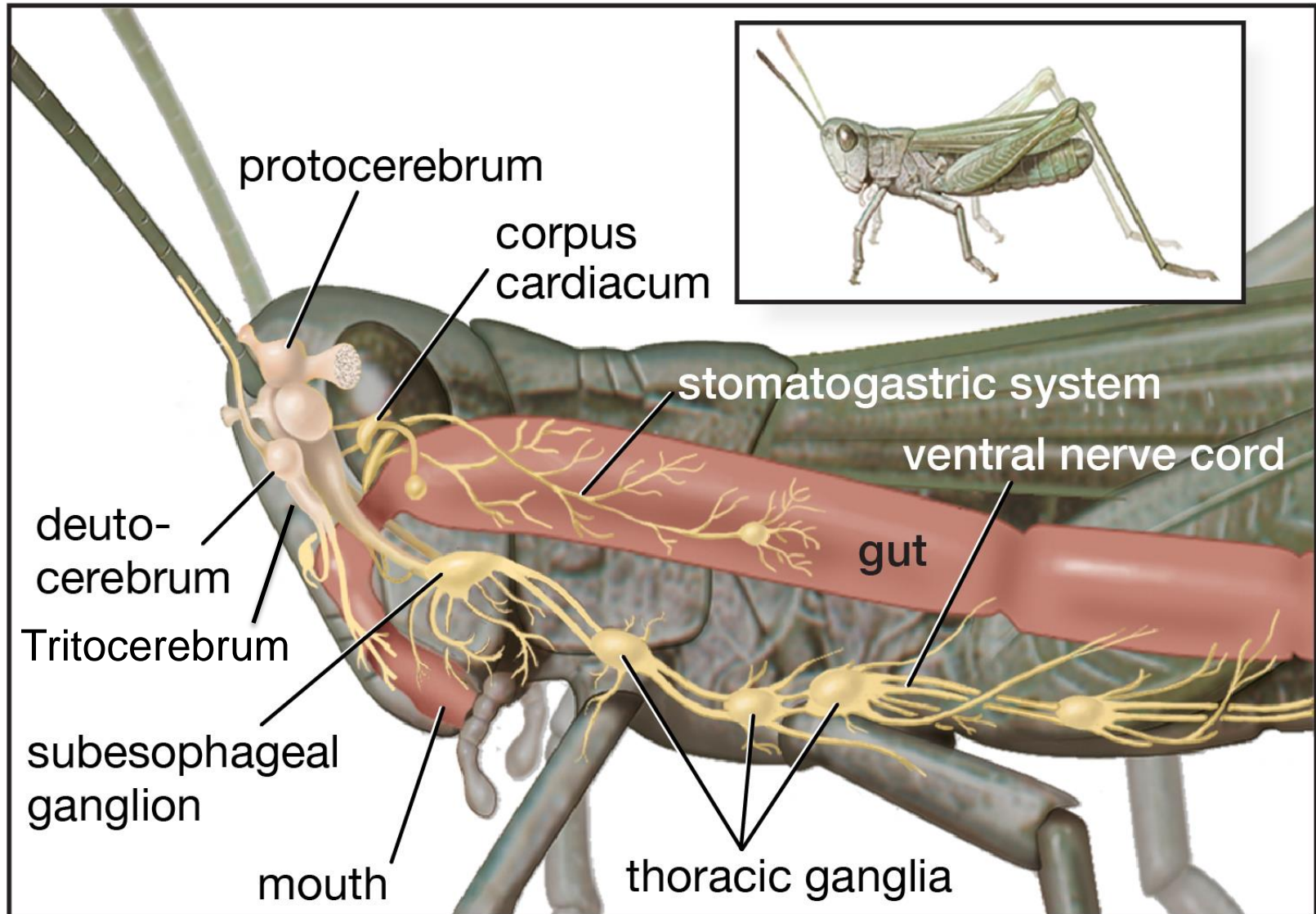


Insect Nervous System

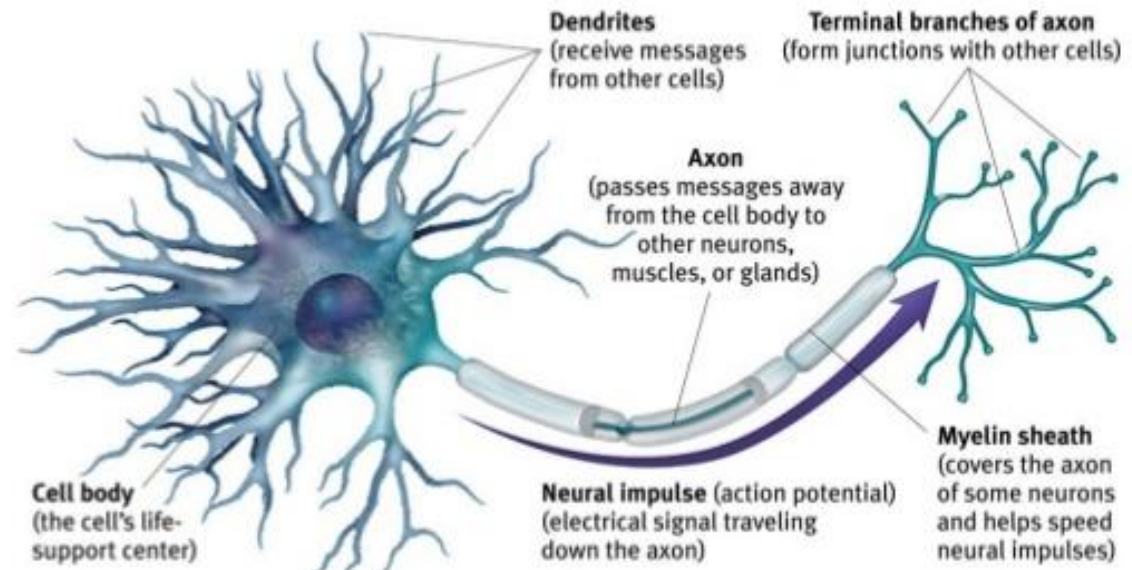


- Co-ordination in **behaviour, memory and intelligence**
- Links the **sense organs** which respond to **various external and internal stimuli** and the **effector organs** such as muscles, glands etc
- Elongated cell which carry the information in the form of **electrical impulses** is **neuron**

Structure of a neuron- derived from **ectoderm**, consists of

a prominent nucleated cell body known as **perikaryon (or) soma**
 an elongated cytoplasmic thin fibre called the **'axon'**
 group of small branches called the **'dendrites'**
 axon gives lateral branches called **'collaterals'**

