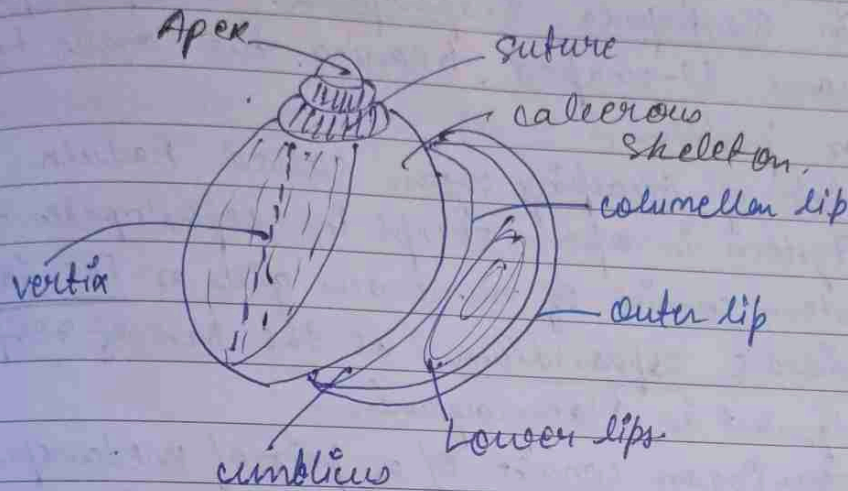


MolluscaGeneral character and Classification of Mollusca

- Soft bodied animal, bilaterally symmetrical.
- Unsegmented



- Coelomic animal, usually shelled having a mantle, ventral foot, anterior head and dorsal visceral mass.
- Mollusca are essentially aquatic, mostly marine, few freshwater and some are freshwater terrestrial.
- The body is soft consisting of head, foot, mantle & visceral mass.
- The body is clothed in one layered often ciliated epidermis.
- Body is commonly protected by an exoskeleton calcareous shell of one or more pieces secreted by the mantle.
- The head is distinct bearing two mouth and provided having eyes, tentacles & other sense organs except in Poli Pelecypoda, Scaphopoda

- Radula teeth are 2h no. in Mollusca.
- Osphradium is a leaf like str. for osmoregulation & respiration.
- metanephridia - kidney like str.

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- ventral body wall is modified into a muscular, ventrally flat plos-like str. called foot, which is variously modified for burrowing, creeping and swimming.
- Mantle is the fold of body wall.
- Body cavity is haemocoel.
- Digestive tract is simple & anterior mouth & posterior anus. But in Gastropoda, Scaphopoda & Cephalopoda intestine become U-shaped, bearing the anus to the anterior position.
- Pharynx contain of grasping organ called Radula.
- Circulatory system is open except in Cephalopoda.
- Respiratory system consist of numerous gills or Ctenidia, usually provided & osphradium at the base of respr.
- Respiratory pigment is haemocyanin.
- Excretory system organ consist of a pair of metanephridia.
- Nervous system consist of paired cerebral, pleural & visceral.
- Sexes usually separate (dioecious) but some are hermaphrodite.
- Fertilisation is external or internal.
- Development is either direct or & metamorphosis through the trochophore stage called Veliger larva.

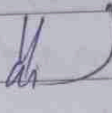
Classification

On the basis of plate mollusca are divided into 4 classes, 7 classes -

1. Monoplacophora

2. Aplacophora - Absence of plates.

3. Polyplacophora - Many plates.

4. Scaphopoda (elephant tusks )

5. Cephalopoda

6. Gastropoda (O-shaped.
(Gastric + poda)

7. Bivalvia

→ * Aplacophora [No + plate bearing]

Order 1: Nemertodica

Eg - Neomenia

Order 2: Chaetodermatodica

Eg - Chaetoderma

class 1: - Monoplacophora

The shape is smooth & cup shape & have dual character like annelida & mollusca. Eg - Neopilina

Class 3 → Polyplacophora.

Class 4 - Scaphopoda
shell is tubular & open at both ends.

Class 5 - Cephalopoda
head & foot region combine & modified into a structure which has eyes & 8 tentacles and hence named head-foot and cephalopoda.

Eg - Sepia, Octopus, Loligo
order 1: Decapoda Eg - Sepia, Loligo
2: Octopoda Eg - Octopus

Class 6 - Gastropoda

Shell is made up of one piece, the early embryo is symmetrical, the body during development twist & torsional strain caused & twist. The large no. of mollusca includes - Pila, Doris, Helix (Garden snail)
(Coelenterates)

Sub class - 1 - Parasobranchia

order 1 - Archaeogastropoda

Eg - Turbo, patella

2 - Mesogastropoda

Eg - Hydrobia, Pila valvata

Sub class 2 - Ophiostobranchia

order 1 - Onchydachia

Eg - Onchidium

2 - Anaspidea

Eg - Aplysia

3 - Pteropoda

Eg - Liana

4 - Neudibranchia

Eg - Doris

Sub-class - 3 Pulmonata

Order ① - Baso banatophora - Eg (Helix) Stylomator-
-phora
Eg - Lingbya

→ Class Polyplacophora

Mang plate bearing animal.

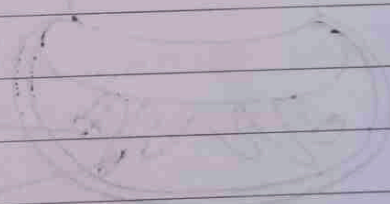
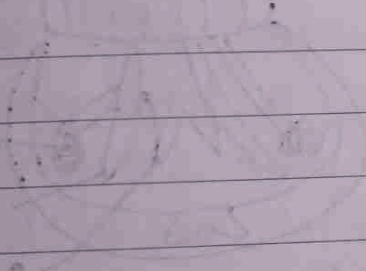
Order 1 - Lepidopleuroidea

Eg - Lepidopleureus

2 - Chitonica

Eg - chiton

→ Class - Bivalvia - Two valve present
Eg - Unio



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Pila globosa (Apple Snail)

Systematic Position

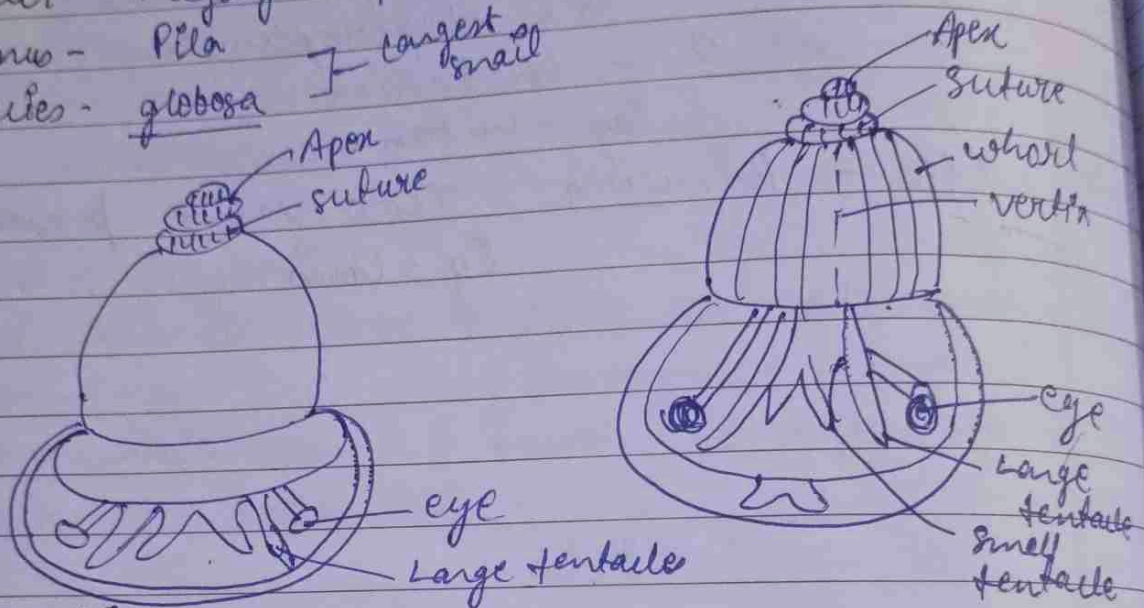
Phylum - Mollusca

Class - Gastropoda

Order - Megagastropoda

Genus - Pila

Species - globosa } largest snail



Introduction

Introduction

Pila is commonly k/a Apple Snail. The Genus Pila is confined to the oriental & ethiopian region. In the oriental region it is found in India except (Punjab & Sindh), Burma, Sri Lanka, Thailand, Vietnam & Philippines.

Distribution

The common species found in North India is Pila globosa & in South India is P. vivens.

