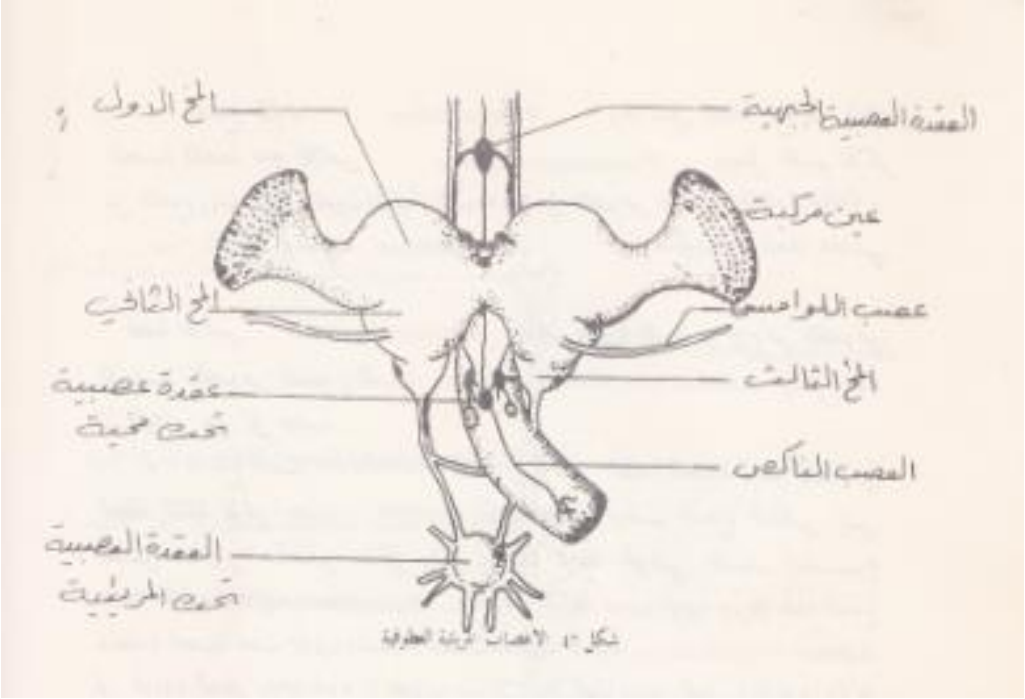
a- **Protocerebrum :-** **represents the ganglia of the preantemnal segment ; and innervates the compound eyes and the ocelli .**

b- **Deutocerebrum :-** **represents the ganglia of the antennal segment ; which innervates the antenna.**

c- **Tritocerebrum:-** **represents the ganglia of the third of segment , it is poorly developed , its function is to innervate the labrum and the fore gut.**



2- **Sub esophageal ganglia** **:- it is the ventral center of the head and is formed by the fusion of the ganglia of the 4th , 5th and 6th head segments .**

In innervate the mandible , maxilla and the labum .

3- **The ventral nerve cord :- Is a median chain of segment ganglia lying beneath the alimentary canal . It is joined to the trito cerebrum by the paraesphageal connectives . The first three ganglia are in the thorax and known as thoracic ganglia , the remainder ganglia lies in the abdomen (abdomenal, ganglia).**

*** the thoracic ganglia gives off two pairs of nerves (to the muscle of the legs , in the meso and meta thorax an addition pair of nerves is present to control the movment of the wings .**

*** The abdominal ganglia are variable in number. The first abdominal ganglia frequently coalesces with that of the metathorax and the terminal ganglia is always composite to form the ventral ganglionic center, each abdominal ganglia give a pair of nerves to the muscles of its segment.**

