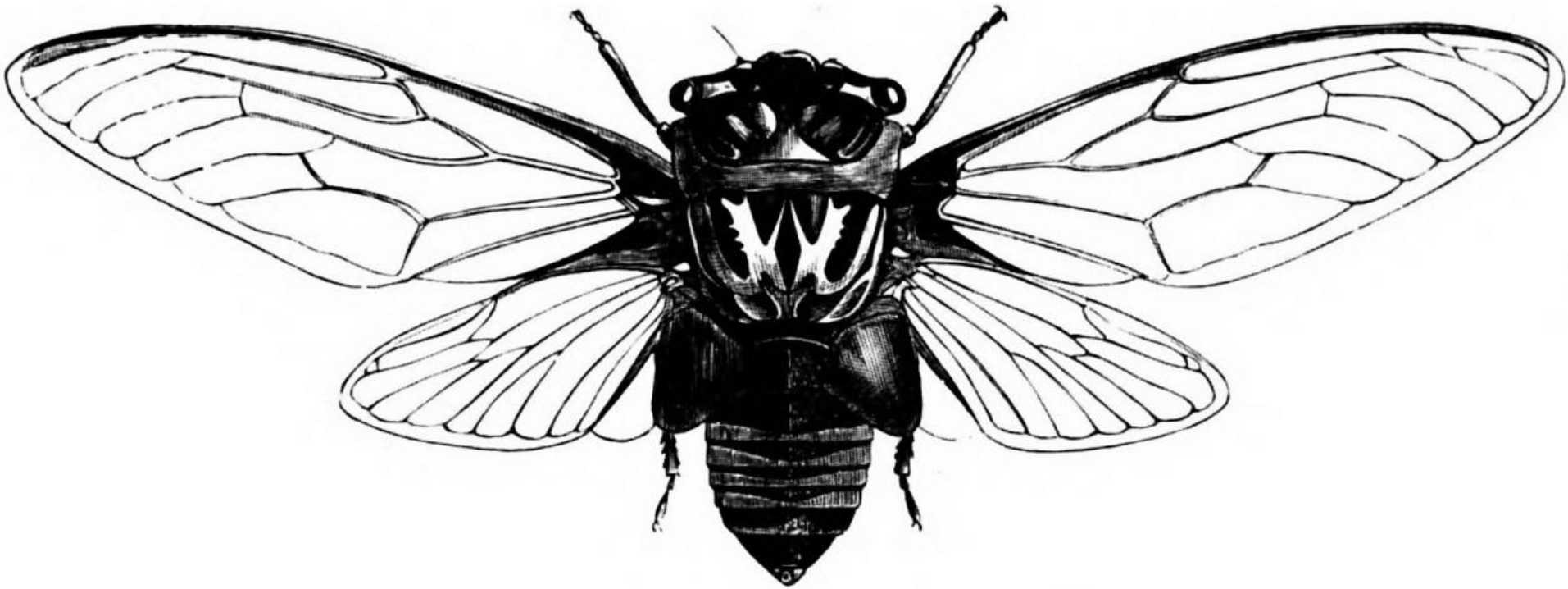
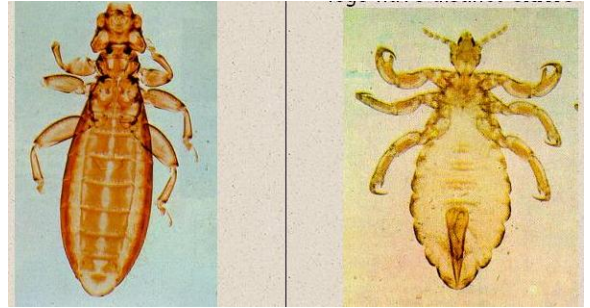


# Insect Wings, its Venation, Modifications and Wing Coupling



## Intro

- Based on the presence or absence of wings, Sub class 1. Apterygota 2. Pterygota.
- The primitive apterygotes are wingless. Eg: Silver fish and Spring tails
- wings arises from meso (forewings) and meta (hind wings ) thoracic segments
- Sometimes wings may be reduced in pterygotes e.g.. Mallophaga& Siphunculata .
- In coccids, only males are winged; and aphids may or may not have the wings.

