APPENDAGES OF THORAX

These consist of the wings and legs.

A. Wings: These are the membranous, paired appendages of flight which are located dorsolaterally on the thorax.

(a) Occurrence of wings: The insects have either no wings or a pair of wings (on the mesothorax) or two pairs of wings (first on the mesothorax and second on the metathorax). Examine these conditions in a silverfish (Fig. 8A), house fly (Fig. 7E) and grasshopper (Fig. 4) respectively. Note that the prothorax never bears wings.

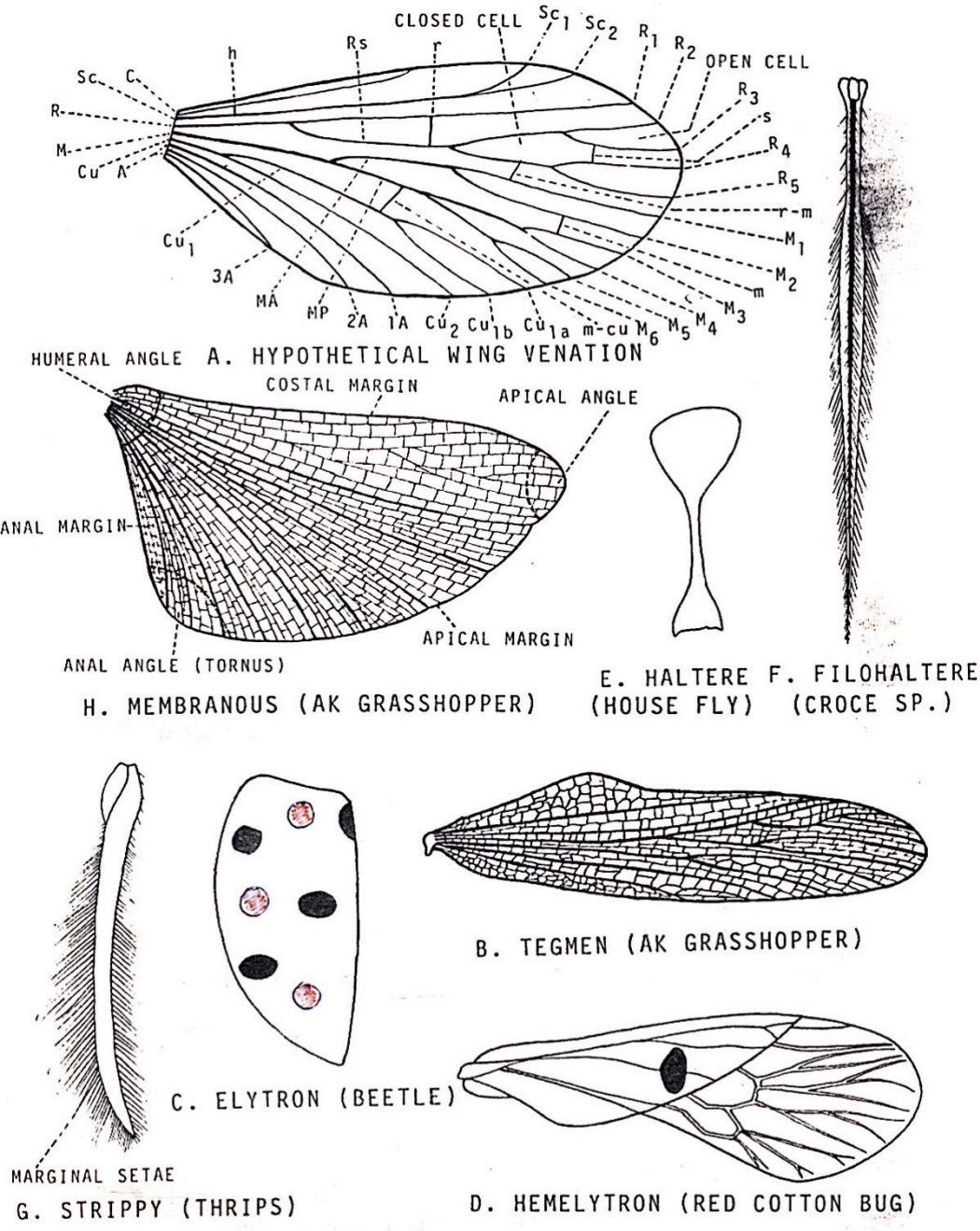
(b) Development of wings: The wingless insects are called the apterous, with reduced wings the brachypterous and with complete wings the macropterous. The undeveloped wings of nymphs and naiads are called wing pads (Fig. 9C).