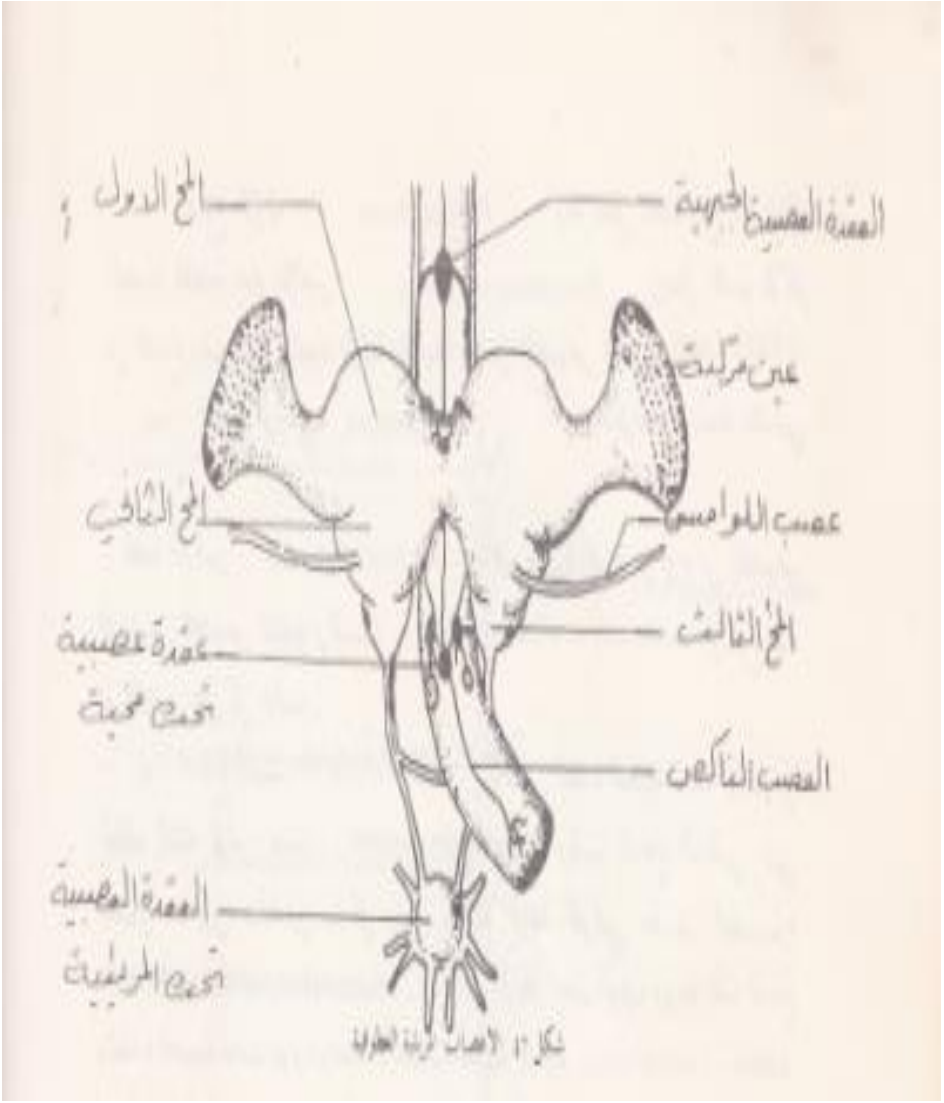
"The sympathetic nervous system"

This is divided into :-

1- ***Esophageal sympathetic nervous system*** **, which directly connected with brain and innervate the : fore and mid intestine, heart and certain other parts .**

Lying above the side of the fore intestine, it consist of a triangular (frontal ganglion , this gives a frontal nerve) which passes to the clypeus and pair of lateral root connects the frontal ganglion with the tritocerebrum .

