

# ROLE OF ENDOCRINE SYSTEM IN INSECTS



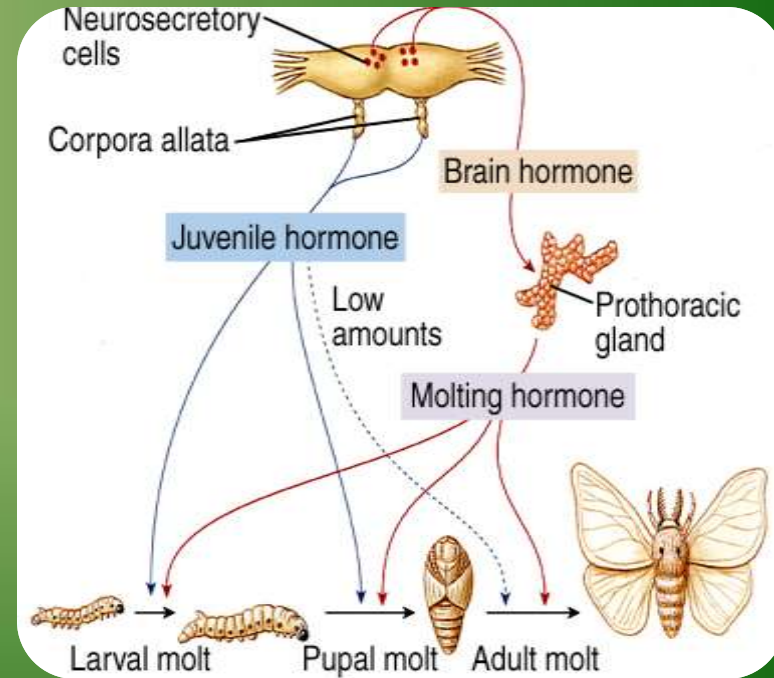
**Presented By:**

*Varun Saini*

*13-503-014*

*MSc(ENTOMOLOGY)*

*TNAU,CBE-3*



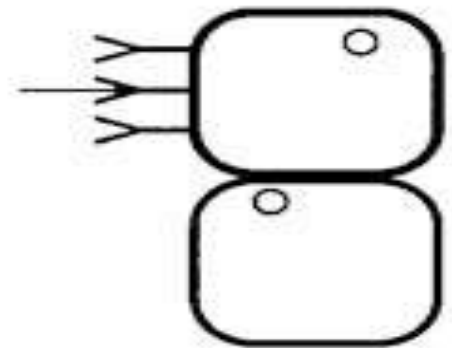
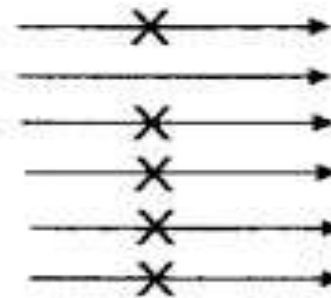
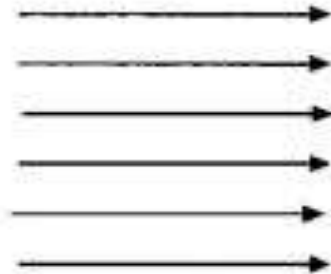
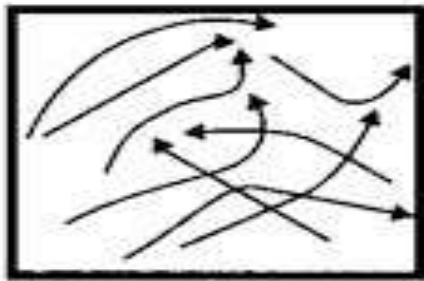
# What are **ENDOCRINE GLANDS**?

- **GLANDS WITHOUT DUCT.**
- A gland that produces and secretes **hormones** within the body.
- Diffuses to haemolymph
- Also called as **RETRO-CEREBRAL GLANDS**

# What is HORMONE ?

- Greek word means **'I EXCITE'**.
- It is defined as Chemicals produced in a gland that are released into the blood and have their effect somewhere else in the animal.