Habit and Habitat

- Pila globosa or the Apple snail is one of the largest freshwater mollusca.
- It is commonly found in freshwater, ponds, pools, tanks, lakes, ricefield & sometime streams and rivers.
- They occur in those areas where there is a large amount of aquatic vegetation like valisneria pistia for food.
- They are amphibious being adapted for life in water & on land.
- The animal creeps very slowly by its ^{ventral} ~~peritremal~~ muscular foot. The movement of animal is like the gliding movement of planaria.

During the rainy season Pila comes out of the ponds and make long terrestrial tour, thus respiring air directly.

It can overcome long periods of drought in a dormant condition & buried in the mud, this period of inactivity is called aestivation/summer sleep.

External features

I Shell of Pila

The shell of Pila globosa as in other gastropoda is univalved but coiled around a central axis in a right handed spiral.

The top of the shell is the apex which is formed 1st & the growth of shell takes place from it.

The apex contains the smallest and oldest whorl. Below the apex is a several successively larger whorl is present. The largest whorl enclose most of the body.

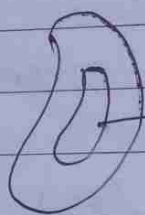
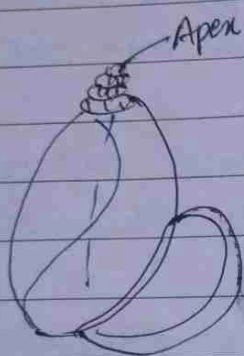
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The lines b/w the whorls are called sutures.
Internally all the whorl of the shell are freely communicate
E one another such a shell is called unilocular.

The body whorl has a large mouth or opening called peristome from which the head & the foot of living animal can protrude.

When viewed from the ventral side $\rightarrow$ the peristome facing the observer. The mouth lies $\rightarrow$ the right side of columella & the shell is spirally clockwise

The outer margin of the mouth is called outer lip & the inner margin as inner or columellar leg lip



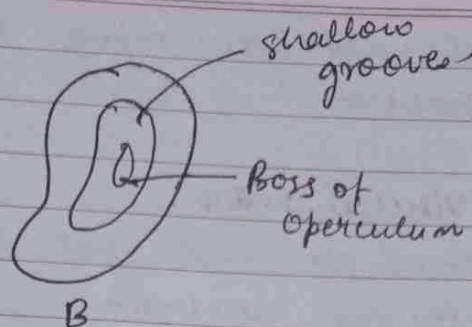
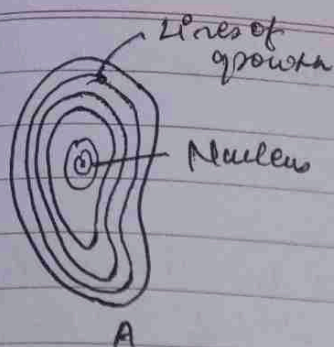
boss of

In the center of the shell runs a vertical axis
The columella is a hollow str. The lines of growth of shell are visible.

The shell of P. globose varies in colour from yellowish to brown or even blackish.

Operculum

Fitting in the mouth of a shell is a calcareous operculum



Operculum — A) Outer view
B) Inner view.

iv) Body of Pila

The body consists of head, foot and a visceral mass.

- Each is an expanded animal the head & foot comes out of the shell mouth but the visceral mass lies inside the shell hole.
- A columellar muscle arises from foot & is inserted in columella. It attaches the body to the shell & it withdraws the animal inside and closes the operculum.

(i) Head.

There is a distinct head, it bears 2 pairs of tentacles. The 1st pair of tentacles are small & lie in front. Behind them there is a 2nd pair of tentacles which are long.

Behind the tentacles the head has a pair of eyes & stalk or ommatophores.

ii) Foot

Below the head is a large muscular foot. Its lower

surface is gray & flattened.

It is triangular & apex pointing backwards.

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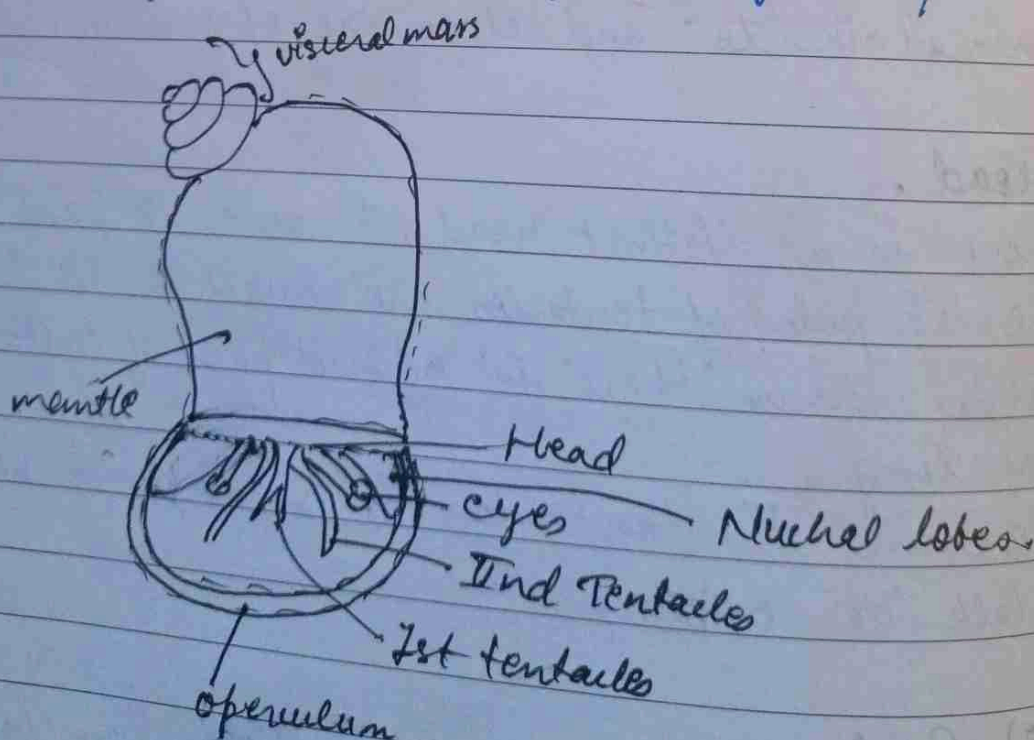
It is used for creeping. It provide power of locomotion.

iii) visceral mass.

Above the head foot complex is a visceral mass containing the main organs. It fills all the holes of the shell and is spirally coiled like the shell. The visceral mass exhibit the phenomena of torsion which is distinct from coiling. It is short, gray to dark brown in colour.

iv) Mantle

The mantle also referred to as Pallium covers the visceral mass and it form a hood over the animal. The edge of the mantle is thick & contains shell gland to which secrete the shell, above the thickened edge there is a supra marginal groove.



(9) Leave 4 page

The mantle has 2 fleshy lobes called nuchal lobes / Pseudopodia which are joint on either side of the head.

The left nuchal lobe forms a long tubular respiratory siphon for aerial respiration & a respiratory current enters through it, the right nuchal lobe is less developed.

v) Mantle cavity & Pallial Cavity

In anterior part there is a large space b/w the mantle & body, this is called mantle & Pallial Cavity.

Coelome of Pila Globosa

The coelome is reduced to unpaired cavities of pericardium, kidney & gonad. The renal & pericardial cavities communicate, but the cavity of gonad is unconnected.

The visceral organ are surrounded by sinus or space containing blood, these blood space constitute the haemocoel.

Digestive System

- ① Alimentary Canal
- Foregut / stomodeum
 - Midgut / Mesenteron
 - Hindgut / Proctodeum.

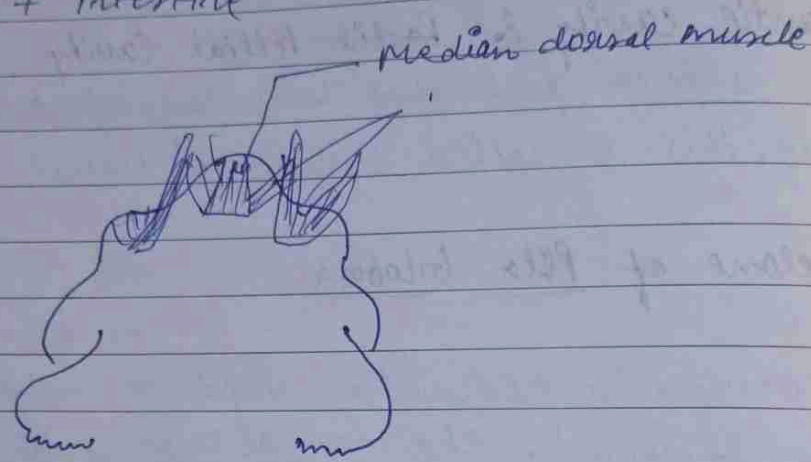
The digestive System of Pila globosa

- a tubular alimentary canal
- a pair of Salivary gland
- a large digestive gland.