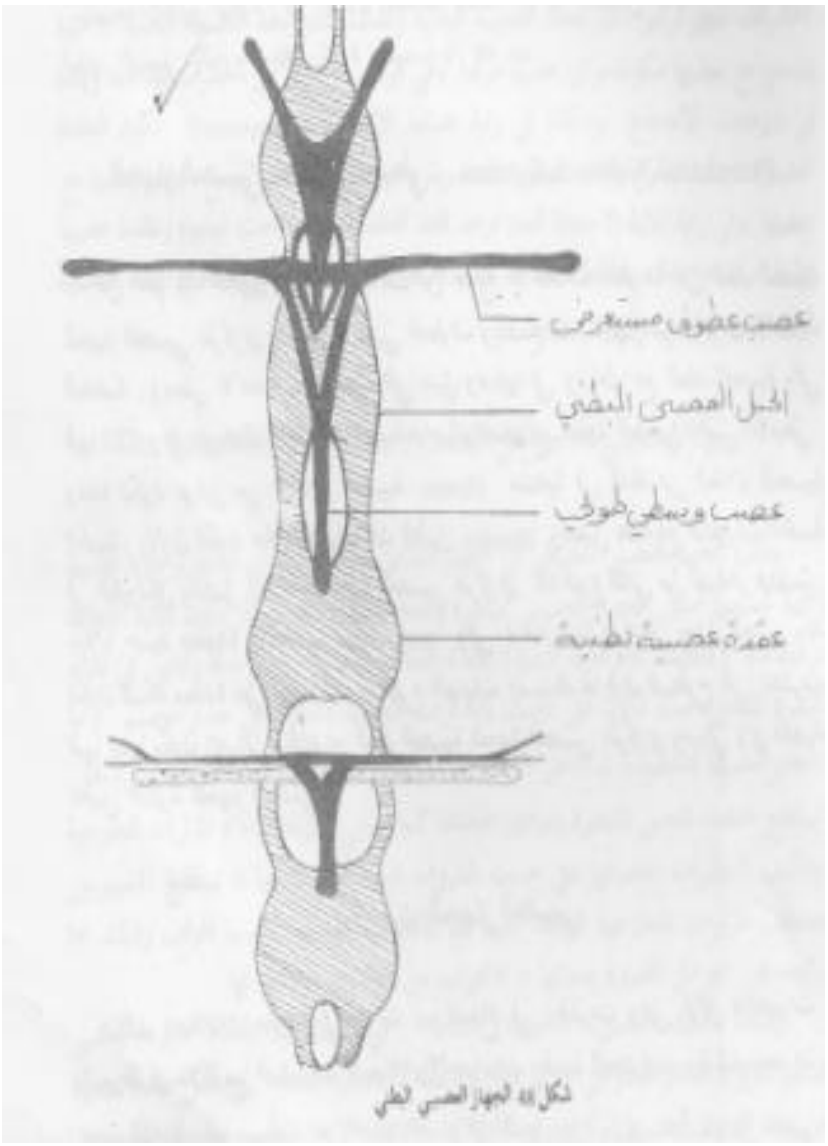
Posteriorly this ganglion gives off a <u>recurrent nerve</u> , which extents along the mid dorsal line of the esophagus and terminate in <u>a ventricular ganglion</u> on the esophagus also lies the <u>corpora</u> cardiaca . it is probable that this ganglia include both nervous and endocrine secretory cells . connected with them the <u>corpora allata</u> with important endocrine function .



2- <u>The ventral sympathetic nervous system,</u> **consist of pair of transverse nerve associated with each ganglion of the ventral nerve cord , and each pair is connected with ganglion preceeding it by**

a median longitudinal nerve . this system control the opening of the spiracles .

3- ***<u>The caudal sympathetic nervous system",</u>*** **Aries from the compound posterior ganglion of the abdominal nerve cord and innervates the hind gut.**



شكل (٥) الجهاز العصبي للنطي

"The peripheral nervous system"

It is composed of a fine network of axons and sensory cells lying beneath the integument.
The nerve cells have branched distal processes that end in the epidermis itself . the axons combine and enter the paired segmental nerves of the ventral cord .

"The sensory receptors"

Most of them are composed of two kinds of cells , (receptor cells + accessory cells). The first kind is bipolar and transmit the sense of the stimuli.
Those are two kinds :-

1- **Extero receptors .**
2- **Entero receptors.**

Extero receptors are :-

a- ***Mechano receptors.***
b- ***Chemo receptors.***
c- ***Sound perception.***
d- ***Thermo receptors.***
e- ***hygro receptors.***
f- ***photo receptors.***

"Photo Receptors"

Insect eyes :- **they are found in most insects .**

Photoreceptive sense cells differs from other types

Of sense cells in two features :-

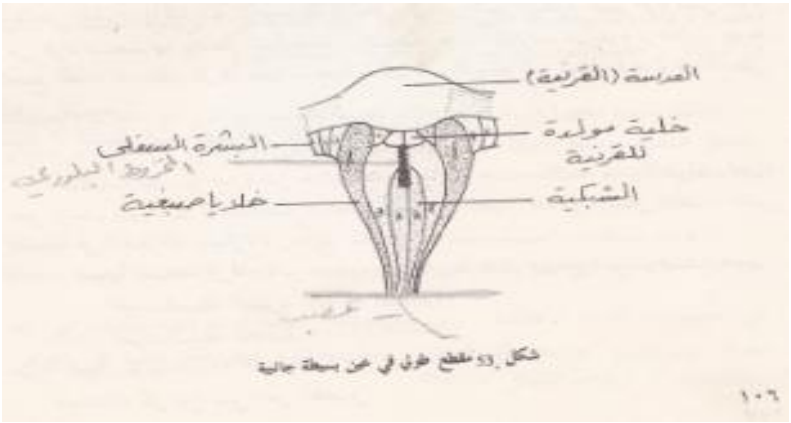
1- **The cuticle overlying them is transparent forming a cornea .**
2- **The sense cells have no definit tip .**

