The wall of heart is perforated by 5 pairs of slit like opening called Ostia. There are 2 pairs on the lateral sides one pair in the ventral, one pair in dorsal and one pair in the posterior end of the heart.

This ostia are contractile and work as valves to permit only flow of blood from pericardial sinus to heart.

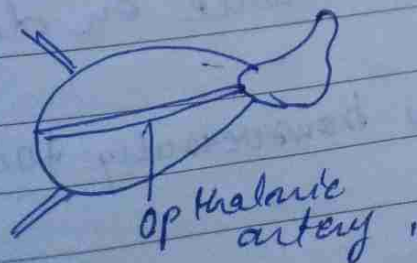
2) True blood vessels

All of them originate from the heart to supply blood to different part of the body. They are better called arteries. From the heart of prawn 6 large vessels originate they are -

- i) Single ophthalmic artery.
- ii) Paired antennary arteries.
- iii) Paired hepatopancreatic arteries.
- iv) Single mid posterior artery.

(I) Ophthalmic artery

The single ophthalmic artery originates from the apex of heart & runs anteriorly along the mid dorsal line upto the base of rostrum and unite with the branches of 2 antennary arteries.



II Antennary artery
Each antennary artery originates from the heart & from the sides of ophthalmic artery. It runs anteriorly along the outer border goes to mandibular muscle.
Each antennary artery send the following branches on its own side.

- i) Pericardial branch to supply blood to the pericardial wall.
- ii) Gastric branch supply blood to the cardiac stomach.
- iii) Mandibular artery supply blood to the muscle of mandible. Each antennary artery split into a ventral & a dorsal branch.

The ventral branch supplies vessels to the 1st & 2nd antennae. The dorsal branch send an optic artery to the eye and two dorsal branch of two antennaries unite to the median ophthalmic artery to run with the notochord as paired Rostral arteries.

III Hepatopancreatic artery.

The hepatic artery of each side originates from the posterior-median end of the heart and runs transversally to enter within the hepatopancreas.

IV Mid posterior artery.

It divide into supra intestinal artery & sternal artery.

The supra intestinal artery runs posteriorly along the mid dorsal line upto the hindgut. It's supplies the alimentary canal & the muscle on dorsal side.

The sternal artery runs transversally towards the ventral side.

- notary organ in
- Heart with ostia
 - Blood supply to arteries.

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All the arteries ultimately break up into finer branches & open within the haemocytic space. Thus the circulatory system of prawn lacks the network of capillaries.

(1) Haemocytic space

The large haemocytic space is called sinuses. These are the placed beneath the hepatopancreas and continued upto the certain length within the abdomen. here this sinus is called ventral sinus.

From the ventral sinus 6 afferent branchial channel take the deoxygenated blood to the gill. The 1st afferent branchial channel supplies the blood to the pedobranch & arthrobranch while the remaining 5 supply to the 5 pleurobranch. From gills oxygenated blood is collected by 6 pair of efferent branchial channel & finally drained into pericardial sinus.

Heart to gills

Mechanism of blood supply -

Excretory System of Praon

Excretory Syst. Organ of Praon are k/a Green gland or antennal gland. They are called green gland for their colour. 2 antennal gland for their position or location at the base of antennae. The green gland, green colour is seen in Astacus. In the case of praon these are paired white organ. Each organ remains within the wall of antennae.

This organ consist of following part -

1) End sac

This small bean shaped part contain a blood lacuna. Its wall is two layered, the inner layer is of epithelial cell having excretory function & the outer thick connective tissue has minute lacunae.

2) Labyrinth

Present outside of the end sac & contains many narrow branched & coiled excretory tubules, each tubules communicate to the end sac by a single opening but open within the bladder through several aperture.

3) Bladder

It is a thin walled sac communicate to the exterior through a small orifice.

4) Excretory opening

It is situated on the base of antennae. Both the green gland are connected to a common large, thin walled, transparent & centrally placed sac called the renal sac. It is situated between the cardiac stomach & the carapace & it communicates to the bladder of each green gland by a separate lateral duct.

Elimination of nitrogenous waste product.

End sac & the labyrinth are the two regions responsible for the excretion of urine from the blood. The most nitrogenous waste product include ammonia a major excretory product in all crustaceans.