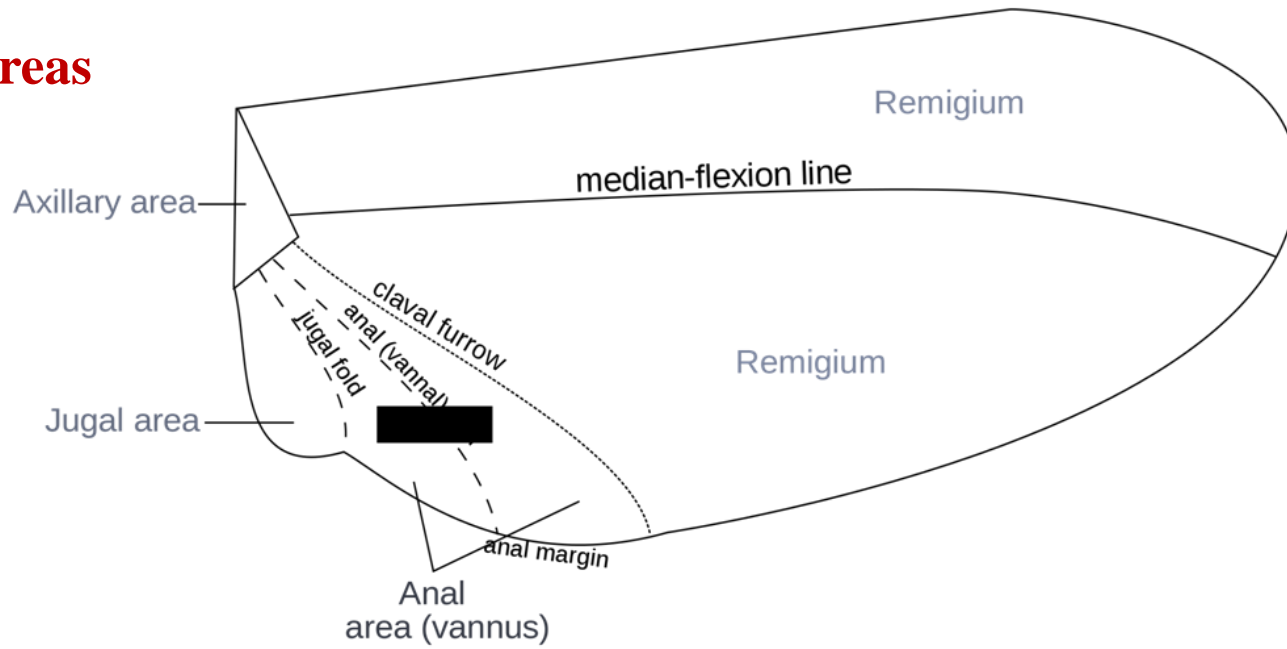


- Based on the degree of development of wings the insects may be classified into Macropterous, Brachypterous and Apterous

## Areas

- The anterior (upper) part of the wing towards coastal margin where more no of longitudinal veins are present is called remigium.
- The posterior part of the wing where veins are sparsely distributed is known as Vannal Area, which is called as clavus in forewings and vanus in hindwings.
- Jugum is the inner most portion of the wing that is cutoff from the main wing by jugal fold.

