

# INSECT METAMORPHOSIS

All changes of form from hatching to maturity of an insect are collectively termed metamorphosis (pl. metamorphoses). All insects during their postembryonic development go on shedding or moulting their skin. This process is called ecdysis. The moulted skin is termed exuvium (pl. exuvia) or exuviae (pl. exuviae). The particular form or shape of an insect between two moultings is known as instar. Thus for example, the first instar is between hatching and first moulting, the second instar between the first and the second moultings, the third instar between the second and the third moultings and so on. The period between two moultings is called stadium (pl. stadia). The adult of an insect is called imago (pl. imagoes or imagines).

## TYPES OF METAMORPHOSIS

According to the degree of change in form, the insects are divided into the following groups.

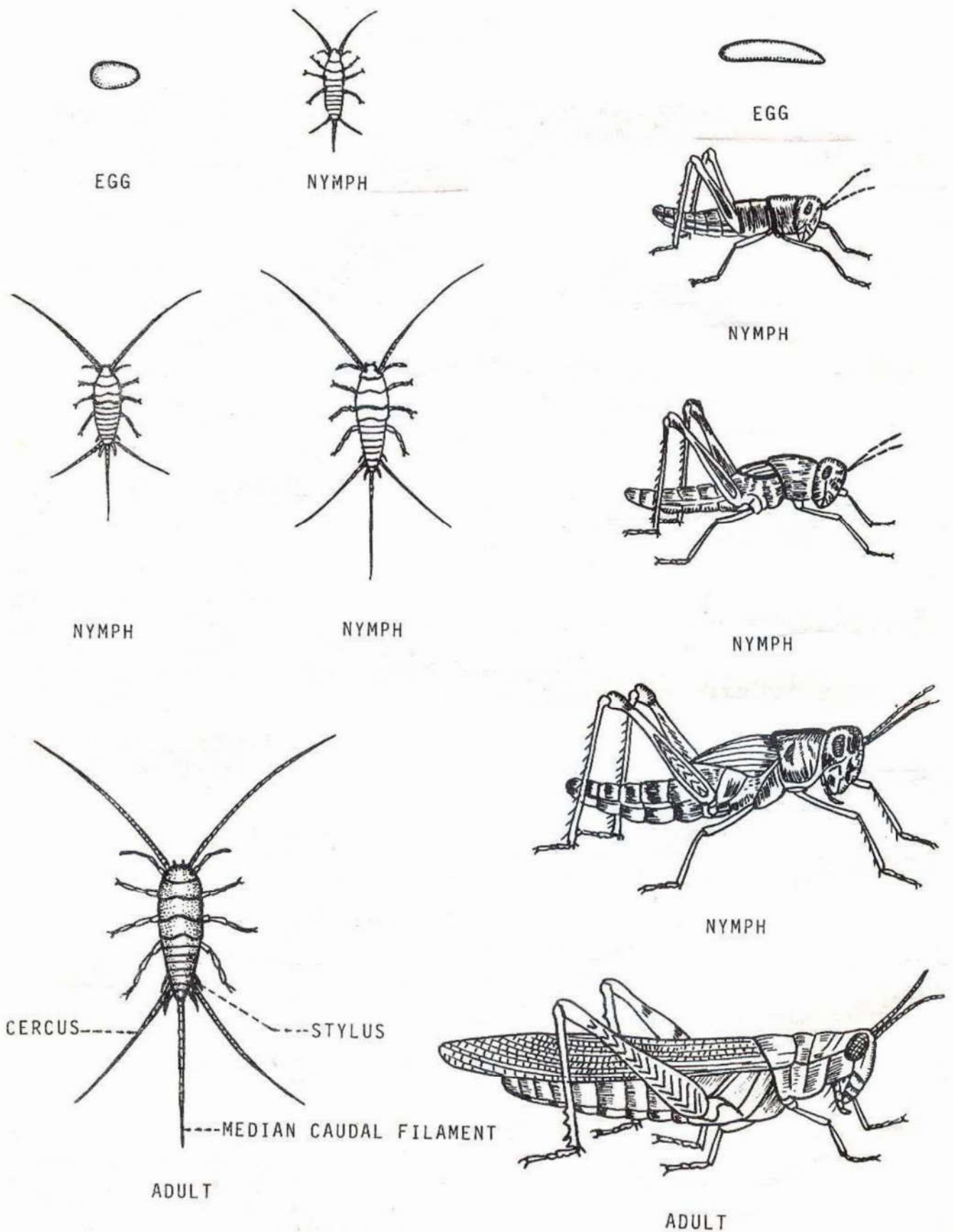
1. **Ametabola (without metamorphosis)** (Fig. 8A): Insects in which the young ones pass through no or slight changes to become adults are said to be without metamorphosis, e.g., silverfish, telsontails, springtails, etc. Although slight changes occur (e.g. absence of abdominal scales and styli in early instars of silverfish and addition of abdominal and antennal segments in telsontails and springtails respectively), but they do not change the appearance of the young. As these insects are considered to be primitively wingless, they are called Apterygota. The young one is called nymph which is similar in appearance to the adult, but smaller in size. These insects have three life stages, viz., egg, nymph and adult.