Ammonia conveyed the excretory duct of labyrinth from the surrounding blood.

Ultrafiltration of blood takes place in end sac & labyrinth takes position for selective reabsorption.

The urine remains temporarily stored in the bladder & time to time expelled through the renal pore.

The green gland, gills & exoskeleton are collectively responsible for the excretion & osmoregulation.

System of Praon -

Nervous System of Praon is well developed. It is divisible into 3 parts -

- i) CNS
- ii) PNS
- iii) ANS.

I CNS (Central N) - CNS runs from anterior to posterior and contains following structures -

(A) Brain

It is made up of a pair of supra-oesophageal ganglia which are placed dorsally & near the base of rostrum. It sends a no. of peripheral nerves to the different organs at the anterior end of cephalothorax.

(B) Circum-oesophageal connectives

There are a pair of chord each of which begins from the supra-oesophageal ganglia of one side & runs posteriorly ventro-lateral wall of the cephalothoracic cavity. A small ganglion is present in each connective to supply the nerve to mandible.

The two connectives ultimately unite at the floor of thoracic cavity & a large ganglion called thoracic mass.

(C) Thoracic ganglionic mass

It is formed by the fusion of 11 pairs of ganglia, it sends 11 pairs of peripheral nerves.

(D) Vent

(D) Ventral nerve chord

From the posterior end of thoracic ganglionic mass originates ventral nerve chord which run posteriorly. The chord appear to be single but in reality it is formed by the fusion of 2 chord. The ventral nerve chord bears a ganglion in each segment. The last ganglia (13) is the largest of all the abdominal ganglion.

II PNS

PNS are given off from the different part of the CNS. Each PNS consist of 2 types of nerve fibres - motor & sensory. The motor fibre carry instruction from the CNS to different part of body and sensory fibres bring messages from different corner of the body to the CNS.

Following peripheral nerve are seen in Insect -

- (i) Optic nerves - goes to eyes.
- (ii) Antennary nerve - to antenna & antennules.
- (iii) Antennular nerve

* Cephalothoracic nerve - 11 pair.

Abdominal - 23 pair.

III ANS (Autonomous)

It includes few minute ganglia or nerves found over the cardiac stomach to supply involuntary part of the body.

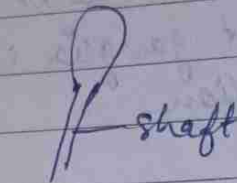
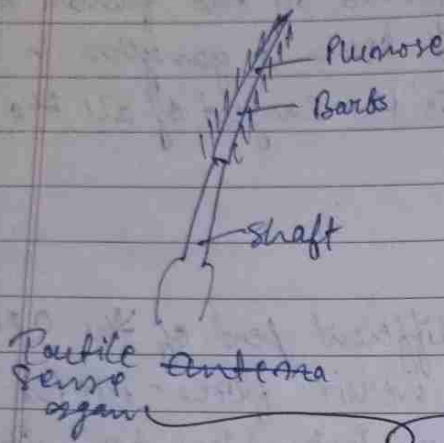
→ compound eye
→ Statocyst

Date
Page

Sense Organ -

→ Tactile Sense organ (Sense of Touch)

- Swollen base or shaft
- Pointed ^{plumose} barbs & double row of barbs.



antennule
of olfactory sense organ

Tactile sense organ

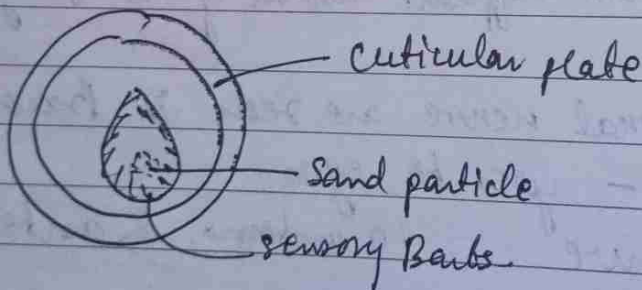


Fig: Statocyst

- Olfactory
- (E) Olfactory organ are responsible for the sense of smell
- This differ from tactile organ in the absence of barbs.
- Statocyst

Compound eye

Statocyst

Inside the base (precora) of each antennule the statocyst is not as a small, white & spherical tubicular sac.