Endocrine gland



Hormone synthesis

Hormone release

Hormone degradation

Receptors on target cells

# COMPONENTS OF ENDOCRINE SYSTEM

- Neurosecretory cells
- Corpora cardiaca
- Corpora allata
- Prothoracic glands

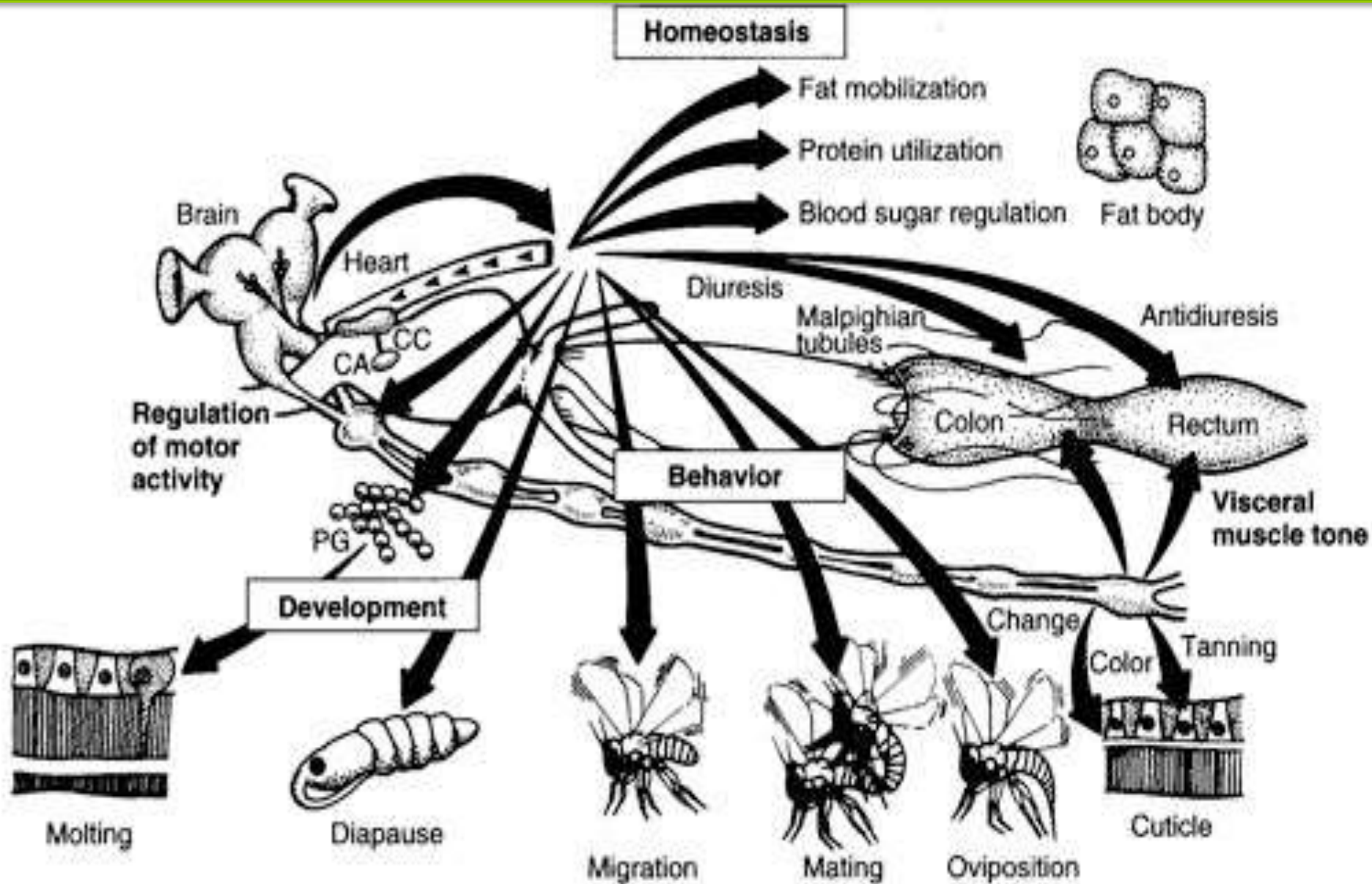


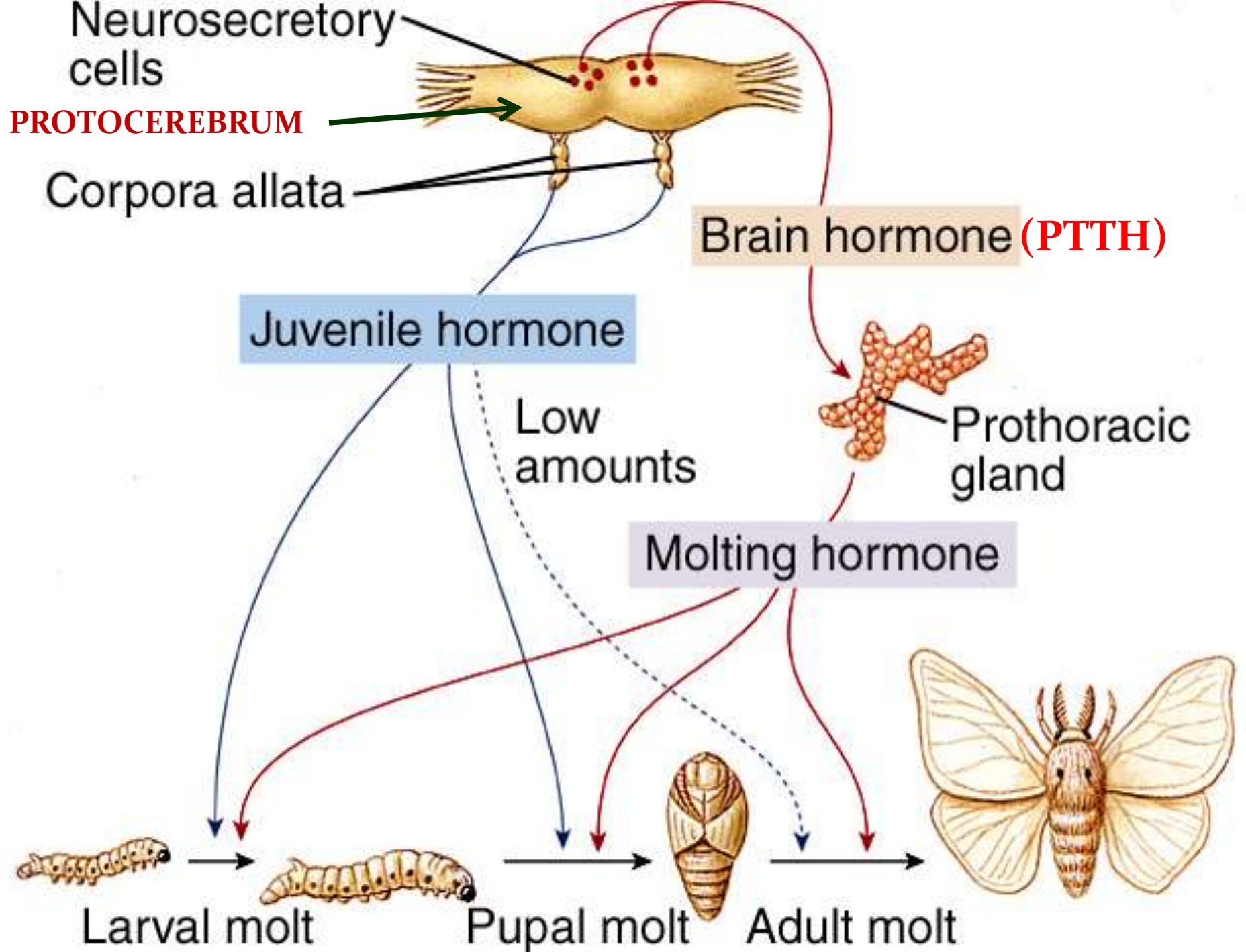
The Cerebral Neurosecretory Cells and Corpora cardiaca form a Neurosecretory system.

# ENDOCRINE GLANDS IN INSECTS

- Prothoracic glands-----Produce Ecdysone.
- Corpora allata-----Produces JH.
- Corpora cardiaca-----Stores and releases brain hormones.  
Also produces and releases some peptides such as Adipokinetic Hormones.
- Midgut endocrine cells----Produce various peptides.
- Epitracheal glands-----Produce the ecdysis triggering hormone “Eclosion” in Lepidoptera
- Neurosecretory cells----Produce Neurosecretion

# Major physiological functions regulated by NEUROHORMONES





# 1. Neurosecretory cells (NSC)

- NSC in dorsal part of protocerebrum produce a hormone called Prothoracicotropic Hormone (PTTH) or BRAIN HORMONE which activates prothoracic glands.
- NSC in brain secretes BURSICON which is involved in hardening and darkening of cuticle.
- Neurosecretory cells scattered in the ventral nerve cord produce Diuretic Hormone.



