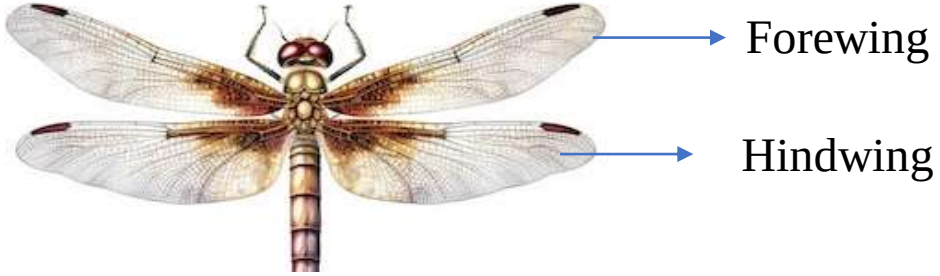
Udai Pratap College (An Autonomous Institution- ICAR Accredited), Bhojubir, Varanasi (U.P.), India.

Lecture
On
Insect wing, wing venation and wing coupling apparatus

Satya Sharan Mishra
Assistant Professor
Department of Entomology

Insect wing

- Insect wing is a **double-layered enlargement of the body wall** that is flattened and has the same integument-like structure on both the dorsal and ventral lamina. Among the **pterygotes**, wings arises from meso and meta thoracic segments *i.e.* **pterothorax**.
- Front pair of wings are known as **forewings** and back pair of wings are known as **hind wings**.
- Sometimes wings may be reduced among pterygotes e.g.. **Mallophaga** and **Siphunculata**.



Based on the degree of development of wings the insects may be classified into three forms

a) **Macropterous-**having large wings

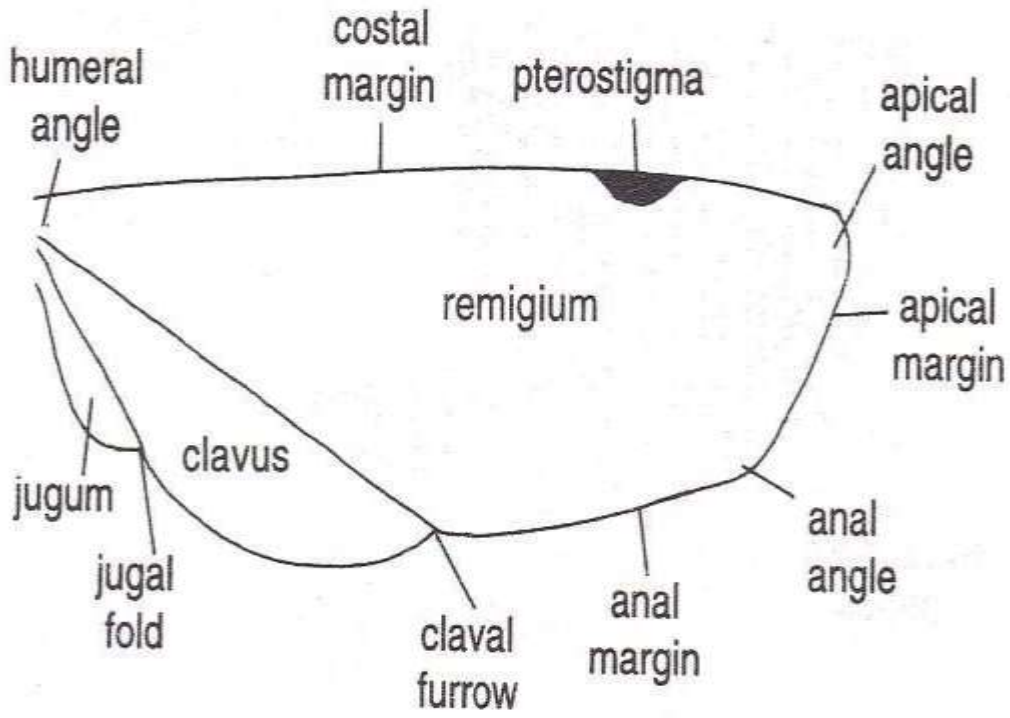
b) **Brachypterous-**having rudimentary or abnormally small wings

