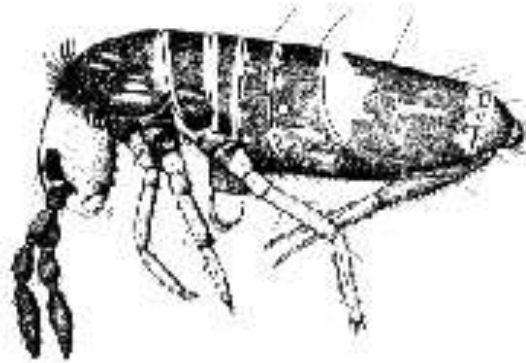
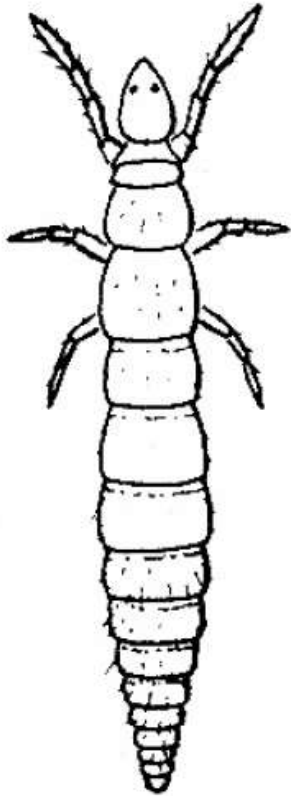
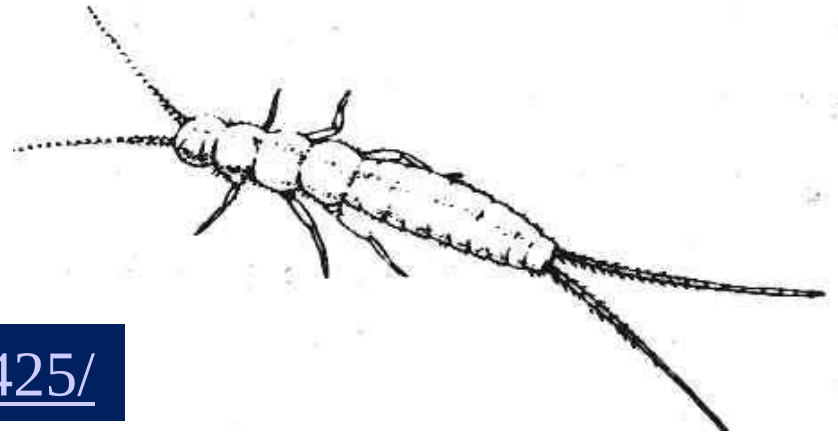


Protura, **Collembola**, Diplura



6-segmented
abdomen; furca and
retinaculum;
collophore on A1



Isotomidae



Sminthuridae



Microcoryphia and Zygentoma

arched trunk; 3 terminal filaments;
dorsally contiguous eyes; styli on A1-9;
monocondylic mouthparts

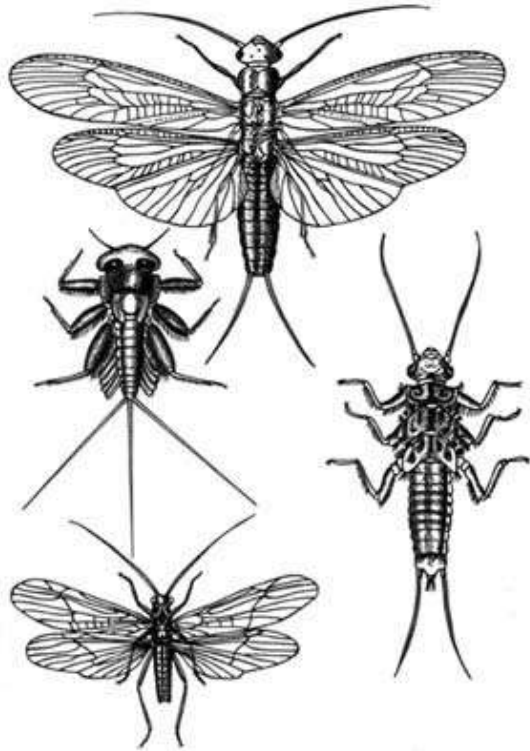


flattened; 3 terminal filaments; eyes
reduced or absent; dicondylic mouthparts



Short filiform or setaceous antennae; mesothorax enlarged with large triangular forewings; hindwings small or absent; A10 with long cerci and often with medial filament

Ephemeroptera



Long narrow wings (4); slender, elongate abdomen, large compound eyes, short bristle-like antennae, cerci unsegmented and function as claspers.