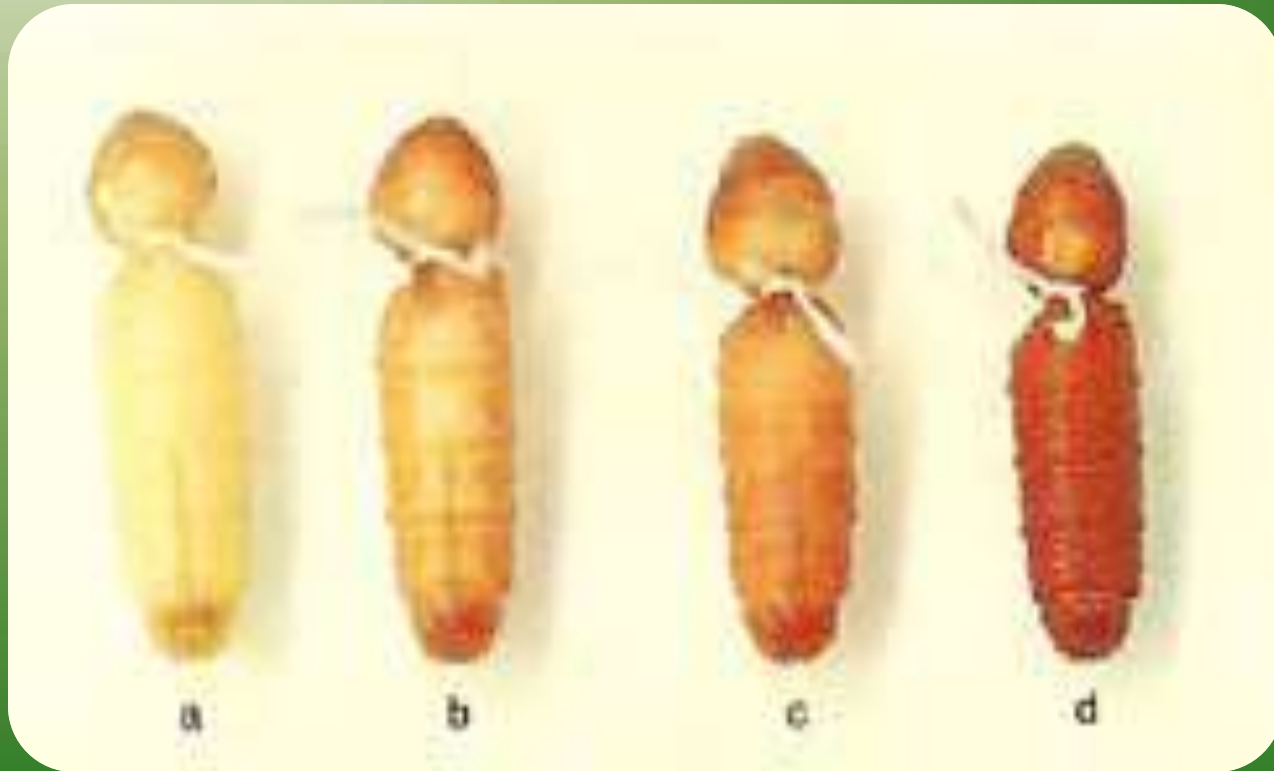
In insects, the **NEUROSECRETORY CELLS** are responsible for production of hormones, **except Ecdysone and Juvenile hormones**, which are produced from **Non-neural Tissues** like **Prothoracic Glands** and **Corpora Allata**.

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

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

# BURSICON

Neurosecretory hormone that controls **Tanning** or **Sclerotization** and mechanical properties of the cuticle during and after a molt. **Found in most ganglia of the CNS.**



**SCLEROTIZATION IN FLY PUPAE**

# Functional significance of NEUROSECRETORY HORMONES

- The **Growth** and **Reproduction** in insects are undoubtedly under the control of neurosecretory hormones
- Neurosecretory hormones have also been associated with **behavioural activities**, such as, **response of the female towards the male, cocoon formation** etc.

## 2. Corpora cardiaca(CC)

- 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
- It **controls heart beat and regulate trehalose level in haemolymph**

# 3. Corpora allata(CA)

- These glands were discovered as early as 1899 by JANET

- CA hormones are responsible for the inhibition of metamorphosis. The CA hormone(s) is therefore sometimes also called as 'Inhibitory or Status Quo' Hormone

- Secretes **JUVENILE HORMONE (JH) OR NEOTININ** there by inhibit metamorphosis (adult characteristics)

- 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**



▪ JH first extracted from the abdomen of *Hyalophora cercopia* (Moth)

● It is needed for **egg maturation** and function as **accessory glands**

● **SER** is structural site for JH regulation

▪ A **decreasing activity of corpora allata** during successive larval instars resulting in the virtual **cessation of activity in the last instar**.