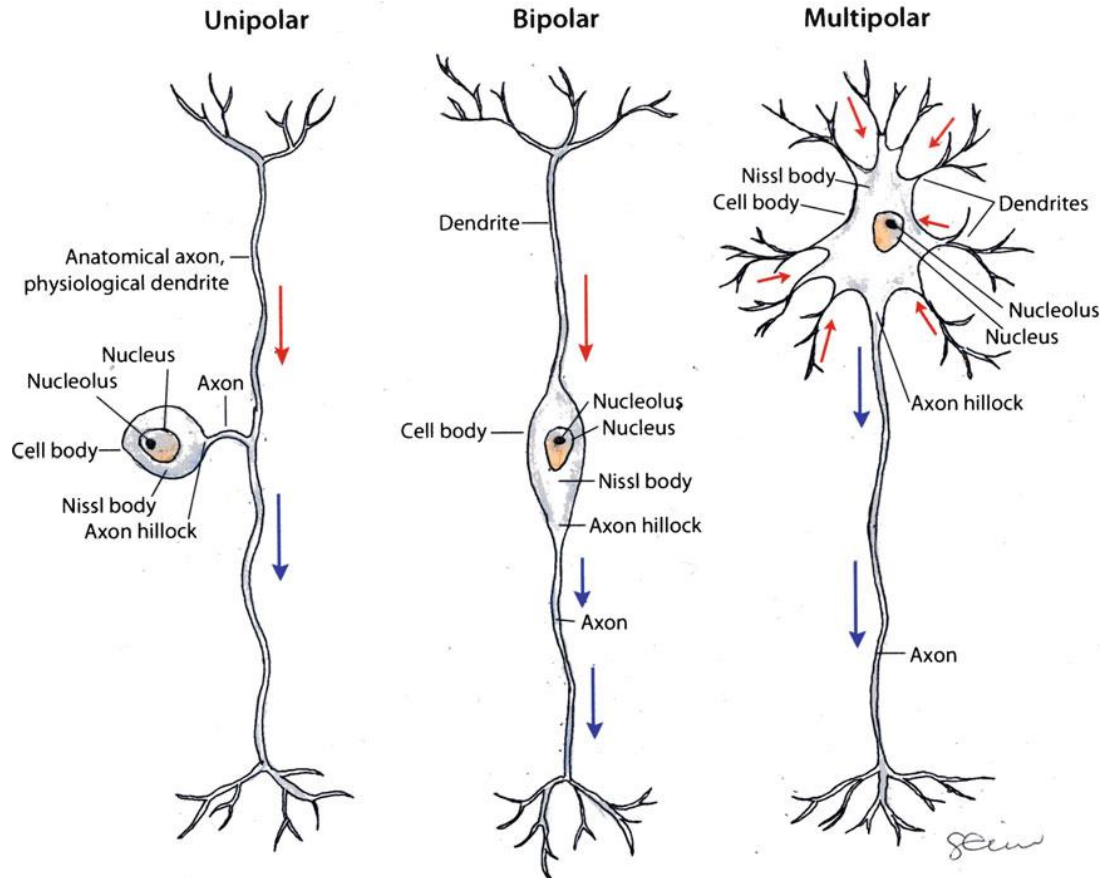
Both the axon and collaterals end in fine fibrils known as **terminal arborizations**



Classification of neurons

I. Based on their structure

1. **Unipolar / monopolar** : Have a single axon without collaterals and dendrites
2. **Biopolar** : Have either collaterals and dendrites in addition to axon
3. **Multipolar** : Neurons have an axon with several collaterals and dendrites



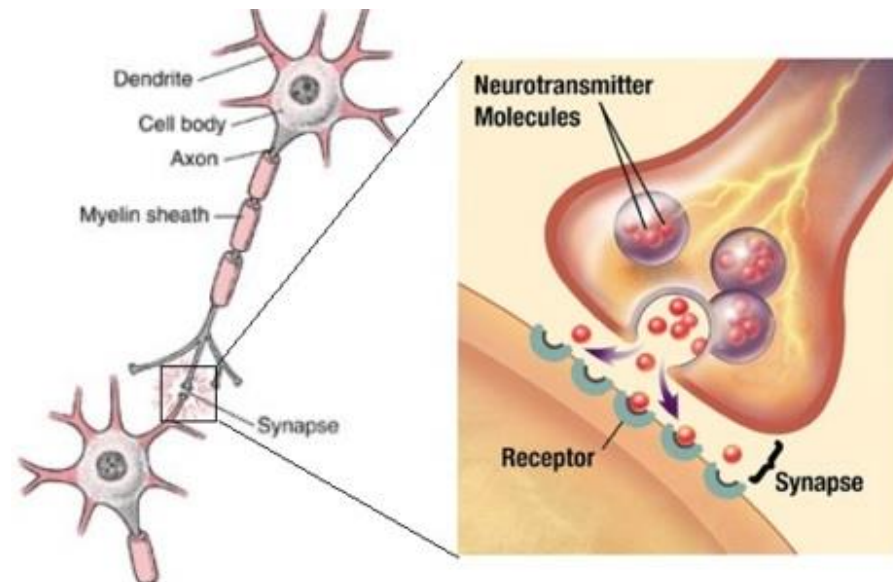
II. Based on function:

1. **Sensory / afferent** : Present just beneath the integument and associated with sensory organs
 - Carry impulses from sense organs to the central nervous system.
2. **Motor / efferent neurons** : Always unipolar / monopolar carry impulses from central nervous system to the organs
3. **Association / internuntial neurons** : Associated in between sensory and motor neurons, usually present in ganglia, consists of axons of sensory neurons and soma of motor neurons
 - The transverse commissures are also formed with these neurons