**Note:** Anamorphosis is an increase in the number of segments during the postembryonic development of an insect. For example, the nymphs of telsontails have eight abdominal segments and a telson at the time of hatching. But three more segments are added between the last segment and the telson during the development. Thus making a total of eleven abdominal segments and a telson in the adult. As this increase or anamorphosis does not change the appearance of the young, it is included in the ametabola.

2. **Hemimetabola (simple, direct or incomplete metamorphosis)** (Fig. 8B): Insects in which the young ones pass through simple or gradual changes to become adults and have no pupal stage are said to be with simple metamorphosis, e.g., grasshoppers, crickets, cockroaches, termites, bugs, etc. These insects are either winged or secondarily wingless. The winged insects develop their wings externally (i.e. outside the body of the young) and are thus known as Exopterygota. The young one is called nymph which is similar to the adult, but smaller in size and with incompletely developed wings.

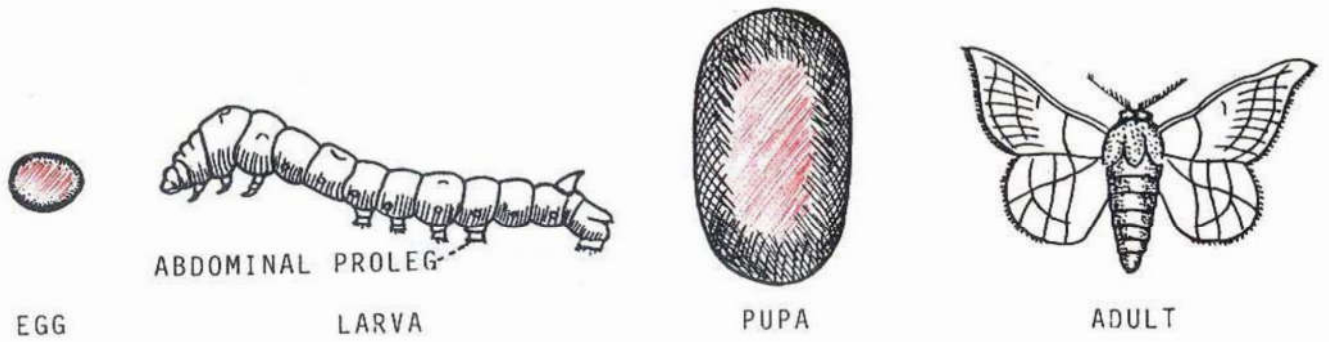
The nymphs of mayflies (Fig. 9C), stoneflies and dragonflies, in addition to the above differences, are aquatic and with gills, while the adults are aerial and without gills. Such nymphs which have a different mode of life from the adults are called naiads. Their aquatic life and possession of gills are of temporary and adaptive nature. Hence these insects also come under hemimetabola.