The alimentary canal divided into 3 region

- ① Foregut / stomodaeum
- ② Midgut / mesenteron
- ③ Hindgut / proctodaeum

- ① Buccal cavity + oesophagus -
- ② Stomach + intestine
- ③ Rectum



Digestive

The foregut includes the mouth, buccal mass and oesophagus.

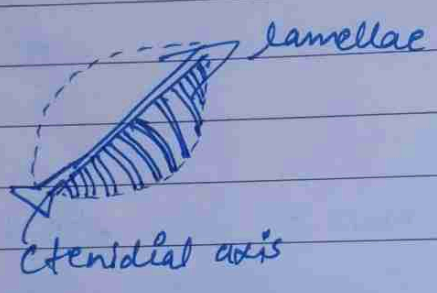
(1) Mouth

The mouth is a narrow vertical slit situated at the end of snout. There are no true lips but the plicose edges alone

Respiratory System

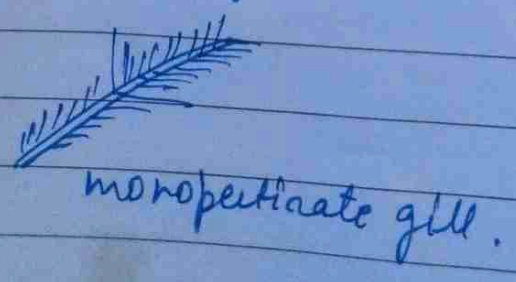
The Respiratory organ consist of a single ctenidium or gill, a pulmonary sac or ^{lung} gill & a pair of nuchal lobes.

- 1) Ctenidium or gill
The Ctenidium or gill is the organ of aquatic respiration. The ctenidium is situated on the dorso-lateral wall of the ventral chamber of the branchial cavity. It is composed of a long series of triangular leaflet or lamellae lying parallel to each other which are attached to the mantle wall by their broad bases but have their apices hanging free in branchial chamber.



The line of attachment of the lamellae to the wall of mantle forms the ctenidial axis. The ctenidial axis is provided with an afferent blood vessels (carrying deoxygenated blood) and an efferent blood vessel (carrying oxygenated blood from gill to heart).

All the gills lamellae are of not of same size, these are largest in the middle & gradually smaller towards the both end. Such a gill is called monopetinate gill.



The ctenidium of *Pila* situated on the right side of the animal is morphologically the gills ~~two~~ of left side which has shifted to right on account of the development of an extensive pulmonary sac on the left side.

This is shown by the blood supply & the innervation of ctenidium further confirmed by situated of oespheredium which still retain its original position on the left side of the animal.

2) Pulmonary sac or lungs

The Pulmonary sac or lungs is a closed cavity like a bag which hangs from the dorsal wall of the mantle in the pulmonary chamber.

The dorsal wall of the pulmonary sac is densely pigmented while the ventral wall is creamy white.

3) Nuchal lobe

The right & left side nuchal lobes are fleshy & highly contractile processes on the mantle wall on the either side of the head.

Mechanism of Respiration

There are 2 types of respiration in *Pila* -

- 1) Aquatic Respiration
- 2) Aerial Respiration

Blood Vascular System of Pila

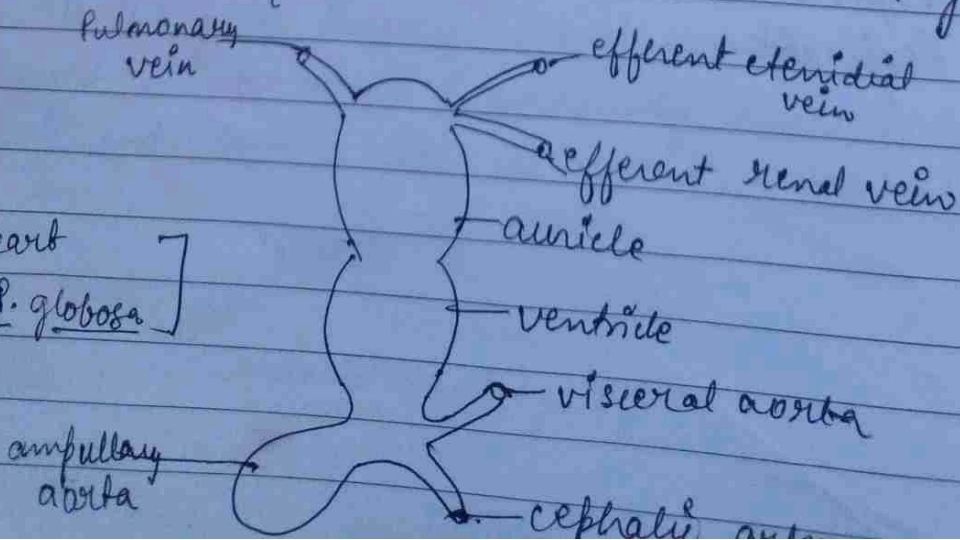
Due to double mode of Respiration the BVS of *Pila globosa* has become very much complicated, it is of open type.
It consists of Pericardium, heart, arteries, sinuses, veins.

1) Pericardium

The Pericardium is thin walled & ovoid sac lying dorsally on the left side of the body.
The body whorl behind the mantle cavity, it extend anteriorly upto the digestive System (stomach & digestive gland). It is a fairly deep cavity which communicate with that of posterior renal chamber through a reno-pericardial aperture.
The Pericardium correspond to the coelome of annelids & vertebrates. It encloses 2 chamber of the heart.
The main aortic arches & aortic ampulla.

2) Heart

The heart of *P. globosa* have a single auricle & one ventricle found enclosed in the pericardium.
Physiologically the heart is said to be myogenic.



[Fig - Heart of *P. globosa*]

a) Auricle

The Auricle lies in the dorsal part of the pericardium while ventricle is situated just below it in the same vertical axis. The auricle is thin walled highly contractile sac.

The efferent renal vein from the renal hilum & efferent renal vein from the posterior chamber of the renal organ open into the apex of the auricle. while the pulmonary vein from pulmonary sac open at slightly lower level at its anterior end.

The auricle communicates with the ventricle by an aperture auriculo-ventricular opening having two semi-lunar valves, so arranged as to allow the blood from the auricle to flow into the ventricle but not in the reverse direction.

b) Ventricle

The ventricle is oval in shape and has thick, spongy wall formed of a large number of muscular strands forming a meshwork which greatly reduces the cavity of the ventricle. The aortic trunk arises from the lower end of the ventricle and divides immediately into two branches, the cephalic aorta and visceral aorta. The opening between ventricle and aortic trunk is guarded by two semi-lunar valves which prevent the flow of blood from back into the ventricle.

3) Arteries.

From the ventricle arises an aorta or aortic trunk which divides into two branches, a cephalic aorta and a visceral aorta.

The cephalic aorta has a bulbous outgrowth called aortic ampulla, a characteristic of the members of the family Filidae, which aids in circulation of blood and works blood pressure. The opening of aortic ampulla into cephalic aorta is devoid of valves. The cephalic aorta sends arteries to the head and buccal mass, the visceral aorta forms arteries going to the visceral mass.

(a) Cephalic aorta.

The cephalic aorta, immediately beyond aortic ampulla, gives out three arteries; first supplying to the skin, the cutaneous artery, second supplying to the oesophagus, the oesophageal artery and third being stout and thick supplies to the left side of the mantle (organs like left nephal lobe and ospharidium), the left pallial artery.

The cephalic aorta on its inner side gives out an artery supplying to the pericardium, renal chambers and to a portion of the genital organs, the pericardial artery.

The main trunk of cephalic aorta then runs ahead and crosses over the oesophagus so as to reach to its right side.

It now gives off numerous small branches to the oesophageal area and a large branch to the right side which finally gives out a right pallial artery, supplying to the right part of the mantle, a right siphonal artery, supplying to the right nuclear lobe and a penial artery, supplying to the copulatory organ.

The main trunk of cephalic aorta, however, also branches to give a radular sac artery supplying to radular sac, an optic artery supplying to the eyestalks and eyes, a tentacular artery supplying to the tentacles and pedal arteries supplying to the foot.

(b) Visceral aorta.

The visceral aorta runs into the visceral mass and supplies to its different organs by giving off many branches.

These branches are -

A pericardial artery to the pericardium, skin and digestive glands, a gastric artery to the stomach, many small intestinal arteries to the intestine, many renal arteries to the roof of the posterior renal chamber, a hepatic artery to the digestive gland and gonad, several small arteries to the tip of the genital duct and then finally the visceral aorta terminates in the rectal wall.

iv) Sinuses -

The blood after being distributed to the various part of the body through the arteries and their branches pass into small launae, which in turn unite to form large sinuses.