Insects eyes divided into :-

1- **Simple eyes ocelli (dorsal and lateral).**
2- **Compound eyes .**

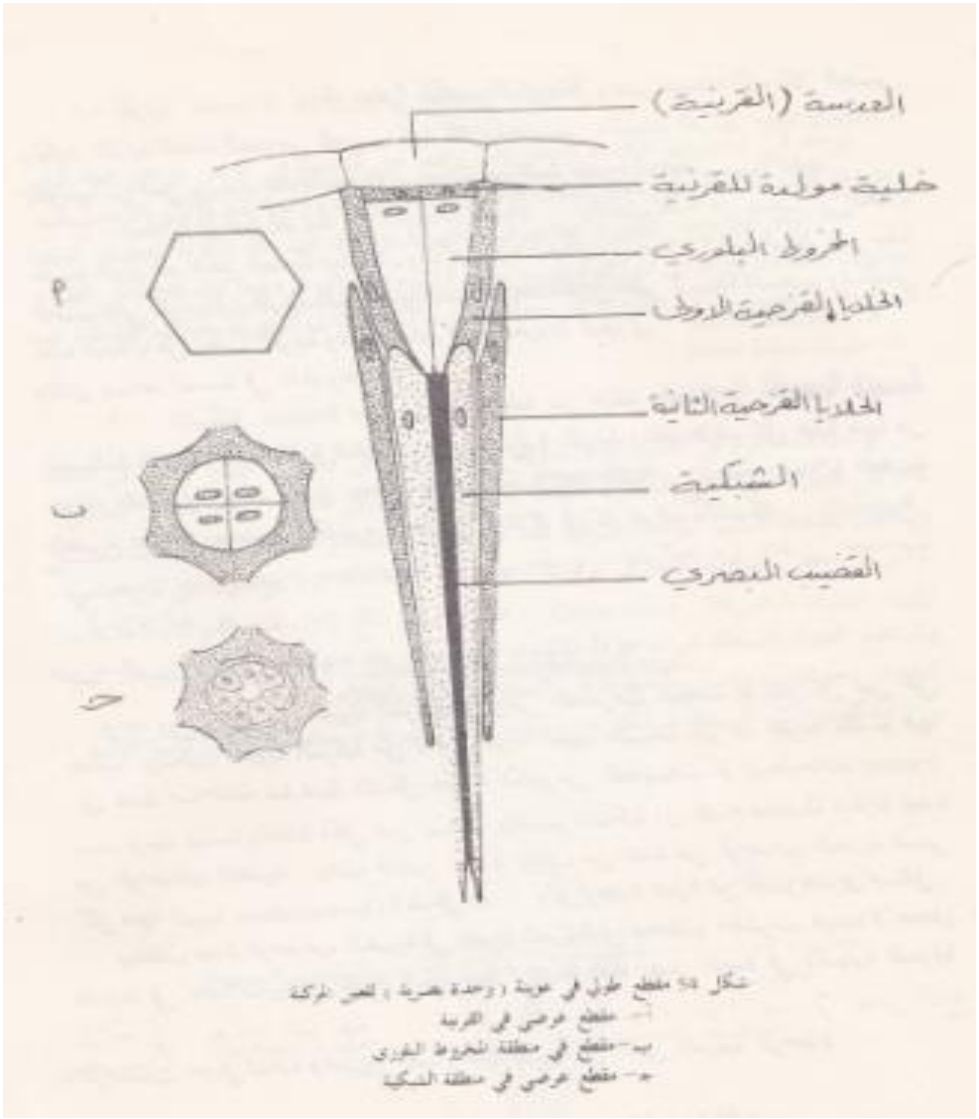
The Simple eyes :- have a single lens for the entire eye. The lens is specialized cuticle secreted by a layer of epithelial cells called the corneagenous cells.

nerve cells form a ratine beneath the corneagenous layer.



The Compound eyes:- have the same basic part as simple eyes , but the sense cells are grouped into concentric units called ommatidia .

Each ommtidium has its own lens (distinguished externally as a <u>facet</u>) sometimes lens like <u>cone,</u> below this, is a central <u>rhabdom and pigment</u> cells around both cone and the rhabdom .



شكل ٥٤ مقطع طولي في عوينة (وحدة بصرية) للعين المركبة
أ – مقطع عرضي في القرنية
ب – مقطع في منطقة الخروط البلوري
حـ – مقطع عرضي في منطقة الشبكية

"Reproductive system"

The reproductive organs , which differ appreciably in the two sexes consist of :-

1- a pair of gonads.
2- System of ducts .
3- Accessory glands.