# Areas



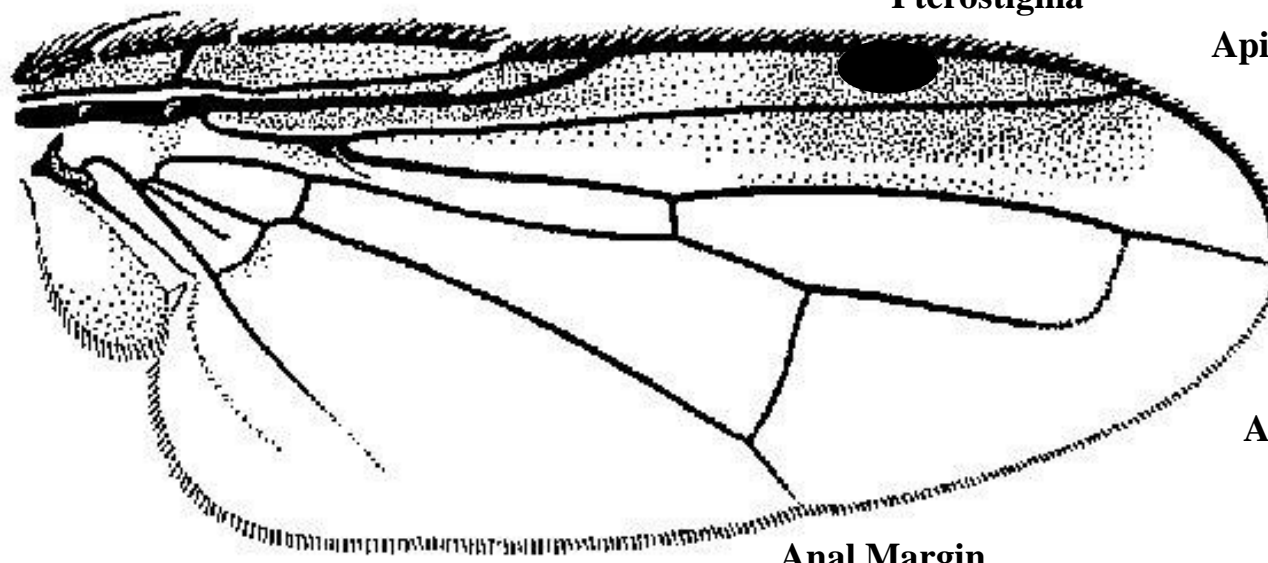
# Margins & Angles

**Humeral Angle**

**Costal Margin**

**Pterostigma**

**Apical Angle**



**Apical Margin**

**Anal Angle**

**Anal Margin**

# Venation

Wings are strengthened by a number of hollow narrow tubular structures called **veins**. Arrangement of veins on wing surface is known as Wing venation

I **Longitudinal**: Extend from base to the margin. may be convex ( $\cap$ ) or concave (U)

II **Cross veins** : That interlink the longitudinal veins

The insect wings may some times possess some pigmented spot near coastal margin known as **pterostigma** or stigma as in Odonata (dragon flies and damsel flies)

**Costa (C)** : the thickened anterior margin of the wing (costal), un-branched & convex

**Sub costa (Sc)** : immediately below the costa and is forked distally into Sc1 and Sc2, concave

**Radial vein (R)** : stout and connects at the base with second auxillary sclerite it divided in to R1 and Rs (Radial sector). R1 touches apical margin & convex; Rs is concave and divided in to 4 branches, R2, R3, R4, R5.

**Media (M)** articulates with some of the small median seclerites.

Media anterior (MA) is convex and Media posterior(MP) is concave.

Media anterior is divided into MA1 &MA2. Median posterior into MP1, MP2, MP3, MP4.

**Cubitus (Cu):** It articulates with median auxillary sclerite.

Cubitus is divided into convex CU1,concave CU2. CU1 is divided into CU1a and CU1b.