c) **Apterous-** wings completely absent e.g. silverfish and spring tail

Structure of insect wing

- A typical insect wing is triangular with three margins and three angles.
- Three margins are **costal (**anterior), **Apical** (outer) and **Anal** (inner).
- Three angles are

a) **Humeral angle:** between body wall and costal margin
b) **Apical or outer angle:** between costal and apical margin
c) **Anal angle or tornus:** between apical and anal margin



Structure of Insect Wing

- The surface area of insect wing is divided in to two portions *i.e.* **Remegium and Vannal Area**
- The anterior (upper) part of the wing towards coastal margin where more no of longitudinal veins are present is called **remigium**.

Hypothetical Wing Venation

The arrangement of veins on the surface of wings is known as **wing venation**. Wings are very thin, broad, leaf-like structures that are strengthened by numerous hollow, narrow tubular structures called **veins**. Veins are of two types:

1. Longitudinal veins: Extend from base to the margin. They may be convex (∩) or concave (U)

2. Cross veins: That interlink the longitudinal veins

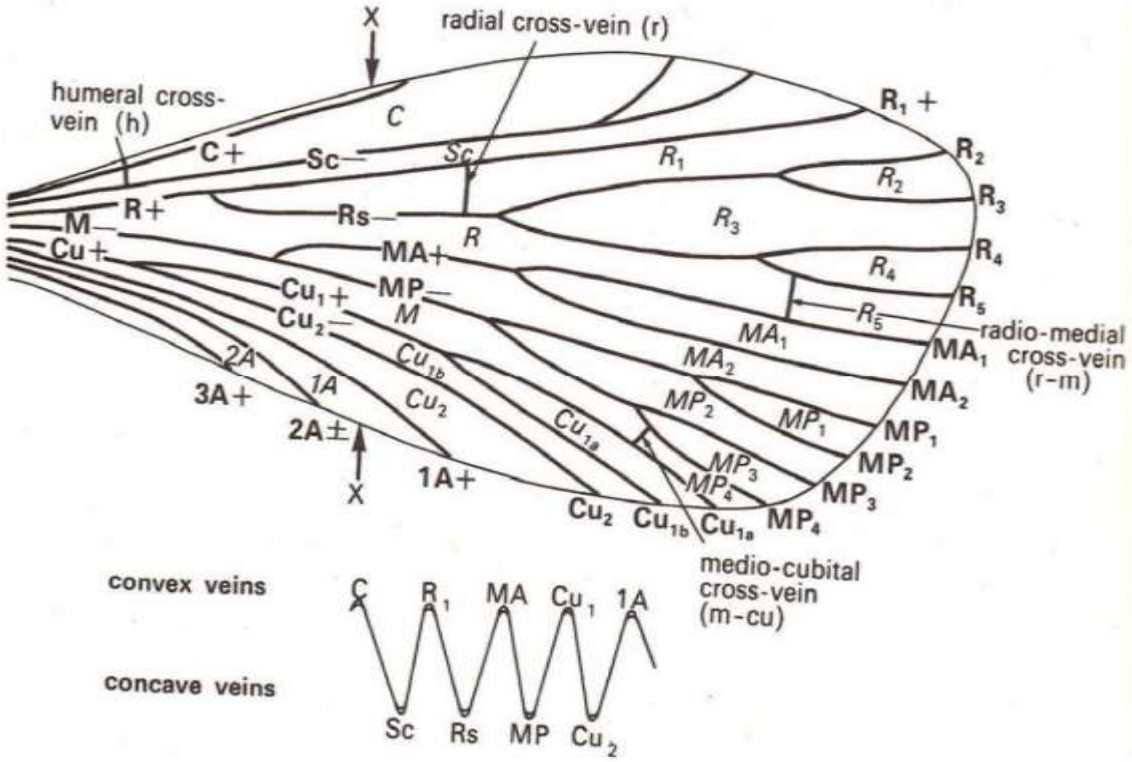


Fig. Hypothetical Wing Venation by Comstock and Needham, 1898

The insect wings may some times possess some pigmented spot near coastal margin known as **pterostigma** or **stigma** as in Odonata.

