Subject : Zoology , Endocrinology (403)

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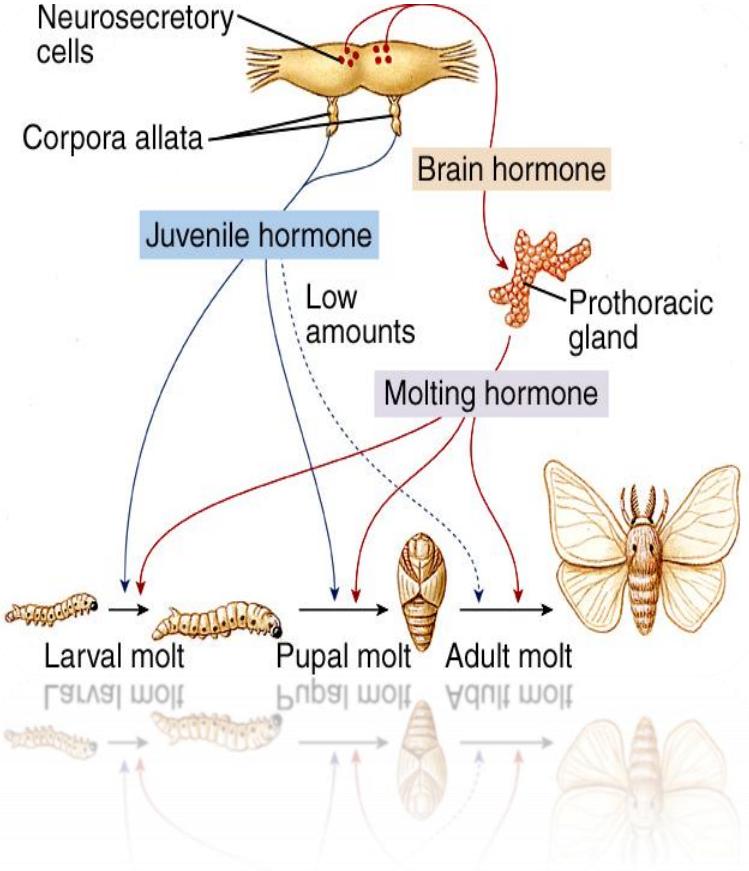
NEUROENDOCRINE SYSTEM IN INSECTS



Endocrine Organs in Insects

A-Neurosecretory cells (NSC)

B-Endocrine glands

A-Neurosecretory cells (NSC)

Origin-Nervous

Produce small neuropeptides – neurohormones

They can be found in brain (major source) and all the ganglia.

1. **Protocerebrum**

A Median NSCs/inter cerebralis
B Lateral NSCs
C Tritocerebral

2.Suboesophageat ganglion

3.All Other ganglion

A Neurosecretory cells (NSC)

1.Dorsal part of protocerebrum produce a hormone called Prothoracicotropic Hormone (PTTH) or BRAIN HORMONE which activates prothoracic glands.

2.NSC in brain secretes BURSICON which is involved in hardening and darkening of cuticle.

3.Neurosecretory cells scattered in the ventral nerve cord produce Diuretic Hormone.

In insects, the **NEUROSECRETORY CELLS** are responsible for production of hormones, **except Ecdysone & Juvenile hormones**, which are produced from **Non-neural Tissues** like **Prothoracic Glands** and **Corpora Allata.**

Insect NSCs shows **Excitatory and Inhibitory post- synaptic potentials.**

The release of hormone is mediated through the **influx of Ca^{2+} ions**.

B-Conventional endocrine glands (hormone synthesis and secretion)

1.Corpora cardiaca(CCStores & releases brain /neuropeptide hormones , Adipokinetic Hormones.

2Corpora allata (CA)-Produces-juvenile hormones (JH).

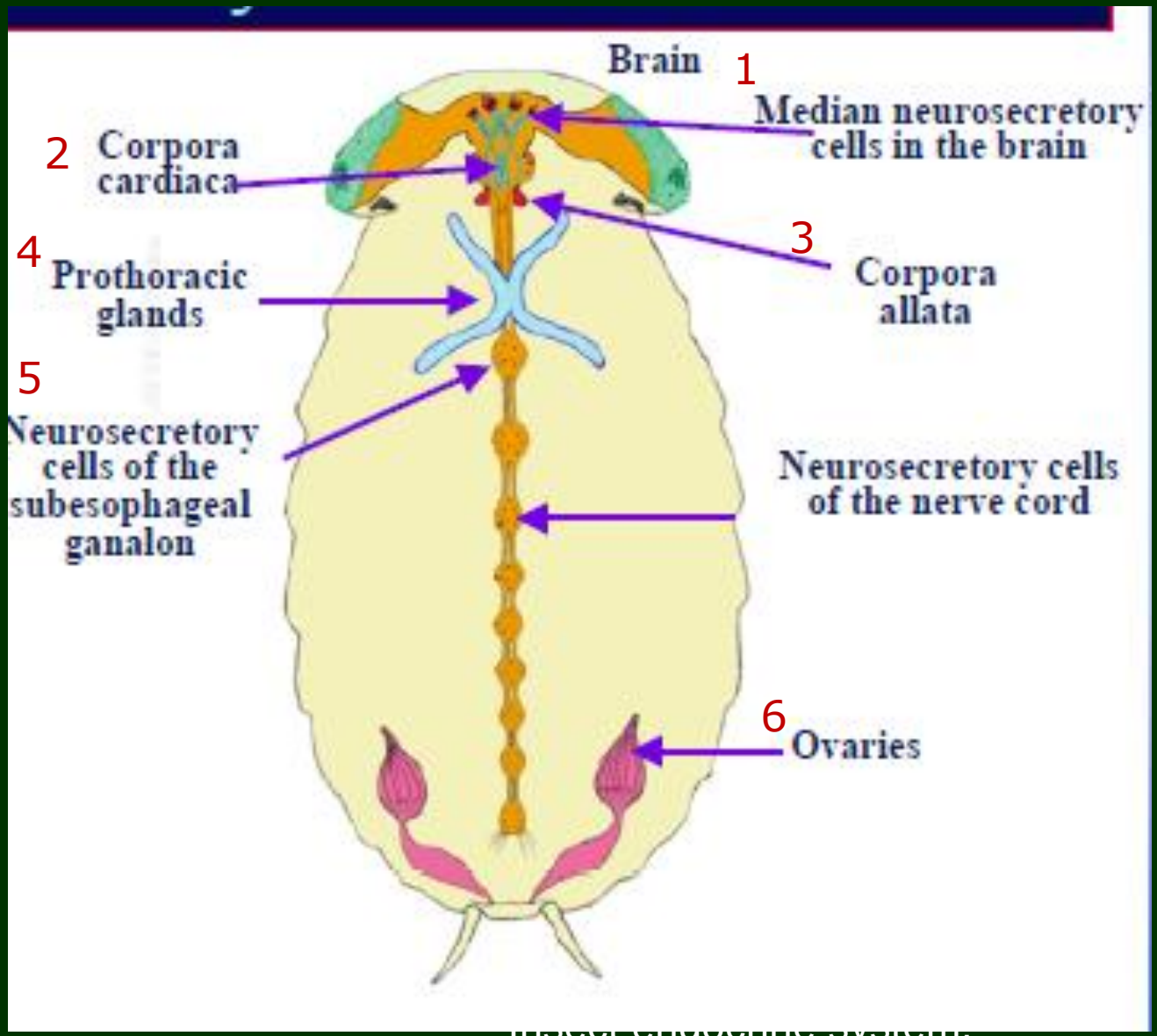
3Prothoracic/Ecdysic-glands(PGs)--Produce- Ecdysone