There are 4 chief sinuses in the body -

- (a) Anterior - peri-visceral sinus.
- (b) Anterior peri-intestinal sinus.
- (c) Branchio-renal sinus.
- (d) Pulmonary sinus.

(a) Anterior peri-visceral sinus.

It lies above the foot and beneath the floor of the pallial cavity surrounding the anterior part of the alimentary canal. It collects blood supplied by the cephalic aorta, except pericardial artery, and some branches of visceral aorta.

(b) Anterior peri-intestinal sinus.

It lies on the columellar axis next to the intestine and the terminal part of the genital duct and runs along the coils of the intestine up to the junction of the anterior and posterior renal chambers. It collects blood from viscera mainly distributed by visceral aorta.

(c) Branchio-renal sinus.

It lies along the right side of the anterior renal chamber. It collects blood from renal chambers.

(17)

(d) Pulmonary sinus.

It lies in the walls of the pulmonary sac. It collects blood from pulmonary sac.

(v) Veins.

The veins carry venous blood from different parts of the body to the auricle directly or through the gill, mantle and kidney.

The chief veins are as follows -

(a) Afferent ctenoidal vein

It lies above the notum and receives branches from the notum, terminal part of the genital duct, perivisceral sinus and branchio-renal sinus. It sends blood through numerous branches, to the gill-lamellae for purification.

(b) Efferent ctenoidal vein

It lies along the roof of the anterior renal chamber and carries blood from ctenoidal leaflets, mantle & conveys to the auricle.

(c) Afferent renal vein.

It is situated on the roof of posterior renal chamber, and originates from the per-intestinal sinus. It pours its blood into the posterior renal chamber.

(d) Efferent renal vein.

It carries the blood of the posterior renal chamber to the auricle.

(c) Pulmonary vein.

It collects blood from the walls of the pulmonary sac and opens into the auricle.

Blood

The blood of gastropods contains a respiratory pigment called haemocyanin which is a compound of copper and protein, haemocyanin is dissolved in the plasma and gives a faintly blue colour to the blood.

But in a few gastropods, such as Planorbis, haemoglobin is found in place of haemocyanin. In the blood plasma are stellate amoebocytes which are phagocytic, they remove waste substances and some of them carry on intracellular digestion.

Course of Circulation.

All parts of the body are supplied with blood from the ventricle through the cephalic and visceral aortae. The cephalic aorta carries blood to the head and its associated structures, a part of the mantle, the buccal mass, the oesophagus, the copulatory organ and the columellar muscle.

The visceral aorta supplies the whole of the visceral mass. The blood is collected from the various parts of the body into two main sinuses the peri-visceral and peri-intestinal.

From these sinuses, the blood passes either into the ctenidium, pulmonary sac or into the renal organ.

Organ of Bojanus - Excretory organ of Pila

(19)

classmate

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During aquatic respiration the blood from the peri-visceral sinuses goes to the ctenidium and is purified; an efferent ctenidial vein then takes this blood into the auricle.

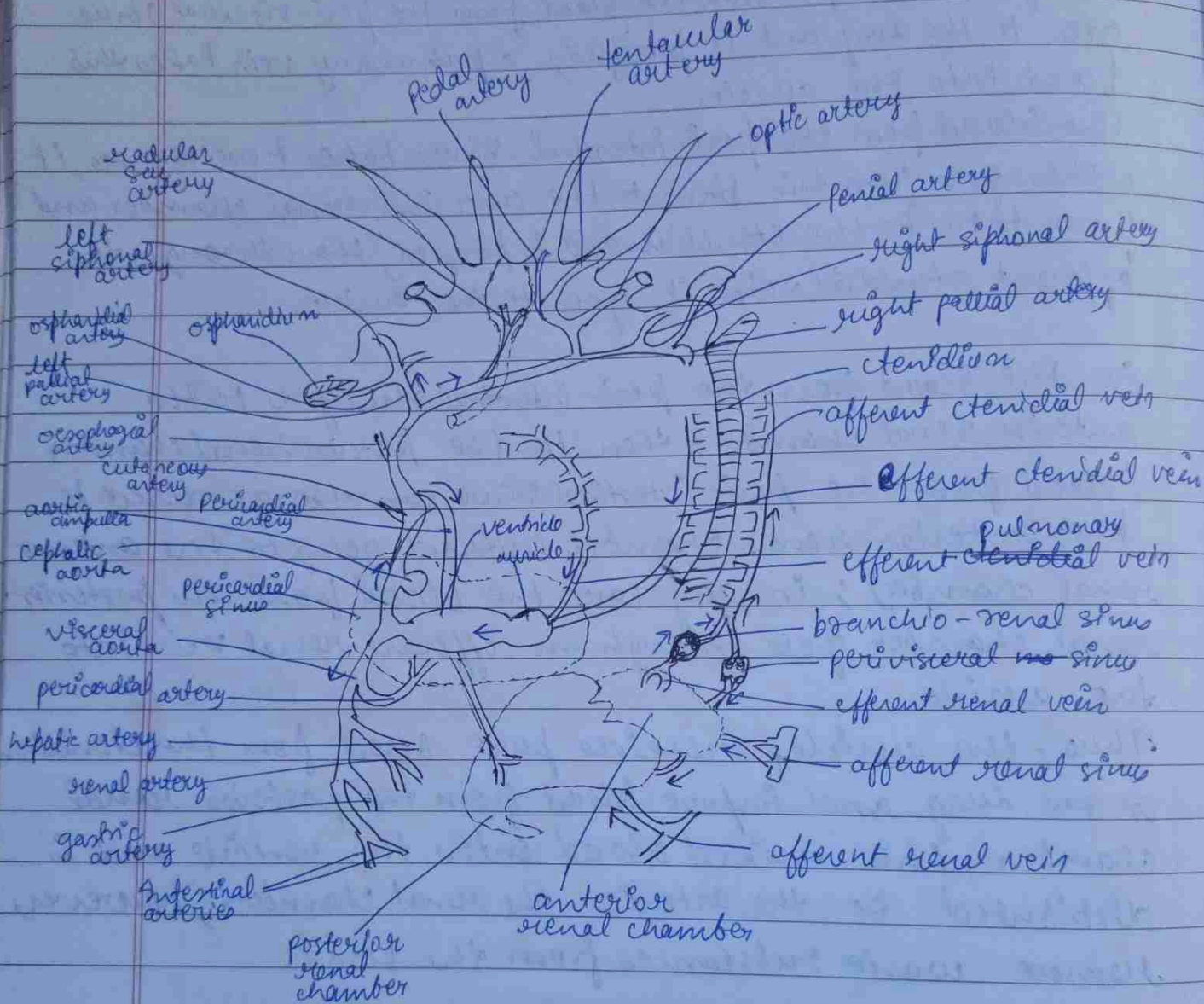
During aerial respiration the blood from the peri-visceral sinus goes to the lung and is purified; a pulmonary vein takes this blood into the auricle.

The blood from the peri-intestinal sinus takes two courses, it either goes from this sinus to the anterior renal chamber and from there to the ctenidium and is purified, then through the efferent ctenidial vein it goes to the auricle.

