INSECT LEGS AND WINGS

DR. NIHAL R

Insect leg

- In almost all 3 thoracic segments (pro, meso and metathorax)
- Consists of 5 segments

1. **Coxa:** first leg segment, freely movable
   articulates with cup like depression on thoracic pleuron

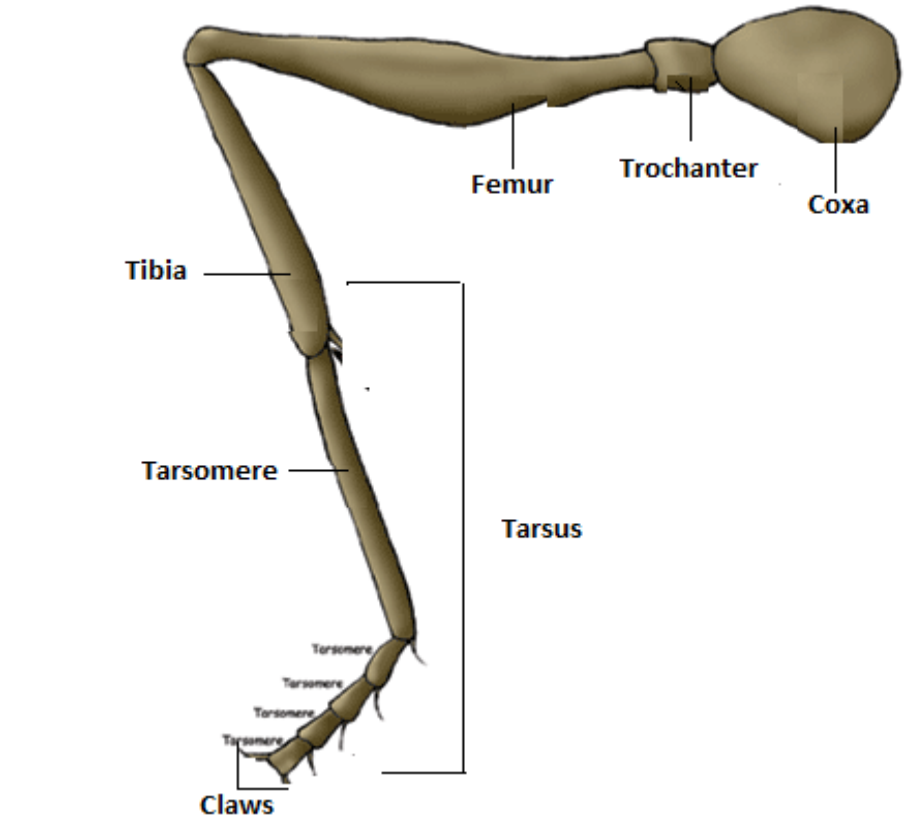
2. **Trochanter:** usually small and single segmented
   2 segmented in dragonfly, damselfly and ichneumonoid wasp
   second part is a part of femur called trochantellus

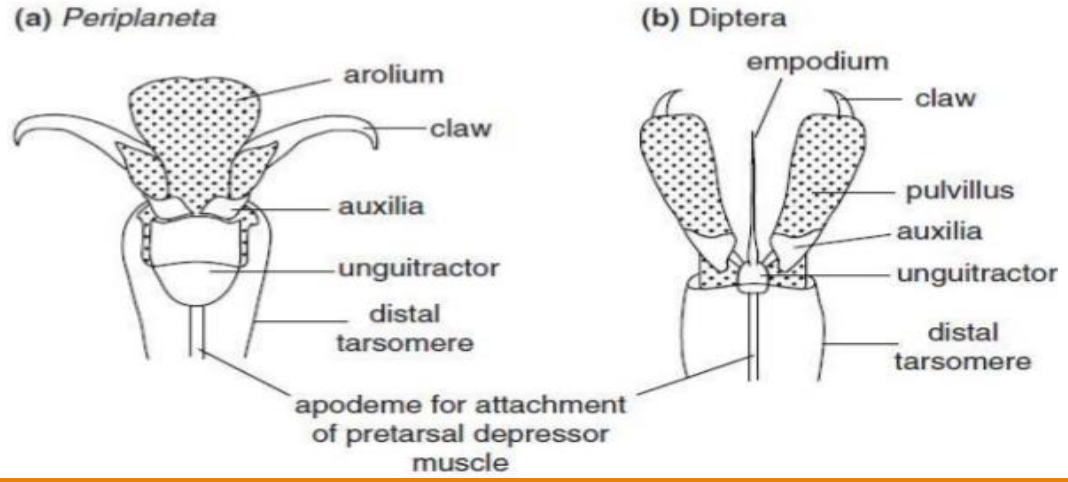
3. **Femur:** largest and stoutest part, articulated with trochanter

4. **Tibia:** long and provided with downward projecting spines (climbing)
   tibia in many insects is armed with large movable spur near apex

5. **Tarsus:** it is further subdivided, subsegments are called tarsomeres
   usually 1 – 5 segments, basal larger segment is basitarsus

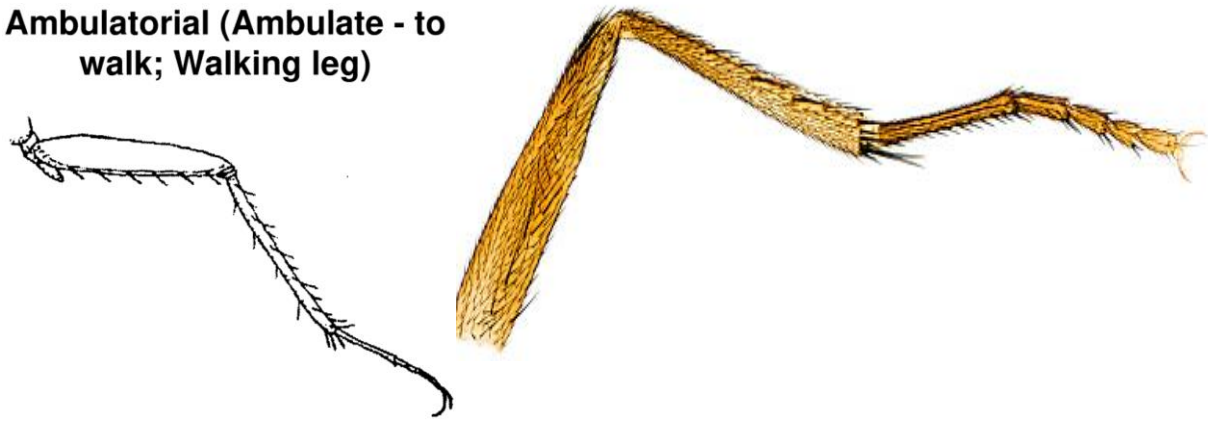
6. **Pretarsus:** beyond tarsus, several structures collectively called pretarsus
   terminates in a pair of strongly curved claws and 2 cushions at the base between them. A median pad (arolium) and a pair of pads at base (pulvilli)
   leg pads are used for walking on smooth surface and claws give grip on rough surface





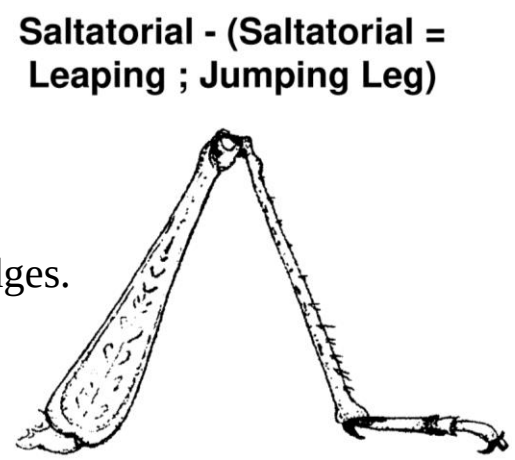
Modifications in Leg

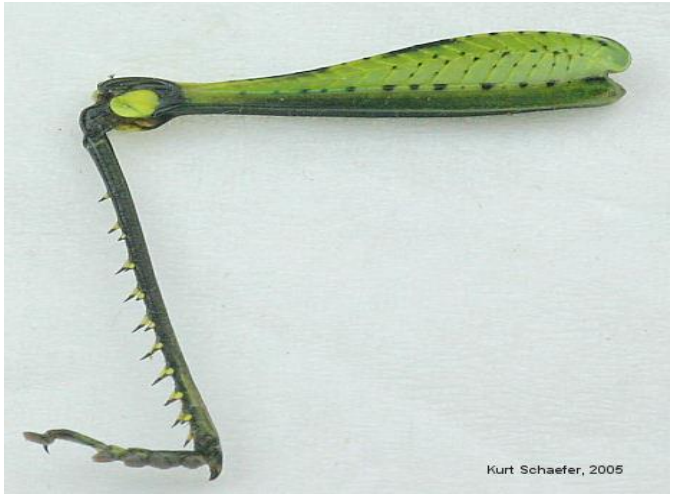
Legs are modified in to several types based on the habitat and food habit of insect and used for a wide variety of functions



1. **Ambulatorial (Ambulate - to walk; Walking leg)**
   e.g. Fore leg and middle leg of grasshopper.
   Femur and tibia are long. Legs are suited for walking.