They have three life stages, viz., egg, nymph (naiad) and adult.

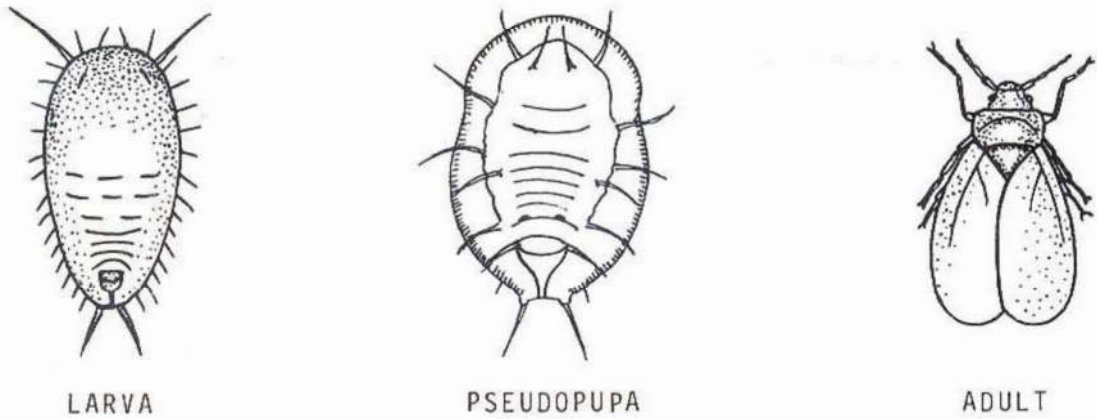


A. AMETABOLA (SILVERFISH)    B. HEMIMETABOLA (GRASSHOPPER)

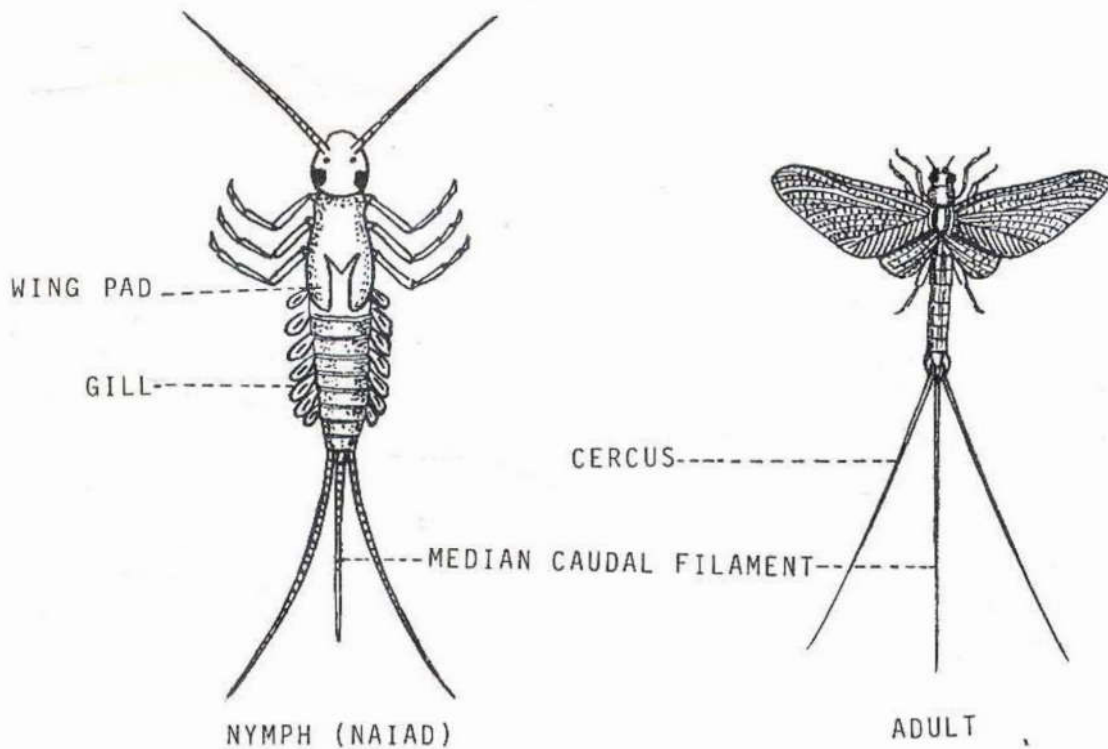
FIG. 8. INSECT METAMORPHOSIS



A. HOLOMETABOLA (SILKWORM)



B. HEMIMETABOLA (WHITEFLY)



C. HEMIMETABOLA (MAYFLY)

FIG. 9. INSECT METAMORPHOSIS

**Note:** Some insects like whiteflies (Fig. 9B), male scales and thrips are included in this type of metamorphosis, but actually they neither fit into hemimetabola nor into holometabola. The early instars of their young are without wings and called larvae. The later instars are with rudimentary wings and resemble with nymphs. The final instar is pupa-like and known as pseudopupa.

**3. Holometabola (complex, indirect or complete metamorphosis) (Fig. 9A):** Insects in which the young ones pass through complex or marked changes to become adults and have a pupal stage are said to be with complex metamorphosis, e.g., moths, butterflies, beetles, flies, bees, wasps, etc. These insects are either winged or secondarily wingless. The winged insects develop their wings internally (i.e. within the body of the young) and are thus known as Endopterygota. The young one is called larva which is entirely different from the adult. There are four stages in their life, viz., egg, larva, pupa and adult.

**Note:** Hypermetamorphosis is a type of complex metamorphosis in which all larval instars are not similar. That is, the shape of larva either goes on changing in all the instars, e.g., blister beetle (Fig. 12) or the first instar is only different from the remaining instars which are similar, e.g., hymenopterous parasites. It may be mentioned here that in case of complex metamorphosis all larval instars are usually similar.

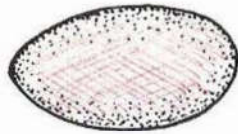