**Anal veins (A) :** Convex, individual un-branched, 1-3 in number. 1 or 2 jugal veins are present in the jugal lobe of the forewing

### **Cross veins**

Humeral (h) : between costa and subcosta

Radial (r ) : between radius and radial sector

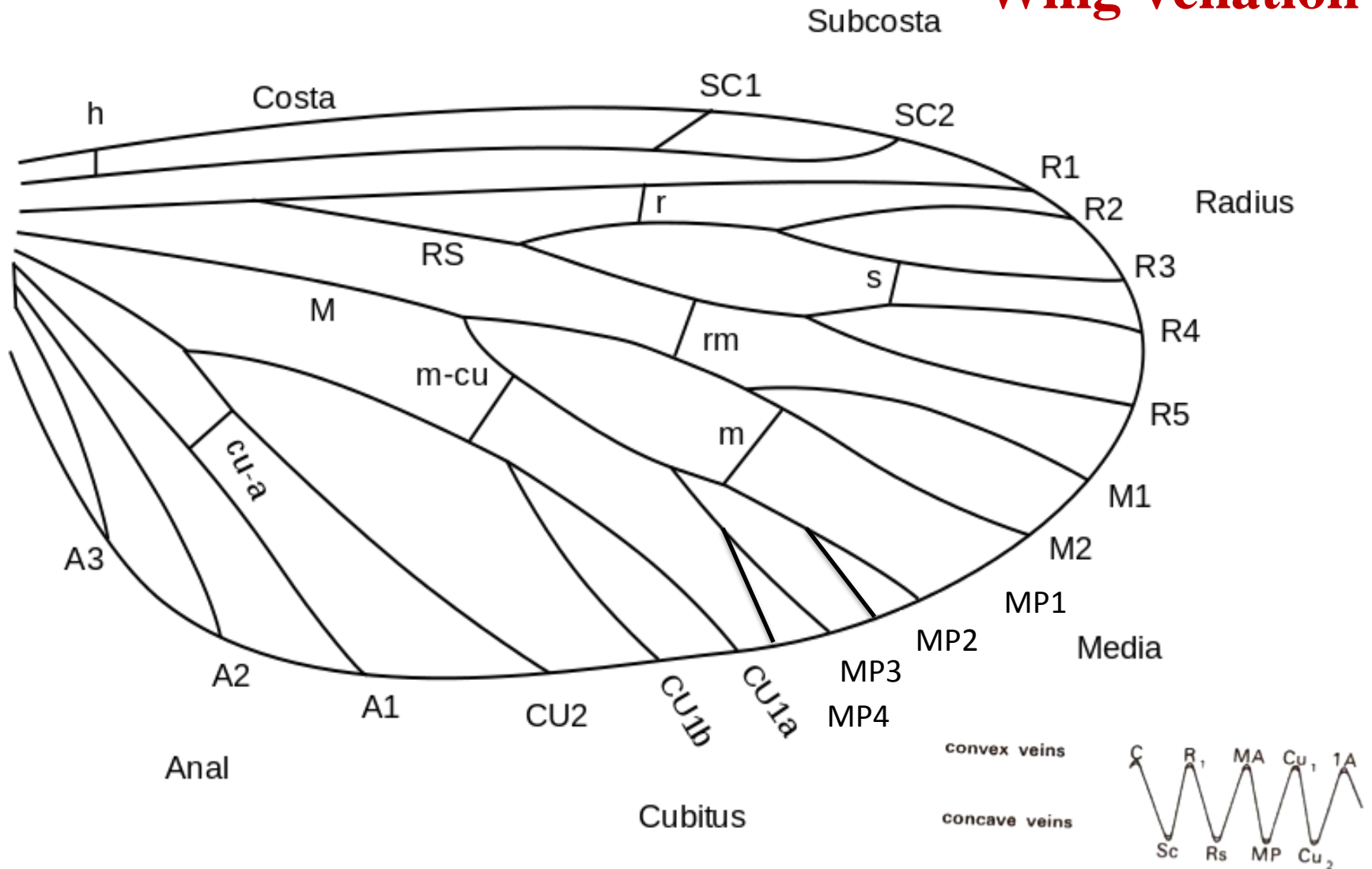
Sectorial (s): between sub branches of radial sector