Anisoptera

hindwings wider at base

Libellulidae: toe well developed on anal loop; no notch on rear wing anal angle

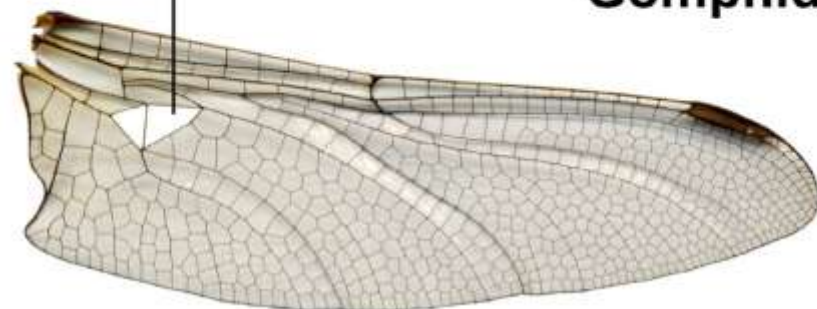
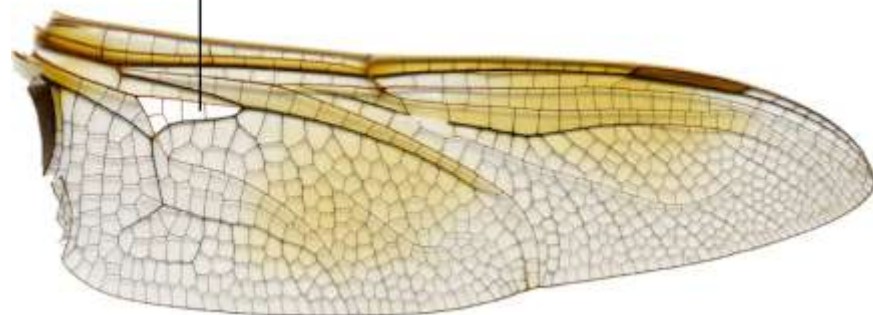
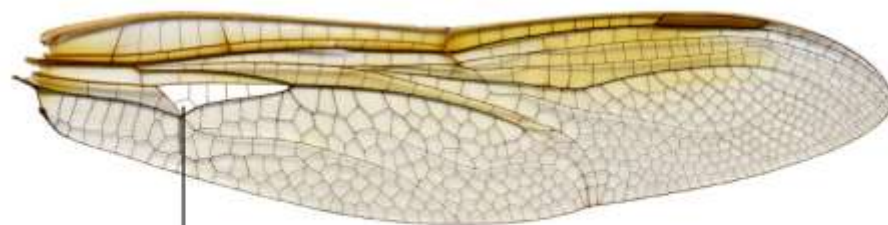
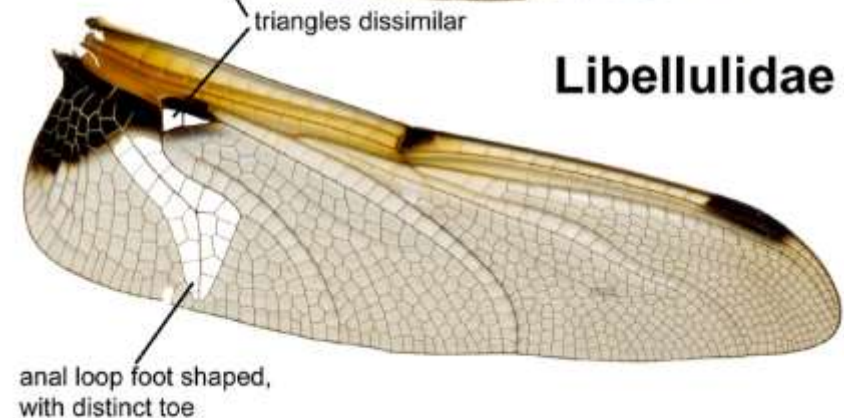
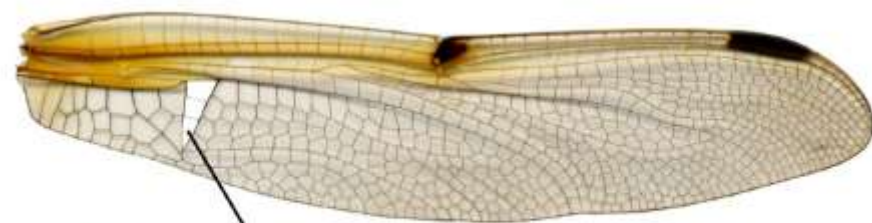
Zygoptera: front and hind wings similar in shape and narrow at base