1. Longitudinal Veins

a) **Costa (C) :** It forms the thickened anterior margin of the wing (costal) and is un-branched. and is convex.

b) **Sub costa (Sc) :** It runs immediately below the costa always in the bottom of a trough between C and R . It is forked distally. The two branches of SC are Sc1 and Sc2 and is concave.

c) **Radial vein (R):** It is the next main vein, stout and connects at the base with second auxillary sclerite, it divided in to two branches R1 and Rs (Radial sector).

R1 goes directly towards apical margin and is convex; Rs is concave and divided in to 4 branches, R2, R3, R4, R5.

(d). Media (M): It is one of the two veins articulating with some of the small median sclerites. It is divided in two branches **Media anterior (MA)** which is convex and **Media posterior (MP)** and is concave. Media anterior is again divided into MA1 and MA2. Median posterior is again divided in to MP1, MP2, MP3, MP4.

(c). Cubitus (Cu): It articulates with median auxillary sclerite. Cubitus is divided into convex CU1 and concave CU2. **CU1** is again divided into **CU1a** and **CU1b**.

(e). Anal veins (A): These veins are convex. They are individual un-branched, 1-3 in number.

(f). 1 or 2 jugal veins (unbranched) are present in the jugal lobe of the forewing

2. Cross Veins

(a). Humeral cross vein (h): between costa and subcostal

(b). Radial cross vein (r): between radius and radial sector

(c). Sectorial cross veins (s): between sub branches of radial sector

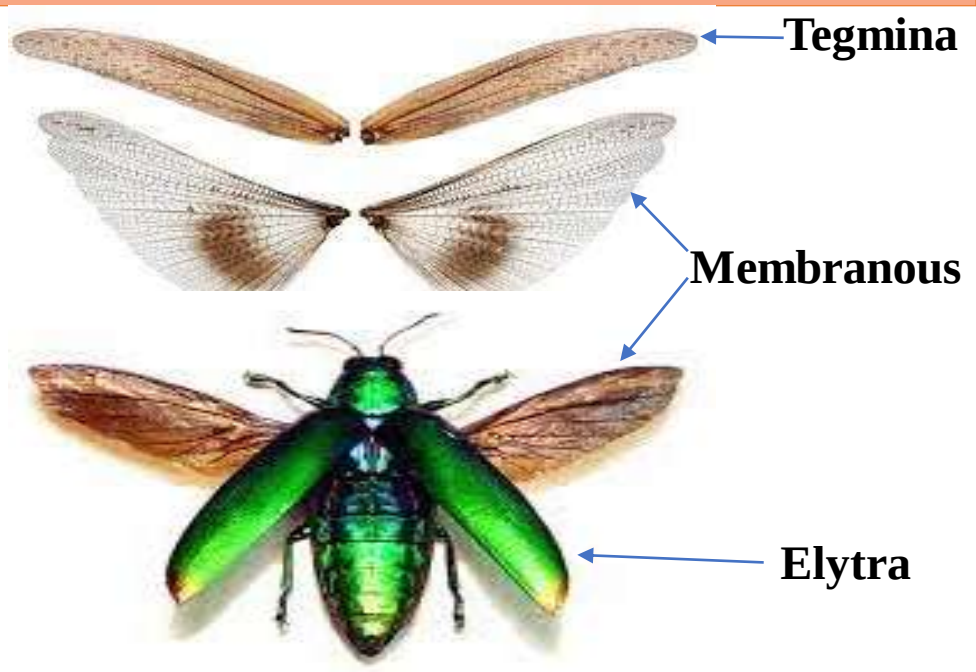
(d). Radio medial cross vein (r-m): between radius and media