Radio medial (r-m): between radius and media

Medial : between branches of media

Medio-cubital : between media and cubitus

# Wing Venation



Longitudinal veins and cross veins



## Different types of wings

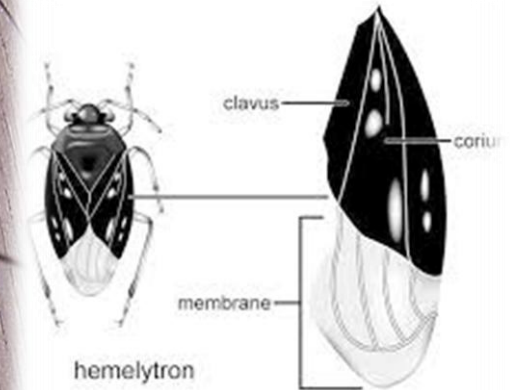
1. **Tegmina:** Forewings are leathery and tough. They protect the membranous hind wings.  
e.g.: forewings wings of cockroach, grasshopper



2. **Elytra:** Hard, shell like without clear venation. They form horny sheet and protect the membranous hind wings and abdomen.  
e.g. Forewings beetles



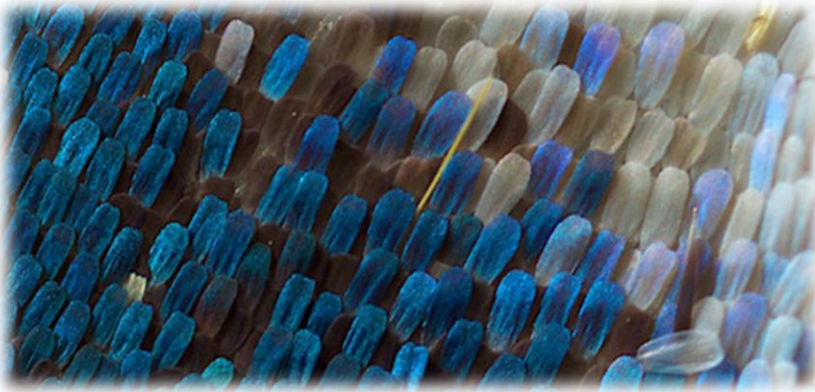
3. **Hemelytra:** The base of the wing is thick like elytra and the remaining half is membranous. This thickened portion is divided in to corium, clavus, cuneus and embolium. They are useful of protection and flight  
e.g. Fore wings of bugs



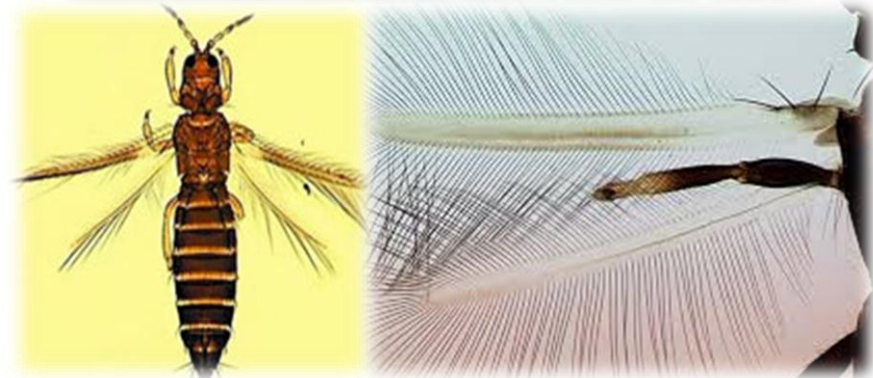
4. **Membranous:** Naked thin with clear venation. Always useful of flight  
e.g.: Both the wings of Dragonflies, bees and wasps, Hind wings of grasshopper, beetles etc.