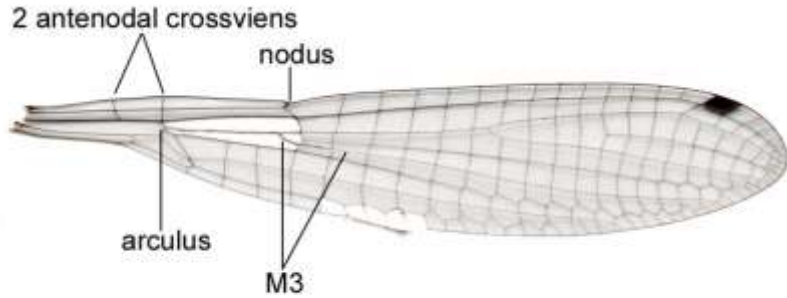
Coenagrionidae

Cu1 + Cu2 well developed (well beyond arculus)

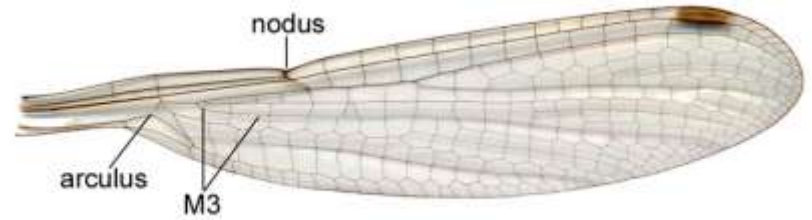
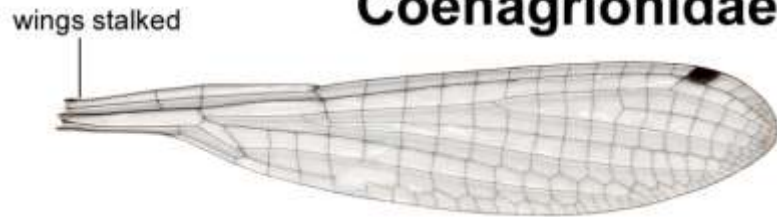


Zygoptera

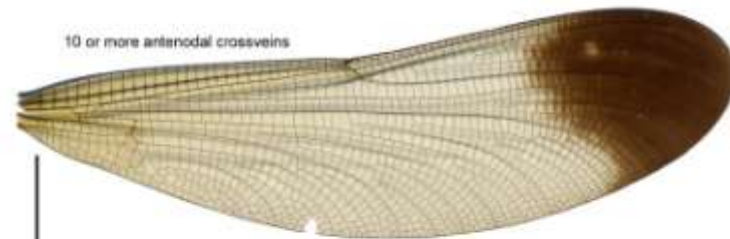
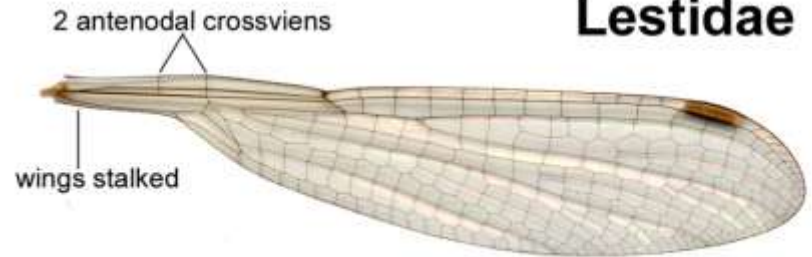




