Metamorphosis in Insects

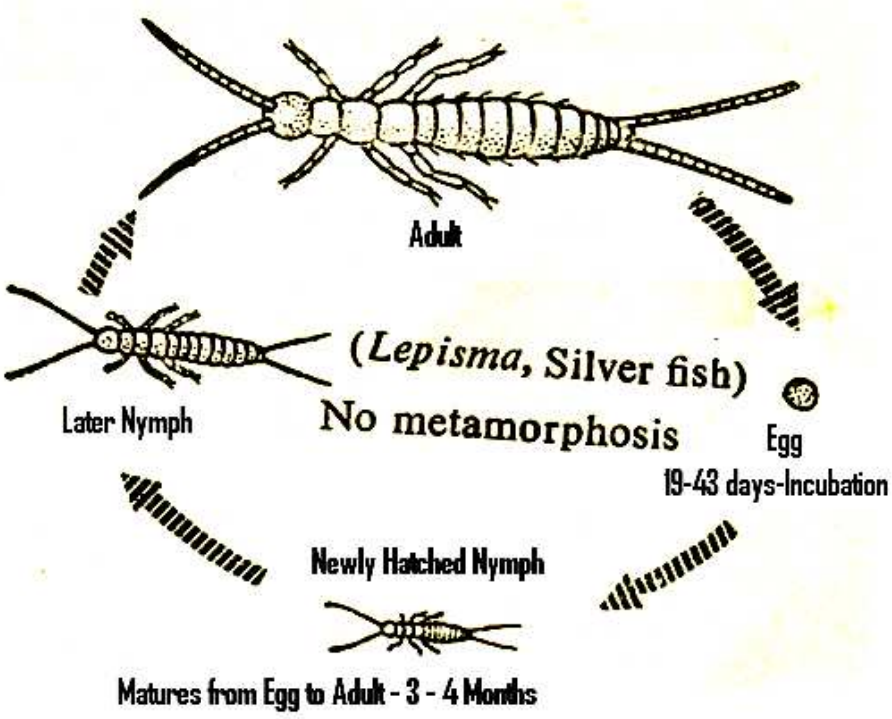
Dr.Mahesha H B, Yuvaraja's College, Mysore.

The term "metamorphosis" is derived from two Greek words *(meta,* change; *morphe,* form), designating a change in form. Insects usually hatch in a condition morphologically different from that of the adult. Consequently, they have to pass through changes of form which are collectively termed *metamorphosis.* Insect metamorphosis has been defined as the transformation of an immature larval individual into a sexually mature adult of different form, structure and habit of life or An abrupt changes in form from one distinctive stage to another in the life cycle/history. According to another definition, metamorphosis refers to abrupt changes in form from one distinctive stage to another in the life history.

