Department of biology
2025-2026

((علم الحشرات 1))

Stage (- TWO-)

LEC- ((SEX)

BY

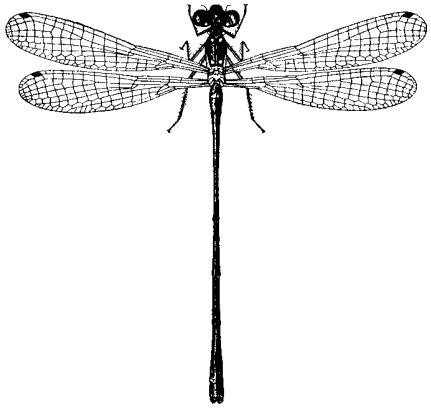
ا.د علي شعلان معيلف

Insect wing: structure and its modifications

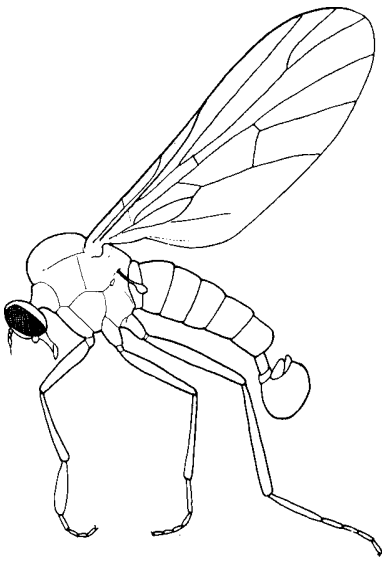
WINGS

Insects have evolved many variations of the wing. Wing venation is a commonly used taxonomic character, especially at the family and species level.

Membranous wings are thin and more or less transparent. This type of wings is found among the Odonata and Neuroptera.

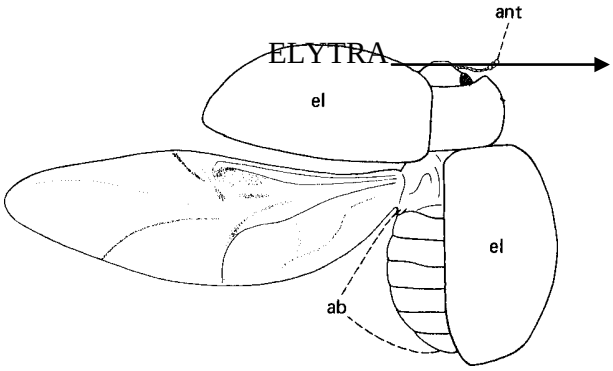


Halteres are an extreme modification among the order Diptera (true flies), in which the hind wings are reduced to mere nubs used for balance and direction during flight.