Coenagrionidae



Lestidae



wings not stalked
Calopterygidae
(*Calopteryx aequabilis* male)

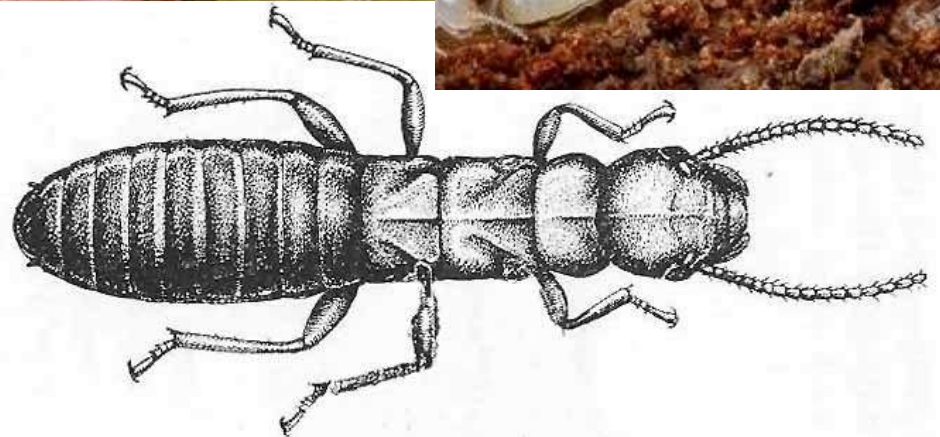


Odonata:
Libellulidae
Coenagrionidae

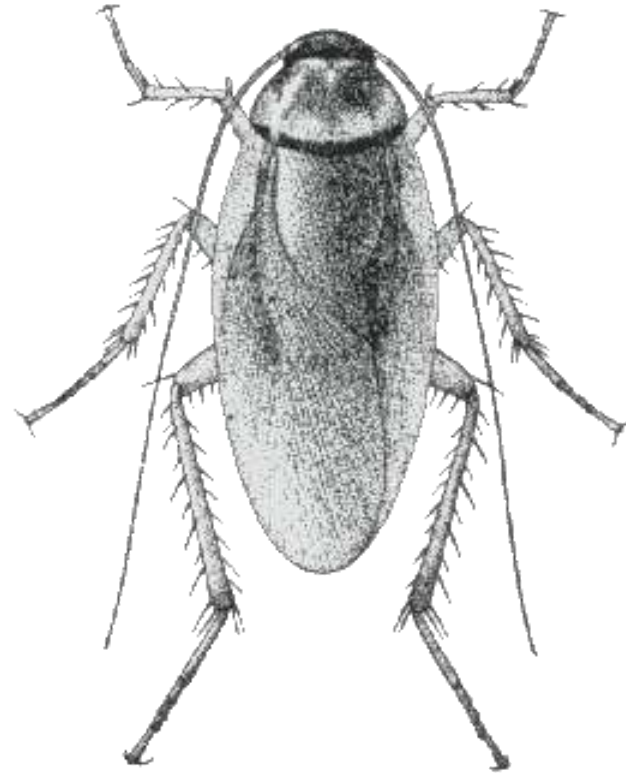
Superorder: Dictyoptera

Orders: **Mantodea**, **Blattaria**, **Isoptera** (1800, 4000, 2900 spp)

Closely related but now it seems that Isoptera is a highly derived family of Blattaria.