Closely associated with the external opening are (4) external genitalia.

"The female Reproductive system"

Consist of :-

(1)Ovaries (2) lateral oviducts (3) common oviduct (4) vagina (5) spermatheca (6) Accessory glands.

The ovaries :- each ovary usually consist of several egg tubes or (ovariole) . The ovariole may open into the lateral oviduct . there are commonly 4-8 ovariole in each ovary .

The ovariole:- is an elongate tube in which developing eggs are deposed in a single chain .

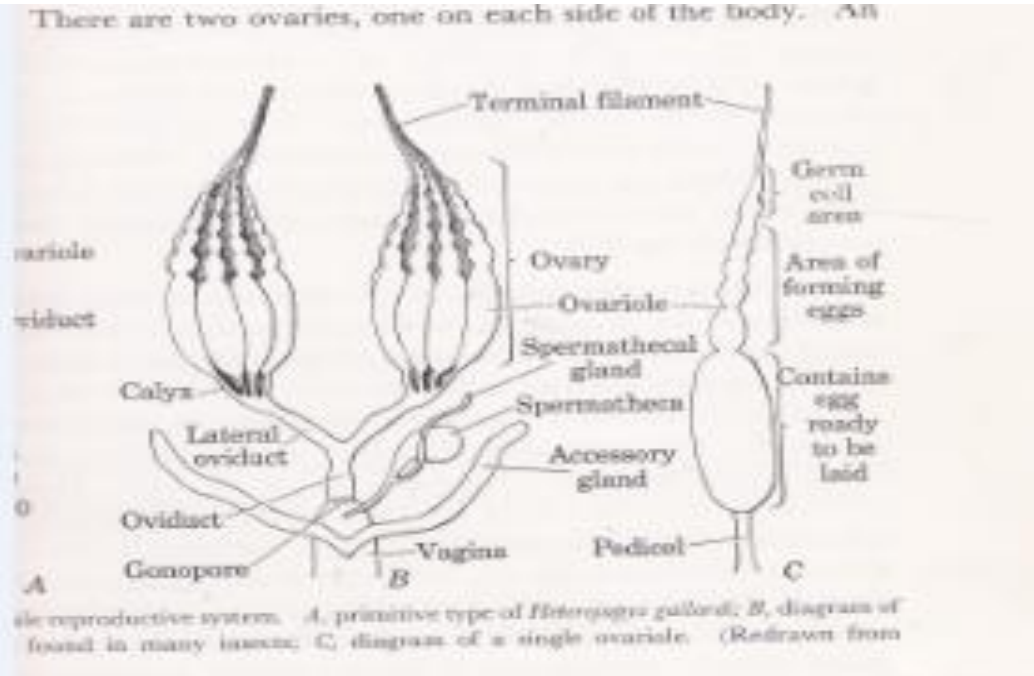
Three regions or zones are recognizable in an ovariole :-

1- Terminal filament .
2- A germarium.
3- A vitellarium .

1- The Terminal filament :- is the slender thread –like structure . The filament of one ovary combines to form a common Thread which unites with that of the other ovary to from a median ligament.

2- <u>The germarium :</u> this is the apex of an ovariole, consist of cells from which the <u>oogonia</u> differentiated .

3- <u>the vitellarium :</u> constitute the major protion of an ovariole consist of a longitudinal series of developing eggs after deposition of yolk here, then covered by <u>chorion</u> (egg shell) .



"Genital Ducts and associated structures"

The lateral oviducts are paired canals leading from the ovaries and the two join the common oviduct .

The spermatheca:- **is usually a sac like organ which opens into the common oviduct or vagina by spermathecal duct .**

It is a store for sperms

The female accessory glands (colleterial glands) usually open into the vagina and often secrete an adhesive substance for :-

a) **Cementing the eggs to each other , or.**
b) **To the substrate on which they are laid , or.**
c) **Produce the ootheca (egg capsule).**

Spermatozoa which enclosed in sac (speratophore) , are deposited in the bursa copulatrix , from which they eventually make their way to the spermatheca.

"The Male Reproductive system"

This system consist of :-

a) **A pair of testes .**
b) **Vas deferens.**
c) **Seminal vesicles .**
d) **ejaculatory duct .**
e) **aedeagus (penis).**
f) **Accessory gland.**

Testes:- **each testis is composed of :-**

Sperm tubes (testicular follicle) . each follicle is divided into two zone :-

a) **Germarium .**
b) **Zone of maturation .**