(e). Medical cross veins: between branches of media

(f). Medio-cubital veins: between media and cubitus

Types of wings

1. **Tegmina:** Forewings are leathery and tough. They protect the membranous hindwings. *e.g.*: forewings wings of cockroach, grasshopper
2. **Elytra:** Hard, leathery, shell like without clear venation. They form horny sheet and protect the membranous hind wings and abdomen. e.g. Forewings beetles



3. Hemelytra: The base of the wing is thick like elytra and the remaining half is membranous. This thickened portion is divided in to corium, clavus cuneus and embolium. They are useful of protection and flight e.g. Forewings bugs

4. Membranous: Naked thin with clear venation. Always useful of flight e.g.: Both the wings of Dragonflies, bees and wasps, Hind wings of grasshopper, beetles etc.

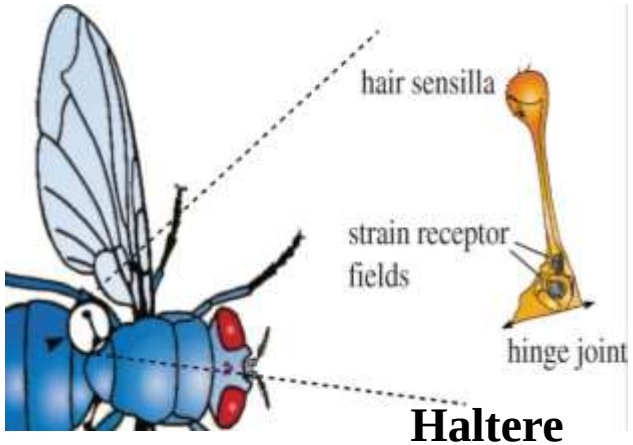
5. Scaly wings: Wings thin , membranous but covered with unicellular scales all over the surface.They are useful for flight e.g.: Both the wings of moths and butterflies.

6. Fringed wings: Wings are highly reduced with reduced venation. The wings are fringed with long marginal hairs giving a feather like appearance e.g. Both the wings of thrips

7. Fissured wings: Forewings are longitudinally divided twice forming a fork like structure whereas hindwings are divided twice in to three arms. All the forks possess small marginal hairs . They are useful for flight. e.g.: Both the wings of plume moth

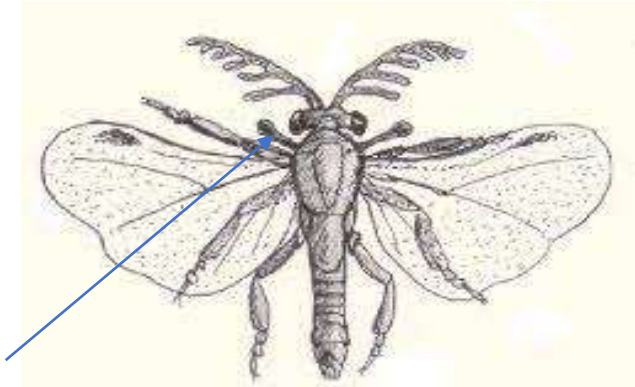
Fissured Wings

8. Halteres: The hind wings of houseflies are modified in to small microscopic structures called halteres and are divided in to three regions namely scabellum ,pedicel and capitellum. They act as balancers. eg. Hind wings housefly and front wings of male stylopids



Haltere

9. Pseudohalteres: They are short and modified in to pseudohalteres which are dumbbell shaped. Eg: Front wings of Strepsiptera



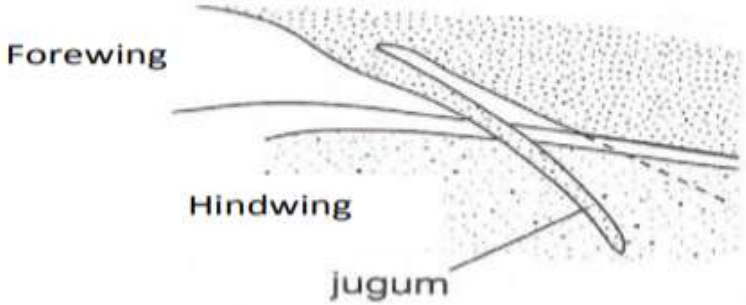
Pseudohaltere

Wing coupling apparatus/ Wing flexing mechanisms

For taking flight, insect need to keep both the fore and hindwings together as a single unit. The structures in the form of lobes , bristles, hairs or spines that help the wings to be together are known as wing coupling organs.