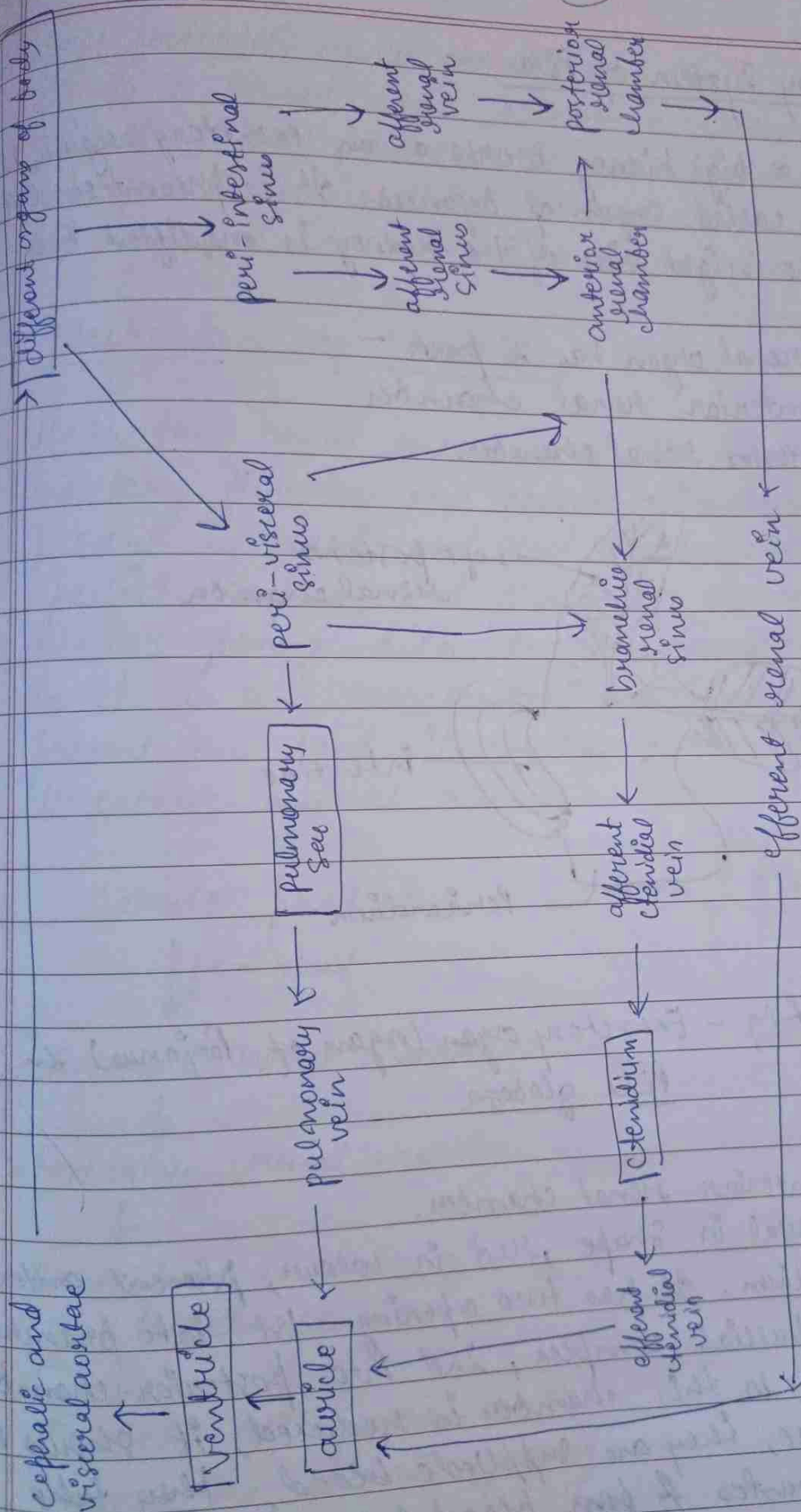
Or the blood from the peri-intestinal sinus goes to the anterior renal chamber, then to the posterior renal chamber (blood from the peri-intestinal sinus can also go direct to the posterior renal chamber without going to the anterior renal chamber); in any case the blood from the posterior renal chamber goes through an efferent renal vein into the auricle.

Thus, the auricle receives pure blood from the ctenidium or the lung and impure blood from the posterior renal chamber, this mixed blood enters the ventricle and is distributed to the arteries. The renal chambers, however, remove waste substances from the blood.

Excretory organ - organ of Bojanus.
(Metanephric kidney)



Pila globosa : Heart and blood Vascular System



Pila globosa :

Diagrammatic representation of the course of circulation.

Excretory System of Pila

In Pila a big kidney works as an excretory organ, it is also called organ of Bojanus. It is present on left side & the right side of the kidney is modified into gonaduct.

Left side renal organ has 2 parts -

- 1) Right anterior renal chamber
- 2) Left posterior renal chamber.

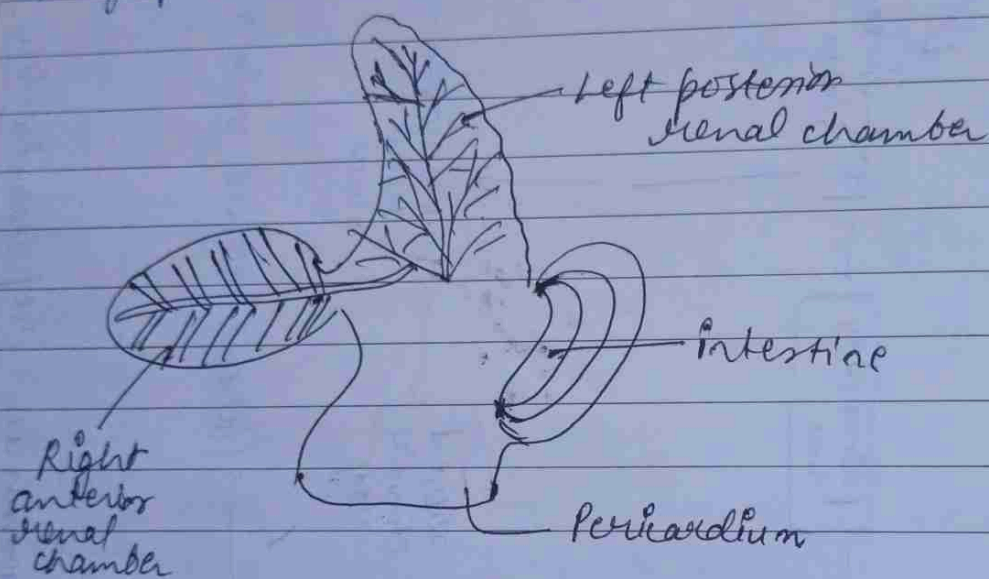


Fig - Excretory organ (organ of Bojanus) in Pila globosa

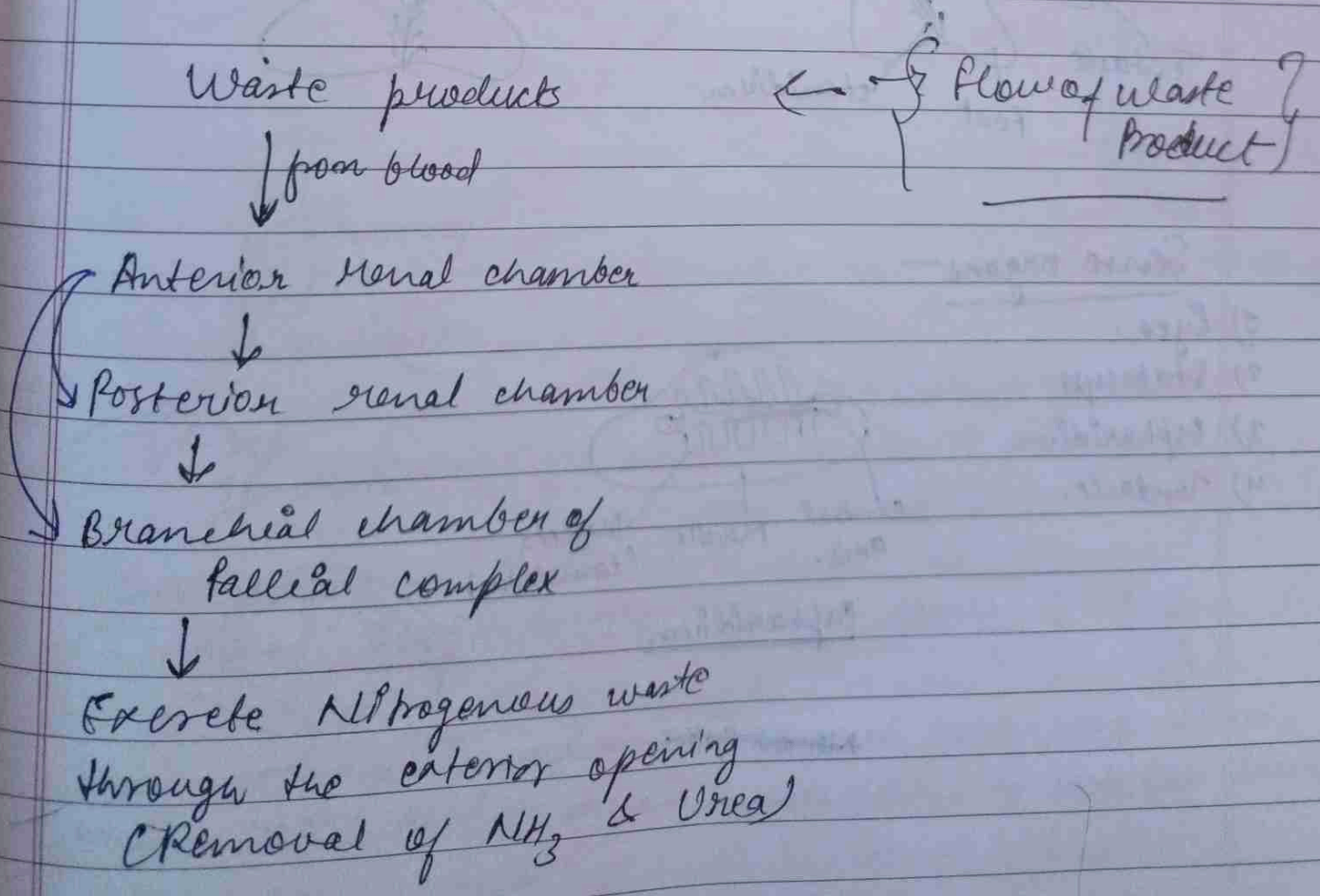
- 1) Right anterior renal chamber.