4Midgut endocrine cells---Produce-various peptides.

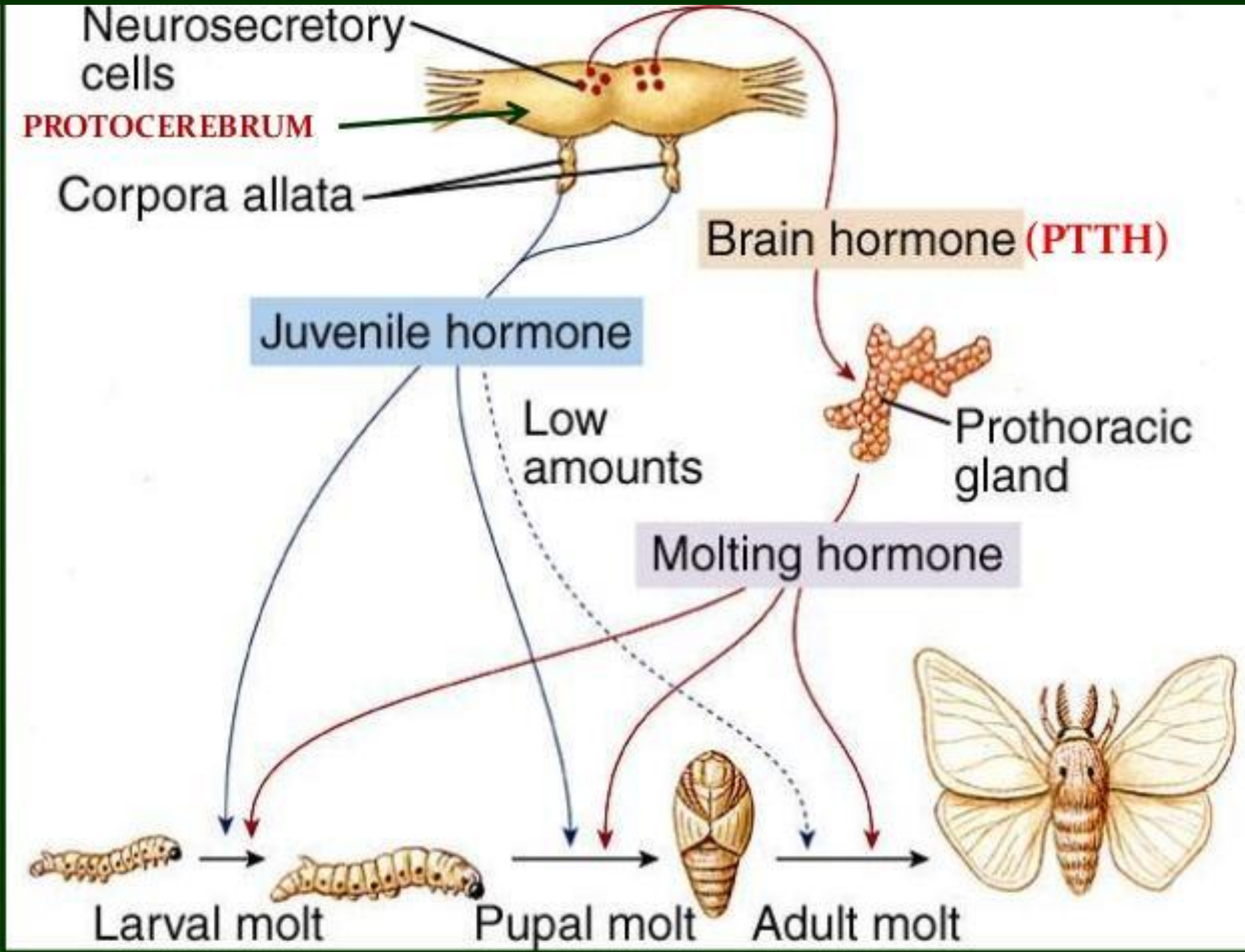
5Gonadal/Epitracheal glands------Produce