In the central part of the sac elongated and slender sensory setae are arranged.

Each seta consist of a pointed bristle ^{end} called shaft which is directed inward and an outer swollen base which is connected to fine branch of statocyst nerve, in area surrounded by setae there are minute sand grains.

When the prawn moves these inner sand grain are displaced at each change of position.

These displaced sand particles rest against the sensory setae. Finer branches of statocyst nerve carry the information from each seta to the brain and the animal corrects its loss of equilibrium.

Eyes

Each movable and stalked eye is compound in nature, it is made up of several simple unit. Each unit is called ommatidium.

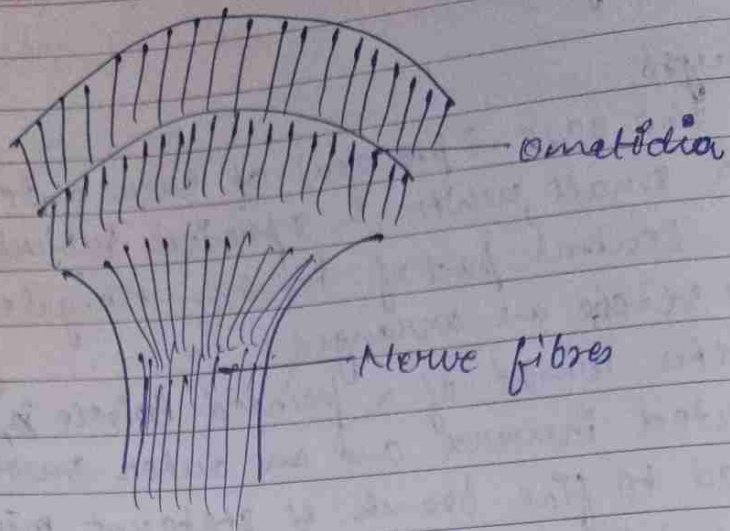
Structure of an ommatidium

Each ommatidium is divisible into 2 parts —

Outer dioptical region for focusing the light rays falling from the object and inner retinal part or receptor region for receiving light stimuli & serve to form the image.

malon triple

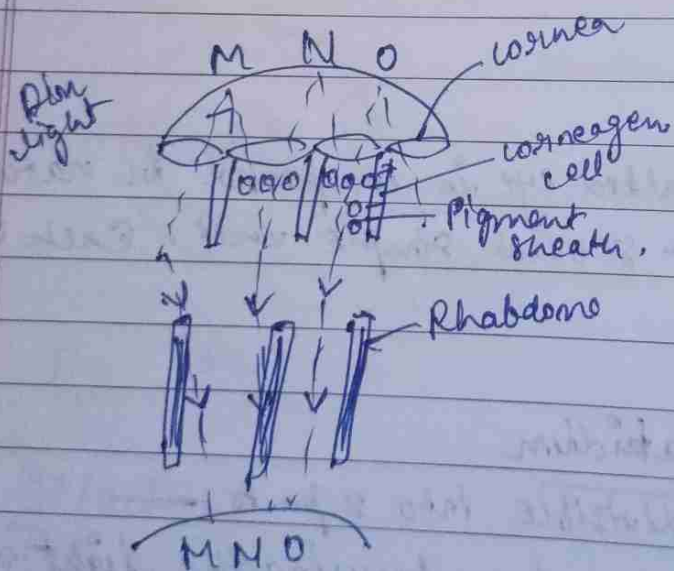
apom...