## TYPES OF EGGS

Some common types of eggs are as follows:

- 1. Spherical (Fig. 10A):** These are rounded eggs, e.g., lemon butterfly, citrus leaf miner, hawk moth, gram cutworm and red cotton bug.
- 2. Oval (Fig. 10B):** These are egg-like in shape, e.g., bean aphid, silverfish, rice bug, mango mealybug, maize borer, red pumpkin beetle and rice weevil.
- 3. Conical (Fig. 10C):** These are conical in shape and with longitudinal ridges, e.g., beet armyworm.
- 4. Elongate (Fig. 10D):** These are elongate, e.g., house fly, grasshopper, cotton jassid, fig borer, sand fly and bot fly.
- 5. Stalked (Fig. 10E, F):** These are with a pedicel or stalk, which may be short or long, e.g., whiteflies, green lacewing, parasitic wasps and citrus psylla.
- 6. With appendages (Fig. 10G, H):** These are with thread-like processes or appendages which come out from the upper side. Their number varies in different insects, e.g., water scorpions (*Ranatra and Nepa*) and stink bugs.
- 7. Sculptured (Fig. 10I, J):** These are with various designs or sculpturing, e.g., malarial mosquito, spotted boll-worm, cabbage butterfly, gram caterpillar and pink gramineous borer.



A. SPHERICAL  
(LEMON BUTTERFLY)



B. OVAL  
(BEAN APHID)



C. CONICAL  
(BEET ARMYWORM)



D. ELONGATE  
(HOUSE FLY)



E. STALKED  
(WHITEFLY)



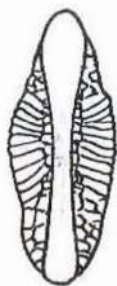
F. STALKED  
(GREEN LACEWING)



G. WITH APPENDAGES  
(RANATRA)



H. WITH APPENDAGES  
(NEPA)



I. SCULPTURED  
(MALARIAL MOSQUITO)



J. SCULPTURED  
(SPOTTED BOLL-WORM)

FIG.10. TYPES OF EGGS

## TYPES OF LARVAE

Some important types of larvae are as follows:

1. **Campodeiform** (Fig. 11A): It has an elongate and flattened body, long thoracic legs and usually cerci on the end of abdomen, e.g., diving beetles, rove beetles, caddisflies and nerve-winged insects.