2. Saltatorial: (Salatorial = Leaping : Jumping Leg)
   e.g. hind leg of grasshopper.
   trochanter is fused with femur,
   femur is enlarged to accommodate powerful extensor muscles of tibia used for leaping
   tibia is long and slender with 2 rows of spines on ventrolateral edges. It is heavily sclerotized and rigid (force is exerted against it)
   at the end of tibia 4 spurs are present for gaining grip against substratum





3. Scansorial: (Scansorial = Climbing; climbing or clinging leg)

e.g. all the three pairs of legs of head louse.

tibia is stout and on one side bears a thumb like processes

tarsus is one segmented

there is a single large claw that fits against a thumb like processes (hanging to the hairs of the host)

tarsus and pretarsus work against thumb (like forefingers)

4. Fossorial: (Fossorial = Digging; Burrowing leg)

e.g. Fore legs of mole cricket.

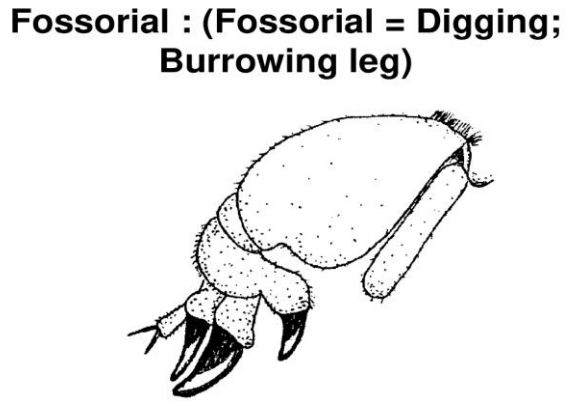
femur is stout

tibia is short and stout and bears 2-3 pointed tines

first 2 segment of tarsus are provided with strong tines

basitarsal tine work against tibial tine to cut rootlets

tympanum is present on fore tibia



5. Raptorial: (Raptorial = predatory ; Grasping leg)

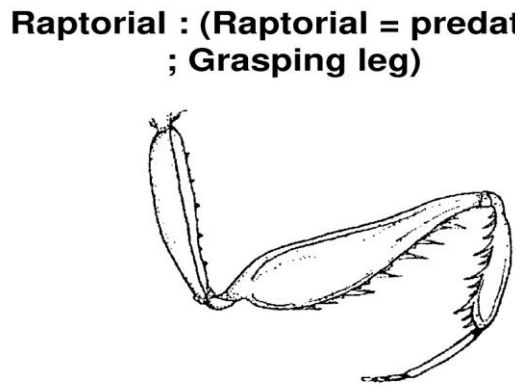
e.g. Forelegs of preying mantis.

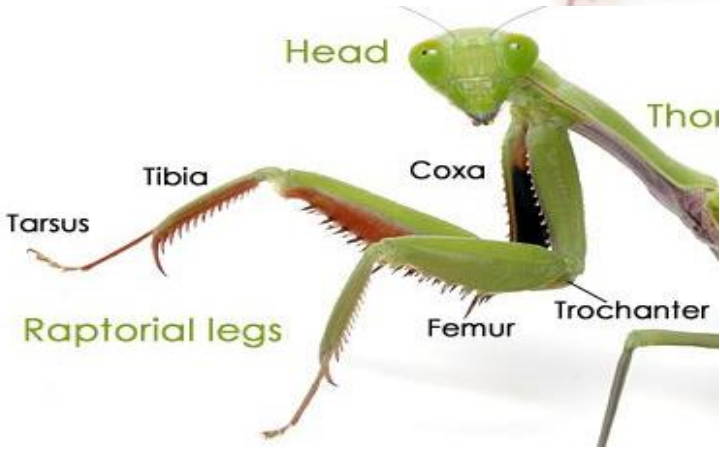
coxa is long and mobile (extended reach to catch prey)

femur is large and grooved with 2 rows spines on ventral side

spiny tibia fits into femoral groove when it snaps down the prey

tarsus has 5 tarsomeres

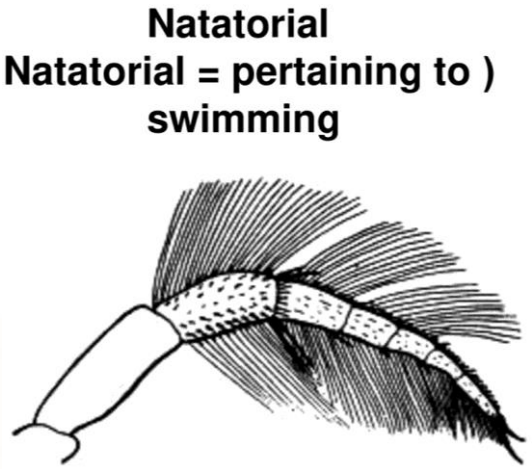




6. Natatorial: (Natatorial = pertaining to swimming; Swimming leg)

e.g. hind legs of water bug and water beetle.

femur, tibia and first four tarsomeres are broad and flattened
their edges are provided with flattened setae which serve as oars



7. Sticking leg:

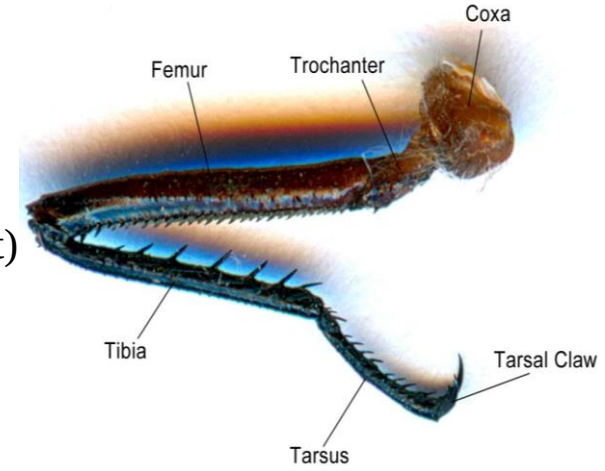
e.g. all the three pairs of legs of house fly.

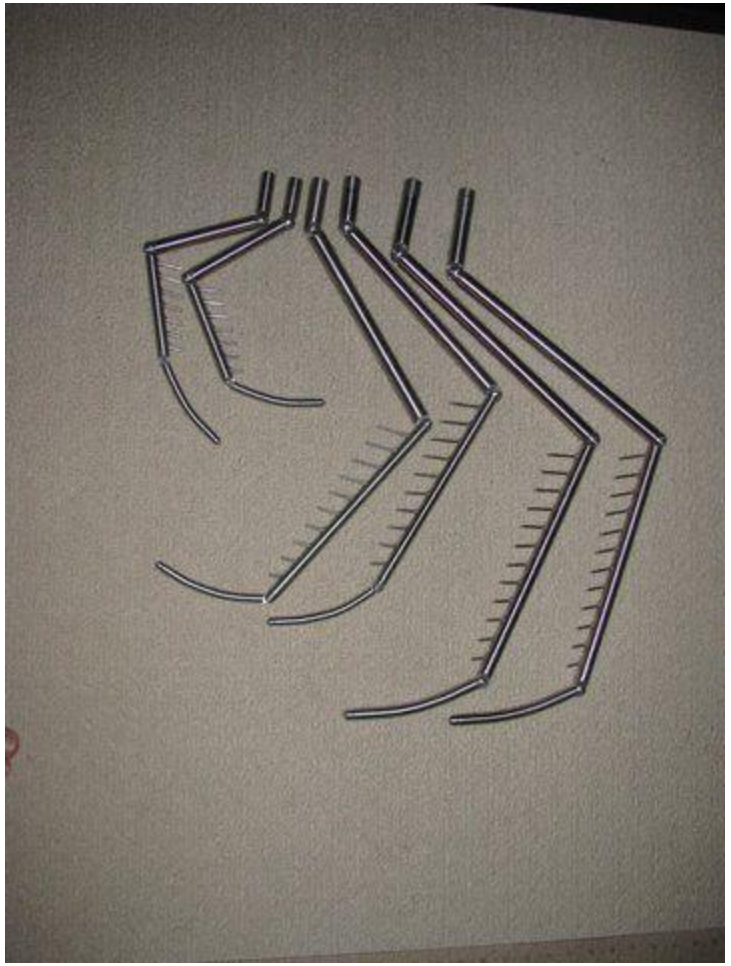
pretarsus consists of a pair of lateral adhesive pads under claws called pulvilli
arolium is absent but a median spine like empodium is present
the pulvilli are covered with dense mass of glandular hairs called tenant hairs
secretions of these hairs are helpful in clinging to smooth surface

8. Basket like leg:

e.g. legs of dragonfly and damselfly (not useful in locomotion)

legs are situated behind the head and anterior in position
legs are spiny and closely placed (seizing the prey during flight)

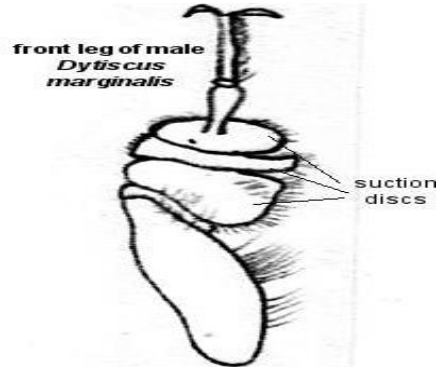




9. Clasping leg:

e.g. forelegs of male water beetle

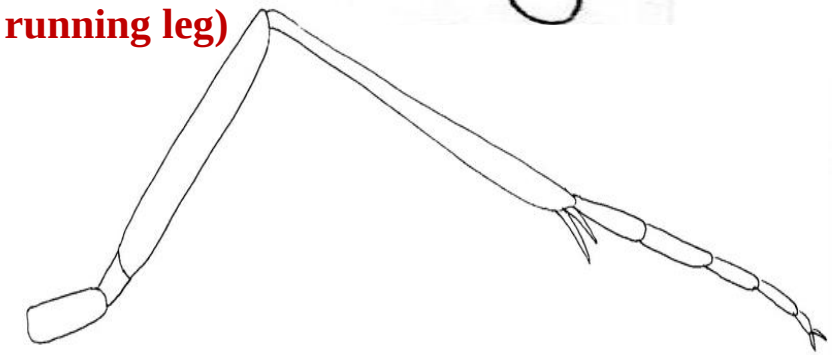
tarsus is flattened with adhesive discs (clasp male during mating)