□ Other activities controlled by CA are **polymorphism, regeneration, metabolism of fat, water balance, colour changes, imaginal diapause, pheromone production etc.**

# Use of juvenile hormone and their mimics in pest control

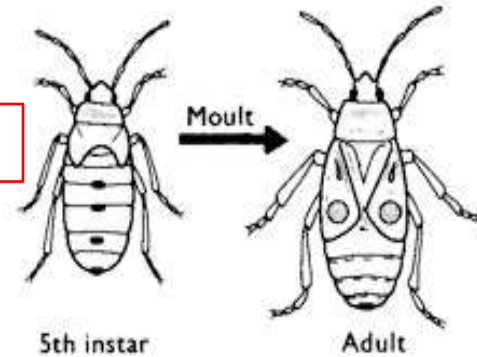
- The concept of juvenile hormone and their mimics as insecticide was developed in a startling way when **Dr. Karl Slama** of Prague went to **Harvard** to collaborate with Professor **Carroll Williams**.
- Slama** took a stock of the bug *Pyrrhocoris apterus* with him but he found that in Harvard the bugs would not develop into normal adult
- A comparison between the culture conditions in Harvard and Prague eventually revealed that **paper towels used in rearing jars were the source of the substance.**
- The substance was called as '**PAPER FACTOR**' which chemically show **resemblance to JH.**
- JH and their analogues have already shown interesting results against *Tribolium* infestation.

# PAPER FACTOR

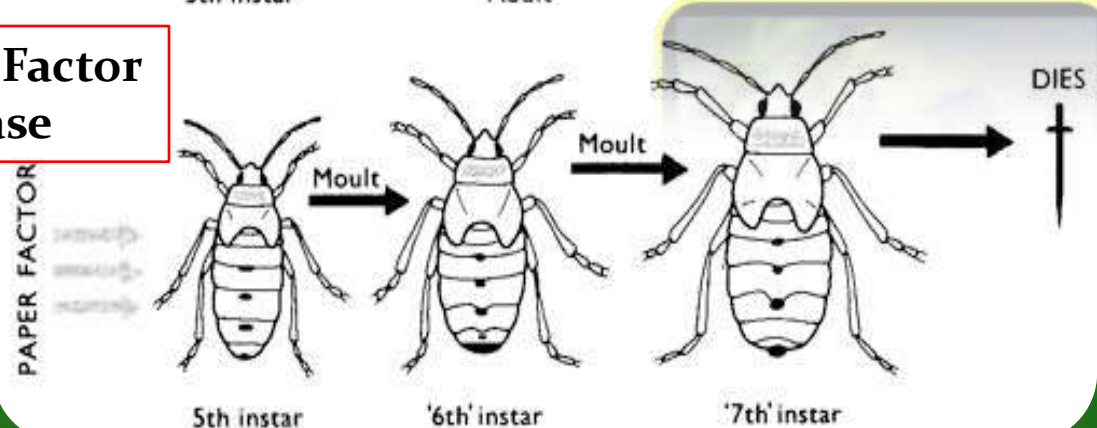


Carroll Williams and John Law getting the “Paper Factor” from brown paper towels

Normal Case



Paper Factor Case





# JUVENOIDS

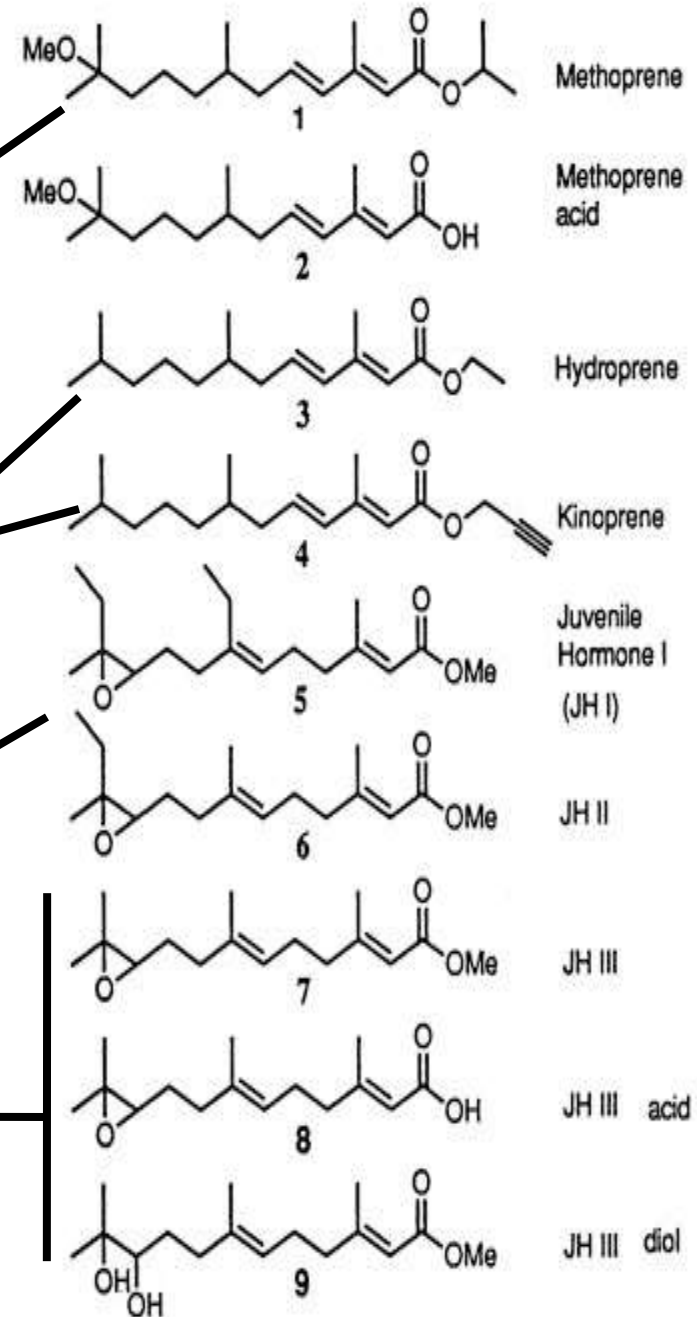
• **METHOPRENE (1<sup>st</sup> Commercial Product)** is used in Mosquito control.