'synapse' - The neurons get connected by a link between

the **terminal arborizations of axon** of a neuron and **dendrites of the soma** of other neuron

- The terminal arborisation of sensory axon ends up into a tiny swelling called **synaptic knob**
- Synaptic gap is approximately **1000A**



Nervous system can be grouped in to

1. Central nervous system (CNS)
2. Visceral or sympathetic nervous system
3. Peripheral nervous system

Central nervous system consist of brain, sub-oesophageal ganglion and ventral nerve cord

Brain- Aggregation of neurons is called ganglion

- **Dorsal ganglionic centre** of the head supported by the tentorium
- Formed by the union of the **ganglia of first 3 segments** of the head

Protocerebrum: formed from ganglia of **pre-antennary segment** and **large**

It gives nerve connection to the **compound eyes and ocelli**

Deutocerebrum: from the ganglia of **antennary segment** and innervates **antenna**

Tritocerebrum : ganglia of intercalary segment and is relatively **small**

Attached anteriorly to deutocerebrum and posteriorly to **suboesophageal ganglion**

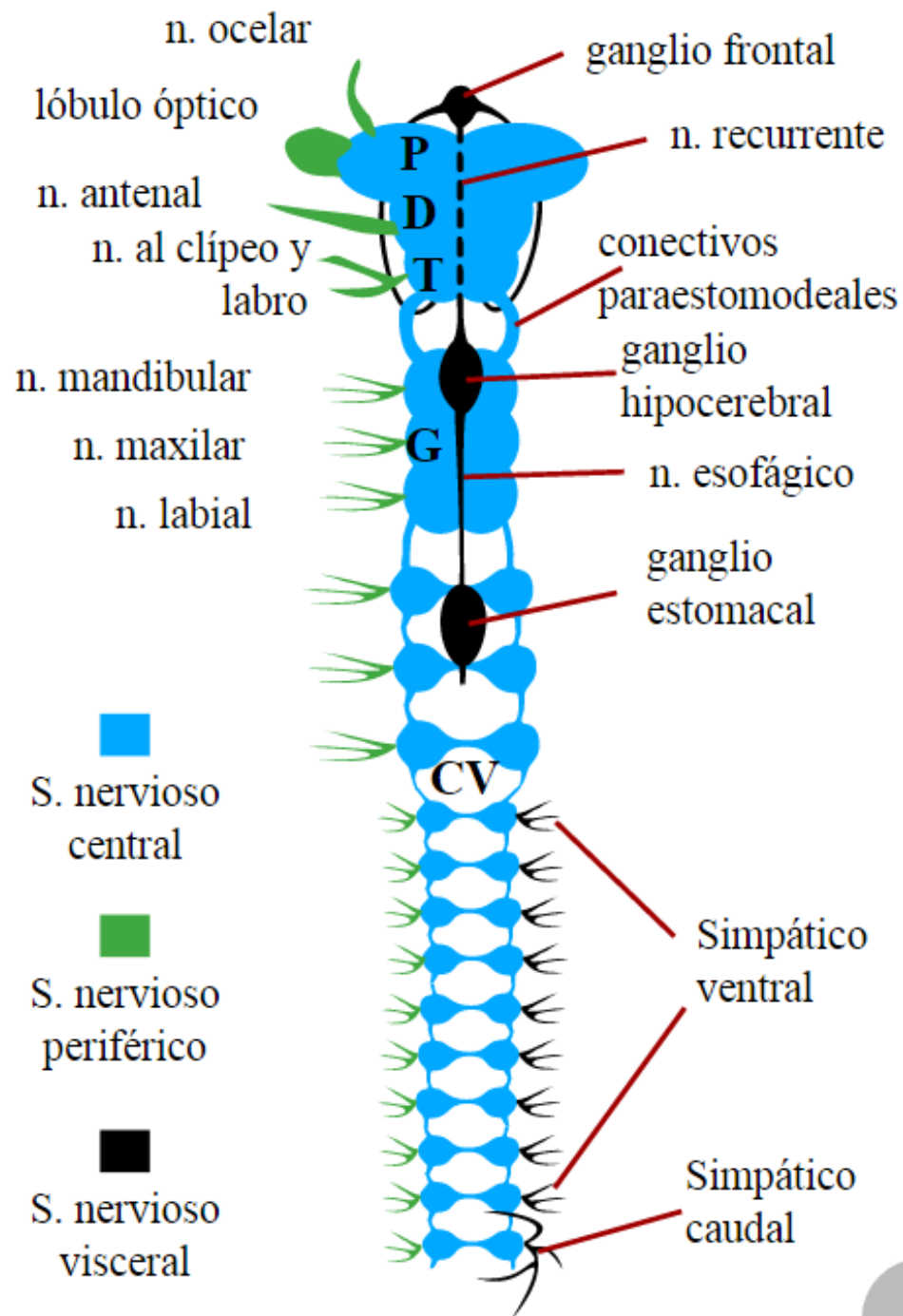
Sub-oesophageal ganglion:

ventral ganglionic centre of head formed by union of ganglia of **gnathocephalic segments**

Innervates **mouth parts, salivary ducts, cervical muscles in the neck and corpora allata**

Ventral nerve cord (VNC)

- chain of ganglia connected by **longitudinal connectives and transverse commissures**
- In thorax, **3 ganglia**, with nerve connections for **legs, wings and general muscles**
- In the abdomen, there are about **8 ganglia**
- The first abdominal ganglia remain closed with that of the metathoracic ganglia
- Ganglia from **9th, 10th, & 11th** abdominal segment form a **composite ganglion**
- The abdominal ganglia gives off nerves to **the muscles of its segment**
- The ultimate ganglia also passes nerves to **anal cerci and ovipositor**



2. Visceral / sympathetic NS: divided in to three systems

(i) Oesophageal sympathetic / stomatogastric

- directly **connected with the brain** and dorsal in position
- supplies nerves to the **foregut, midgut and heart**

(ii) Ventral sympathetic

- Consist of a pair of transverse nerves that are **connected with each ganglia of VNC**
- supplies nerves to the **spiracles** of that particular segment

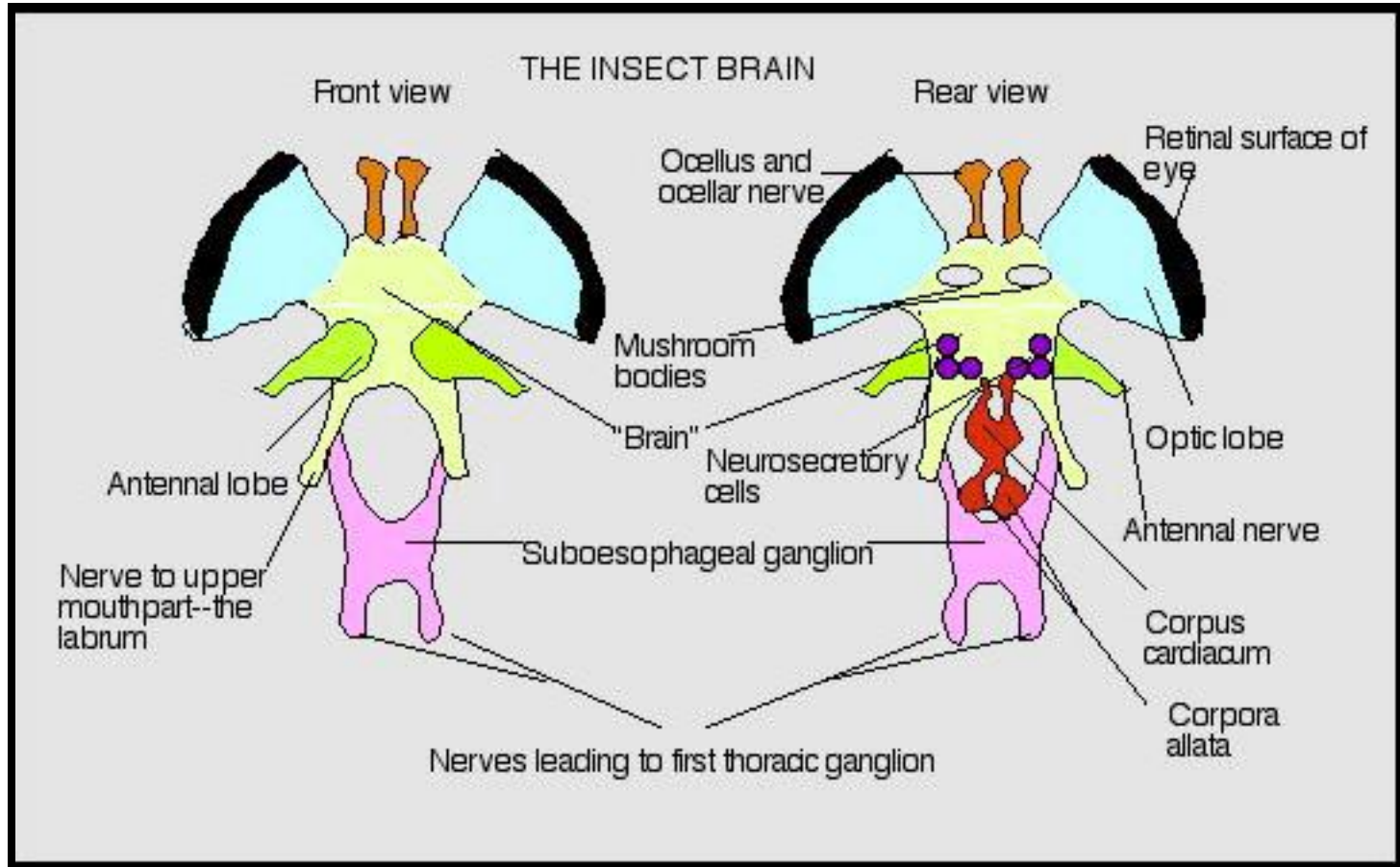
(iii) Caudal sympathetic

- Some additional nerves arises from **posterior compound ganglion of VNC**
- supply nerves for the **posterior part of the gut and the reproductive system**

3. Peripheral NS:

It includes all the nerves coming from the **ganglia of CNS and that of the visceral nervous system**

Insect Endocrine System



Endocrine system

- Structurally and functionally integrated with nervous system
- secrete hormones coordinating their long term activities
- Endocrine organs are of two types

a) Neuro-secretory cells in the central nervous system

- produce hormones which act directly on effector organs or on other endocrine glands stimulated to secrete hormones