Blattaria



body flattened and oval; head concealed by pronotum; antennae long and slender

Isoptera

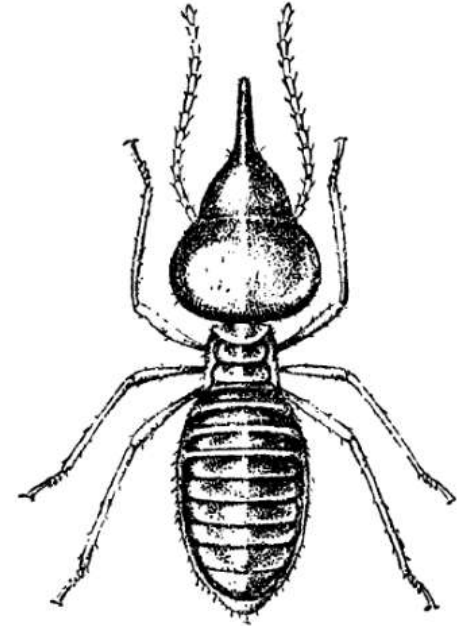


FIG. 19.—*Eutermes costaricensis*, Nasute Soldier
After Banks and Snyder (loc. cit.).

usually pale colored; antennae short and often moniliform; with and without wings—held flat over abdomen at rest; tarsi 4-segmented



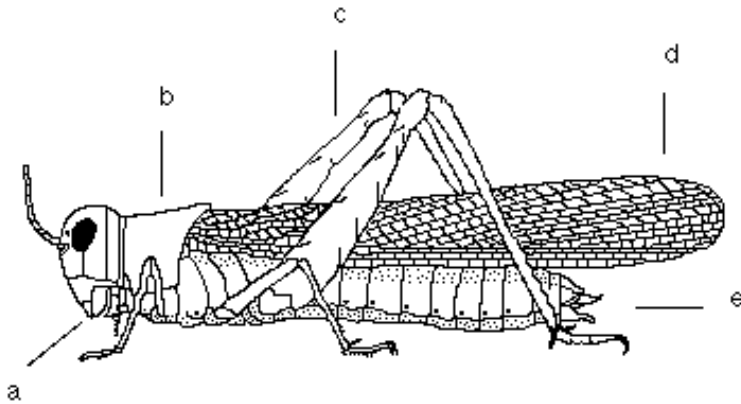
Dermaptera



short elytra meeting dorsally in a straight line;
cerci well-developed and forceps-like;
antennae filiform and about $\frac{1}{2}$ length of body
or less