• **HYDROPRENE** and **KINOPRENE** are JH analogues and are used in insect control

• **JH I** is found mainly in the Lepidoptera *Manduca sexta*

• **JH III** was discovered by **DR. YIN** Found mainly in the **CYCLORRHAPHOUS DIPTERANS.**



# OTHER JUVENOIDS

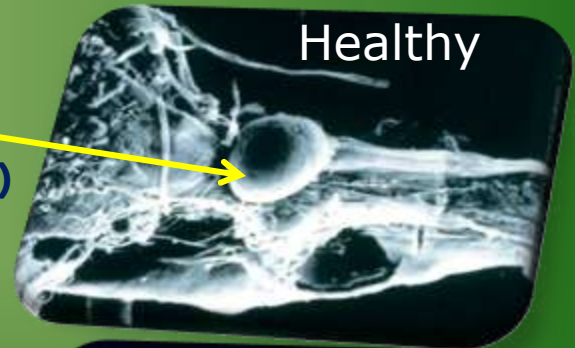
- Fenoxycarb - Fruit Pests.
- Pyriproxyfen - Sucking Pests
- Diofenolan - Lepidopteran Pests.
- NC-196 - BPH of Rice.

JH treated immature insects fail to moult, died soon after ecdysis ,fail to reproduce and develop in b/w larva & pupa Pupa & adult or larvae & adult.

PRECOCENE-  
from the  
common  
Bedding plant,  
*Ageratum  
houstonianum*

**Corpora allata**

(Before Precocene injection)



**Corpora allata**

(After Precocene injection)



CA in adult *Phormia regina*

ANTI-HORMONES

# 4. Prothoracic glands(PG)

•First experimental proof about the importance of Prothoracic Glands was provided by a Japanese worker, Fukuda in 1940 working with 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**

# ECDYSTEROIDS

In 1954, Butenandt and Karlson for the first time extracted a steroid hormone, ecdysone in crystalline form *Bombyx moori*.  
 **$\alpha$ -Ecdysone and  $\beta$ -Ecdysone**