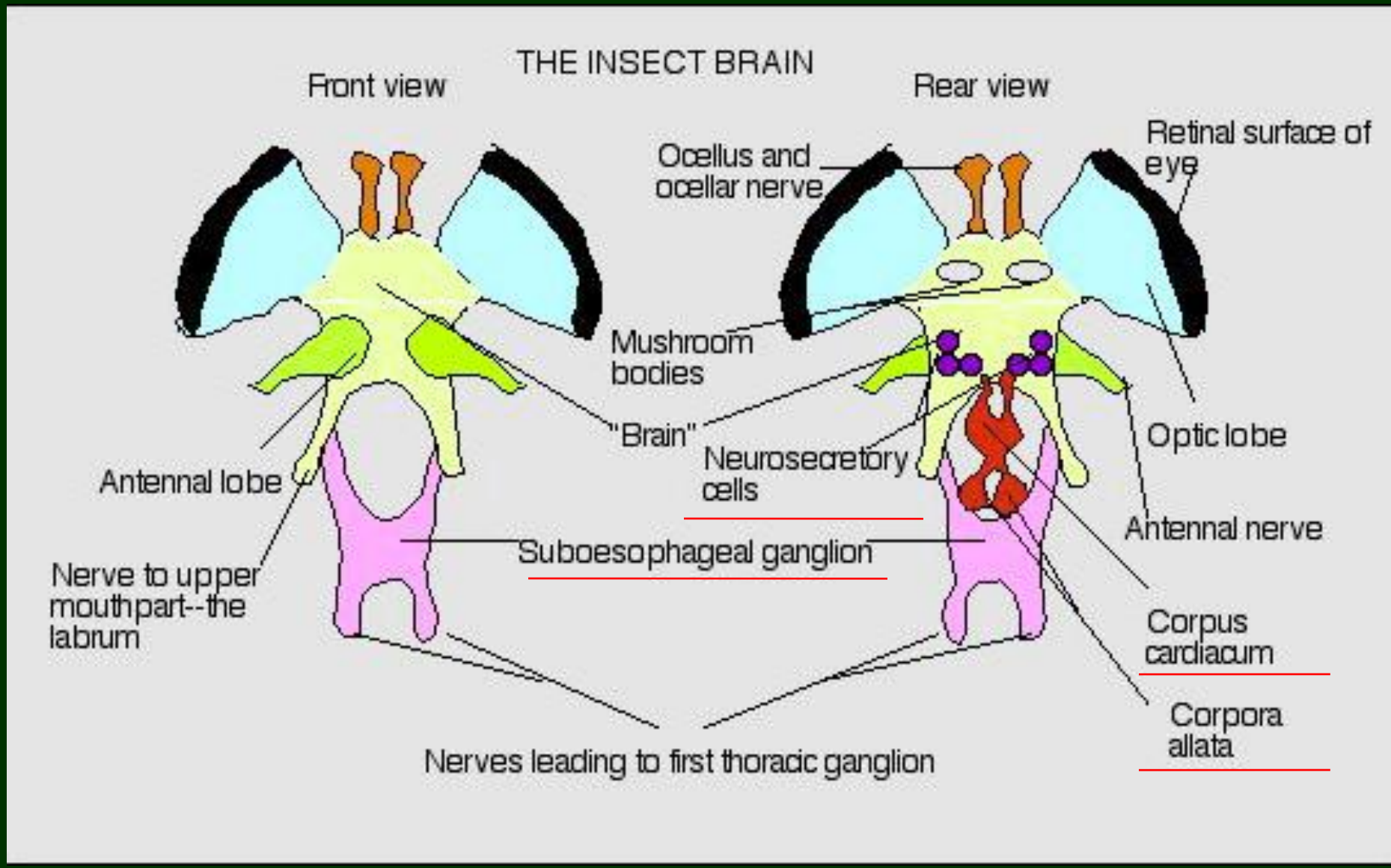
Ovaries: ecdysteroid

Testes: androgen



Insect endocrine system.


Neurosecretory cells
PROTOCEREBRUM
Corpora allata
Brain hormone (PTTH)
Juvenile hormone
Low amounts
Prothoracic gland
Molting hormone
Larval molt
Pupal molt
Adult molt


THE INSECT BRAIN
Front view
Rear view
Ocellus and ocellar nerve
Retinal surface of eye
Mushroom bodies
"Brain"
Neurosecretory cells
Optic lobe
Antennal lobe
Antennal nerve
Suboesophageal ganglion
Nerve to upper mouthpart--the labrum
Corpus cardiacum
Corpora allata
Nerves leading to first thoracic ganglion