10. Cursorial leg: (Cursorial = adapted for running; running leg)

e.g. all three pairs of legs of cockroach

femur is not swollen



11. Foragial legs: (forage = to collect food material)

e.g. legs of honeybee (all 3 pairs are modified to suit their lifestyle)

i. Forelegs: has 3 important structures

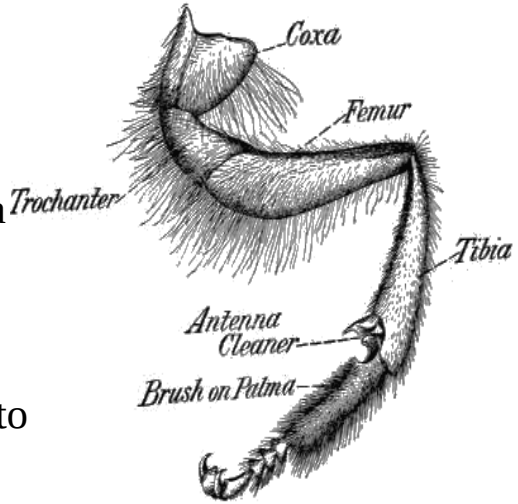
a. Eye brush: hairs of tibia constitute eye brush (clean compound eyes)

b. Antenna cleaner/ strigillis: contains 2 structures vellum and antenna comb

vellum is a movable clasp present at distal end of tibia

antenna comb is semi-circular notch lined with small spines

c. Pollen brush: bristles on basitarsus from pollen brush which is used to collect pollen from head and mouthparts



ii. Middle legs: two important structures

a. Pollen brush: stiff hairs on basitarsus from pollen brush (collect pollen from the middle part of body)

b. Tibial spur: movable spur present at the distal end of tibia

useful to loosen the pellets of pollen from pollen baskets of hindlegs and to clean wings and spiracles

iii. Hind legs: has 3 important structure

a. Pollen basket: also called **corbicula**

outer surface of tibia contains shallow cavity

edges of cavity are fringed with hairs

to carry larger load of pollen and propolis to the hive

b. Pollen packer: also called **pollen press**

it consists of pecter and auricle

pecten is a row of stout bristles at distal end of tibia

auricle is a small plate fringed with hairs at base of basitarsus

useful to load pollen in corbicula

c. Pollen comb: about 10 rows of stiff spines on the inner side of basitarsus. Used to collect pollen from middle legs and posterior part of body

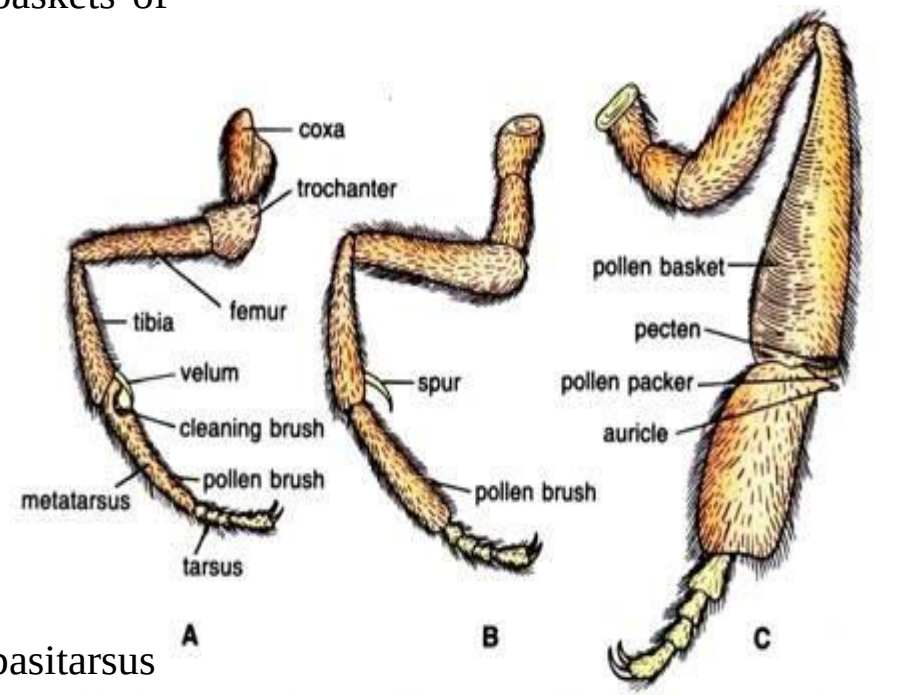


Fig. 77.5. Honeybee. Legs. A—Prothoracic leg; B—Mesothoracic leg; C—Metathoracic

12. Prolegs or false legs or pseudolegs

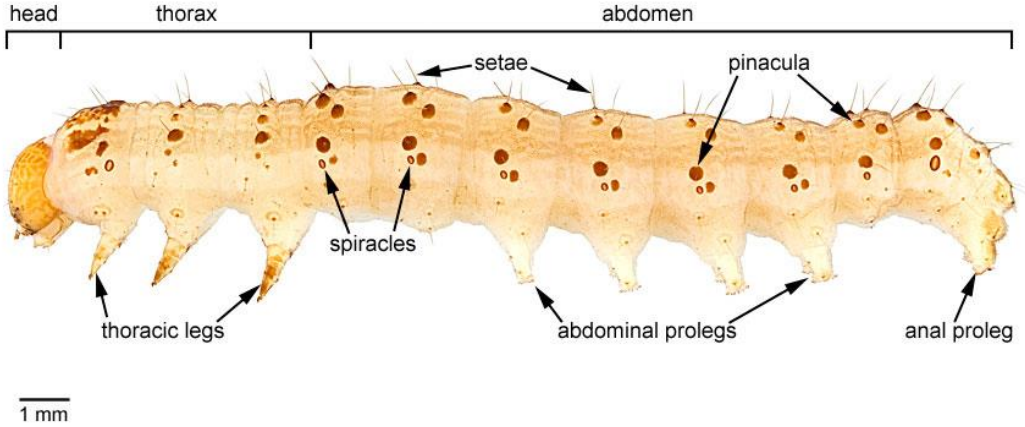
e.g. abdominal legs of caterpillar (2-5 pair)

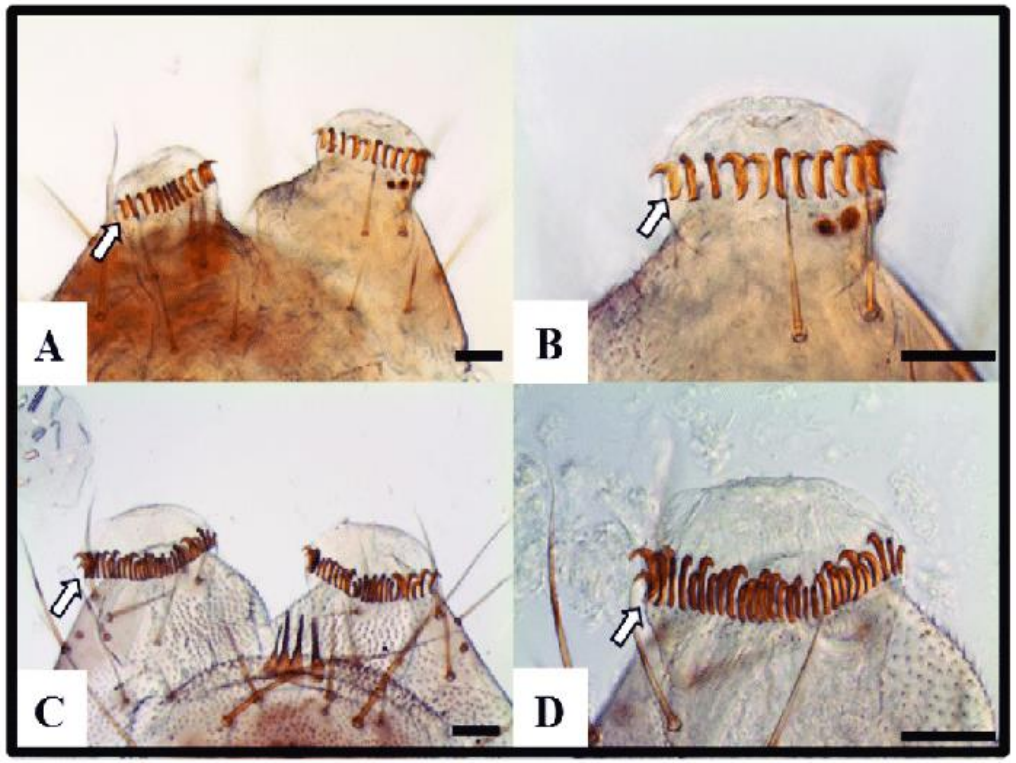
they are thick, fleshy and non-segmented

they are shed with last larval moult

1 pair of prolegs on last abdominal segment are called **anal prolegs/claspers**

tip of proleg is called **planta** which bears hooks or claws called **crochets**





WINGS:

Insects are of two type

1. which do not have the wing are called **APTERIGOTE**/ wingless insect
   e.g. silverfish and spring tails (primitively wingless)
2. those have wings at any stage of their life called **PTERIGOTE** /winged insects
   e.g. butterflies, bees