The insects which are supposed primitively wingless are known as Apterygota, e.g., silverfish (Fig. 8A), doubletails, telsontails and springtails. The insects which are winged or secondarily wingless are called the Pterygota. It has further two types. The insects which develop their wings outside the body are called Exopterygota, e.g., grasshoppers (Fig. 8B), bugs, etc. The insects which develop their wings inside the body are known as Endopterygota, e.g., flies, wasps, moths (Fig. 9A), butterflies, beetles, etc.

(c) Wing margins and angles: Place the hind wing of an ak grasshopper (Fig. 22H) between two slides under a microscope and note the following: It is almost triangular in shape. Its anterior border is called the costal margin, outer border the apical margin and inner border the anal margin. The following three angles are also defined: the humeral angle between the costal and anal margins, the apical angle between the costal and apical margins, and the anal angle (tornus) between the anal and apical margins.

(d) Wing venation (Fig. 22A): The wings of most insects are membranous. They are supported by a framework of hollow ribs or thickened ridges, the veins. Most of these veins extend lengthwise in the wing and are called longitudinal veins. A few of them connect the longitudinal veins and are called cross veins. The arrangement of veins in a wing is called venation or neuration.

In the wings of certain insects, the areas between the longitudinal veins contain an irregular network of veins called archedictyon, e.g., dragonflies, mayflies, stoneflies and ant-lions. The wings of these insects are also called net-veined.



A. HYPOTHETICAL WING VENATION

H. MEMBRANOUS (AK GRASSHOPPER)

E. HALTERE (HOUSE FLY)

F. FILOHALTERE (CROCE SP.)

B. TEGMEN (AK GRASSHOPPER)

C. ELYTRON (BEETLE)

D. HEMELYTRON (RED COTTON BUG)

G. STRIPPY (THRIPS)

FIG.22. STRUCTURE AND TYPES OF WINGS

The longitudinal veins and most of the cross veins bear names. These names (from the anterior to the posterior) with their abbreviations are as follows:

Longitudinal veins	Cross veins
1. Costa (C)	1. Humeral (h)
2. Subcosta (Sc)	2. Radial (r)
3. Radius (R)	3. Sectorial (s)
4. Media (M)	4. Radiomedial (r-m)
5. Cubitus (Cu)	5. Medial (m)
6. Anals (A)	6. Mediocubital (m-cu)
	7- Cubital vein (cu)
	8- Cubital anal (cu-a)

Note the abbreviations of longitudinal veins are always in capital letters and those of cross veins always in small letters.

The longitudinal veins may be simple or branched in varying degrees in different insects. But the basic hypothetical or primitive arrangement is as follows: The costa is unbranched. It forms either the anterior margin or lies along the anterior margin. The subcosta is 2-branched distally. The radius is divided into two branches: R1 and the radial sector (Rs). The radial sector divides into two branches and each branch further divides into two. The radius is thus 5-branched. The media is divided into two branches: anterior media (MA) and posterior media (MP). The anterior media divides into two branches. Similarly the posterior media divides into two branches and each branch divides again into two. The media is thus 6-branched. The cubitus is 2-branched, with its first branch further divided into two. There are 3 or 4 anals which are typically unbranched.