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



**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

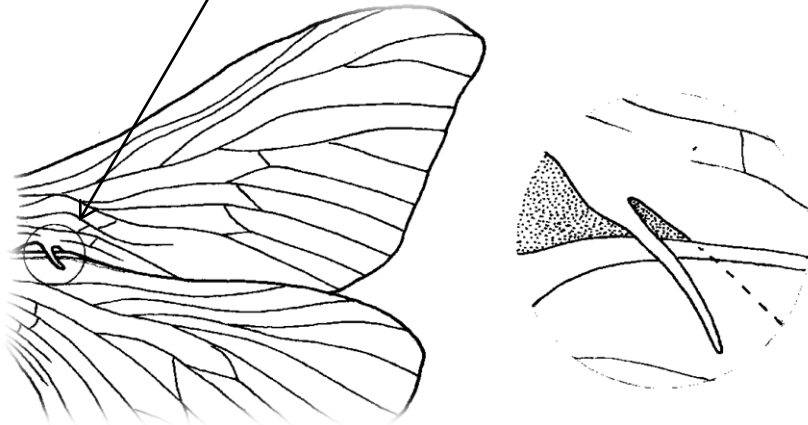


**9. Pseudohalteres:** They are short and modified into pseudohalteres which are dumbbell shaped. Eg: Front wings of Strepsiptera

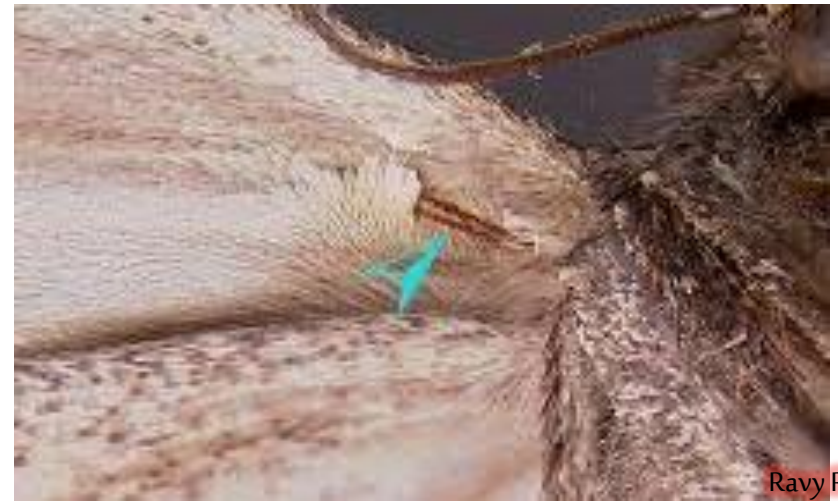
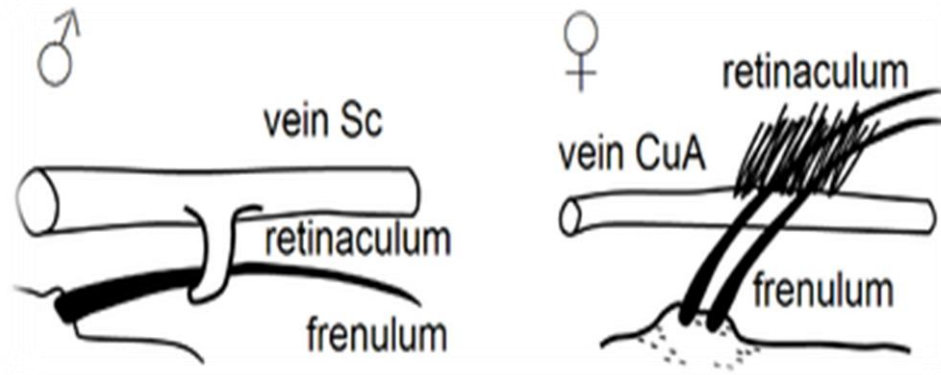