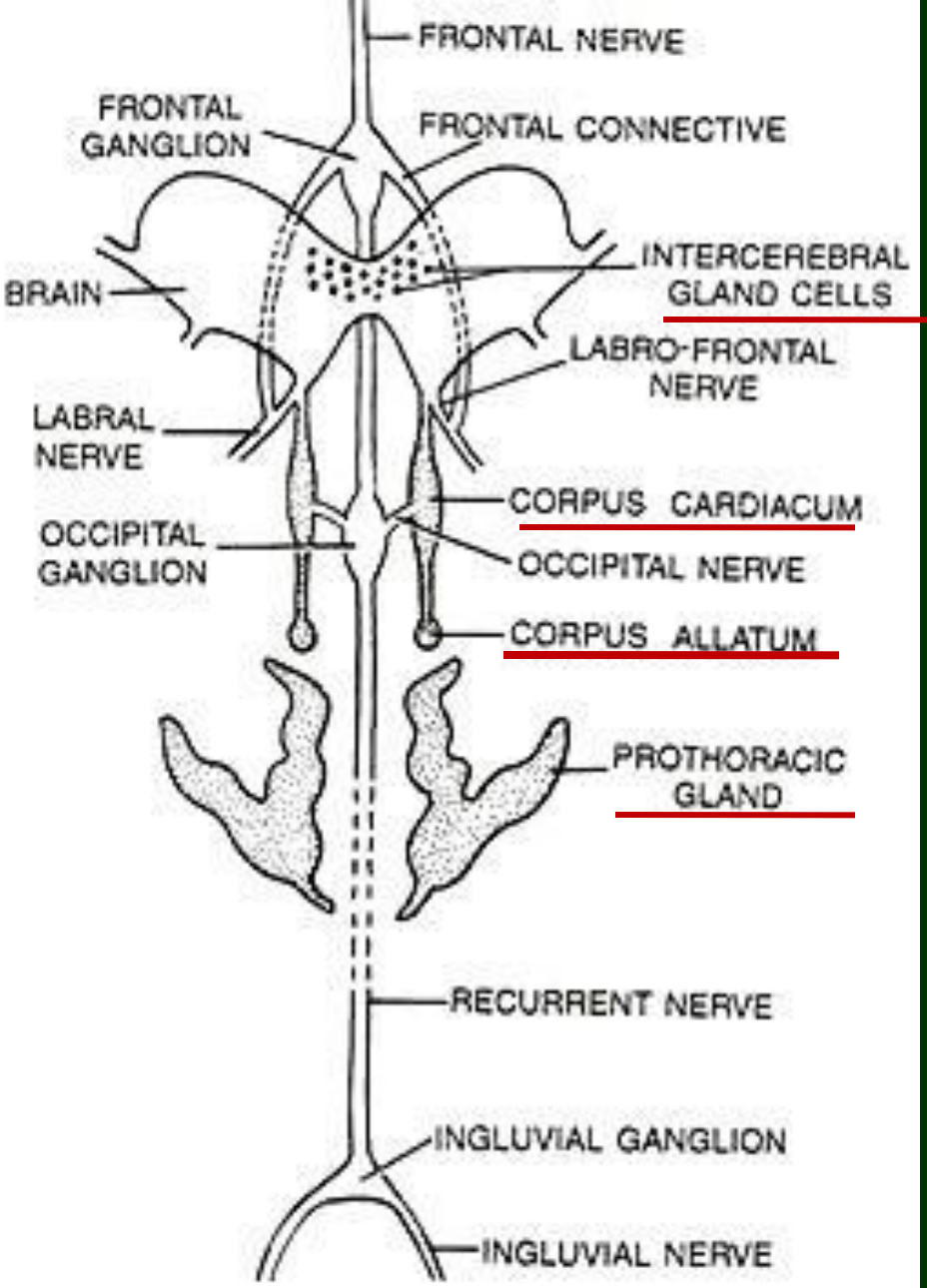


Fig. 7A.37. Sympathetic nervous system and endocrine glands of cockroach.

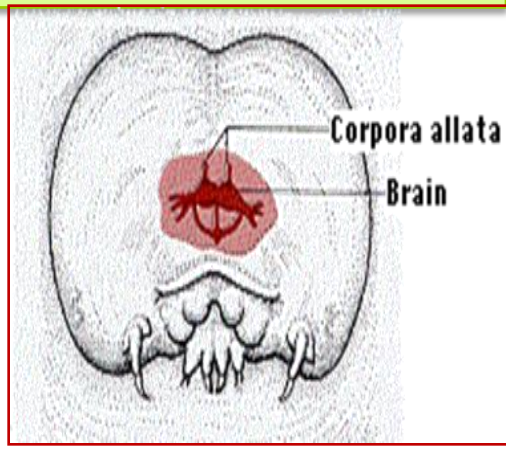
2. Corpora cardiaca(CC)

- paired/fused
- **(cardiacum-Singular)**
- **Origin-ectodermal / epithelial origin**
- **(neurohemal organ-Stores & releases brain /neuropeptidehormones**
- Found in most of insects except COLLEMBOLA
- Lies on each side of Aorta behind brain
- Connected to protocerbrum and hypocerbral ganglion
- It acts as a Conventional Storage and release organ for neurosecretory cells

Corpora cardiaca(CC)

- Contain 4 cellular element
- 1.Bulbous ending of NS axones whose perikarya are located in the dorsum of the brain
- 2.The perikarya of NSC the send axons into nerve that supply various peripheral organs
- 3.Glia like cells
- 4.Intrinsic corpus cardiacum cells
- Function-
- Growth & differenciation
- It controls heart beat & regulate trehalose level in haemolymph

3. Corpora allata(CA)



- Discovered- **JANET 1899**
- **Origin –ectodermal/epithelail origin**
- **Paired/fused gland present in between**
- **mandible & I-Maxillary**
- **Secretes -JUVENILE HORMONE (JH)**
- OR **NEOTININ**

Function-

1. there by **inhibit metamorphosis** (adult characteristics)
2. CA hormones are **responsible for the inhibition of metamorphosis.**
3. The CA hormone(s) is therefore sometimes also called as '**Inhibitory or Status Quo' Hormone**
4. **In adult serve as an endocrine gland-reproduction & other body function**

4. Prothoracic (PG)/ thorasic/ventral/ ecdysial glands

- I experimental proof -Fukuda 1940 in silkworm.
- Paired gland present in ventro lateral part of prothorax of larva
- Also called as Pericardial or Ecdysial Gland
- Degenerated in adults
- Secretes the moulting hormone ECDYSONE
- Neurosecretory cells (NSC) activate prothoracic glands to secrete ECDYSONE

5 Gonadal/Epitracheal glands-

- **Ovaries: ecdysteroid**
- **Testes: androgen**

Midgut endocrine cells

Source ---various peptides-proctodone hormone.

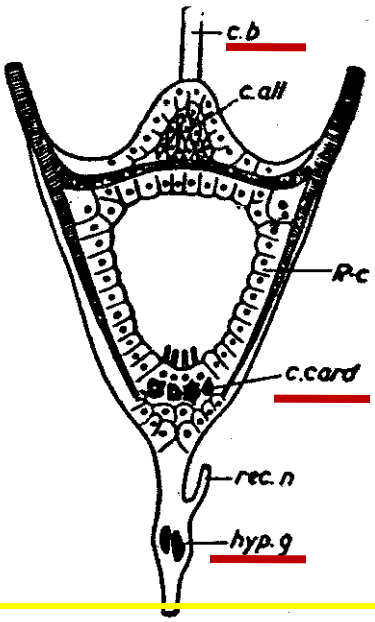
Found in 2 species of lepidoptera

Function :