Orthoptera

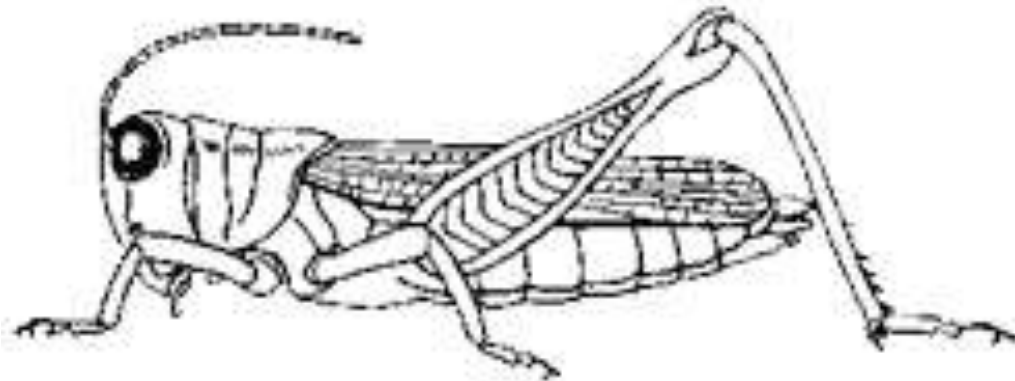
large hind femora; leathery wings



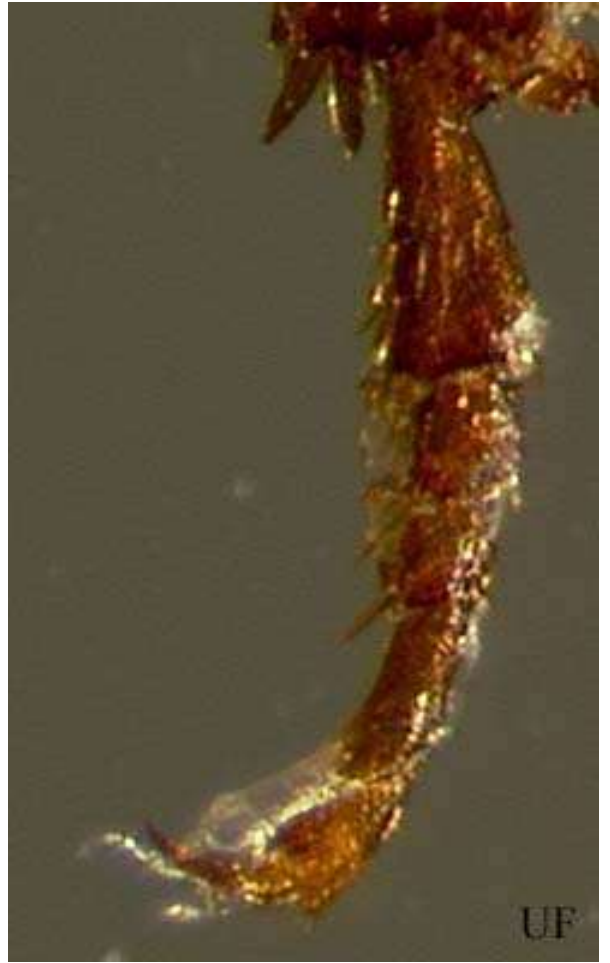
Caelifera: diurnal jumping orthoptera; tympana on A1; short antennae and ovipositer; tarsi 3 or fewer.



Tetrigidae: pronotum extends over abdomen and is narrowed posteriorly



Acrididae



Ensifera: nocturnal jumping orthoptera; tympana on front tibiae; long antennae; stridulate with wings; long ovipositor



Gryllotalpidae



Tettigoniidae: long-horned grasshoppers and katydids; most tarsi 4-segmented; ovipositor flattened