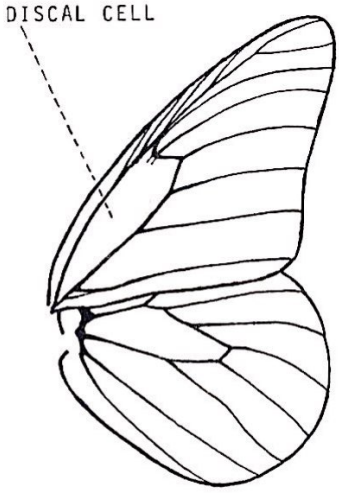
It must be remembered that the abbreviations of the main longitudinal veins are generally written at their bases. But their final branches are indicated at the wing margin (Fig. 22A).

The most important cross veins are: the humeral connects the costa and subcosta near the base of the wing. The radial connects R1 and radial sector (Rs). The sectorial connects R3 and R4. The radiomedial connects radius and media, usually near the middle of the wing. The medial connects M2 and M3. The mediocubital connects media and cubitus.

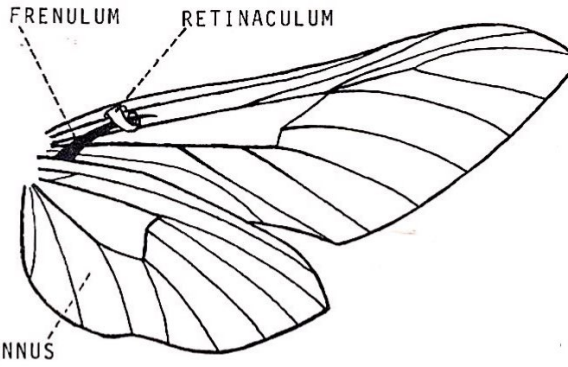
This hypothetical or primitive wing venation can not be seen in any wing at present because some veins or their branches have either lost or fused together. The fusion of two branches (e.g. R4 and R5) is written as R4+5.

(e) Cells of wings: The longitudinal and cross veins surround the areas of various shapes which are called cells. There are two types of cells. If the area is entirely surrounded by veins, it is a closed cell (Fig. 22A). If the area extends to the wing margin, it is an open cell (Fig. 22A). A cell is named after the vein which forms its anterior border. In some insects certain cells have special names, e.g., discal cell of butterflies and moths (Fig. 23A).

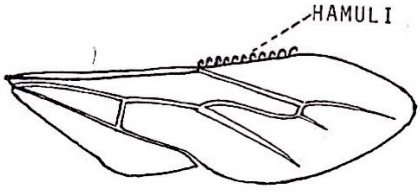
(f) Areas of wings: The central area of the wing is called the disc. The area of the wing having the maximum number of veins is called remigium (Fig. 23B). The area containing only the anal veins is termed the annal or vannal area (Fig. 23C).



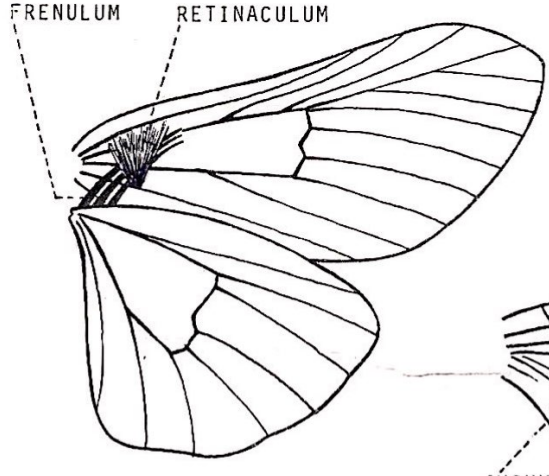
A. OVERLAPPING (BUTTERFLY)



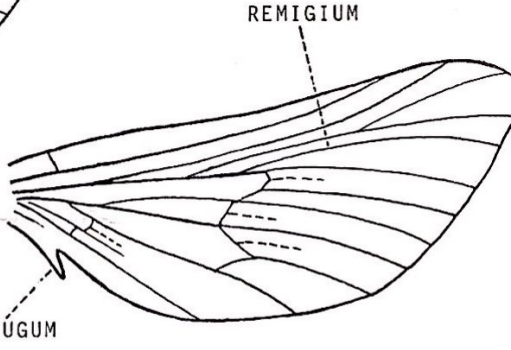
C. FRENULUM AND RETINACULUM
(MALE GEOMETRID MOTH)