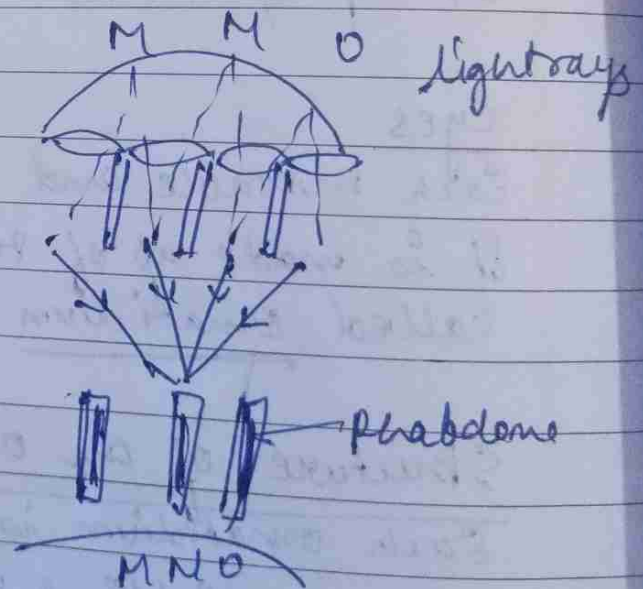
An eyestalk : Innervation

The dioptrical region consist of cornea, corneagen cell and crystalline cone & cone cell.

The receptor region includes rhabdome, retinal cell & pigment sheath.



Apposition



Superposition

Mechanism of Image formation

The ommatidia of a compound eye may work singly or collectively. Several adjacent ommatidia take part in the formation of an image & each ommatidium produces a separate image of a part of the object. Therefore the whole image which is produced by compound eye is made of several pieces of images so the vision produced by the compound eye is k/a mosaic vision.

During bright light both the pigment sheath extend & completely separate the ommatidia which result formation of large no. of / several pieces of image so the vision produced by the compound eye is k/a Mosaic vision.

When light is dim ommatidia work together to form a single but blurred image such image is called superposition image & the kind of vision is k/a superposition image.

Reproductive system

Reproductive System

Sexes are separate in prawn. The gonads are of different shapes & both occupy similar position. The basic difference b/w ♂ & ♀ are —

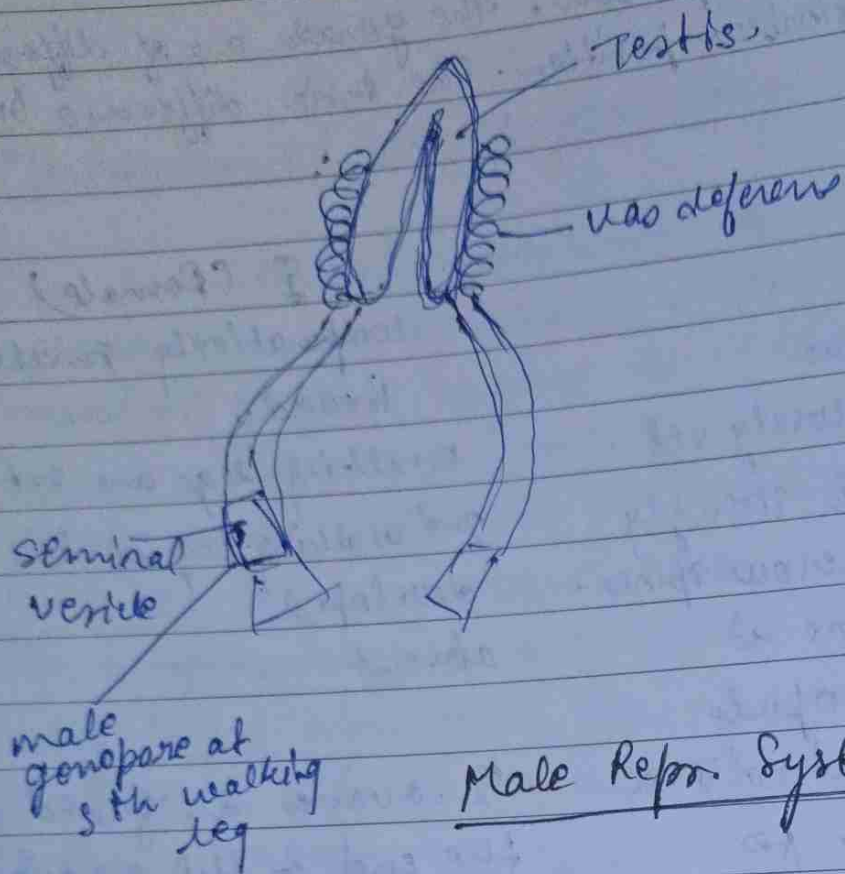
♂ (Male)

- i) Larger in size
- ii) Abdomen is narrow
- iii) Walking legs are closely set.
- iv) 2nd walking leg is strongly developed & numerous spines.
- v) Appendix musculine is not in 2nd Pleopods
- vi) Testes are elongated & a long median gap for cardiopyloric strand, posterior ends are free.
- vii) 1st part of reproductive duct, vas deferens is coiled.
- viii) The ♂ gonopore are not near the 5th walking leg.