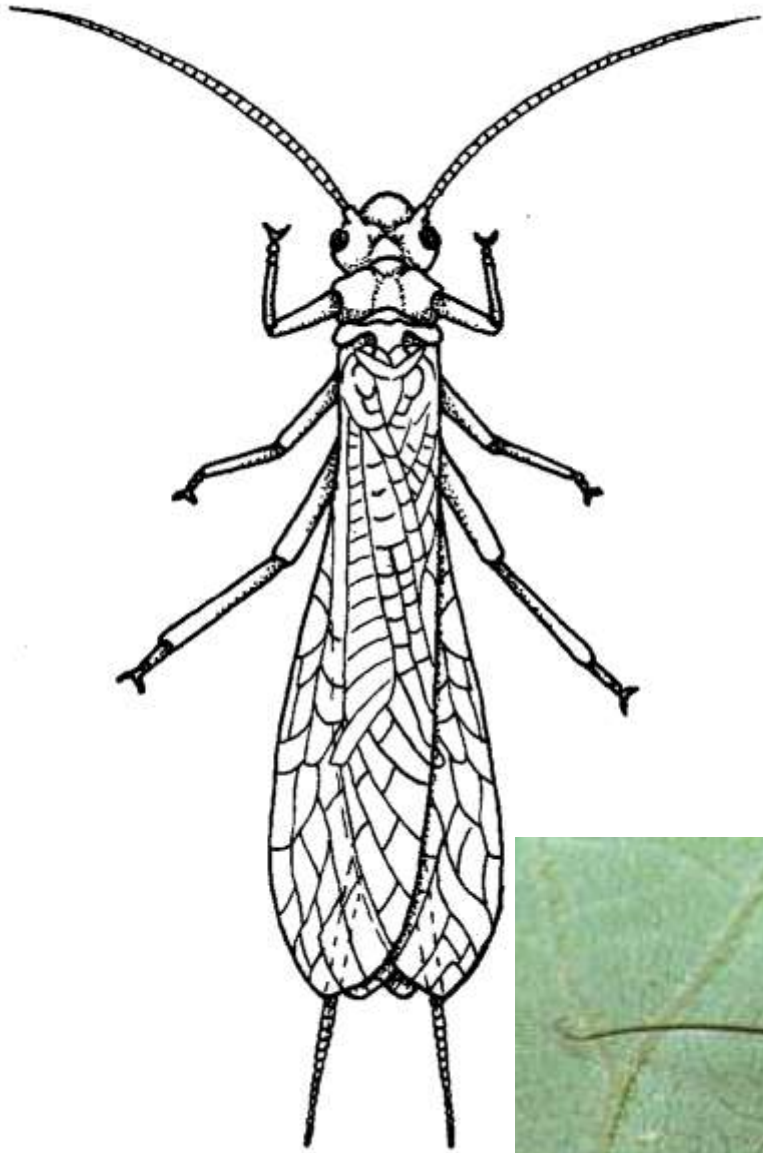
Gryllacrididae



Gryllidae: crickets; 3-segmented tarsi; ovipositor reduced

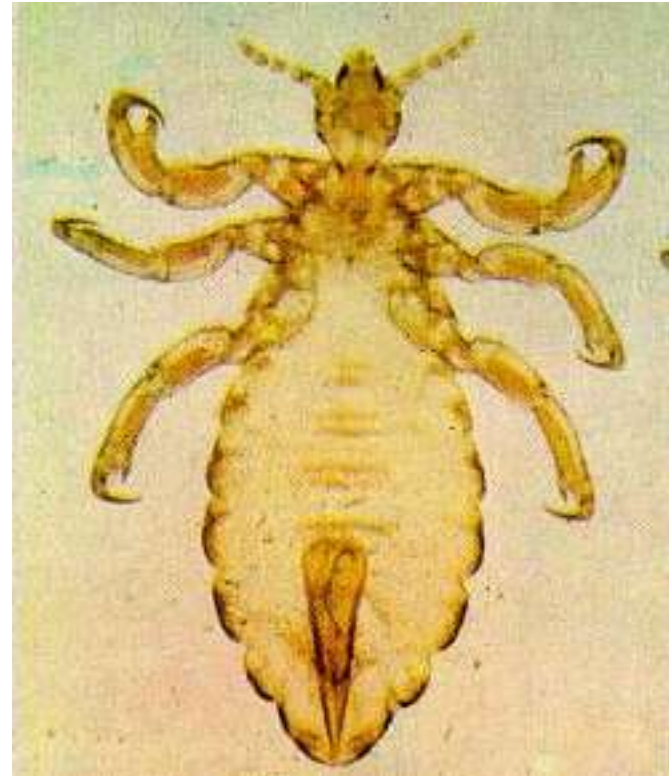


Stenopelmatidae

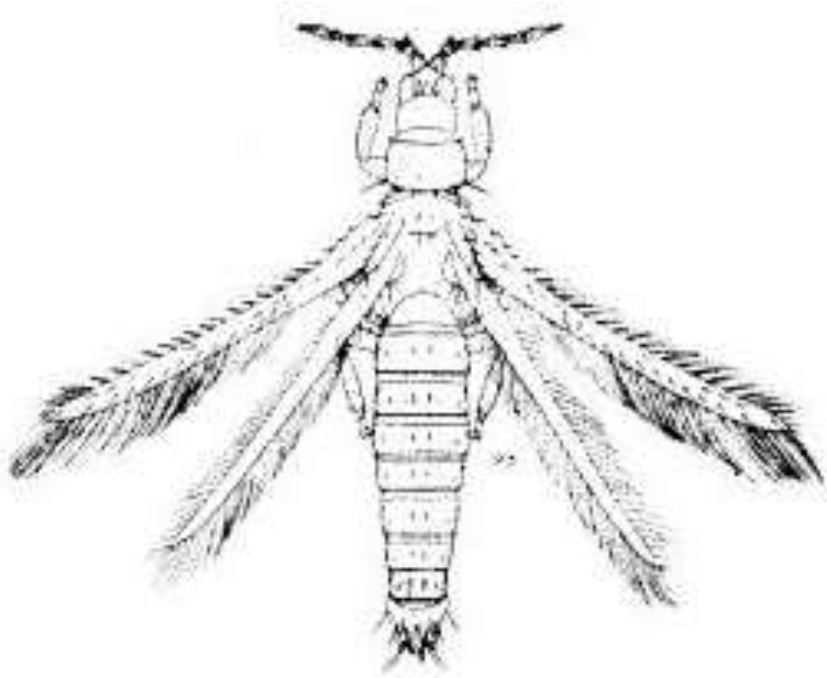


Plecoptera: elongate; flattened; FW long and narrow, HW shorter with large anal lobe; wings