1. Jugate type or jugum type: The costal margin of the front wing possess a small lobe at its base called **fibula** which rest on the surface of the hind wing or sometimes engages with spines present on the upper surface of hind wings . e.g. Hepialidae family of lepidoptera

2. Frenulum and retinaculum type: The hind wings posses bristle or spine like structure or group of hairs known as frenulum.The forewings possess hook like retinaculum on anal side. During flight the frenulum passes beneath the retinaculum and thus the both the wings are kept together. e.g.: moths



3. Amplexiform

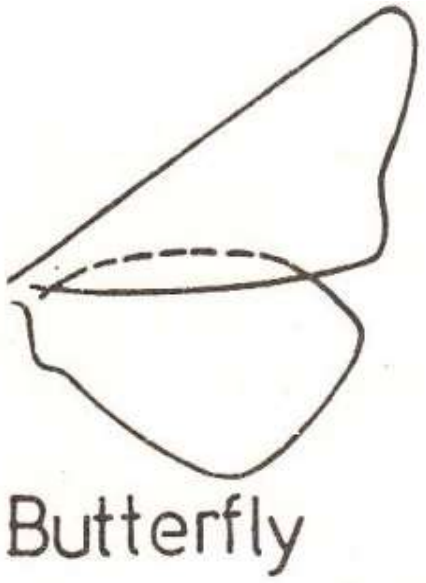
Costal margin of hind wing and anal margin of forewing overlap one above the other.

e.g.: butterfly

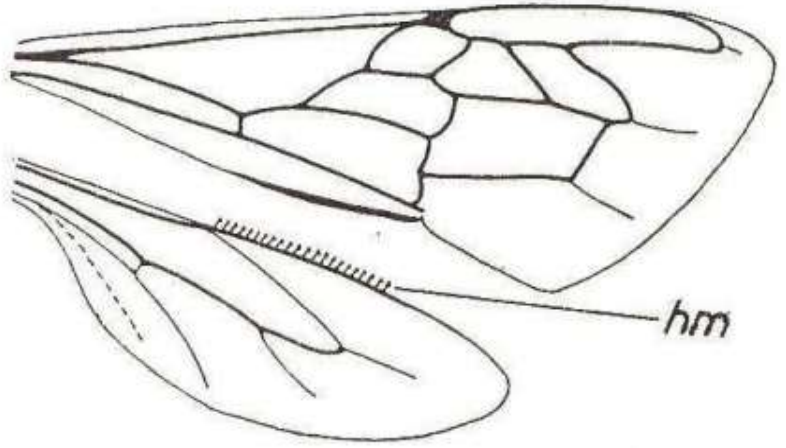
4. Hamuli

Small curved hook like structures present on the costal margin of the hind wing known as Hamuli that fit into the upward fold of the anal margin of the forewing.

e.g.: hymenopterans (wasps and bees)



Amplexiform



Hamuli

Exercise

Q.1. Define insect wing and it’s parts.

Q.2. Hemielytra is found in which type of insects ?

Q.3. Weevils and beetles have which type of wings ?

Q.4. Why insects need wing coupling mechanisms ?

Q.5. Draw a labelled diagram of hypothetical wing venation

Write a short note on following:

Q. 1. Frenulum and retinaculum

Q.2. Amplexiform

Q.3. Fringed wings

Q.4. Hamuli wings

Q.5. Fissured wings


Thank You