Play role in photoperiodism & diapause

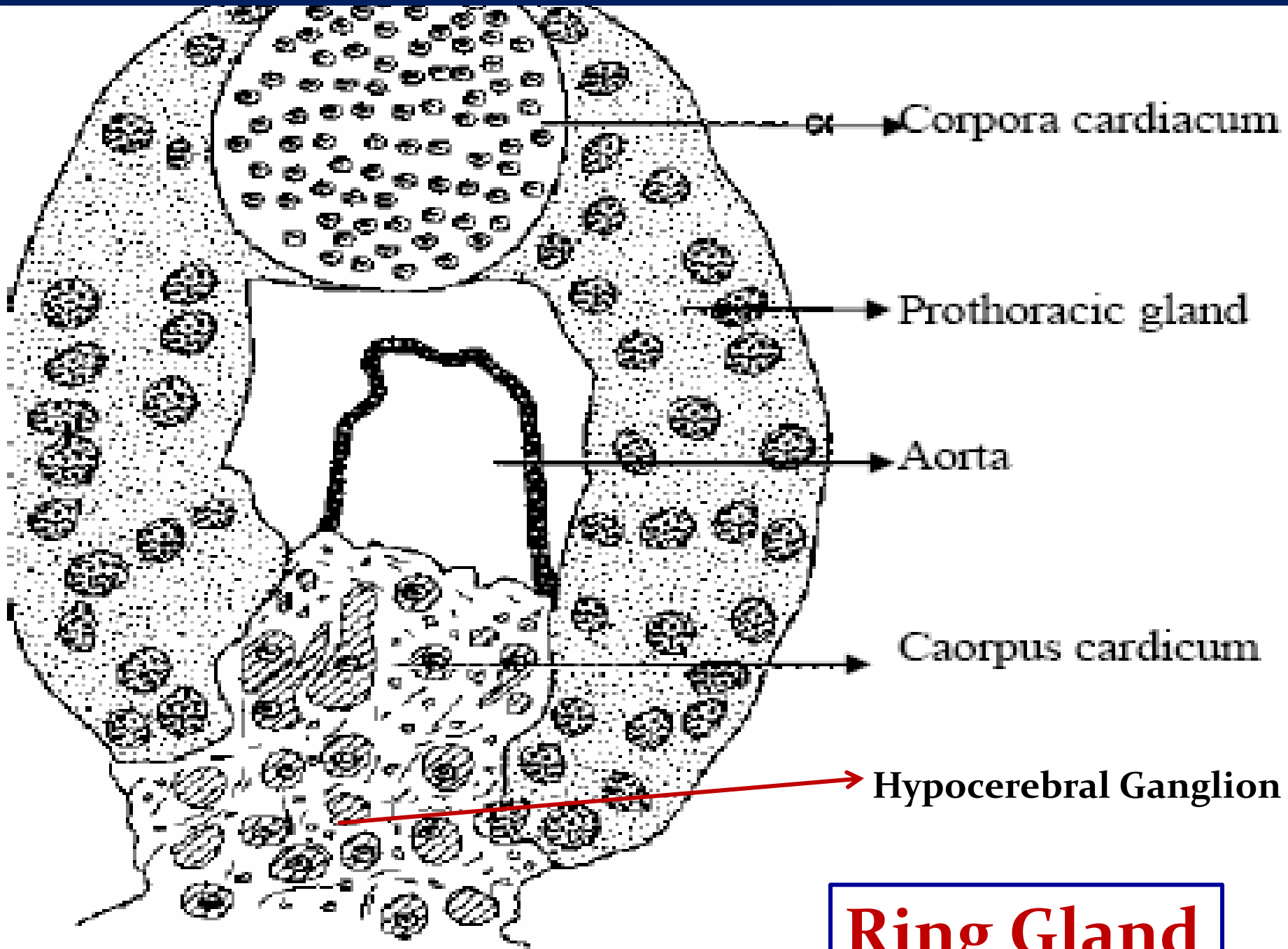
5. Weismann's ring/ Ring gland

- Present in **Cyclorrophous Diptera**
- Formed by the **fusion of Carpora cardiaca, Carpora allata, Prothoracic glands and Hypocerebral ganglion**
- Occur as **small ring like tissue** supported by **trachea around aorta**
- Secrete **puparium hardening hormone**
- Controls **metamorphosis in flies**



Weismann's ring

•A special type with **both CC and CA fused** and connected by the **fused PG** to form a single structure is represented by the **RING GLAND in CYCLORRHAPHOUS DIPTERA**


Corpora cardiacum
Prothoracic gland
Aorta
Caorpus cardicum
Hypocerebral Ganglion

Ring Gland

Functions of the Endocrine Glands

- Regulation of **Molting**
- Determination of form at **Metamorphosis**
- **Polymorphism**
- Regulation of **Diapause**
- Involvement in **Reproduction**
- Regulation of **Metabolic Activities** and general body functions
- Regulation of **Behavior**

Types of Hormones in Insects

- Steroid hormone
  - ecdysteroids
- Sesquiterpenes
  -
- Peptide hormones
  - prothoracicotropic hormone
  - many others
- Biogenic amines
  - octopamine
  - serotonin

Insect endocrine glands & neurosecretory cells & location

Active Principle	Origin	Target	Role/function
I. Nonneural hormones			
A. Immature insects			
Ecdysone	ecdysial gland	epidermis	initiates molt
Juvenile hormone	corpora allata	epidermis	controls or directs fate of metamorphosis at molt
B. Adult insects			
Ovarian hormone (ecdysteroids)	ovarian tissue-follicle cells	fat body	initiates + regulates the production of vitello-genin (VG)
Juvenile hormone	corpora allata	fat body	primes fat body to become competent to produce vitellogenin

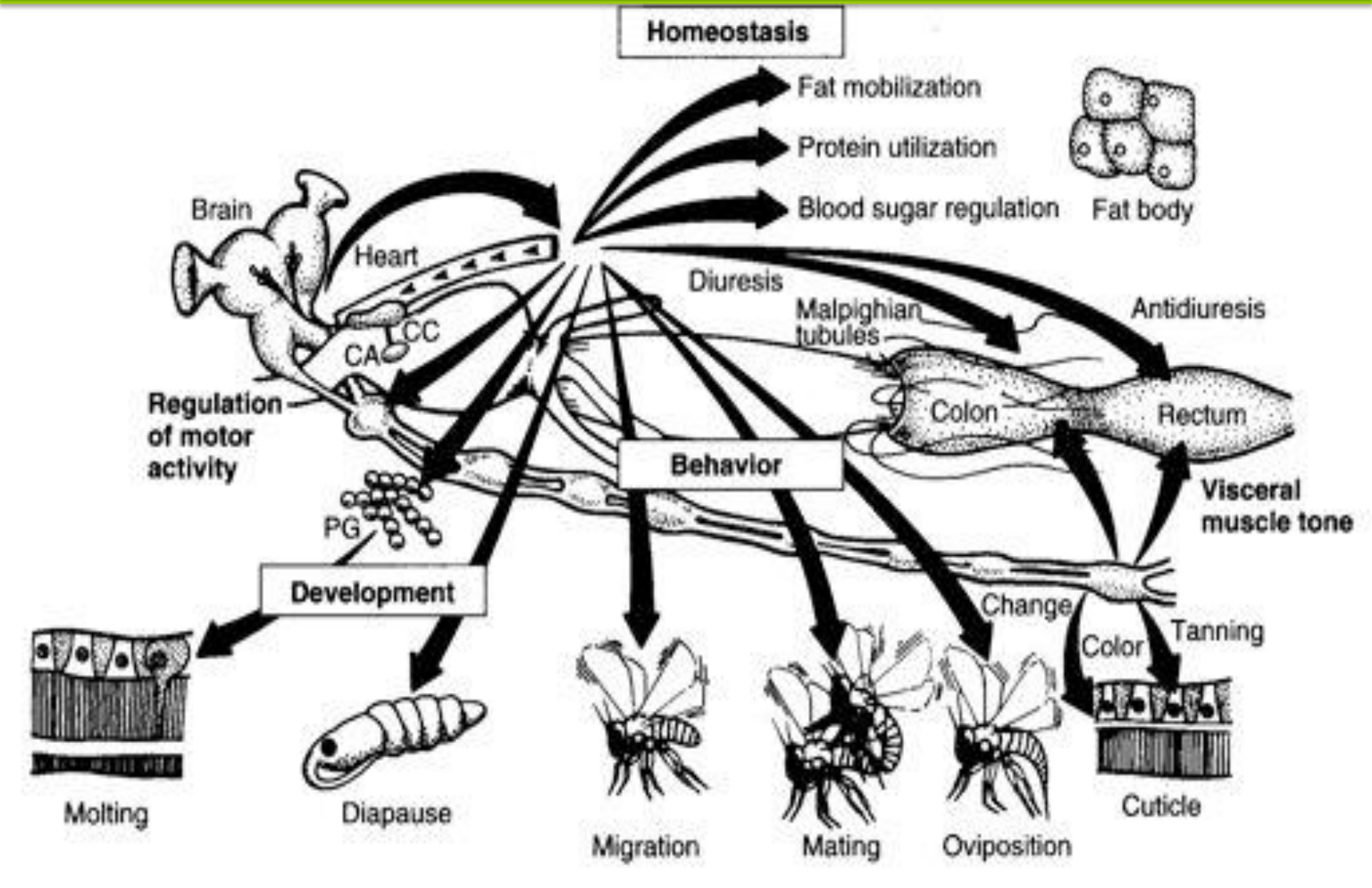
Insect endocrine glands & neurosecretory cells & location

