GENERAL INSECT MORPHOLOGY
Lab 7 - A study of insect wings

A. **Generalized wing venation, wing lobes.**

1) **Label all longitudinal and cross veins, and also the wing cells on the xeroxed sheet labeled "Generalized wing venation."** [See rules for naming veins, cross veins, and wing cells].

2) Examine the Tabanidae wing [there are pinned specimens of tabanids available and also some wings mounted in 2 x 2 projector slides - you will probably want to look at both. The slides are easier to work with, but the calypters can be seen best on the pinned specimens]. **On the xeroxed sheet of the tabanid wing label: inner calypter, outer calypter, posterior lobe, axillary incision, humeral angle, apical angle, anal angle, costal margin, outer margin, and anal (or inner) margin.**

B. **Coupling mechanisms (to help wings function as a unit).**

1) **Prepare a drawing of the hind wing of a bumble bee, Bombus sp., and label the hamuli, and the vannal lobe.** [Probably best to use one of the mounted wings] **Enlarge the section with the hamuli and show the structure of the hooks, on the side of your wing drawing.**

2) **Prepare a drawing of the hind wing of a Lepidoptera, Suborder Frenatae, Arctiidae sp. Draw and label the bristle located on the humeral angle of the hind wing.** This bristle, the frenulum, unites the hind and front wing while in flight.

3) Examine the ventral surfaces of the wings of a butterfly. Note that the humeral angle and costal margin of the hind wing is expanded anteriorly. This increases the amount of overlap of the two wings and helps them to work in unison.

C. **Reduction in wing venation.**

1) Look once again at the Tabanidae wing. **On the same xeroxed sheet label all the longitudinal and cross veins, and the wing cells, and show:**

a. an example of a wing vein failing to branch (eg. R_{2+3}).
b. an example of vein fusion, side by side (eg. $Cu_2 + 2A$).

[Note - you can also have vein fusion, end to end; for example in the hind wing of Nymphalidae (Lepidoptera): $Sc + R_1$ fuse end to end].

D. **Increase in wing venation.**

1) **Prepare a drawing of the wing of Syrphidae (Diptera).** [Both pinned and glass mounted specimens are available]. Show the following:

a. an example of a spurious vein.
b. label the other longitudinal and cross veins showing the failure of a vein to branch (eg. R_{2+3}, R_{4+5}), and vein fusion, side by side (eg. M_{1+2}, $M_3 + Cu_1$, $Cu_2 + 2A$).

2) Examine the wings of Libellulidae (Odonata) [pinned specimens]. Note the following:

a. an example of marginal accessory vein (bifurcation of a vein) (eg. M_1, M_{1a}).
b. two examples of the following adventitious or secondary veins. (eg. the radial supplement - R_3, R_{spl}; or median supplement (eg. M_4, M_{spl}).

E. **Types of insect wings.**

1) Examine the mesothoracic wings of the grasshopper. These are somewhat hardened and leathery, and serve as a protective covering for the principal flight wings, the membranous metathoracic wings. This type of leathery protective wing is called **tegmina.**

2) Examine the mesothoracic wings of the Scarabaeidae beetle. These are very hardened and also serve as a

protective covering for the membranous metathoracic wings. This type of protective wing is called **elytra.**

3) Examine the mesothoracic wings of the stink bug, Pentatomidae. In these wings the basal portion is somewhat hardened and the distal portion is membranous. This type of wing is called **hemelytra.**

4) Examine the metathoracic wings of the Diptera. These will look very different. They will be reduced down to a small stalk-like protuberance with a small club on the end. These are called **halteres,** and function as organs of balance.

SOME GENERAL RULES IN NAMING WING VEINS AND CELLS

A. **The longitudinal veins.**

To orient yourself in naming the longitudinal veins of the generalized wing you should begin at the base of the wing. There may be as many as 7 major vein systems:

1. Costal - abbreviated C in drawings
2. Subcostal - abbreviated Sc in drawings
3. Radial - abbreviated R in drawings
4. Medial - abbreviated M in drawings
5. Cubital - abbreviated Cu in drawings
6. Anal or Vannal - abbreviated A or V in drawings
7. Jugal - abbreviated J in drawings