2. **Carabiform** (Fig. 11B): This is a modified form of the campodeiform larva. It has flattened body, shorter legs and no cerci, e.g., ground beetles, leaf beetles and fireflies.

3. **Eruciform** (Fig. 11C): The body is cylindrical with both thoracic and abdominal legs, e.g., butterflies, moths and scorpionflies.

4. **Scarabaeiform** (Fig. 11D): The body is cylindrical and C-shaped with usually thoracic but no abdominal legs, e.g., scarab beetles and pulse beetles.

5. **Elateriform** (Fig. 11E): The body is thin, elongate, cylindrical with short thoracic legs, e.g., click beetles and darkling beetles.

6. **Platyform** (Fig. 11F): The body is very broad with short or no legs, e.g., some syrphid flies.

7. **Vermiform** (Fig. 11G): The body is cylindrical, elongate, narrowing anteriorly and without legs, e.g., flies, fleas and parasitic wasps.

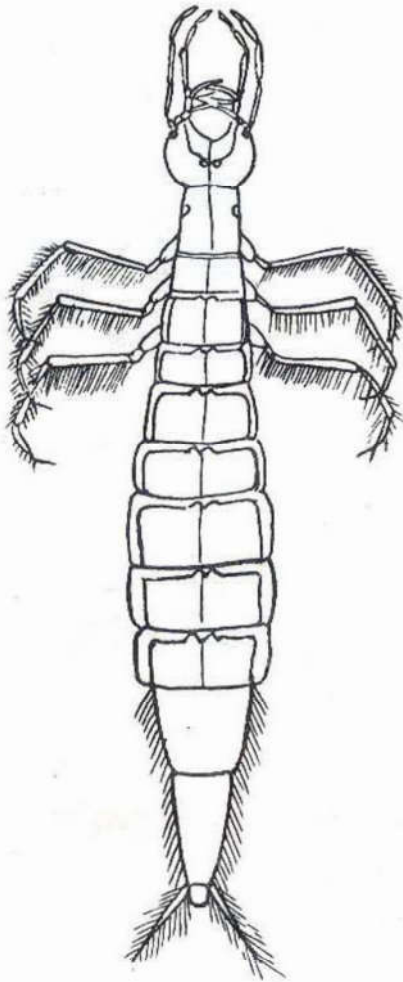
## TYPES OF PUPAE

There are three types of pupae:

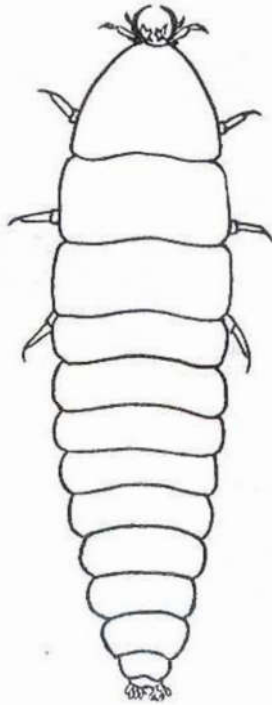
1. **Obtect** (Fig. 13A): The appendages (antennae, legs and wing pads) are firmly glued to the body, e.g., butterflies, moths and many beetles. The obtect pupa of a butterfly is also called chrysalis.

2. **Exarate** (Fig. 13B): The appendages are free and not glued to the body, e.g., most wasps and bees, beetles, caddisflies and nerve-winged insects.

3. **Coarctate** (Fig. 13C): It is like an exarate pupa covered in a loose hardened case which is called puparium. This puparium is formed from the last larval skin which is not shed but retained as a body covering, e.g., most flies.