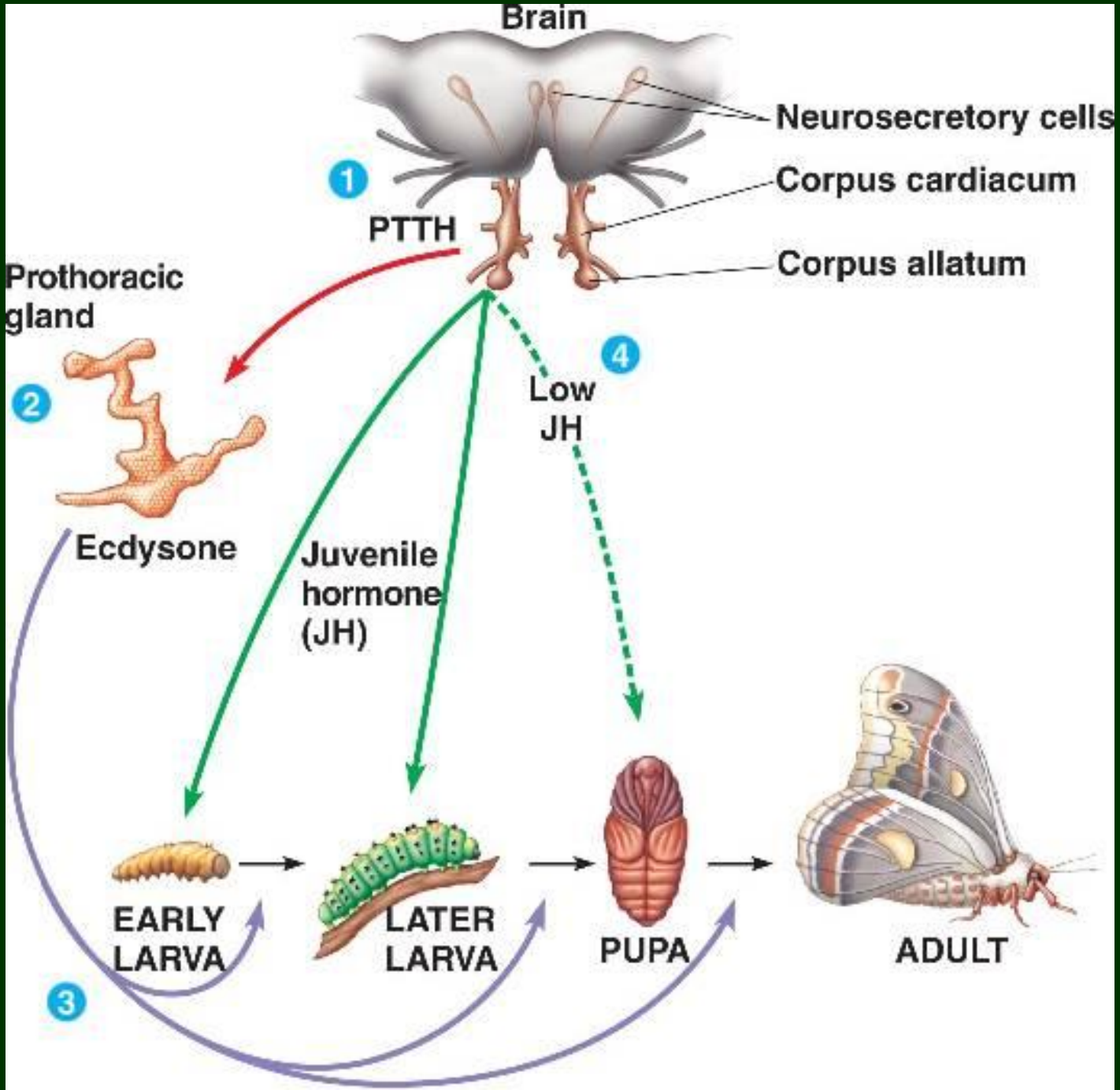
Active Principle	Origin	Target	Role/function
II. Neural hormones and peptide hormones			
A. Ecdysiotropin (PTTH) (=prothoracicotropic hormone).	brain hormone protocerebrum	ecdysial glands	developmental-stimulates and regulates production and release of ecdysone
B. Bursicon	MNSC and thoracicoabd. ganglion of flies	epidermis	dev.-stimulates sclerotization and melanization of cuticle
C. Eclosion hormone	brain of pre-ecdysis moths	abdominal ganglion	behavior-synchron. of eclosion with photoperiod
D. Ecdysis-triggering hormone	epitracheal glands (ventrolateral tracheal tube near each spiracle)	CNS (abdomin. ganglia)	Beh.-synchron. of eclosion
E. Allatostatins	Brain(lateral nsc)	corpora allata	dev./beh/homeostasis inhibits JH production
F. Allatotropin	Brain	corpora allata	dev./beh/homeostasis stimulates JH production
G. Diuretic hormones	brain/cc and thoracic ganglia	Malpig. tubules	homeostasis-controls diuresis or fluid secretion