Kinds of Metamorphosis

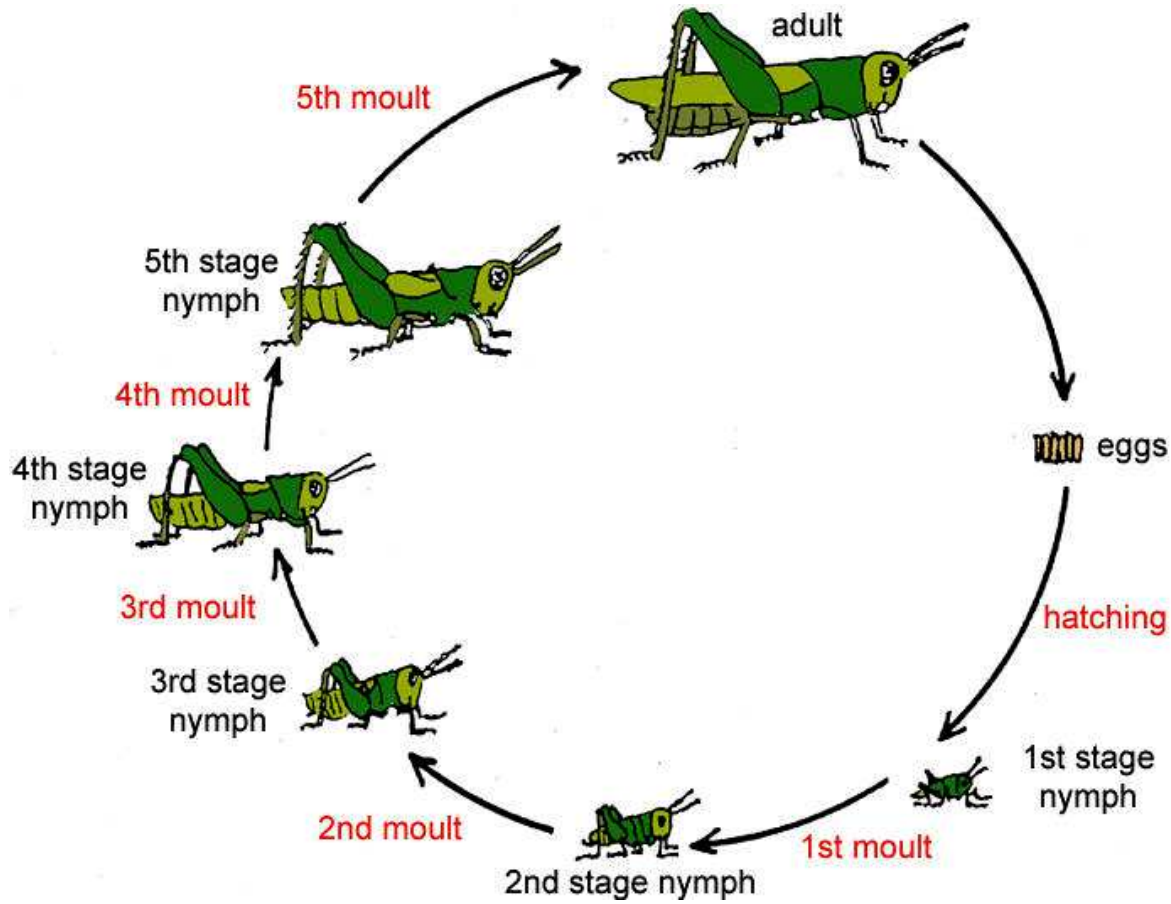
There are various degrees of metamorphosis found in insects, depending upon the conspicuous external changes during development. Classification of insects is often based on the type of metamorphosis they have, as follows-

1. Ametabola or ametamorphosis. Some species of insects show no etamorphosis. The eggs hatch soon after being laid or even while in the body of the mother. The young insects coming out are like the adult except in size, colour, armature, etc. As they grow, they moult several times finally reaching sexual maturity and adult functions. This group includes the orders Collembola (spring tails), Thysanura (silver fish) and Protura.

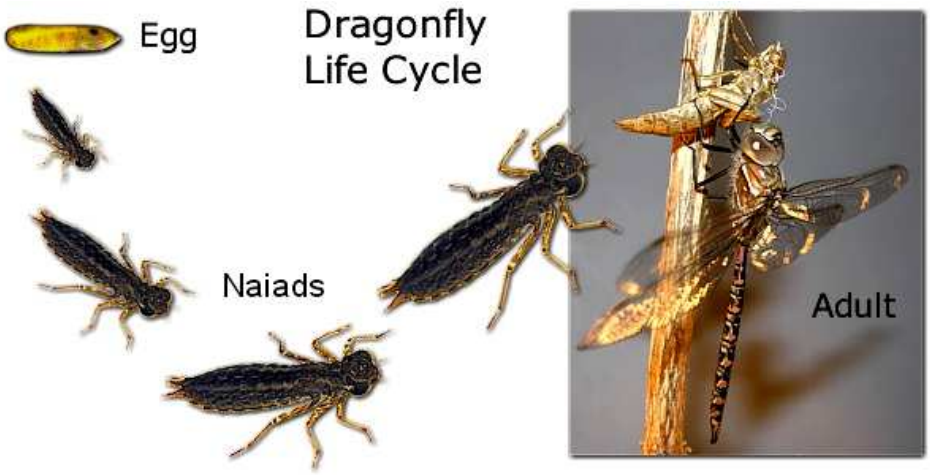


2. Metabola. In most insects distinct changes in form and size during growth and development are observed. It is divided into the following sub-types-