- Ectoparasites like head louse and poultry louse are secondary wingless
- Wings are deciduous in ants and termites

- insects have one or two pair of wing originate at **pterothoracic** region

- the first pair of wing that originate at mesothorax is known as fore wing while the wing which develop from meta thorax joint is called hind wing

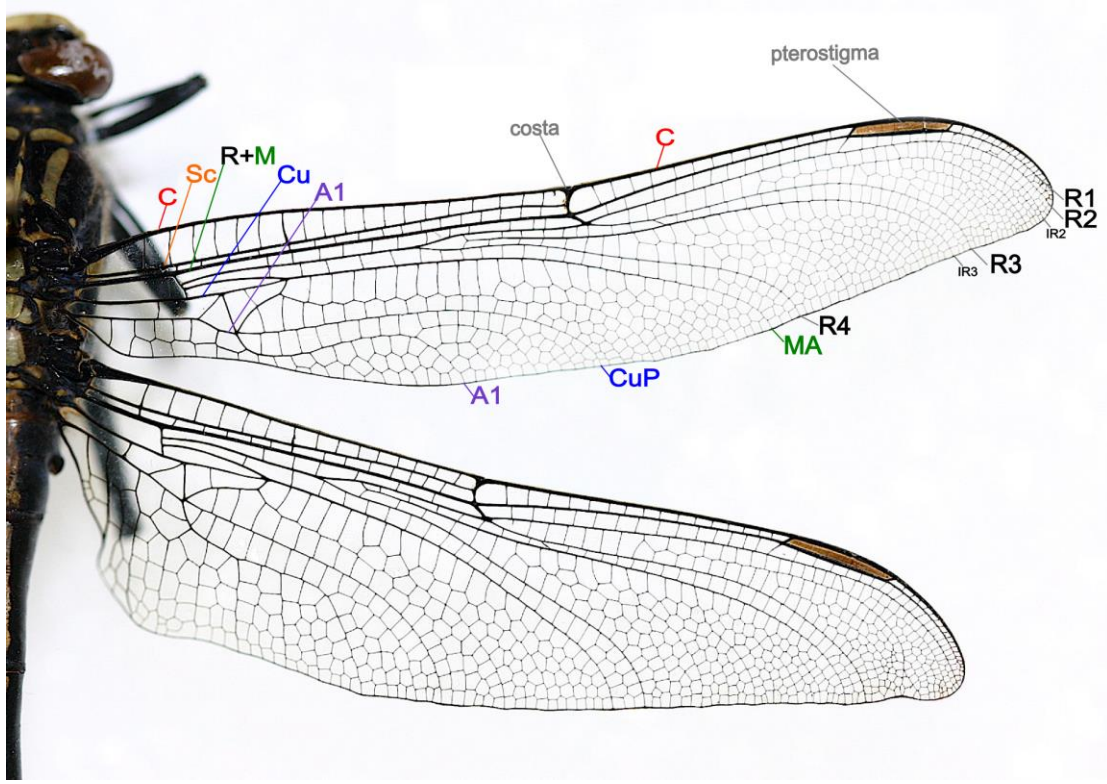
- These are helping the insect for aerial movement. Shape and size of wing shows a great variation among insects

- wings are strengthen by numerous vein called **wing venation**. The venation pattern in the wing help the insect taxonomist in identification of insect species and classification

- A generalized structure of wing venation was given by **Comstock & Needham**

Venation

- Venation is the name given to the arrangement (number and position) of veins within an insect's wing
- Most insect groups have the veins running down the wing (longitudinal veins) are connected by a series of cross veins
- Most insect groups have less cross veins. However but some insects such as dragonflies and damselflies have wings with large number of cross veins
- The venation is often used as a way of differentiating between related similar species
- There are 6-8 longitudinal veins.
- According to a system devised by John Comstock and George Needham—the Comstock– Needham system



1. Costa (C): the leading marginal vein of the wing, some time small pre costa is found

2. Subcosta (Sc): It is second vein (behind the costa), typically unbranched

3. Radius (R): branched into five separate veins.

Toward the middle of the wing, it is divided into a first undivided branch (R1) and a second branched called radial sector (Ra), which is further subdivides into four distal branches (R2, R3, R4, R5).

Basally, the radius is articulated with the anterior end of the second axillary (2Ax)

4. Median (M): divided into two main branches i.e. median anterior (MA), which is further subdivides into two distal branches (MA1, MA2), and a median sector, or media posterior (MP), which has four terminal branches (M1, M2, M3, M4) which reaches to the wing margin

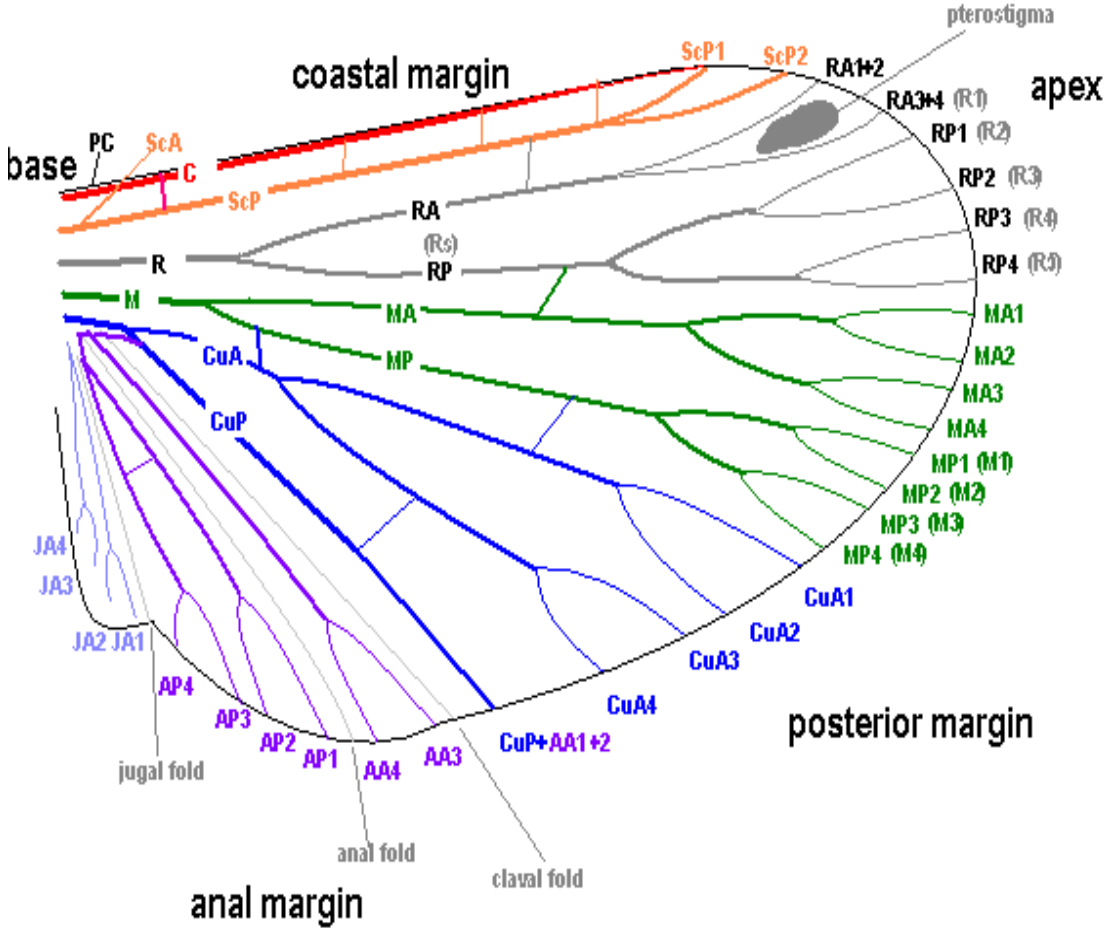
5. Cubitus (Cu): it is primarily two branched.

The primary forking takes place near the base of the wing, forming main branches (Cu1, Cu2).

The cu1 branch may break up into a number of secondary branches, but commonly divided into two distal branches i.e. Cu1a & cu1b

cu2 branch of the cubitus would be unforked branch

6. Anal veins: unbranched (A1, A2, A3) veins located behind the cubitus



The cross veins commonly occur in insects are:

C-Sc cross-veins: run between the costa and subcostal and indicated by small “h”
R cross-veins: run between adjacent branches of the radius and indicated by small “r”
R-M cross-veins: run between the radius and media and indicated by rm
M-Cu cross-veins: run between the media and cubitus and indicated by m-cu