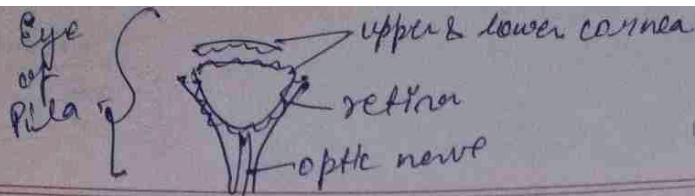
It is oval in shape, red in colour, present anterior to pericardium. It has two opening. 1st into branchial cavity of pallial complex, 2nd into posterior chamber. The cavity in this chamber is reduced, it shows no. of lamellae, they are supplied to blood. They take excretory wastes from blood & send into branchial cavity.

- 2) Left posterior renal chamber.
It is a broad lobe, brown in colour, present on left side of hepato-pancreas. It has a big lumen, its one end open in pericardium. Throughreno-pericardial aperture the other end connective to anterior chamber.

Mechanism of Excretion

Both the renal chamber of Pila have a true excretory function and excrete nitrogenous waste product present in blood and send into branchial chamber of pallial complex, and finally it excrete out to the exterior opening. Pila excrete ammonia inside water so it is a ammonotelic animal & when it is present on land it excrete urea so it is called Ureotelic animal also.





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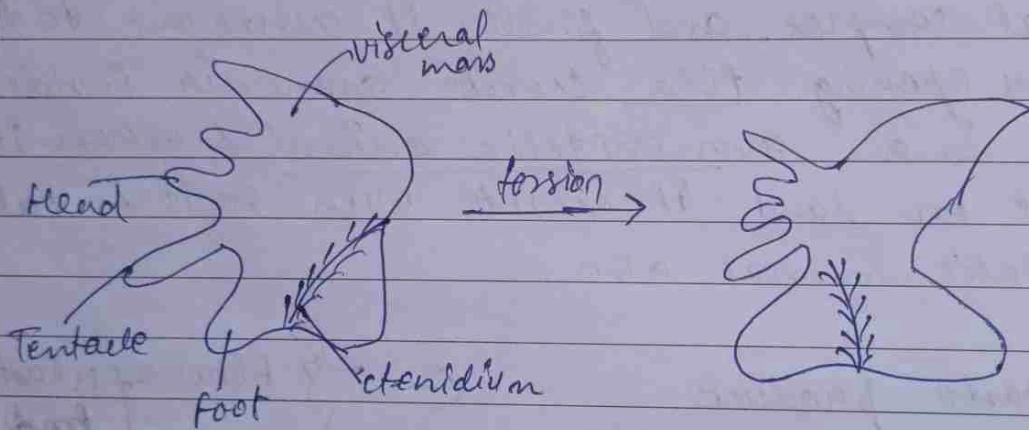
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Nervous System & Sense organ of Pila

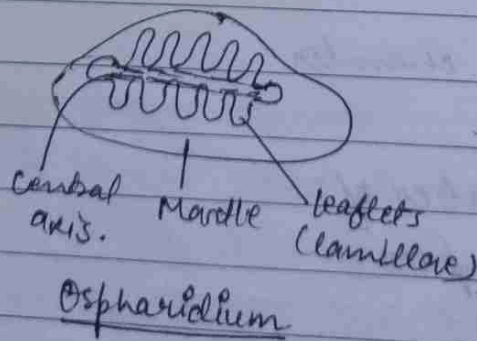
5 pairs of ganglion.

- ① Cerebral ganglion.
- 2) Buccal ganglion
- 3) Pleuro-pedal ganglion
- 4) Supra-intestinal ganglion.
- 5) Intra-intestinal ganglion
- 6) Visceral ganglion.



Sense organs—

- 1) Eyes.
- 2) Statocyst
- 3) Oospharidium
- 4) Tentacle.

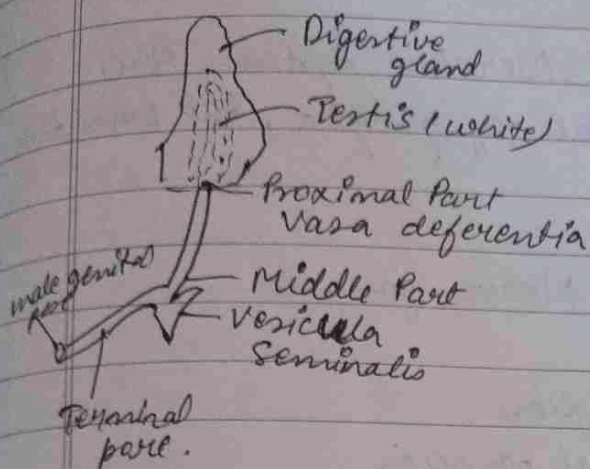


Oospharidium

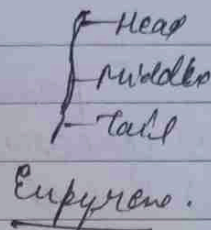
Nervous System



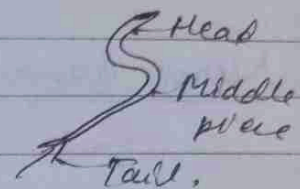
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Reproductive System

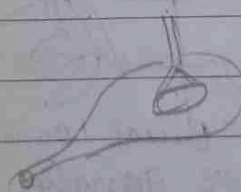
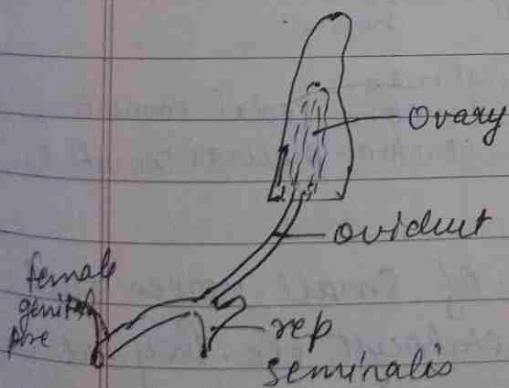
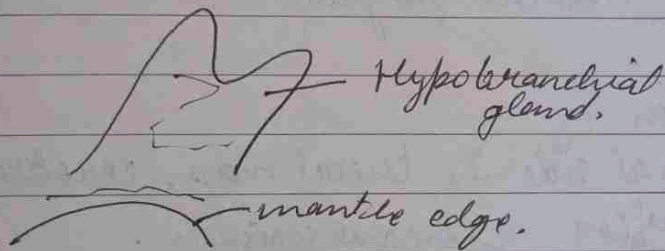
Sperm —
 1) Eupyrone (Active)
 2) Oligopyrene (Inactive)



Eupyrone.



Oligopyrene sperm.

Hypobranchial organ

Development - Indirect

2 larval stage - Trochophore larva & Veliger larva.

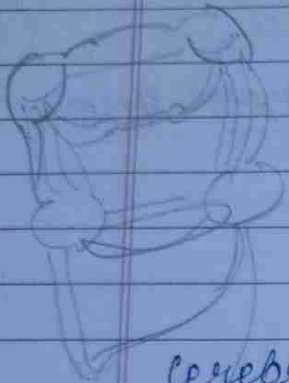
Veliger larva is advanced stage of trochophore larva, much more active, much more clear to look like larva.

Nervous System of Pila

Pila shows a well developed Nervous System. This Nervous System will show 5 pair of ganglia, the connective commissures & nerves.

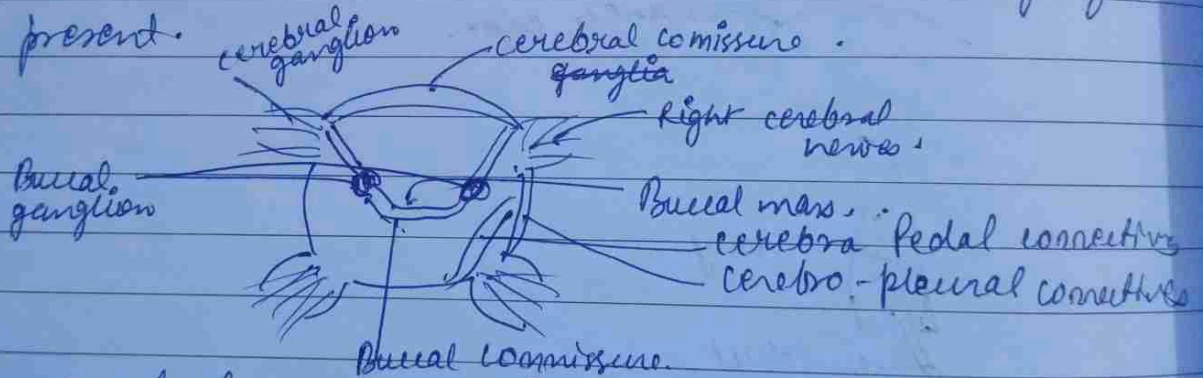
Nerve Ganglia - 5 pair of Nerve ganglia.