# Wing coupling apparatus/Mechanisms

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

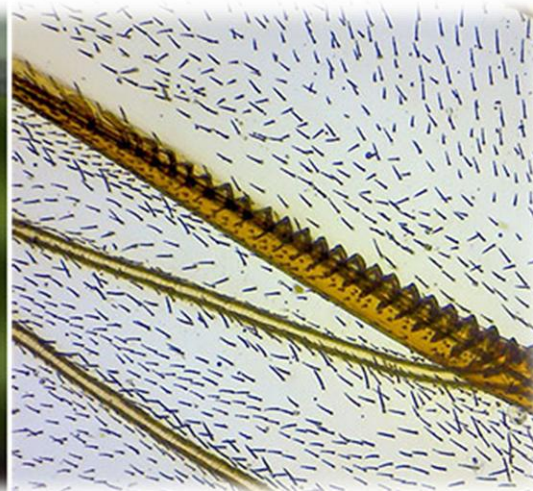
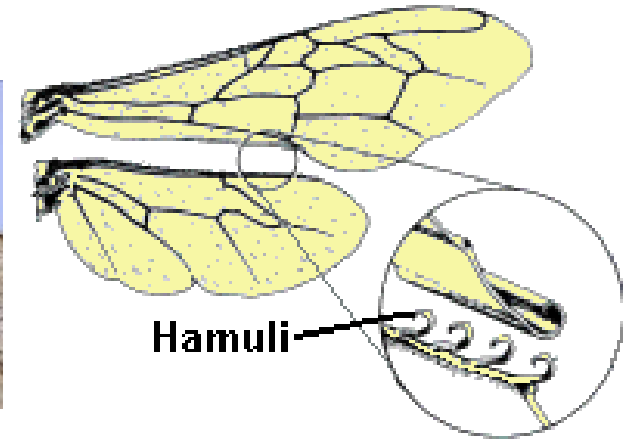
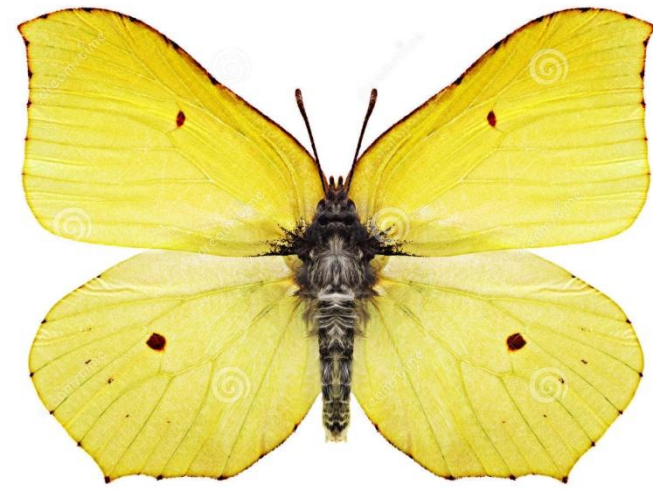
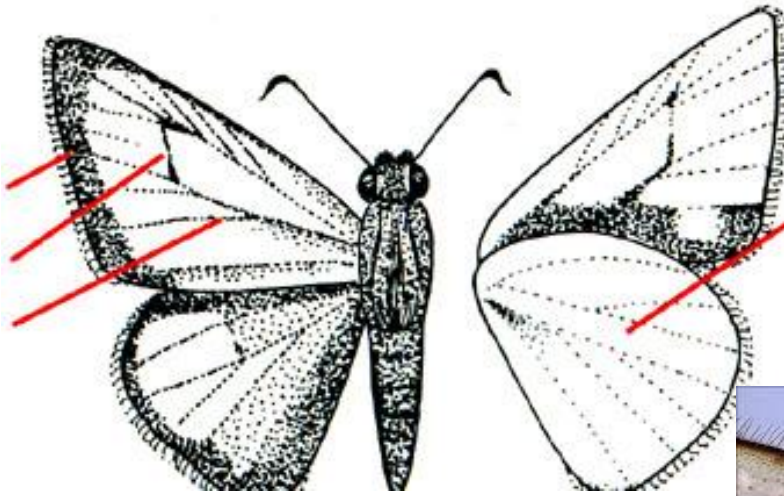


2. **Frenulum and retinaculum type**: The hind wings possess bristle or spine like structure or group of hairs known as **frenulum**. The forewings possess hook like **retinaculum** on anal side. During flight the frenulum passes beneath the retinaculum and thus the both the wings are kept together..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