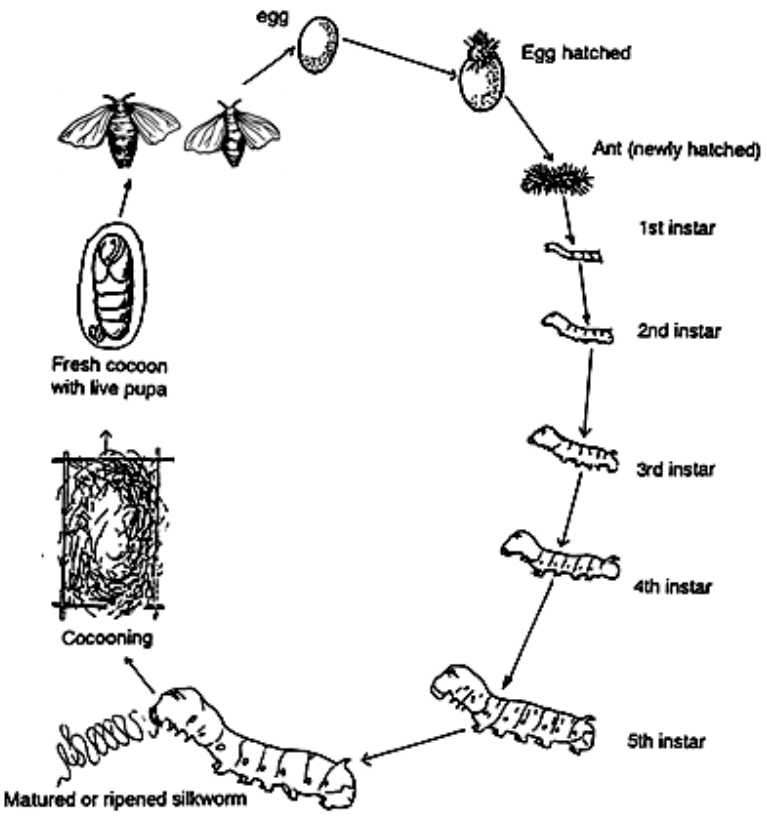
(a) Paurometabola *(gradual metamorphsis):* certain species undergo s imple, gradual or direct external changes during development. The newly hatched or immature young, called *nymph,* is active and strikingly like the adults except in size, colour and absence of wings and genital organs. It undergoes various moults to reach the adult stage. Thus, three stages of development are present-egg, series of nymphs and adult. The lrowth of body and wings occurs gradually between successive noults, Paurometabolous insect orders are Orthoptera grasshopper, cockroach), Isoptera (white ants) and Hemiptera aphids).



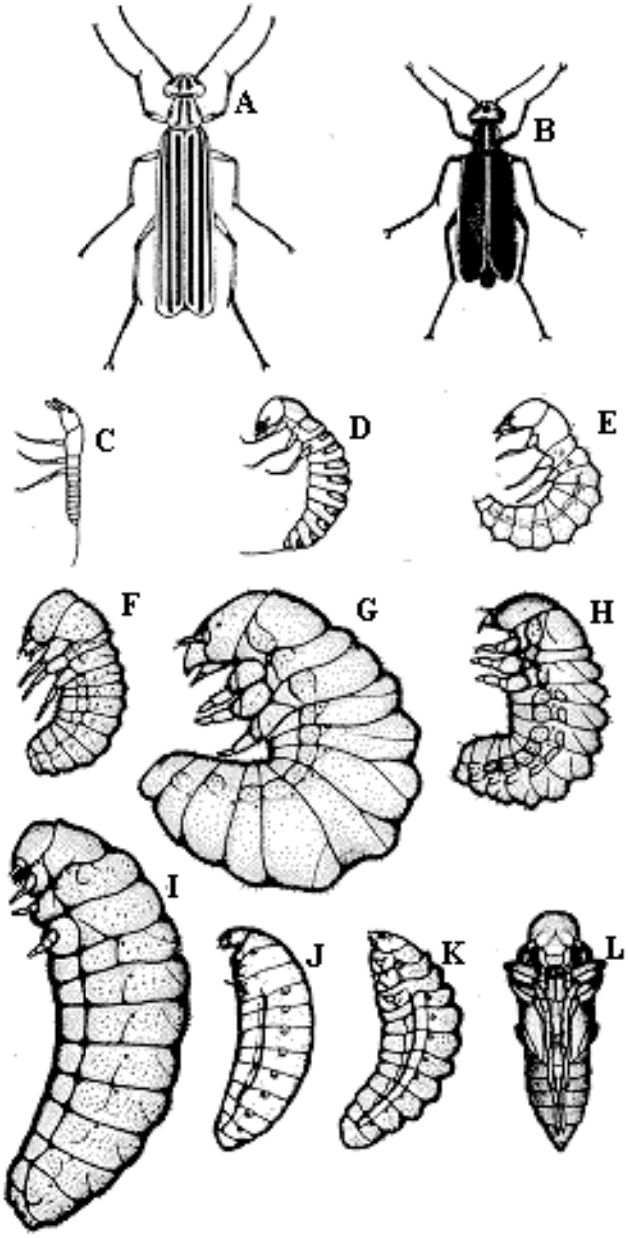
(b) Hemimetabola *(incomplete metamorphosis):* In case of incomplete metamorphosis, the immature forms are aquatic, ailed *naiads.* They breathe by gills, whereas the adults are terrestrial or aerial and respire by treacheae. The naiads ate. similar to the adults except for size, body proportions and lack of wings. However, they do not resemble the adult as much as the nymphs of paurometabolous insects. Stages of development are-egg, series of naiads and adult. Hemimetabolous orders are represented by Odonata (dragonflies), Ephemeroptera (Mayflies) and Plecoptera (stoneflies),