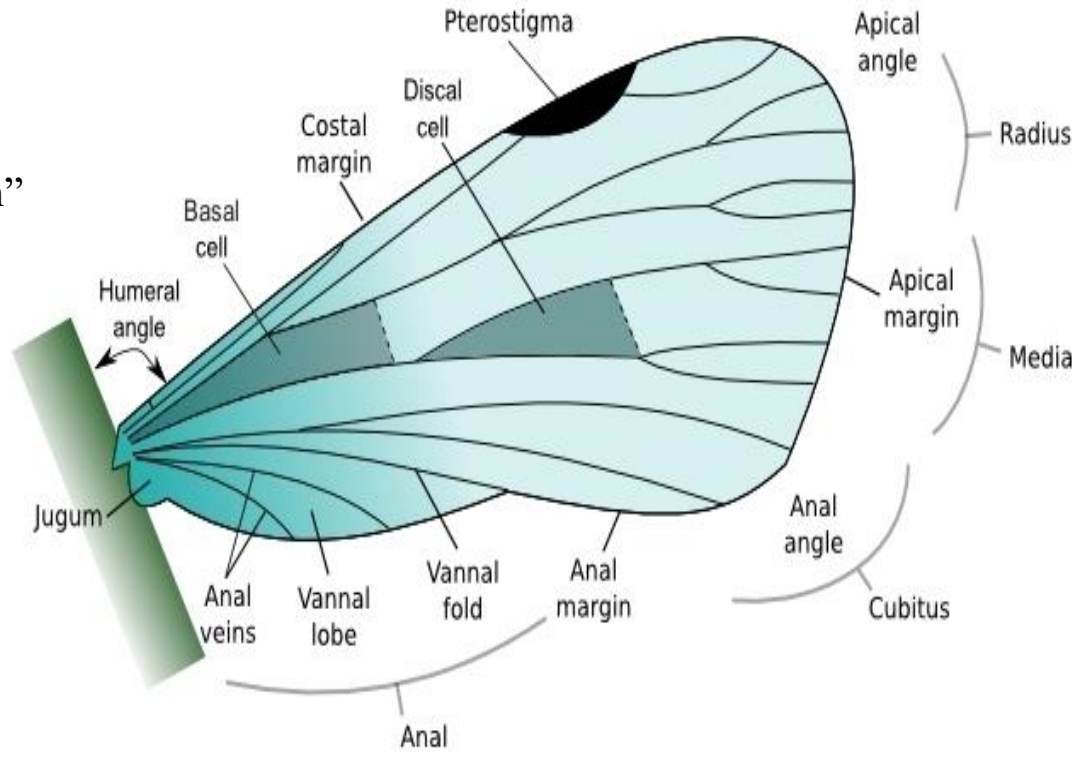
Margins and angles: 3 sides and 3 angles

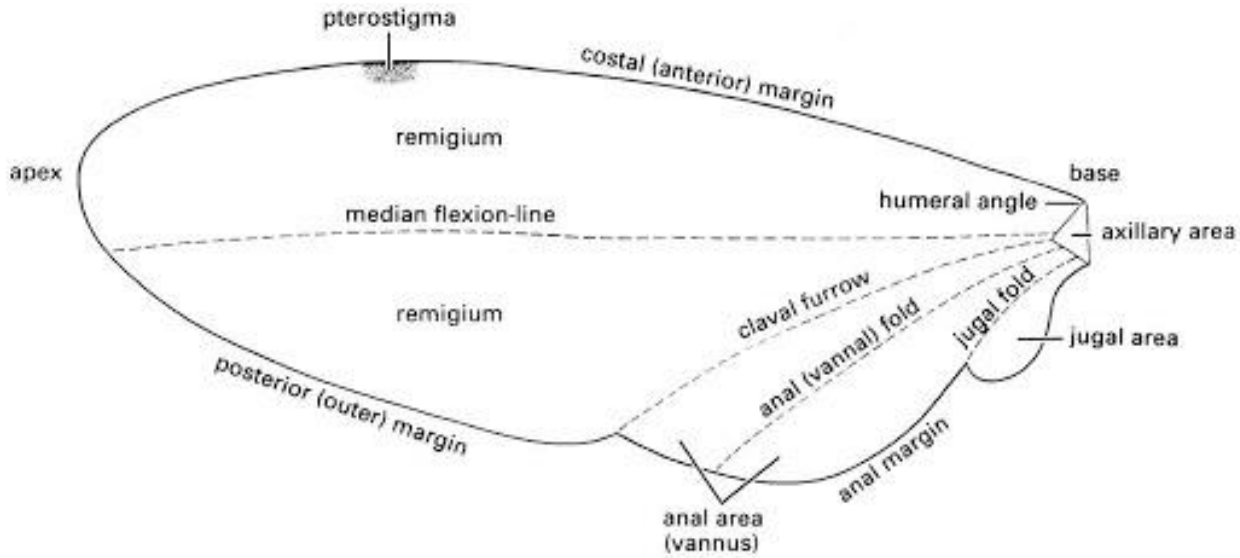
- Anterior margin by costa is **costal margin**
- Lateral margin is called **apical margin**
- Posterior margin is called **anal margin**

- Angle by which wing is attached to thorax is **humeral angle**
- Angle between coastal and apical margin is **apical angle**
- Angle between apical margin and anal margin is **anal angle**

Wing regions:

- Anterior area of wing supported by veins usually called **remigium**
- Flexible posterior area is called **vannus**.
- Both are separated by **vannal fold**
- Proximal part of vannus is **jugum** separated by **jugal fold**
- The area having wing articulation sclerites, ptelaria is called **axilla**





Modifications of insect wings

- **Tegmina (singular tegmen):** leathery forewings of insects in the orders Orthoptera, Blattaria, and Mantodea.

  The tegmina help protect the delicate hind wings.

  Examples: Grasshoppers, crickets and katydids (order Orthoptera), Cockroaches (order Blattaria), Mantids (order Mantodea).

- **Elytra (singular elytron):** hardened, heavily sclerotized forewings of beetles and are modified to protect the hind wings when at rest.

  Examples: All beetles (order Coleoptera).

- **Hemelytra :**

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, while the distal portion is membranous.

Unlike elytra, hemelytra function primarily as flight wings.

Examples: bugs (order hemiptera).

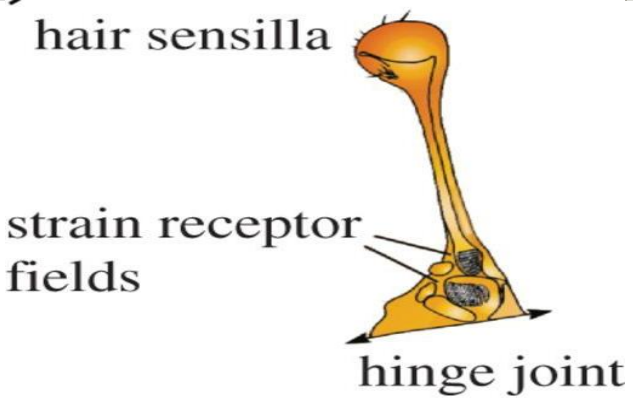
- **Halteres**

Halteres are an extreme modification in hindwings of the order diptera (true flies).

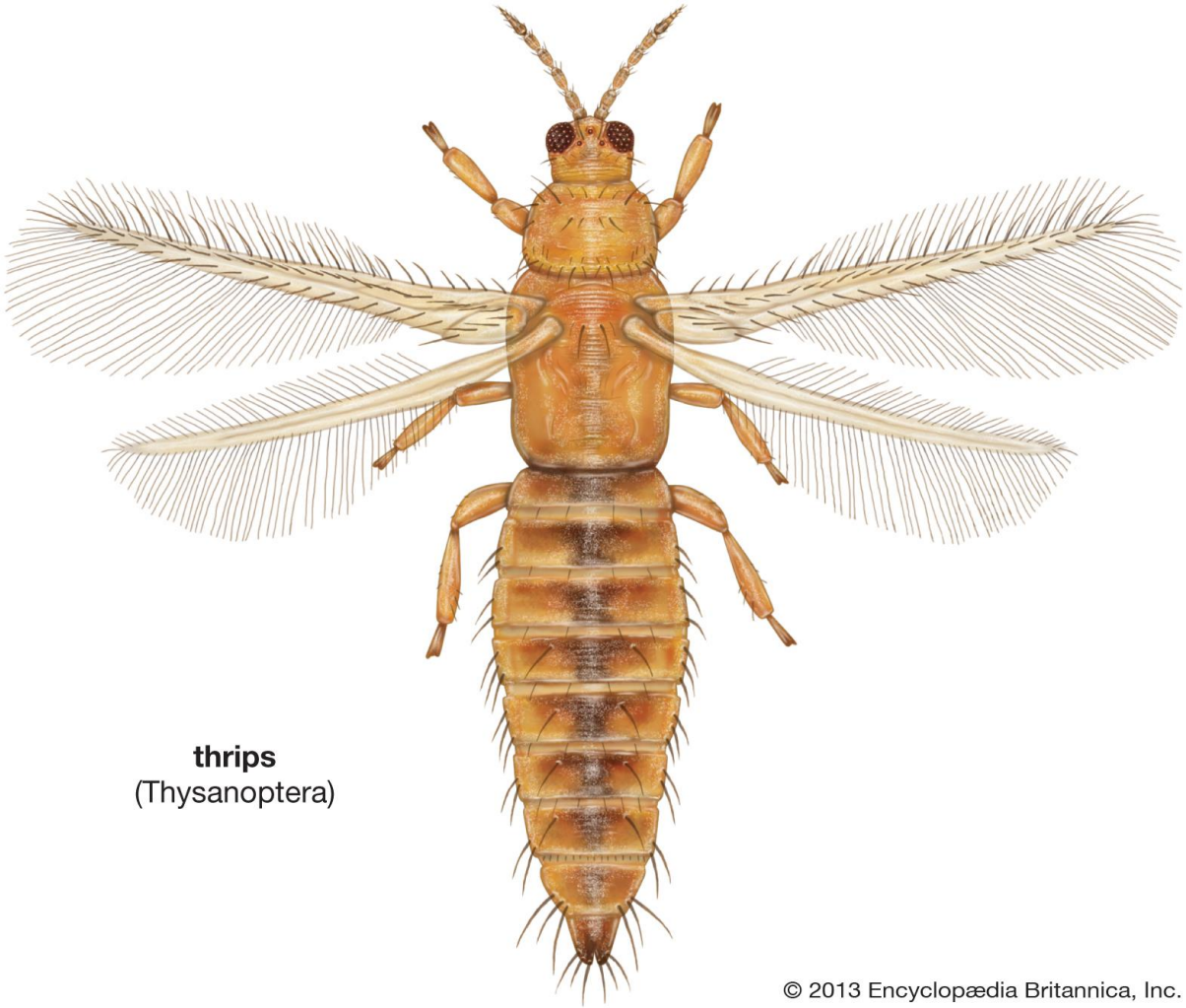
The hind wings are reduced to small knob like vibrating organs used for balance and stability during flight.