1. Ecdysone is the most common ecdysteroid produced in insects.

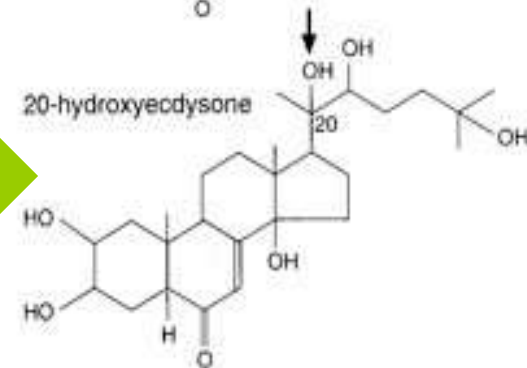
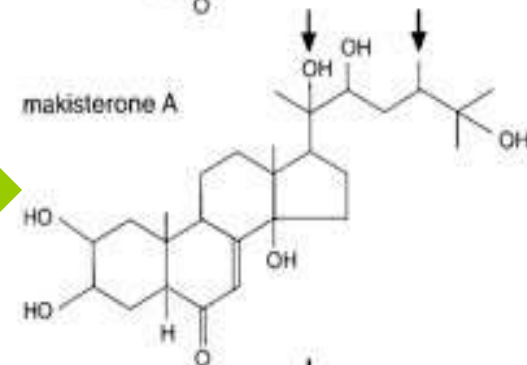
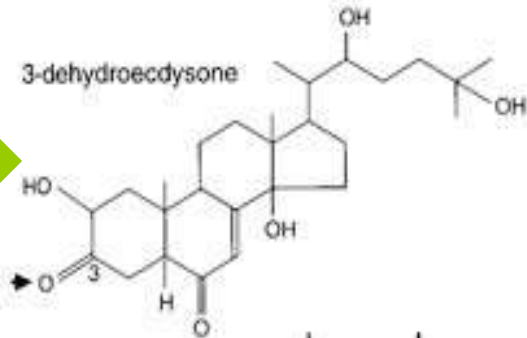
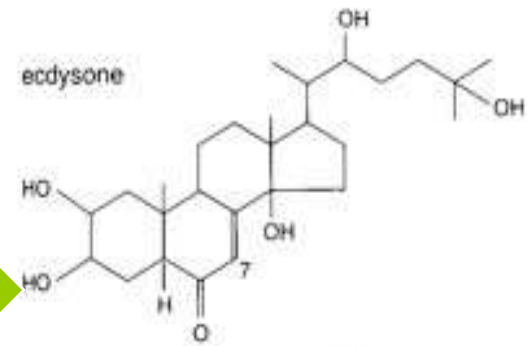
2. High doses of  $\beta$ -Ecdysone cause death in insects due to toxic effect it may undergo abnormal moulting.

Most of insects

Some Lepidopteran larvae

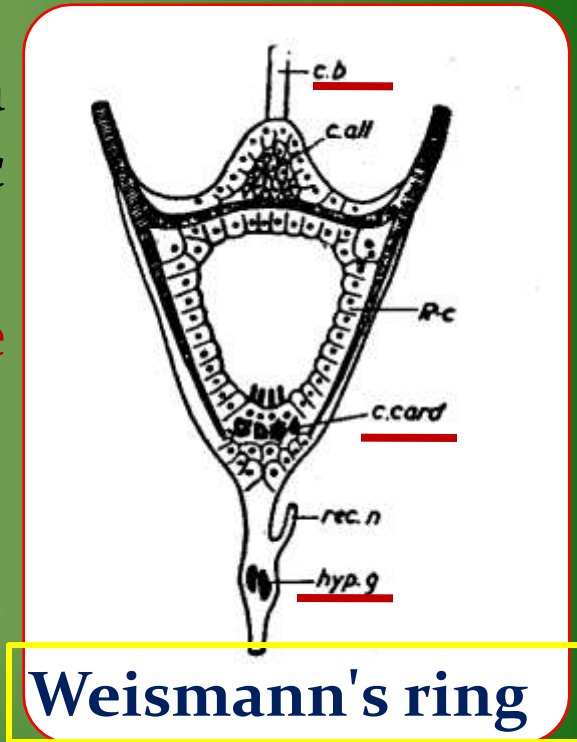
In Honey bees and Heteroptera

In Diptera released from the Ovaries and stimulates the fat body to produce Vitellogenin.