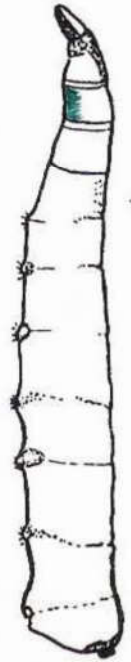
A. CAMPTODEIFORM (DIVING BEETLE)



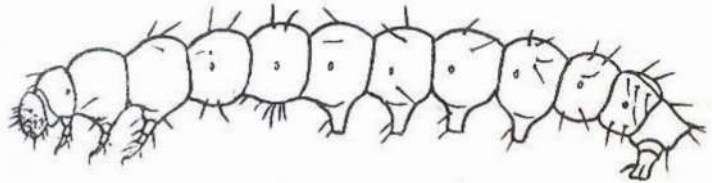
B. CARABIFORM (GROUND BEETLE)



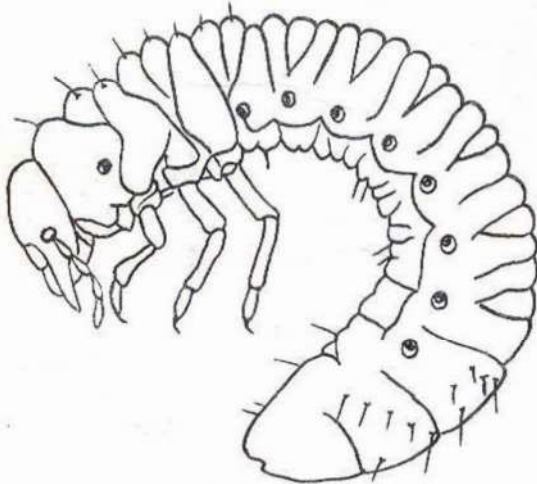
E. ELATERIFORM  
(CLICK BEETLE)



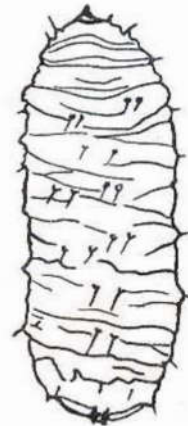
G. VERMIFORM (HOUSE FLY)