Each haltere is a slender rod clubbed at free end (**capitellum**) and enlarged at base (**scabellum**)

On the basal part 2 large group of sensory bodies forming the smaller **Hick's papillae** and large set of **scapel plates**



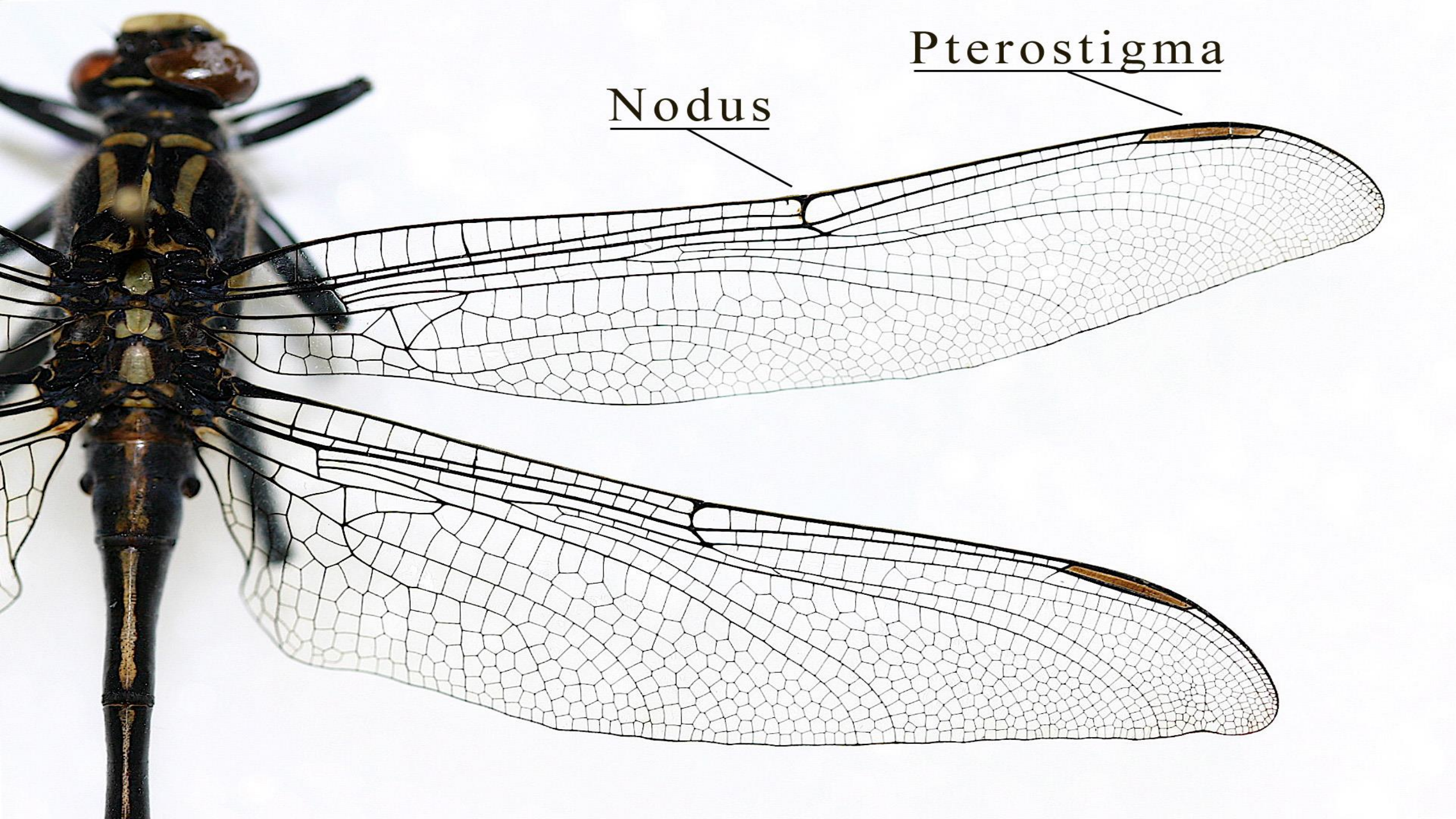
- **Fringed wings:**
  Wings are usually reduced in size.
  Wing margins are fringed with long setae.
  e.g.: Thrips



- **Scaly wings:**
  Wings of butterflies 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.
  They aid in smoothing the airflow 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.