- Cerebral
- Buccal ganglion
- Pleural Pedal ganglion
- Supra-intestinal ganglion
- Intra intestinal ganglion
- Visceral ganglion



Cerebral ganglion

On the dorso lateral side is buccal mass, cerebral ganglia are present.



From cerebral nerve ganglia a no. of small nerves will arise they travel to tentacles, eyes, statocyst etc. They are connected by cerebral commissure.

Buccal ganglion

At the junction of buccal mass & Oesophagus two buccal ganglia are present, they are connected in the cerebral ganglia & connectives & two buccal ganglia are connected by buccal commissure.

Buccal ganglion send nerve in to buccal mass modula cell.

Pleural-Pedal Ganglion

On the ventro-lateral side of buccal mass, a pair of ^{pleural & a pair of} ganglia are present. The cerebral ganglia and pleural ganglia are connected by cerebro-pleural connectives & the two pedal ganglia are connected by cerebro-pedal connectives.

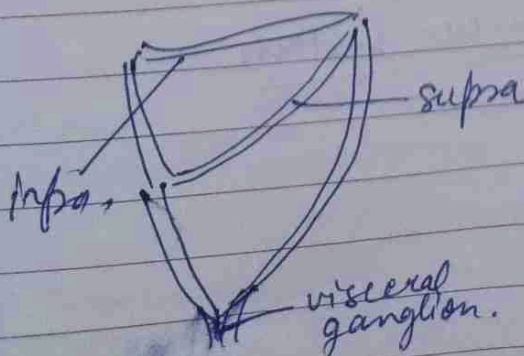
From pleural ganglia nerve will arise and goes inside the mantle region & from the pedal ganglia send nerve to foot.

Supra-Intestinal ganglia

From the right pleural ganglia a supra intestinal nerve will arise, it will travel over the oesophagus & is connected to left pleural visceral connectives.

Infra-Intestinal ganglion

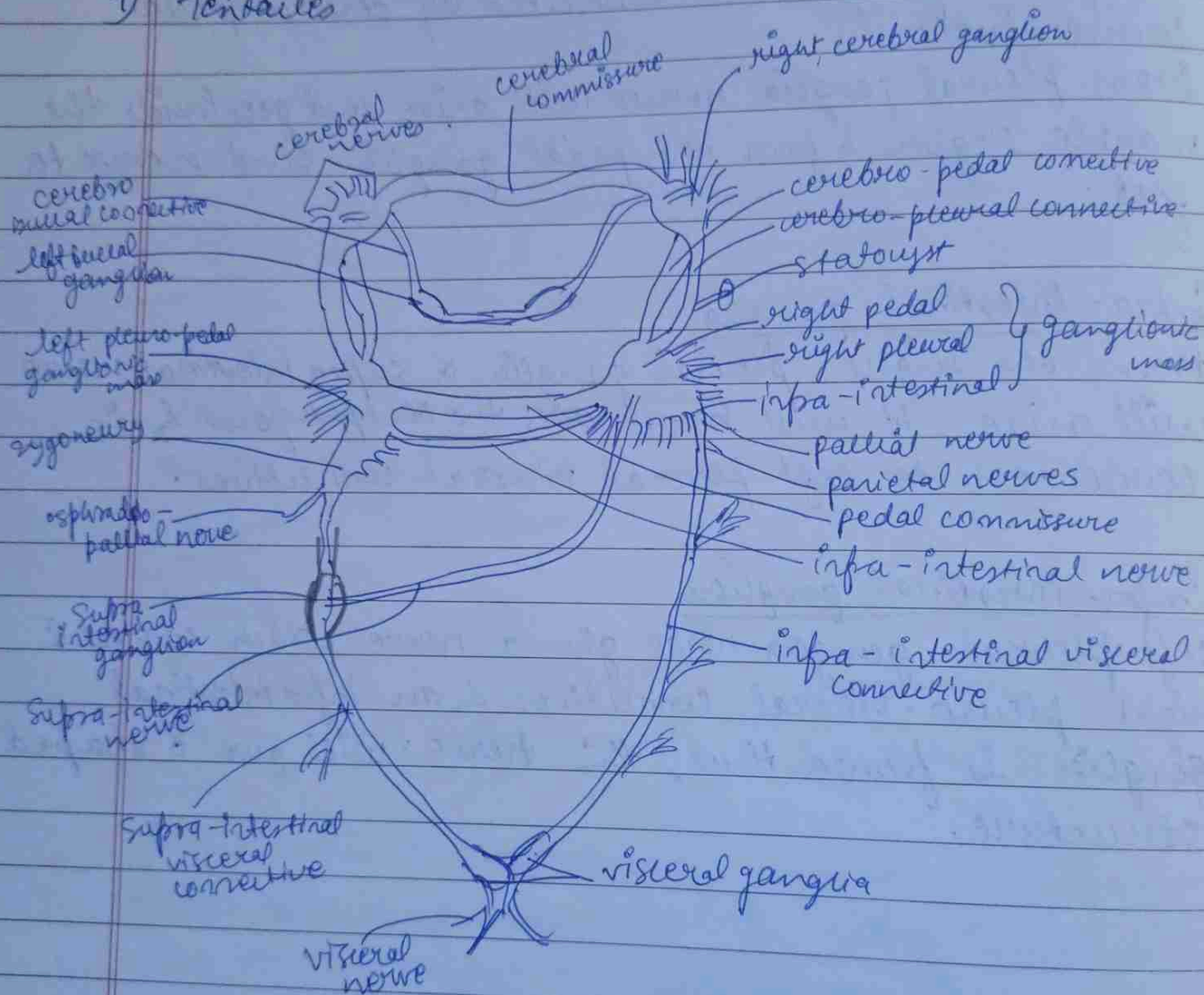
Left pleural ganglia nerve give a nerve which connect to right pleuro-visceral connectives & an infraintestinal ganglion is formed thus, this nerve will give 8 shaped structure.