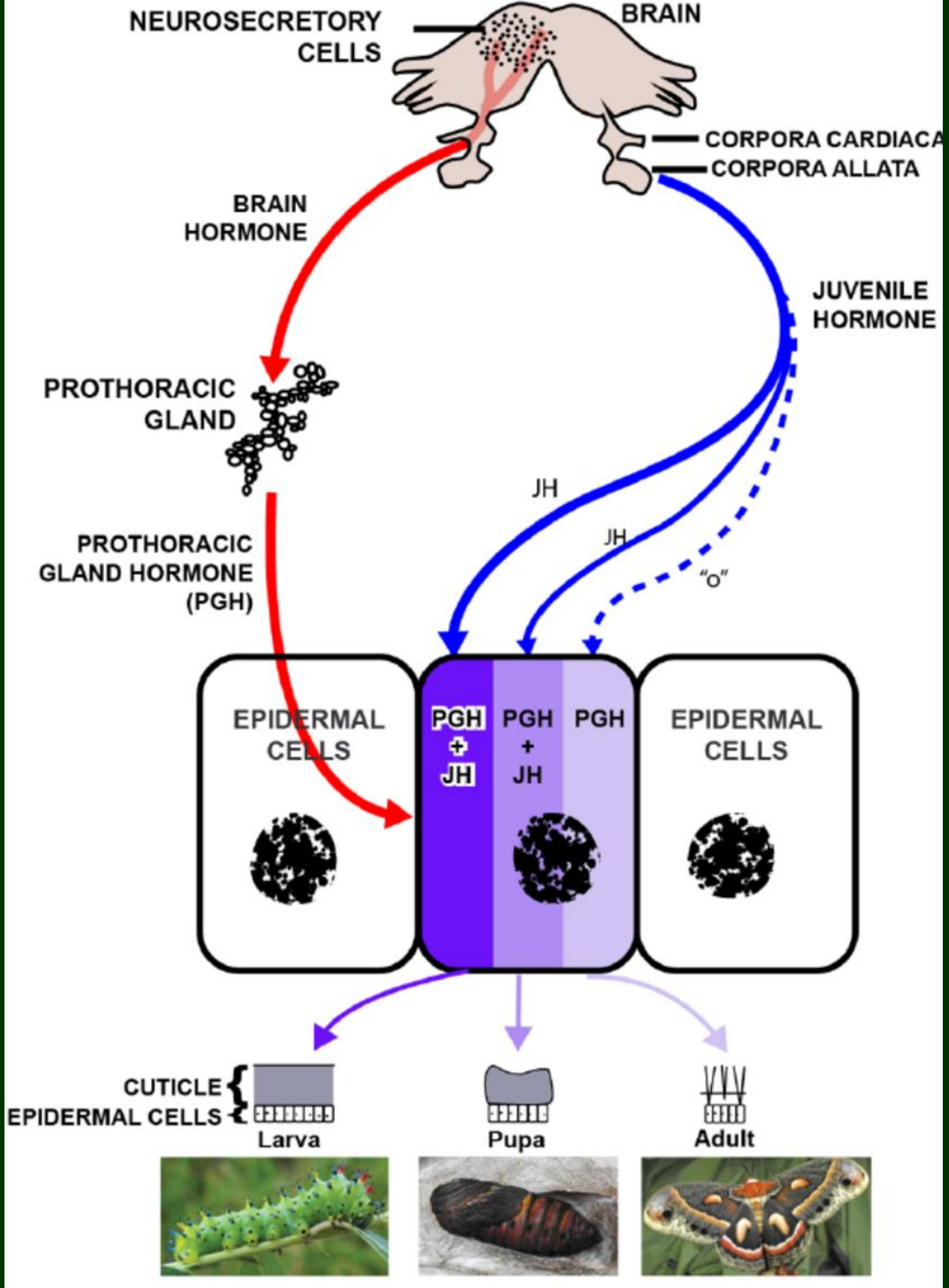
Insect endocrine glands & neurosecretory cells & location

Active Principle	Origin	Target	Role/function
H. Mating inhibition	ARG of male	female's brain	beh.-prevents remating
I. Oviposition initiation	ARG of male	oviduct?	beh.-initiations egg laying
J. Cardioaccelerator	brain/CC	myocardium	Homeostasis-increase in freq. + amplitude of muscle contraction
K. Proctolin	brain/CC	hindgut and poss. visceral muscle in general	homeo.-muscles contraction, defecation, egg-laying, + heartbeat
L. Dromyosuppresin	brain/CC	muscles of crop	inhibits muscle contract
M. Ovarian ecdysteroidogenic hormone (OEH) (also know as EDNH) (these may be similar to PTTH)	brain	ovaries	stimulate ovarian tissue to produce ecdysteroids
N. Hypo- + hyper-glycemic hormones	brain/CC	fat body	conversion of glycogen to trehalose + maintain level of blood sugar

Major physiological functions regulated by NEUROHORMONES




Brain
Neurosecretory cells
Corpus cardiacum
Corpus allatum
1
PTTH
Prothoracic gland
2
Ecdysone
4
Low JH
Juvenile hormone (JH)
EARLY LARVA
LATER LARVA
PUPA
ADULT
3