Pterostigma
Nodus

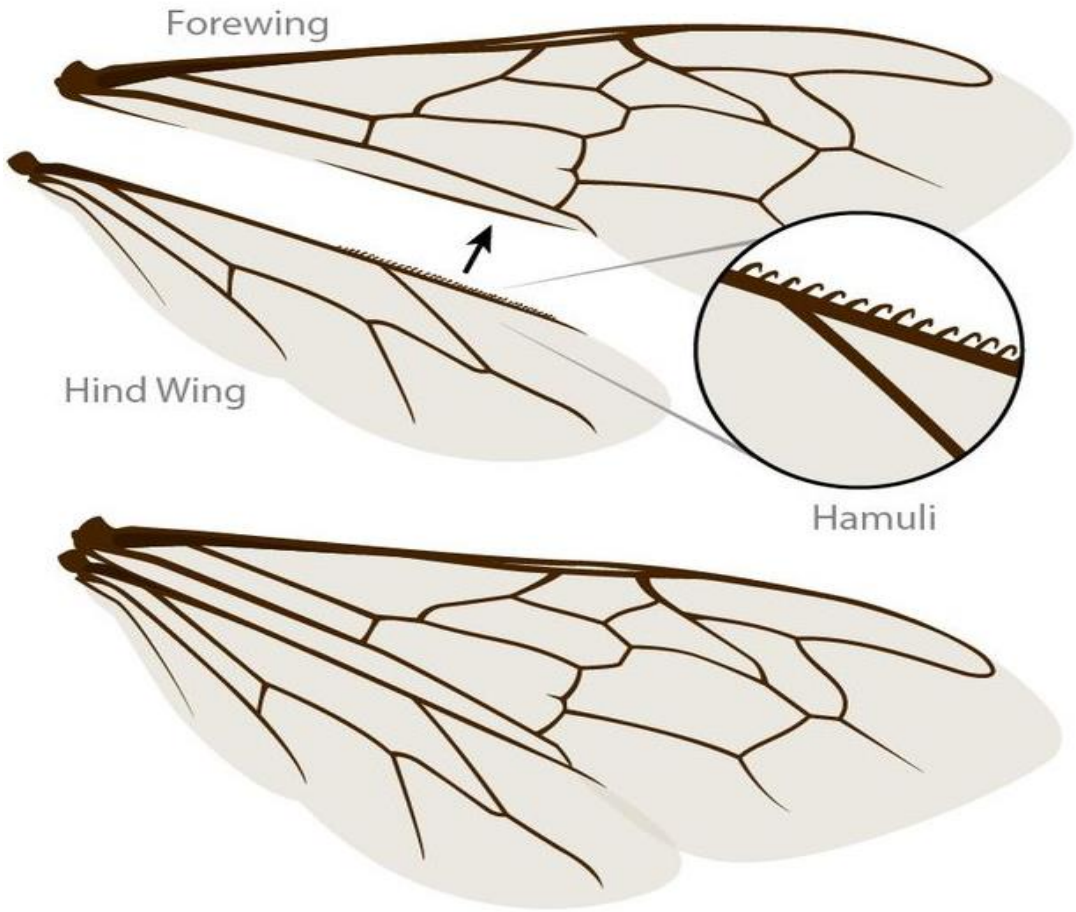
WING COUPLING

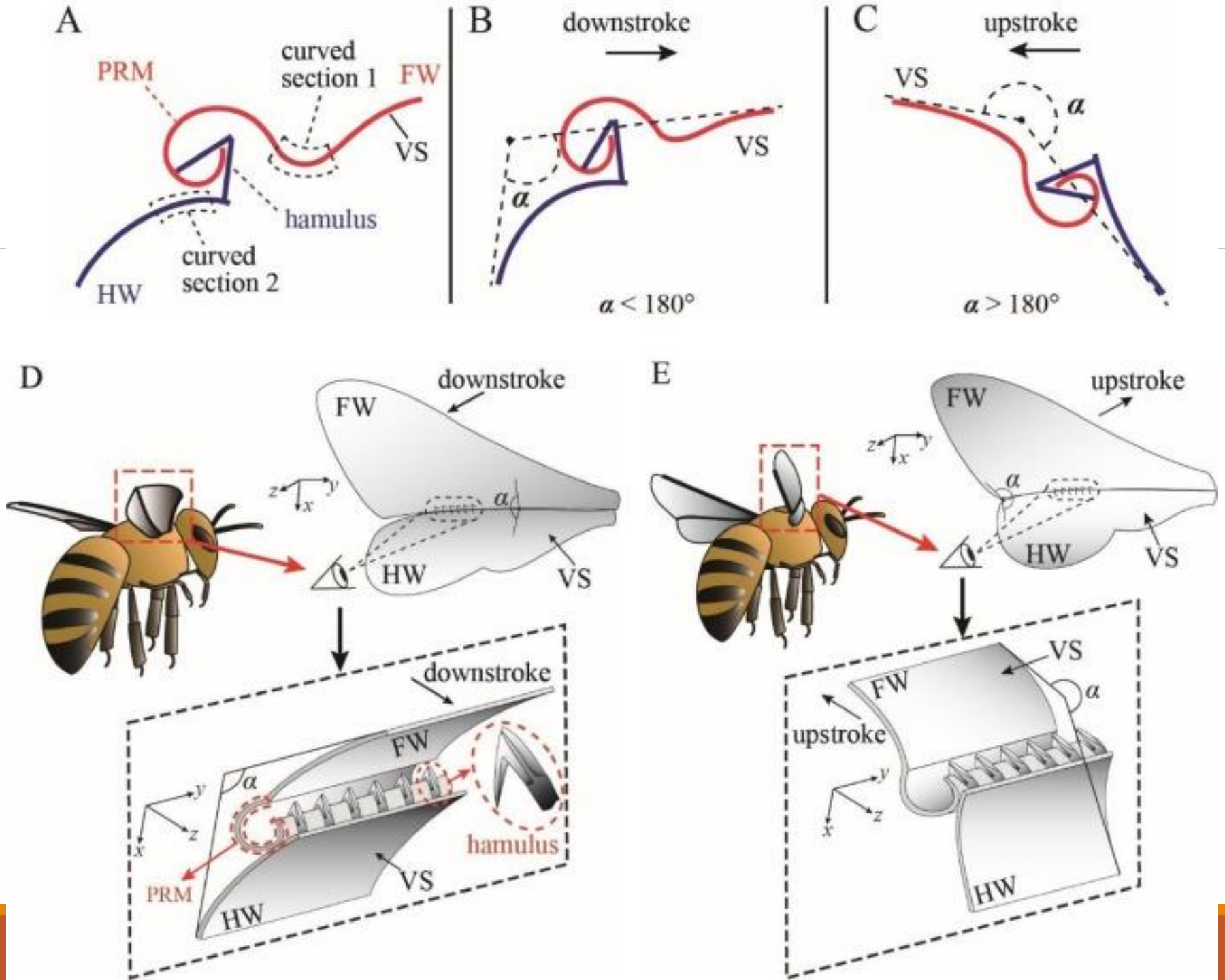
- **Amoung the insects with two pairs of wings, the wings may work separately as in the dragonflies and damselflies.**
- **But in higher pterygote insects, fore and hind wings are coupled together as a unit, so that both pairs move synchronously.**
- **By coupling the wings the insects become functionally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




A
PRM
curved section 1
FW
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hamulus
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HW
B
downstroke
VS
α
α < 180°
C
upstroke
VS
α
α > 180°
D
downstroke
FW
z
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HW
VS
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VS
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TYPES OF WING COUPLING

2. Amplexiform:

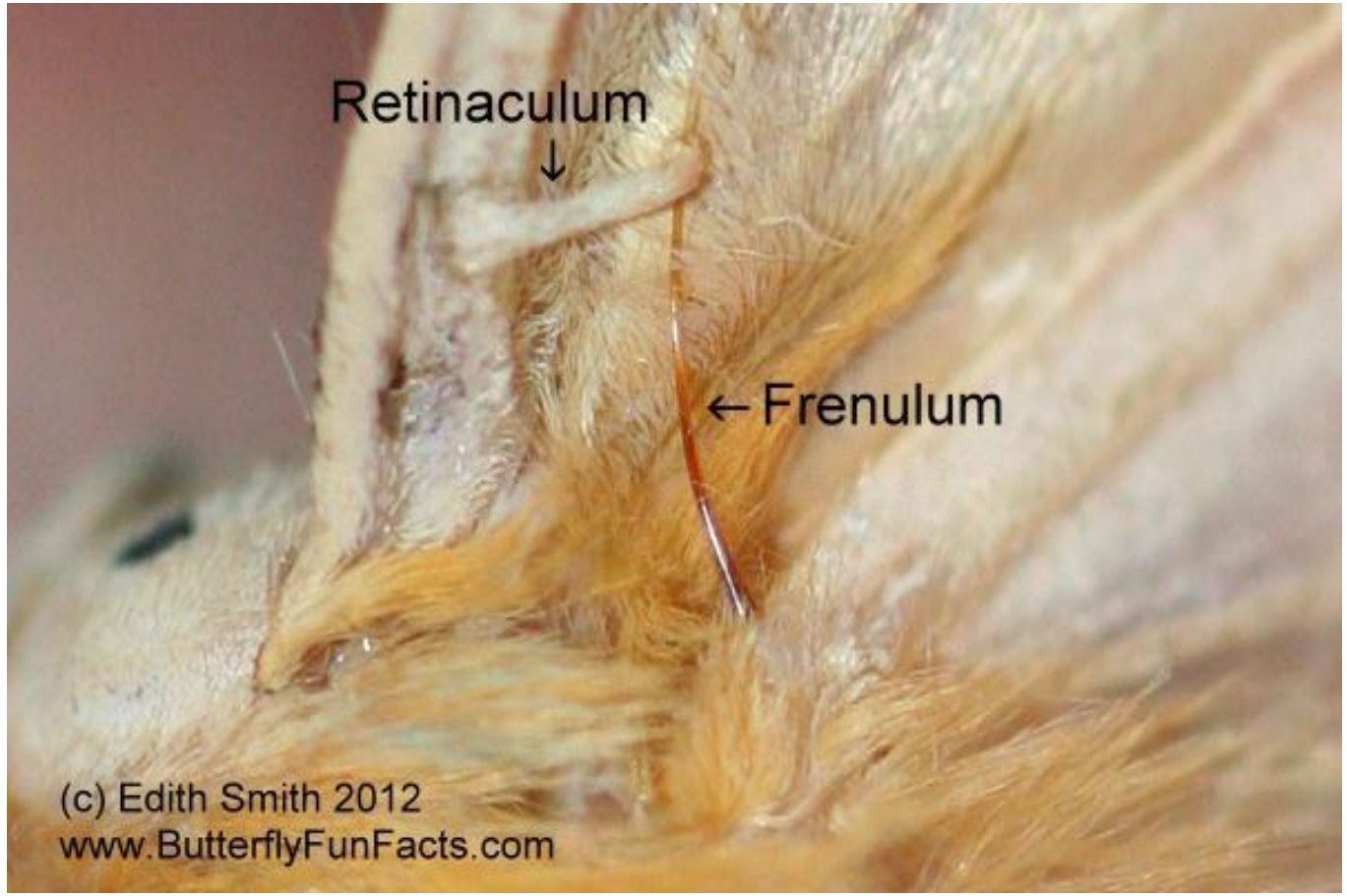
- **It is the simplest form of wing coupling.**
- **A linking structure is absent.**
- **Coupling is achieved by broad overlapping of adjacent margins.**
- **E.g. butterflies.**

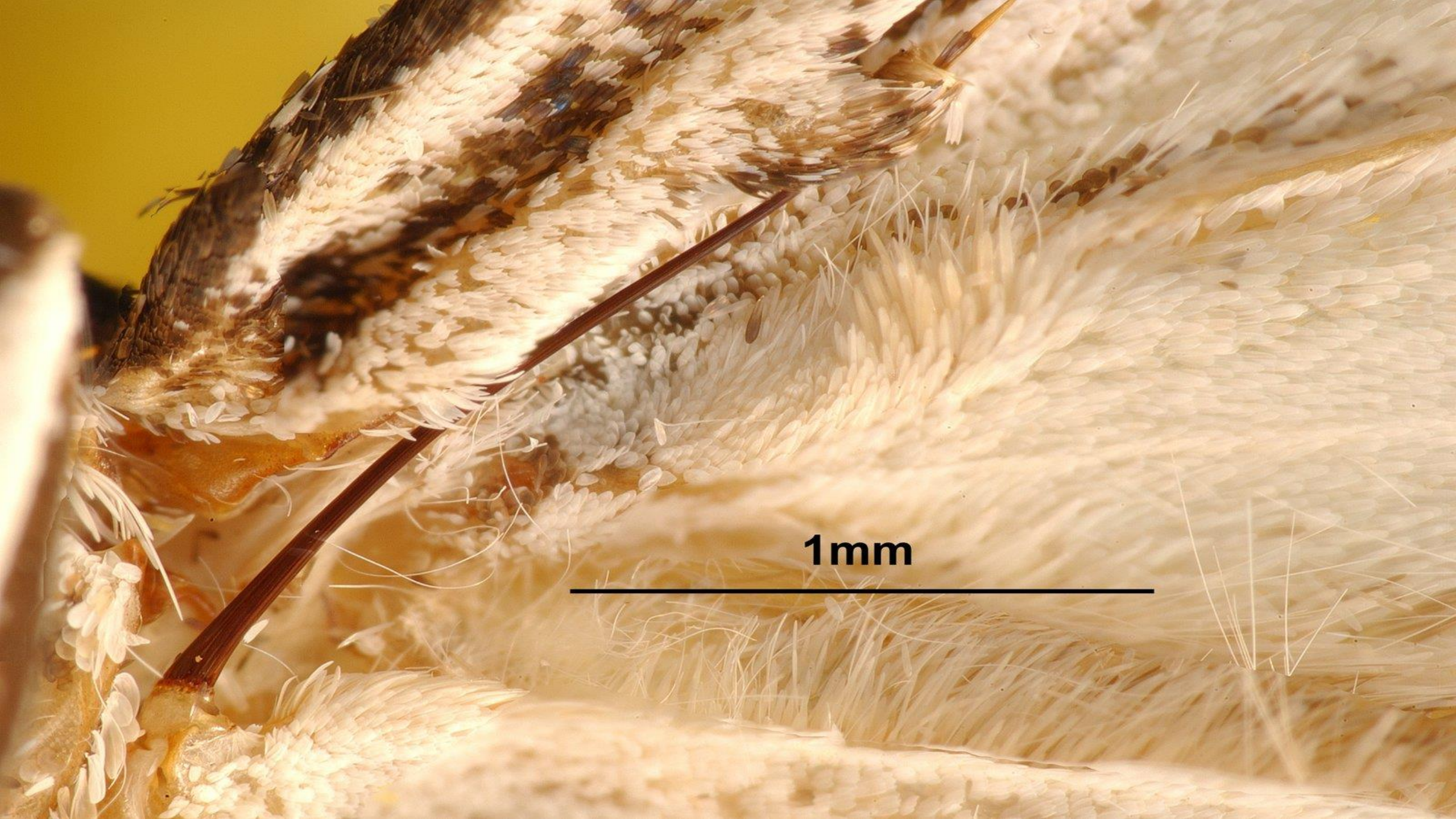
TYPES OF WING COUPLING

3. Frenate: **e.g. Fruit sucking moths and hawk moths**

There are two sub types.