- secretions of neurosecretory cells are called **brain hormone or activator hormones**
- occur in the **mid region of brain** and central nervous system
- axons are from brain, cross each other and enter in to or lie apposed to the corpora cardiaca

Neuro-secretory cells are three types

A. Median NSC of the brain (PTTH hormone)

B. Lateral NSC of the brain

They Promote function of prothoracic glands

Stimulate protein synthesis

possibly control water loss and

Oocyte development and activity

C. Ventral NSC of the other ganglia (ventral nerve cord):

these secretions are known to concern with activity, water regulation

b) specialized endocrine glands

Corpora cardiaca

- paired structures, lying close with neurosecretory cells of brain
- Each corpora cardiacum is transversed by **neurosecretory axons** from the brain
- **Neurosecretions from brain is stored in corpus cardiacum** and released into the blood

Corpora allata

- glandular bodies, usually situated one on **either side of the Oesophagus**
- may be fused to a single median organ as in **higher Diptera**
- Connected with Corpus cardiaca of the same side by a nerve which carries fibres from NSC
- Under the influence of brain hormone, corpora allata secretes **Juvenile hormone (JH)**
- Regulates **metamorphosis** and **yolk deposition on eggs**
- **JH** helps to keep the **insect in young stage** only

Prothoracic glands

- Two in number and placed mostly in thoracic region
- Prothoracic glands secrete **moulting hormone, Ecdysone** under influence of brain hormone
- Moulting hormone, helps in insects in the **initiation and process of moulting**
- Except in **Thysanura** (which moult as adults) and **solitary locusts**, they break down soon after final moult to adults, so they are **seen only in immature forms** but not in adults