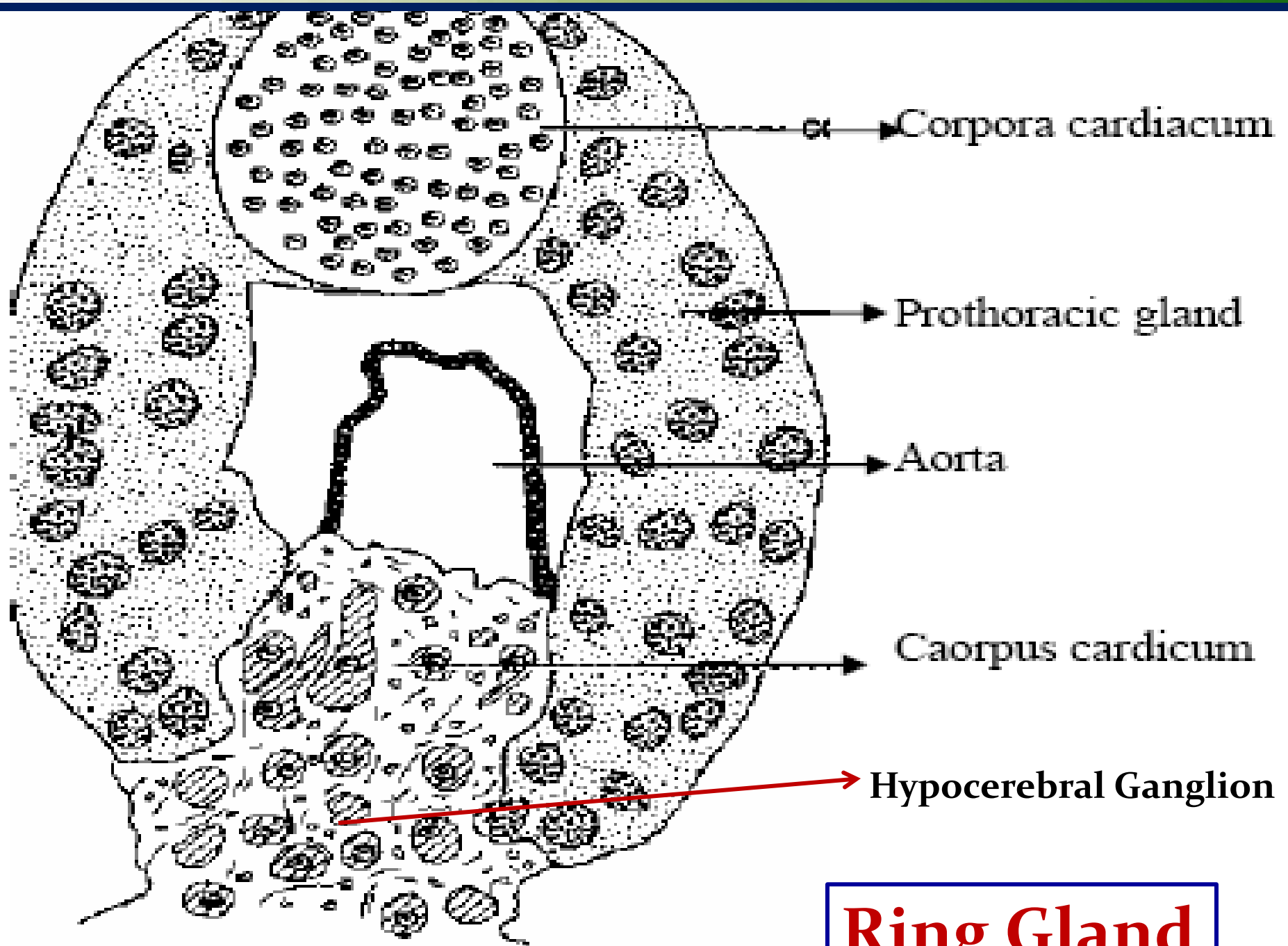


# 5. Weismann's ring/ Ring gland

- Present in **Cyclorrophous Diptera**
- Formed by the **fusion** of **Carpoca cardiaca**, **Carpoca 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



**Ring Gland**

# OTHER HORMONES

## PEPTIDE HORMONES:-

It is known to control wide range of **Physiological, Biochemical, and Developmental function** including **water balance, lipid and carbohydrate metabolism, muscle contraction ,reproduction , growth and development**

## DIURETIC HORMONE (s)

It involved in the regulation of **Insect Water balance**

# CHLORIDE-TRANSPORT STIMULATING HORMONE

In **Desert Locust**, **rectum of insect** is an important organ, which regulates the ionic balance. It is stimulated by the hormone from **Corpora Cardiaca**, the **Chloride-Transport Stimulating Hormone(CTSH)**.

## Neurohormone -D

Material isolated from **CC of *Caracius morosus*** called Neurohormone-D which **increasing the frequency of amplitude of Heart Beat**, stimulating colour change in ***Caracius***.



# PROCTOLIN

Isolated from *Periplanata americana*. It acts as an Excitatory Neurotransmitter to modulate Muscle Excitability.

## ADIPOKINETIC HORMONE(AKH)

It is an **Decapeptide** isolated from the **Locust**. **AKH in CC** of **Locust** regulates **LIPID METABOLISM**.

# 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**

# REFERENCES

**The Insects: Structure and Function, 5<sup>th</sup> Edition, 2013**  
- **R.F. Chapman**

**Physiological Systems in Insects, 2<sup>nd</sup> Edition, 2007**  
- **Marc J. Klowden**

**The Insects : An Outline of Entomology, 4<sup>th</sup> Edition, 2010**  
- **Penny J. Gullan and Peter S. Cranston**

**Principles of Insect Physiology, 7<sup>th</sup> Edition, 1972**  
- **V. B. Wigglesworth**

**Journal of Insect Physiology, Pergamon Press, NY**

**Journal of Insect Science, PAU, Ludhiana**

**[www.wiley.com/go/gullan/insects](http://www.wiley.com/go/gullan/insects)**



**THANK YOU**