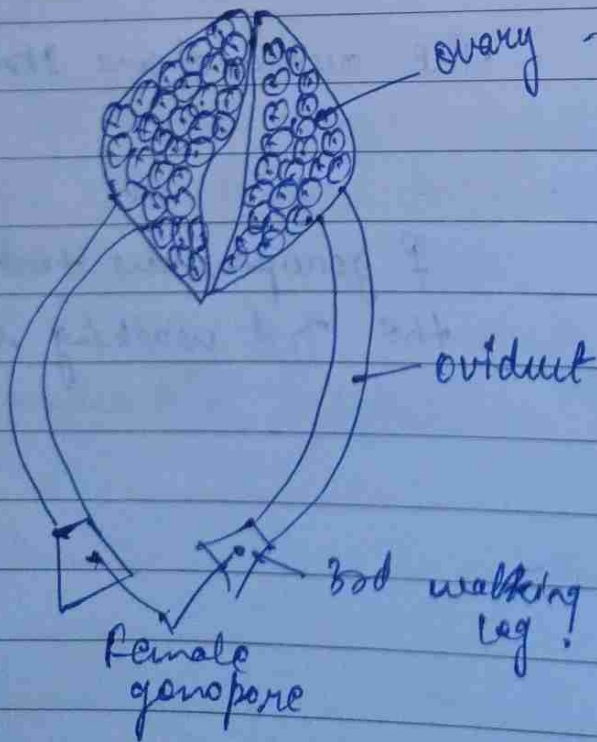
♀ (Female)

- i) comparatively smaller broad.
- ii) walking legs are set apart.
- iii) 2nd walking leg is less developed
- iv) absent
- v) 2 ovaries are fused at both the end & the median gap is short.
- vi) The oviduct are straight.
- vii) ♀ gonopore are not near the 3rd walking leg.

Fig.



Male Repro. System of Prawn



Female Repro. System of Prawn

Male Reproductive System

It consists of following parts.

- i) Testis - This paired, soft & white organs are just above the hepatopancreas & beneath ant. end of 2 are united but post. end are free. Each testis includes numerous minute tubes called seminal vesicle. Each tubule has inner lining of for transformation transfer to spermatozoid.
- ii) Vas deferens - From the posterior end of each testis, a long must called vas deferens. It runs downwards b/w the thoracic wall & abdominal flexure muscle toward the 5th walking legs.
- iii) Seminal vesicle - Each vas deferens near the base of 5th walking leg is swollen as seminal vesicle, it serve as a chamber for storage & transformation of spermatophores.
- iv) Male gonopore - The base of each 5th walking leg contains a opening called male gonopore through which the seminal vesicle of corresponding side opens.

Female Reproductive System

It consists of

- i) Ovaries - These paired white & compact organs are placed above the hepatopancreas & beneath the heart. The 2 ovaries are united at their both ends. Each ovary is bounded by a hard capsule within which egg cell or ova remain serially arranged. The mature eggs remain serially.

larva -

near the margin & the immature egg occupy the center.

(i) Oviduct - From the outer side & from the middle of each ovary originates a short & wide oviduct which runs straight downwards to the 3rd walking leg.

(ii) Female gonopore - Just on the inner side of each 3rd walking leg as a small aperture is called the ♀ gonopore or the reproductive opening.

Breeding & Life History of Prawn

The eggs or ova are yolk filled & each egg contains a large nucleus.

Sperm cell are large in size. Reproduction takes place during rainy season.

→ Fertilisation is external i.e. union of reproductive cell occurs outside of the body.

→ The ♀ prawn carry the fertilised egg within the abdominal basket.

The dev. is direct i.e. young one resembles the adult.

→ Quick moulting occurs for the growth & development.