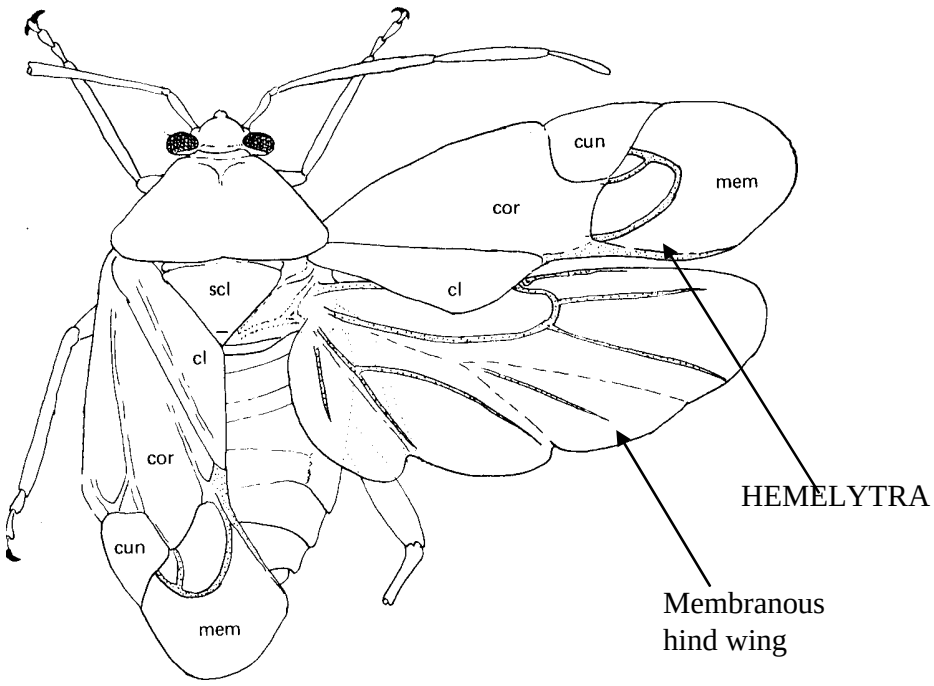


HALTERE

Elytra (sing. elytron) are the hardened, heavily sclerotized forewings of beetles (Order Coleoptera) and are modified to protect the hind wings when at rest.



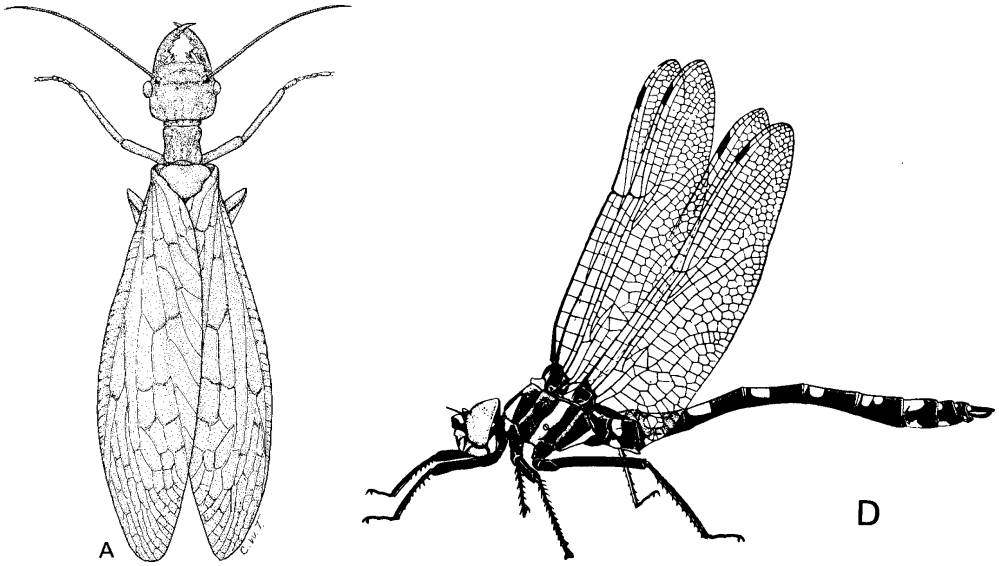
A variation of the elytra is the **hemelytra**. The forewings of Hemipterans are said to be hemelytrous because they are hardened throughout the proximal two-thirds (approximately), while the distal portion is membranous. Unlike elytra, hemelytra function primarily as flight wings. In both cases, the membranous hind wings (when present) are used in flight and are folded beneath the forewings when at rest.



The wings of butterflies and moths are covered with scales, and mosquitoes possess scales along wing veins.

NEOPTEROUS VS PALEOPTEROUS WING CONDITIONS

In most living insects (the Neoptera), there are three axillary sclerites that articulate with various parts of the wing. In the Neoptera, a muscle on the third axillary causes it to pivot about the posterior notal wing process and thereby to fold the wing over the back of the insect. (In some groups of Neoptera, such as butterflies, the ability to fold the wings over the back has been lost.) Two Orders of winged insects, the Ephemeroptera and Odonata, have not evolved this wing-flexing mechanism, and their axillary sclerites are arranged in a pattern different from that of the Neoptera; these two orders (together with a number of extinct orders) form the Paleoptera.



Types of insect wings

Among invertebrate animals, only insects posses wings. Wings are present only in adult stage. Number of wings vary from two pairs to none. Certain primitive insects like silverfish and spring tail have no wings (apterous). Ectoparasites like head louse, poultry louse and flea are secondarily wingless. Wings are deciduous in ants and termites. There is only one pair of wings in the true flies. Normally, two pairs of wings are present in insects and they are borne on pterothoracic segments viz., mesothorax and metathorax. Wings are moved by thoacic flight muscles attached to their bases.