Sense Organ

In Pila special organ of sense organ —

- 1/ A single oesophandium
- 2/ Statocyst
- 3/ Eye
- 4/ Tentacles



Pila globosa : Nervous System

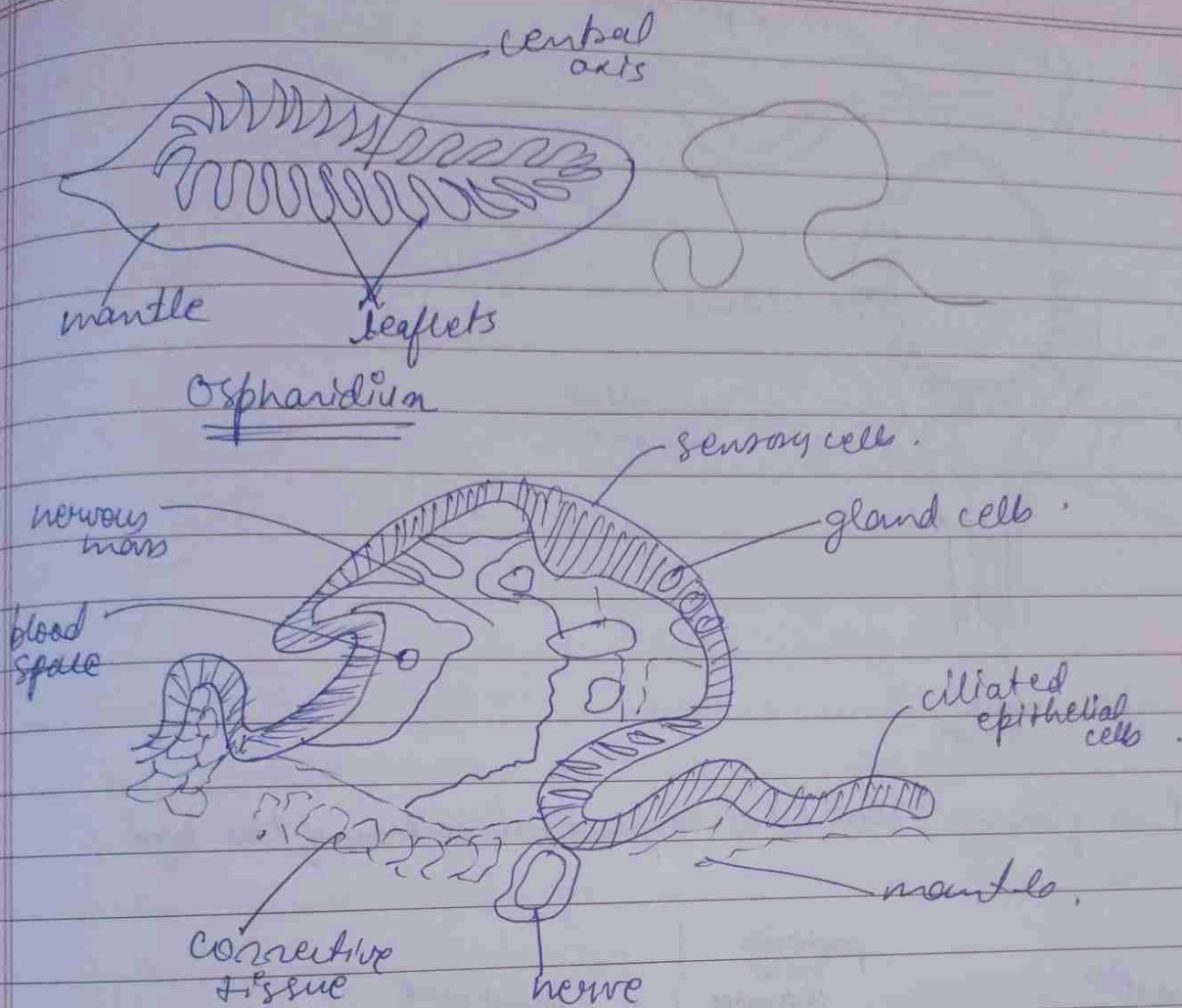
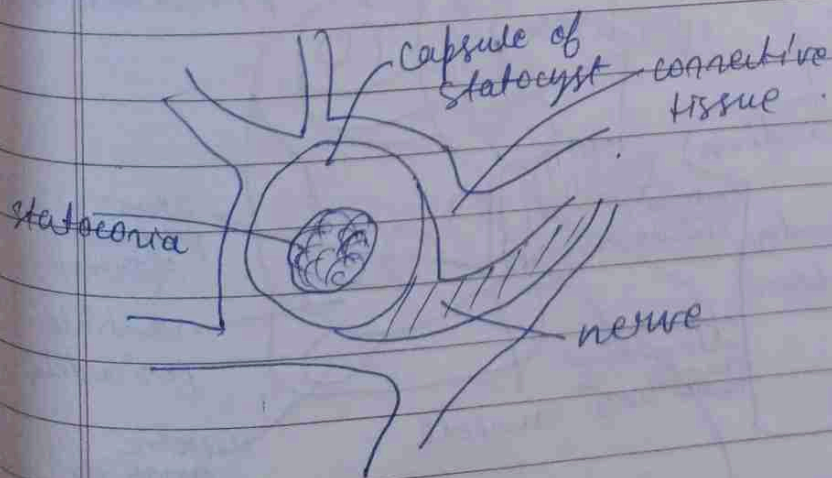
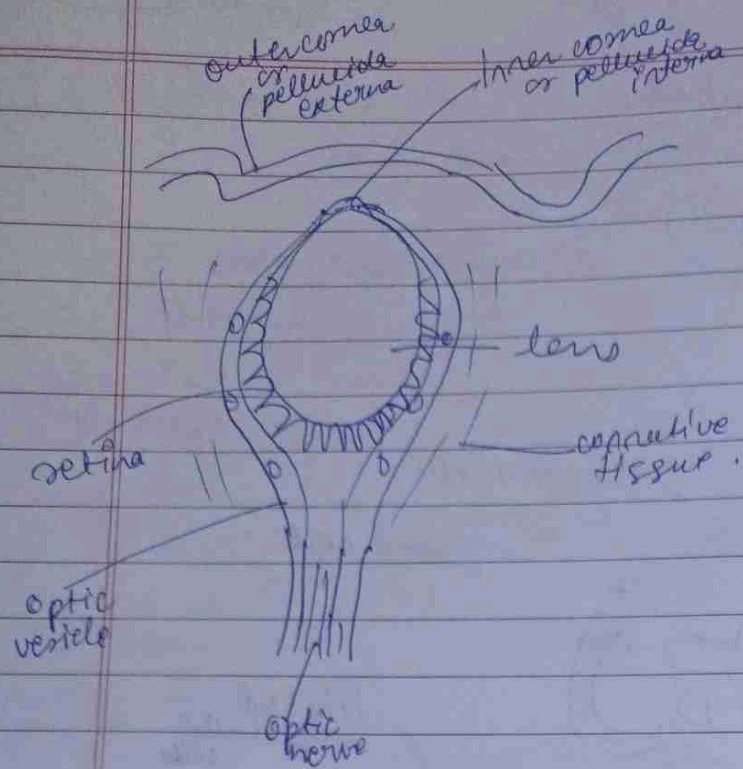


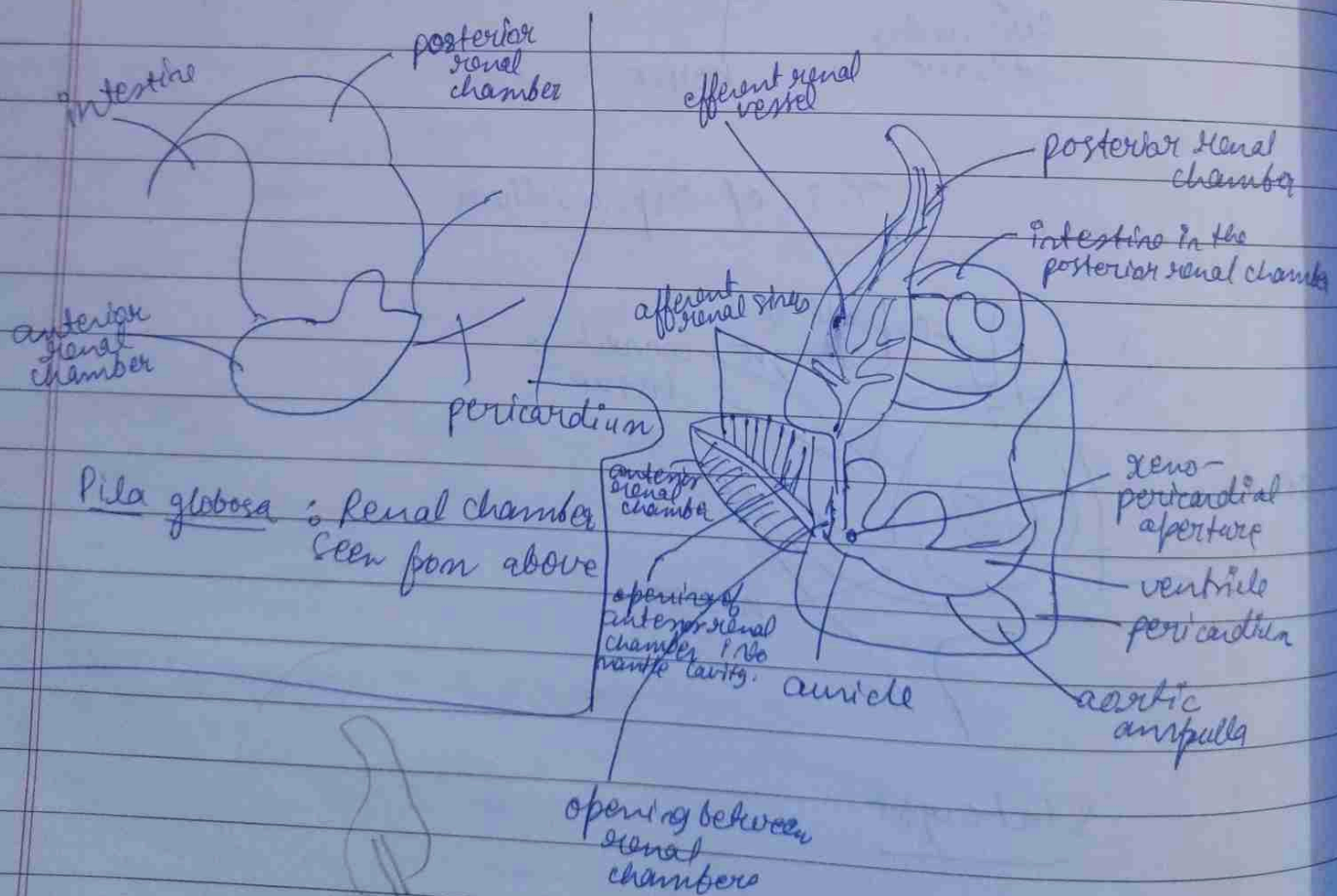
Fig of Osphradium



Statocyst



Pila globosa : horizontal longitudinal section of the eye.



Pila globosa : renal chamber seen from above

Pericardium and two chambers of renal organ