In general the longitudinal veins are abbreviated as above on drawings and are in capital letters. As the major veins bifurcate or fork the forks are then numbered as a subscript (eg. Sc_1, Sc_2, etc.). These are numbered with 1 being anterior and then 2, etc. In the generalized diagram at the distal end of the veins there are 2 subcostal veins, 5 radial veins, 4 medial veins, 3 cubital veins, and 3 anal veins. In the central part of the wing some of the veins have split and will split again more distally, but in the central part they are named for the 2 veins that they will split into. For example the Medial vein (M) splits into the M_{1+2} and the M_{3+4} veins. These then split into the M_1, M_2, M_3, and M_4 veins. {Exceptions: the anal veins actually have 3 veins at the base also, so these are named slightly differently. They are named 1A, 2A, and 3A rather than using subscripts. Also, for some reason the second split of the cubital vein is different than the other bifurcations. So, the 3 resulting cubital veins are labeled Cu_{1a}, Cu_{1b}, and Cu_2; the radial vein first splits into 2 veins: R_1 and the radial sector vein (abbreviated Rs)}

[REMEMBER - THERE WILL BE MANY EXCEPTIONS TO THESE RULES]

B. **The cross veins.**

Many of the cross veins are named for the 2 veins that they connect with the anterior vein first and the posterior vein second. These are abbreviated as in the longitudinal veins, but they are usually left in small letters. For example the cross vein between the cubital vein and the first anal vein is named the cu-a cross vein. If the cross vein connects two branches of the same major vein it is usually named for that major vein system. For example the cross vein that connects the R_1 and R_{2+3} veins is simply called the r cross vein. Some cross veins are given special more descriptive names. For example the cross vein near the humeral angle that connects the costal and subcostal veins is called the humeral cross vein (abbreviated as h), and the cross vein connecting the R_3 and the R_4 veins is called the sectorial cross vein (abbreviated as s).

C. **The wing cells.**

The wing cells are named by the vein that is just anterior to the cell (with the same abbreviations, and are capitalized). For example the cell just posterior to the R_5 vein is called the R_5 cell. If there is more than one cell posterior to the same vein then they are named as 1st and 2nd cells (eg. 1st radial cell, 2nd radial cell).

[REMEMBER - THERE WILL BE MANY EXCEPTIONS TO THESE RULES]

THE PREPARATION OF WING MOUNTS

(slightly modified from Borror, D. J. and D. M. DeLong)

Materials: 2 x 2 slides, 35-mm. masks, slide binding tape, distilled water, 95 percent alcohol, 10 percent hydrochloric acid, chlorox, watch glasses, forceps, dissecting needle, and specimens of insects whose wings are to be mounted.

The wings are mounted dry on these slides; the labeling is put on the mask (if a mask is used), or on the outside of the mount. The base of the wings should be to the left and the anterior edge of the wing toward the top of the slide.

Mounting Wings in General. If the wings are membranous, they are broken off the dried insect (being careful not to tear them), kept in 95% alcohol for a few minutes to be relaxed, placed on a slide and properly centered and oriented. After completely dried, the cover slide is added, and the slide is bound. It may be necessary to apply moderate pressure on the wings with the cover slide as the wings are drying to keep them from folding up again as they dry. If non-membranous wings are to be projected, it is better to clear them with KOH before they are mounted.

Mounting Wings of Lepidoptera.

1. Remove the wings from one side of the specimen, being careful not to tear them or to break any connections such as a frenulum between the front and hind wings.

2. Dip the wings in 95 percent alcohol for a few seconds to wet them.

3. Dip the wings in 10 percent hydrochloric acid for a few seconds.

4. Place the wings in the mixture of sodium chloride and sodium hypochlorite (chlorox), and leave them there until the color is removed. This usually requires only a few minutes; if the wings are slow in clearing, dip them in the acid again and then return them to the bleaching solution.

5. Rinse the wings in distilled water to remove the excess bleach.

6. Place the wings on the slide, centered and properly oriented (preferably with the base of the wings to the left); this is most easily done by floating the wings in water (for example, in a preparation dish) and bringing the slide up from underneath; the wings should be oriented on the slide while they are wet.

7. Allow the slide and wings to dry under a desk light. If all the bleach has not been removed and some is deposited on the slide, place the slide again in water, carefully remove the wings, clean the slide, and remount the wings.

8. Place the mask on the slide around the wings (data, labeling, and the like should be put on the mask), put on the cover slide, and bind.

A wing slide of this sort will keep indefinitely and can be studied under a microscope or can be projected on a screen for demonstration.