Wing is a flattened double - layered expansion of body wall with a dorsal and ventral lamina having the same structure as the integument. Both dorsal and ventral

laminane grow, meet and fuse except along certain lines. Thus a series of channels is formed. These channels serve for the passage of tracheae, nerves and blood. Wing is nourished by blood circulating through veins. Later the walls of these channels become thickened to form veins or nervures. The arrangement of veins on the wings is called venation which is extensively used in insect classification. The principal longitudinal veins arranged in order from the anterior margin are costa (C), sub costa (Sc), radius (R), median (M), cubitus (Cu) and anal veins (A). Small veins often found inter connecting the longitudinal veins are called cross veins. Due to the presence of longitudinal veins and cross veins, the wing surface gets divided into a number of enclosed spaces termed cells. In insects like dragonfly and damesefly, there is an opaque spot near the coastal margin of the wing called pterotigma.

Margins and angles: The wing is triangular in shape and has therefore three sides and three angles. The anterior margin strengthened by the costa is called coastal margin and the lateral margin is called apical margin and the posterior margin is called anal margin. The angle by which the wing is attached to the thorax is called humeral angle. The angle between the coastal and apical margins is called apical angle. The angle between apical and anal margins is anal angle.

Wing regions: The anterior area of the wing supported by veins is usually called remigium. The flexible posterior area is termed vannus. The two regions are separated by vannal fold. The proximal part of vannus is called jugum, when well developed is separated by a jugal fold. The area containing wing articulation sclerites, pteralia is called axilla.

Wing types:

1. Tegmina : (Singular : Tegmen) Wings are leathery or parchment like. They are protective in function. They are not used for flight. e.g. Forewings of cockroach and grasshopper.

2. Elytra : (Sigular : Elytron) The wing is heavily sclerotised. Wing venation is lost. Wing is tough and it is protective in function. It protects hind wings and abdomen. It is not used during flight. But during flight they are kept at an angle allowing free movement of hind wings. e.g. Fore wings of beetles and weevils.

3. Hemelytra : (Singular : Hemelytron) The basal half of the wing is thick and leathery and distal half is membranous. They are not involved in flight and are protective in function. e.g. Fore wing of heteropteran bugs.

4. Halteres: (Singular : Haltere) In true flies the hind wings are modified into small knobbed vibrating organs called haltere. Each haltere is a slender rod clubbed at the free end (capitellum) and enlarged at the base (scabellum). On the basal part two large group of sensory bodies forming the smaller hick's papillae and the large set of scapel plate. They act as balancing organs and provide the needed stability during flight. e.g. true flies, mosquito, male scale insect.

5. Fringed wings: Wings are usually reduced in size. Wing margins are fringed with long setae. These insects literally swim through the air. e.g. Thrips.

6. Scaly wings: Wings of butterfly and moths are covered with small coloured scales. Scales are unicellular flattened outgrowth of body wall. Scales are inclined to the wing surface and overlap each other to form a complete covering. Scales are responsible for colour. They are important in smoothing the air flow over wings and body.

7. Membranous wings: They are thin, transparent wings and supported by a system of tubular veins. In many insects either forewings (true flies) or hind wings (grass hopper, cockroach, beetles and earwig) or both fore wings and hind wings (wasp, bees, dragonfly and damselfly) are membranous. They are useful in flight.

Wing coupling: Among the insects with two pairs of wings, the wings may work separately as in the dragonflies and damselflies. But in higher pterygote insects, fore and hind wings are coupled together as a unit, so that both pairs move synchronously. By coupling the wings the insects become functionally two winged.

Types of wing coupling

1. **Hamulate** : A row of small hooks is present on the coastal margin of the hind wing which is known as hamuli. These engage the folded posterior edge of fore wing. e.g. bees.

2. **Amplexiform** : It is the simplest form of wing coupling. A linking structure is absent. Coupling is achieved by broad overlapping of adjacent margins. e.g. butterflies.

3. **Frenate** : There are two sub types. e.g. Fruit sucking moth.

i. Male frenate : Hindwing bears near the base of the coastal margin a stout bristle called frenulum which is normally held by a curved process, retinaculum arising from the subcostal vein found on the surface of the forewing.

ii. Female frenate : Hindwing bears near the base of the costal margin a group of stout bristle (frenulum) which lies beneath extended forewing and engages there in a retinaculum formed by a patch of hairs near cubitus.

4. **Jugate :** Jugam of the forewings are lobe like and it is locked to the coastalmargin of the hindwings. e.g. Hepialid moths.