(c) Holometahola *(complete metamorphosis):* Life cycle of these insects has complete or indirect metamorphosis comprising four stages-egg, larva (caterpillar or gru b), pupa (chrysalis or cocoon) and the adult (imago). The newly hatched larva does not egg 0 resemble the adult in any way. It is usually worm - like and its diet varies radically from that of the adult. It moults several . times, including a series of ins tars, to become fully grown. *Pupa* is the resting stage between larva and adult, during which the larva surrounds itself in a secreted case, called *puparium,* and transforms into the *imago* or the adult. Majority of insect orders belong to this group, represented by housefly, mosquito, butterfly, moth, honey bee, etc.



(d) Hypermetabola: It is a still more complex metamorphosis including four stages *i.e*., egg, larva, pupa and the adult; but the larva undergoes many instars, each instar differing in habit and food from the others. Example: Blister beetles.



Blister beetles. A & B, Adults. C-K, Larval stages. L, Pupa.

Significance of Metamorphosis:

1. It helps to tie over unfavorable climatic conditions by entering into hibernation, aestivation or diapauses.

2. It helps to accommodate growth by periodical shedding of their old cuticle and by formation of new cuticle (Moulting).
3. It helps to reduce or avoid competition for food amongst themselves by either entering into inactive stage or by acquiring different feeding habits & habitats.
4. It also serves as important aspect in classification of insects

Hormonal Control of Metamorphosis

Changes during metamorphosis are accompanied with growth and ecdysis. Hormones play an important role in ecdysis and metamorphosis. The various hormones controlling ecdysis and metamorphosis are as follows-

1. Brain hormone (JH). It is secreted by the neurosecretory cells of the brain *(H.A. Schneiderman* and *L.I. Gilhert, 1964).* Chemically, it is a lipid. It activates the *corpora cardiaca,* a component of the retro-cerebral complex.

2. Prothoracicotropic hormone (PTTH). It is secreted by the corpora cardiaca and activates the prothoracic glands.

3. Prothoracic gland hormone (PGH). Ecdyosone, a hormone secreted in the prothoracic gland, chiefly controls ecdysis.

4. Juvenile hormone (JH). The hormone is secreted by *corpora allata,* another component of the retro-cerebral complex.

Chemically it is an unsaponifiable, non-sterolic lipid. It prevents metamorphosis of the insect larva into the pupa, under the influence of ecdysone. As long as the juvenile hormone remains active, each moult simply results into a larger larva. When juvenile hormone declines, the ecdysone is free to bring about the change from larva to pupa and then to the adult.

Evolution of Metamorphosis

Metamorphosis and wings in insects have evolved together.

In many insects, wings are found only in the reproductive members, which is of great advantage in distribution of those species. This has also enabled the wingless larva and the winged adults to adapt to different ecological niches and different food habits. Thus, insects could restrict their energy for growth and development to the larval and pupal stages, and their energy for locomotion and distribution to the adult stages.