C. ERUCIFORM (BUTTERFLY)



D. SCARABAEIFORM (SCARAB BEETLE)



F. PLATYFORM (SYRPHID FLY)

FIG. 11. TYPES OF LARVAE

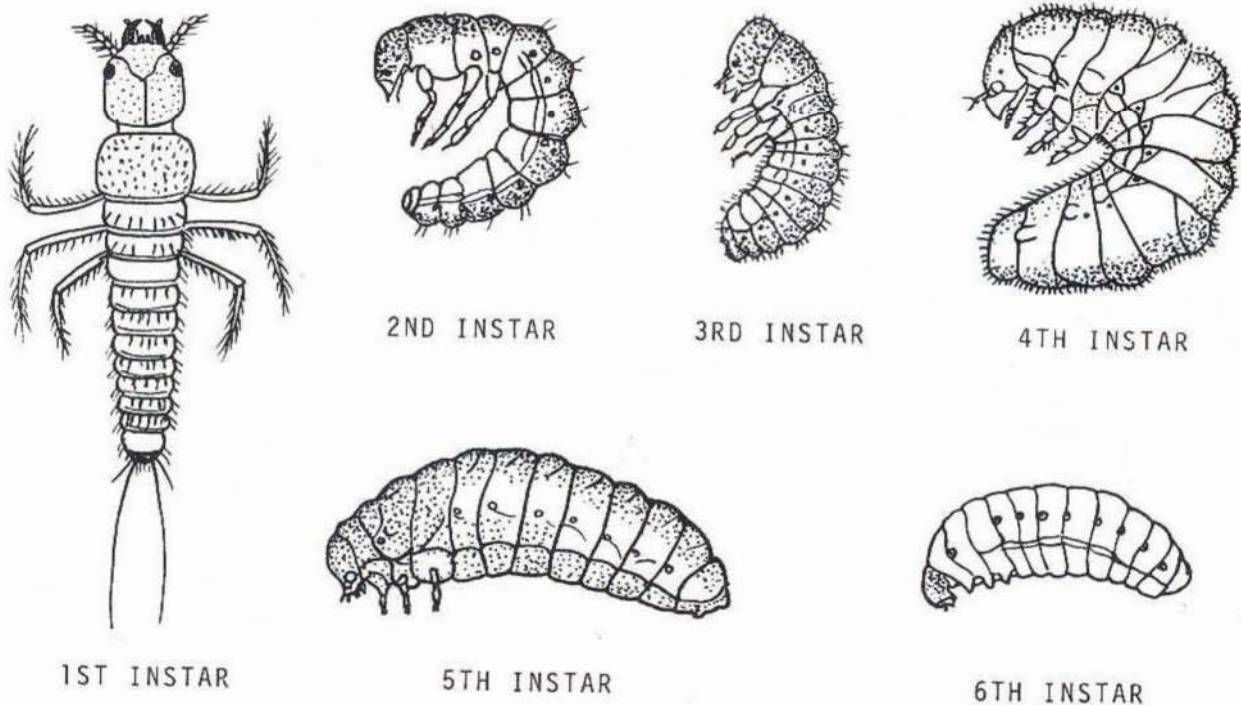


FIG.12. HYPERMETAMORPHOSIS  
(LARVAL INSTARS OF A BLISTER BEETLE)

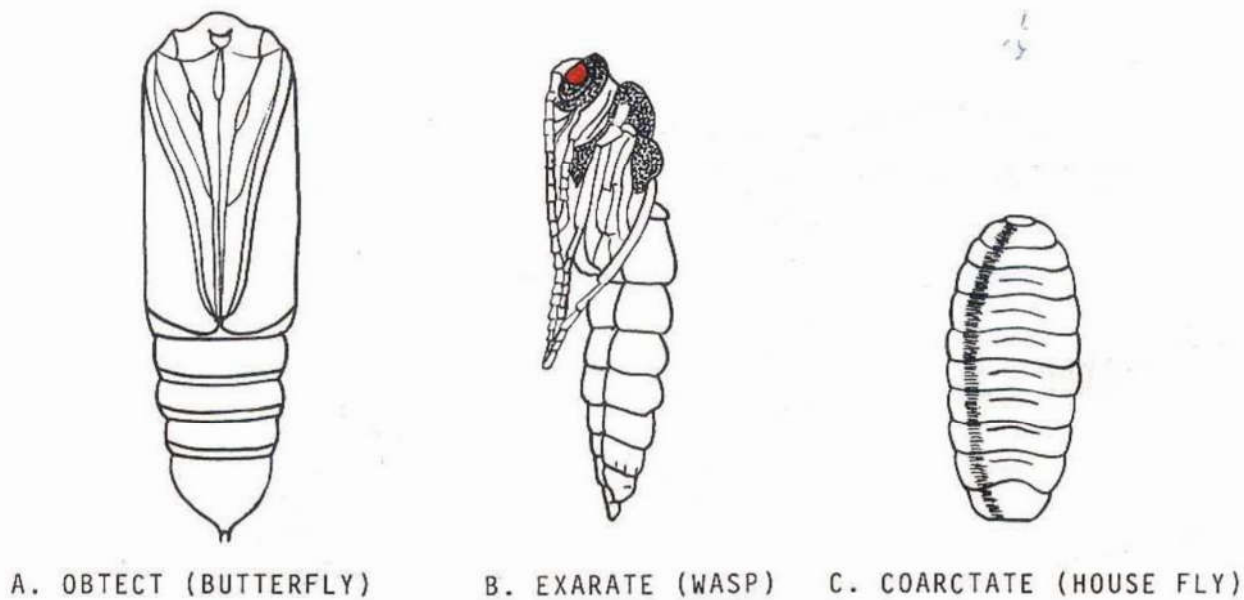


FIG.13. TYPES OF PUPAE