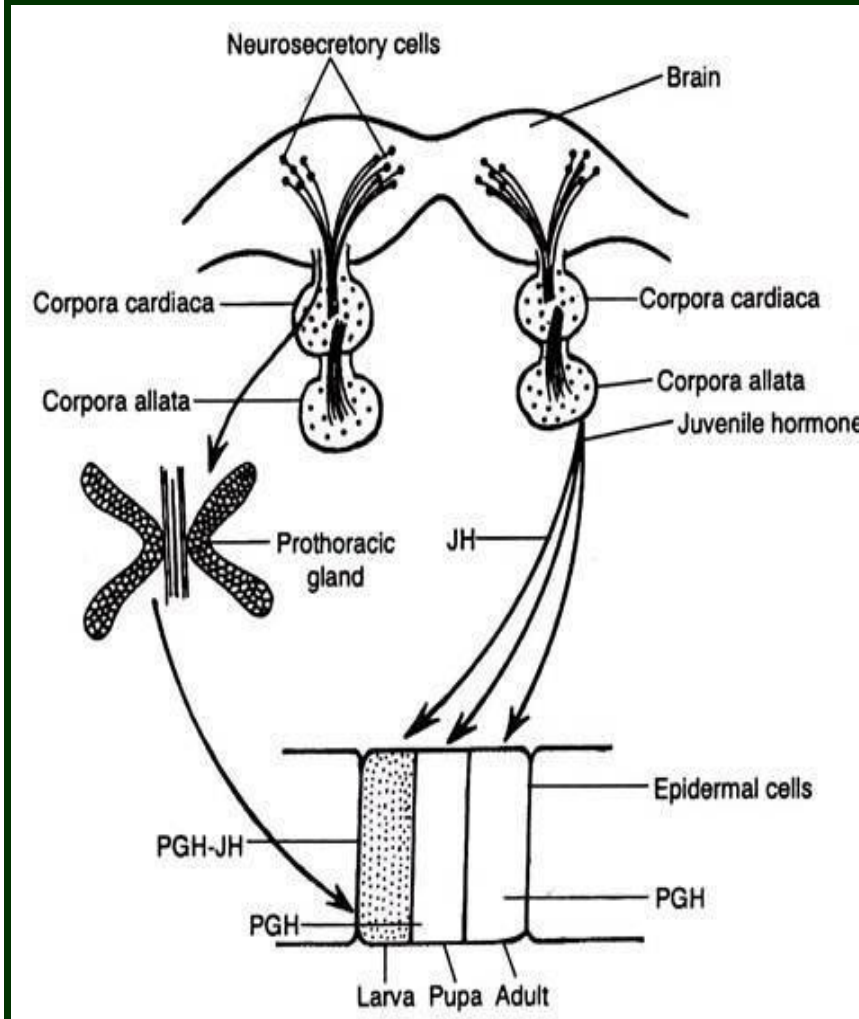
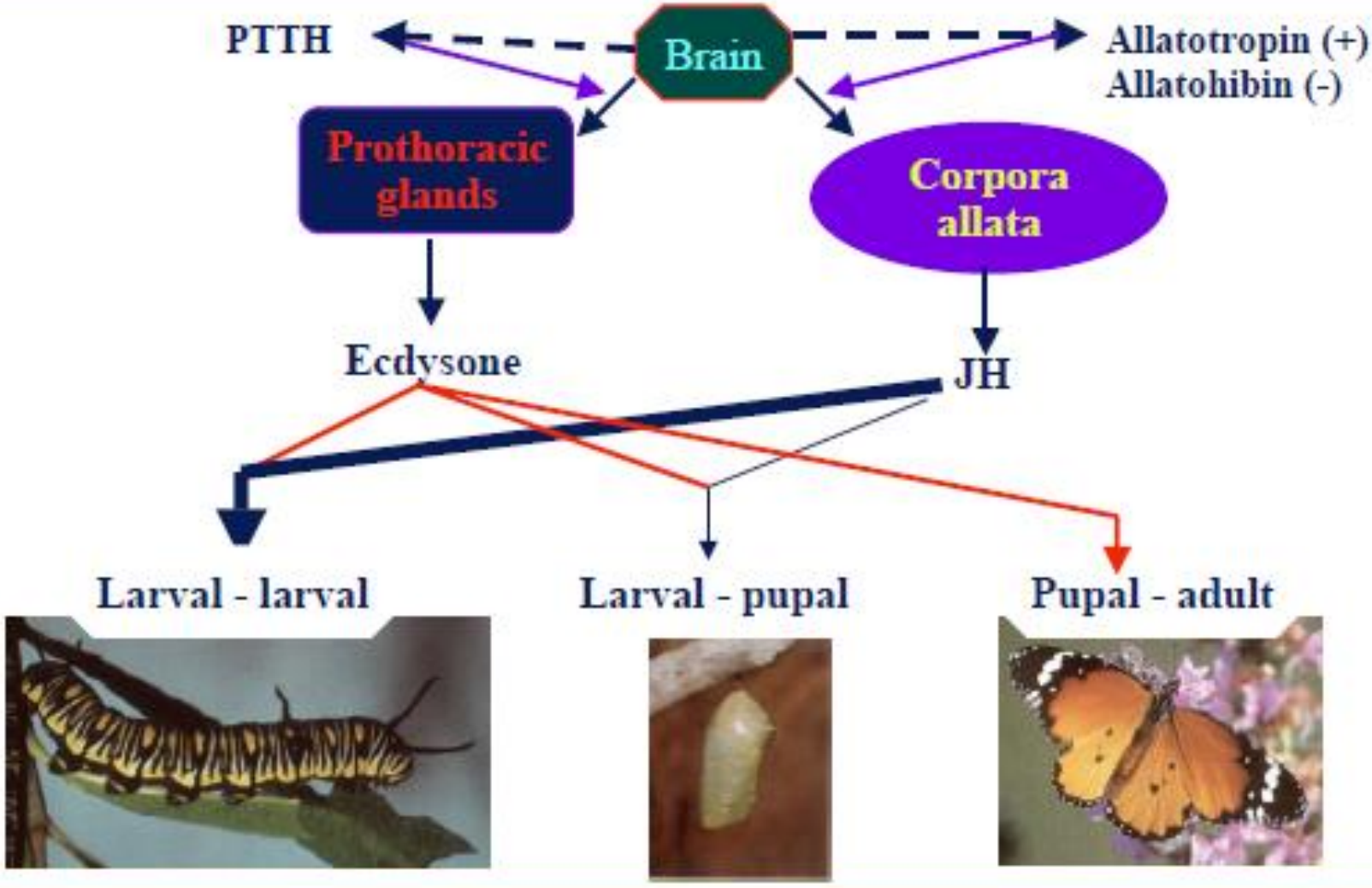


Fig. 18.141: Endocrine glands of insects and their influence during moulting.

Hormonal balances that direct metamorphosis in a holometabolan insect



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