- **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.**

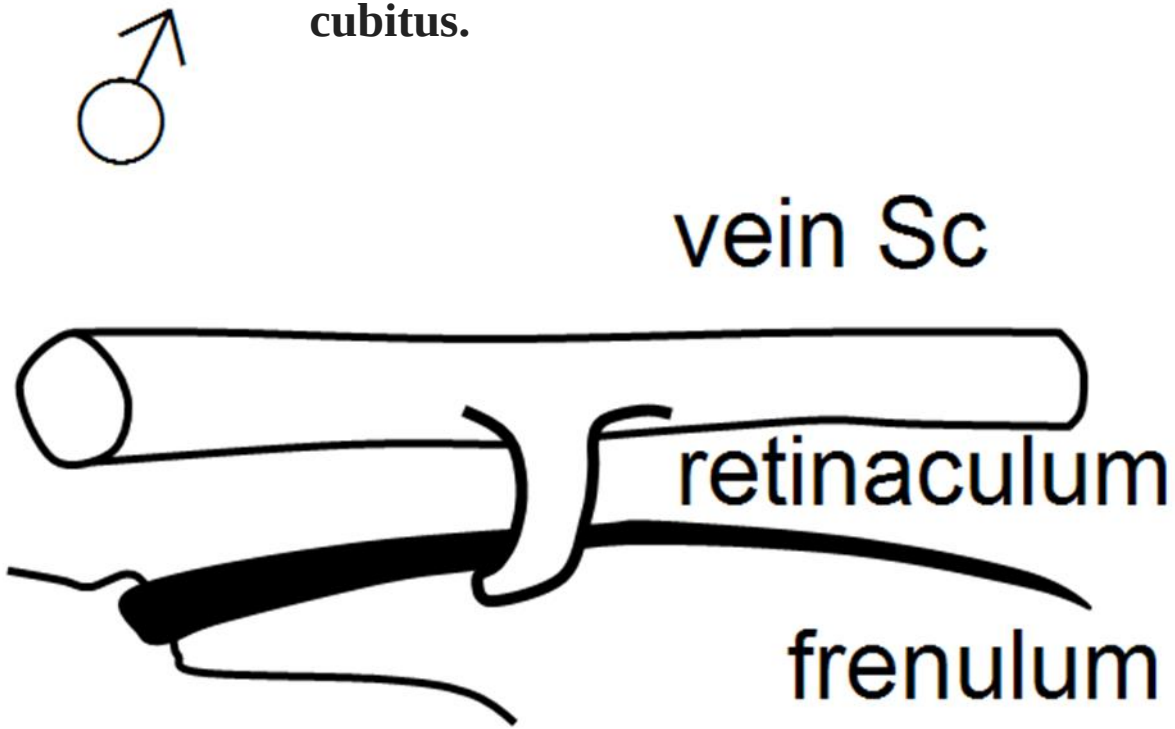


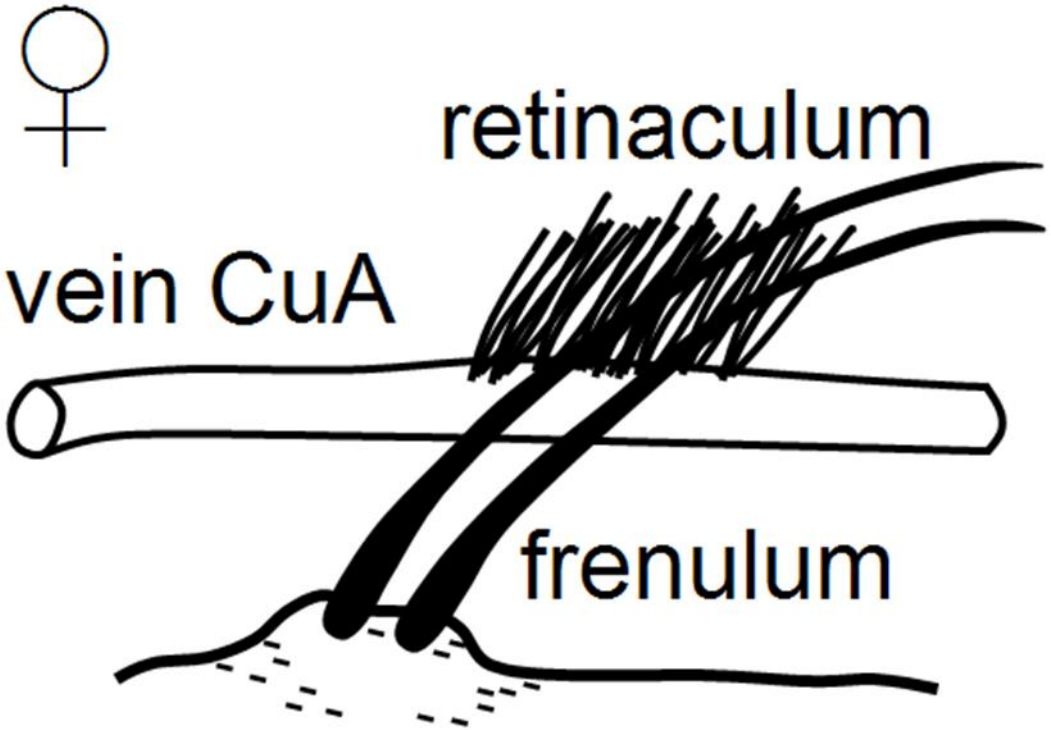

1mm

TYPES OF WING COUPLING

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.**

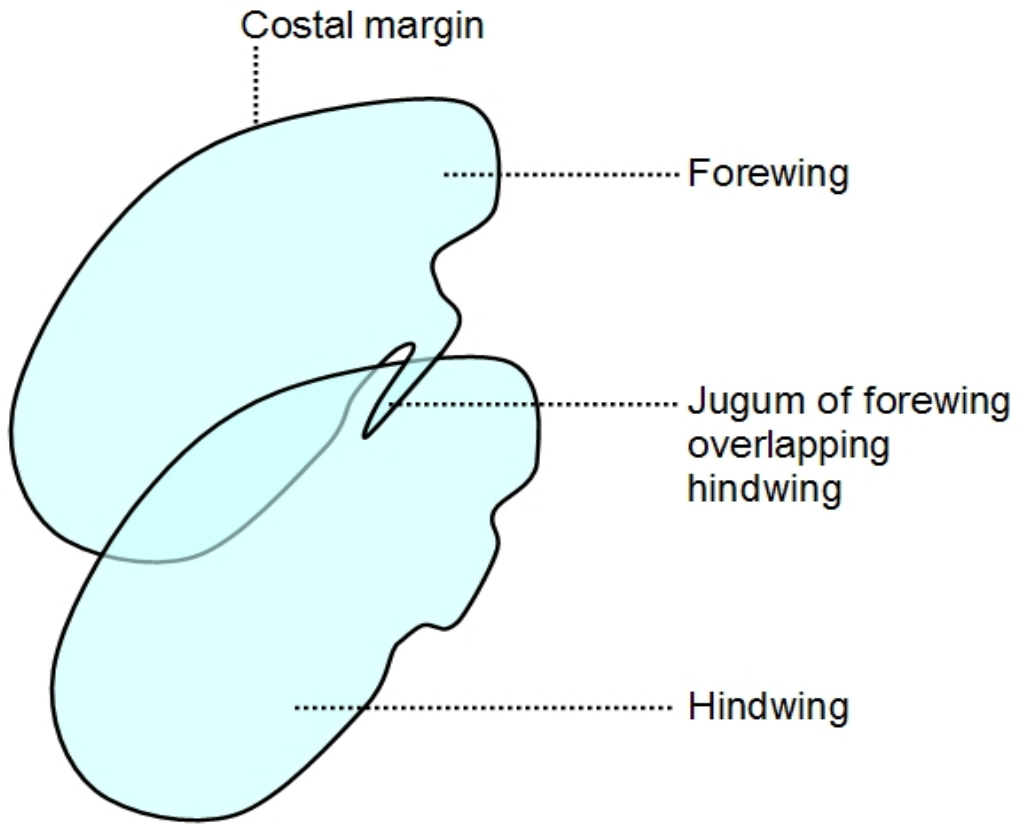




TYPES OF WING COUPLING

4. Jugate:

- **Jugum of the forewings are lobe like and it is locked to the coastal margin of the hindwings.**
- **e.g. Hepialid moths, strepsipterans.**



Jugal coupling