E. HAMULI (HONEYBEE)



D. FRENULUM AND RETINACULUM
(FEMALE GEOMETRID MOTH)



B. JUGUM (JUGATE MOTH)

FIG.23. WING COUPLING APPARATUS

(g) Special structures of wings: Some insects have a thick pigmented spot along the costal border near the apex of the wing which is called Pterostigma, e.g., dragonflies, damselflies, most hymenopterous insects, etc. A thick, short, cross vein descends from the middle of the anterior border which is called nodus in dragonflies. The border appears to be broken and jointed at this point. The wings of butterflies and moths are covered with scales of various shapes. The rod-like wings of thrips have fringes of long hair which are called marginal setae (Fig. 22G).

(h) Types of wings: Some important types or modifications of wings are as follows:

(1) **Tegmina** (Fig. 22B): The fore wings are modified into long, narrow, hard and slightly thick structures, the tegmina (sing. tegmen), e.g., grasshoppers, cockroaches, mantids, crickets, etc.

(2.) **Elytra** (Fig. 22C): The fore wings are modified into very thick and hard structures, the elytra (sing. elytron), e.g., beetles, weevils and earwigs. They form a protective covering for hind wings when the insect is in rest.

(3.) **Hemelytra** (Fig. 22D): The basal part of the fore wing is thick and hard while the apical part is thin and membranous. Such wings are called hemelytra (sing. hemelytron), e.g., true bugs (like red cotton bug).

(4.) **Halteres** (Fig. 22E): The hind wings are modified into tiny, knobbed structures, the halteres, e.g., flies (like house fly), male coccids (like mango mealybug).

(5.) **Pseudohalteres:** When the fore wings are modified into halteres, they are known as pseudohalteres, e.g., male stylopids.

(6.) **Filohalteres** (Fig. 22F): When the hind wings are modified into very long, thread-like structures, they are termed filohalteres, e.g., some lacewings *(Croce sp.)*.

(7.) **Strippy** (Fig. 22G): The wings are modified into strips or rod-like structures and fringed with long hair, e.g., thrips.

(8.) **Membranous** (Fig. 22H): The hind wings are very thin and broad like a membrane, e.g., grasshoppers, locusts, crickets, earwigs, beetles, etc.

(i) Wing coupling apparatus: The mechanism by which the two wings of one side are linked together and act as a unit during the flight is called wing coupling apparatus. ~~Study the following devices:~~ mechanism; and the linking structure is known as wing coupling apparatus

1. **Overlapping** (Fig. 23A): This is the simplest method in which the fore wing overlaps the anterior border of the hind wing, e.g., butterflies.

2. **Jugum** (Fig. 23B): This is a finger-like process at the base of the posterior border of the front wing which projects under the hind wing, e.g., jugate moths.

3. **Frenulum** (Fig. 23C, D): This is a single stout spine (in males) or several spines (in females) on the humeral angle of the hind wing, e.g., geometrid moths.

4. **Retinaculum** (Fig. 23C, D): It is a strong curved process (in males) or a group of strong hair (in females) on the lower side of the fore wing. The frenulum is held by the retinaculum, e.g., geometrid moths.

5. **Hamuli** (Fig. 23E): These consist of a row of minute hooks on the anterior border of the hind wing that catch into the uprolled hind border of the fore wing, e.g., honeybees.

B. Legs: These are paired, jointed, primarily locomotary appendages which are articulated on the ventral side of the thorax.

The adult insects normally have three pairs of legs. The first pair is on the prothorax, the second on the mesothorax and the third on the metathorax. Now pull out the metaleg of an ak grasshopper (Fig. 24B), which is considered to be a typical or generalised leg, and study its parts.