with many veins; tarsi 3-segmented; cerci present and often long; usually 3ocelli





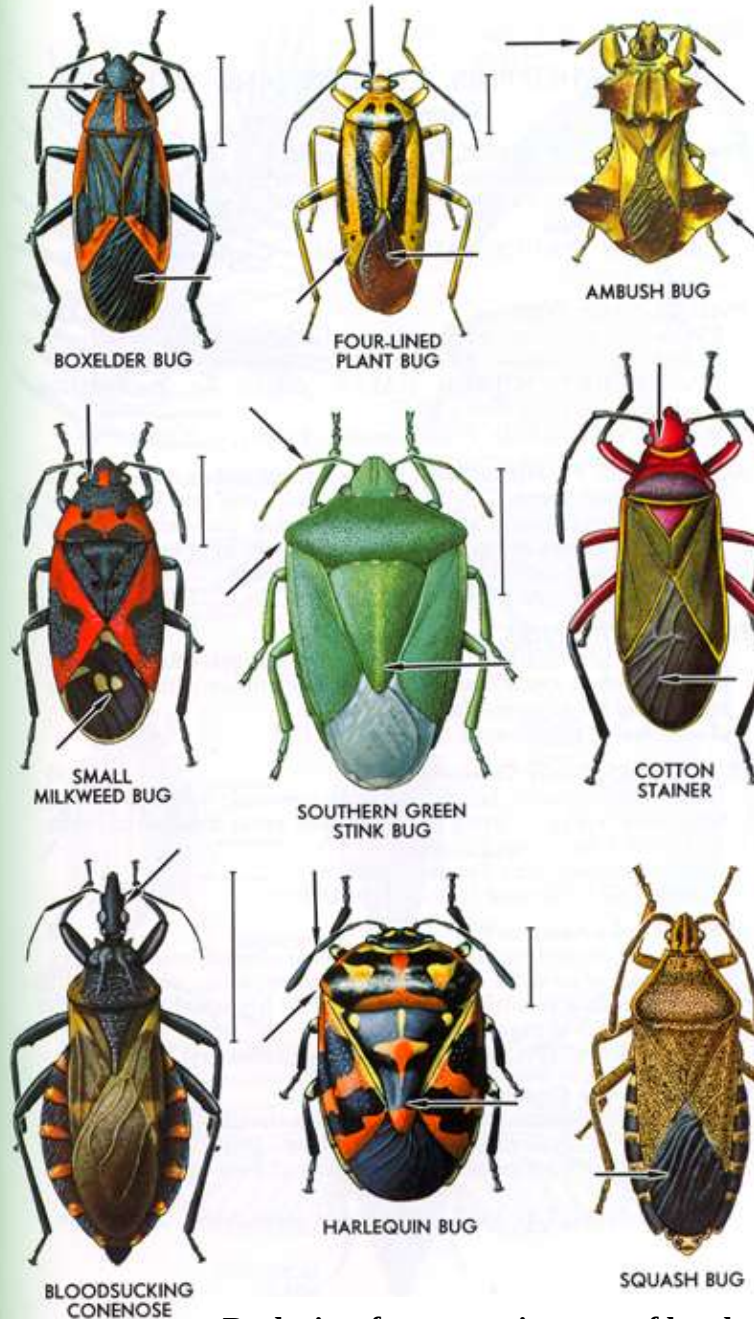
Phthiraptera



Thysanoptera

minute (.5-2mm); pale to black; with and without wings—long and narrow, fringed with long hairs; sucking mouthparts (conical beak)

Heteroptera

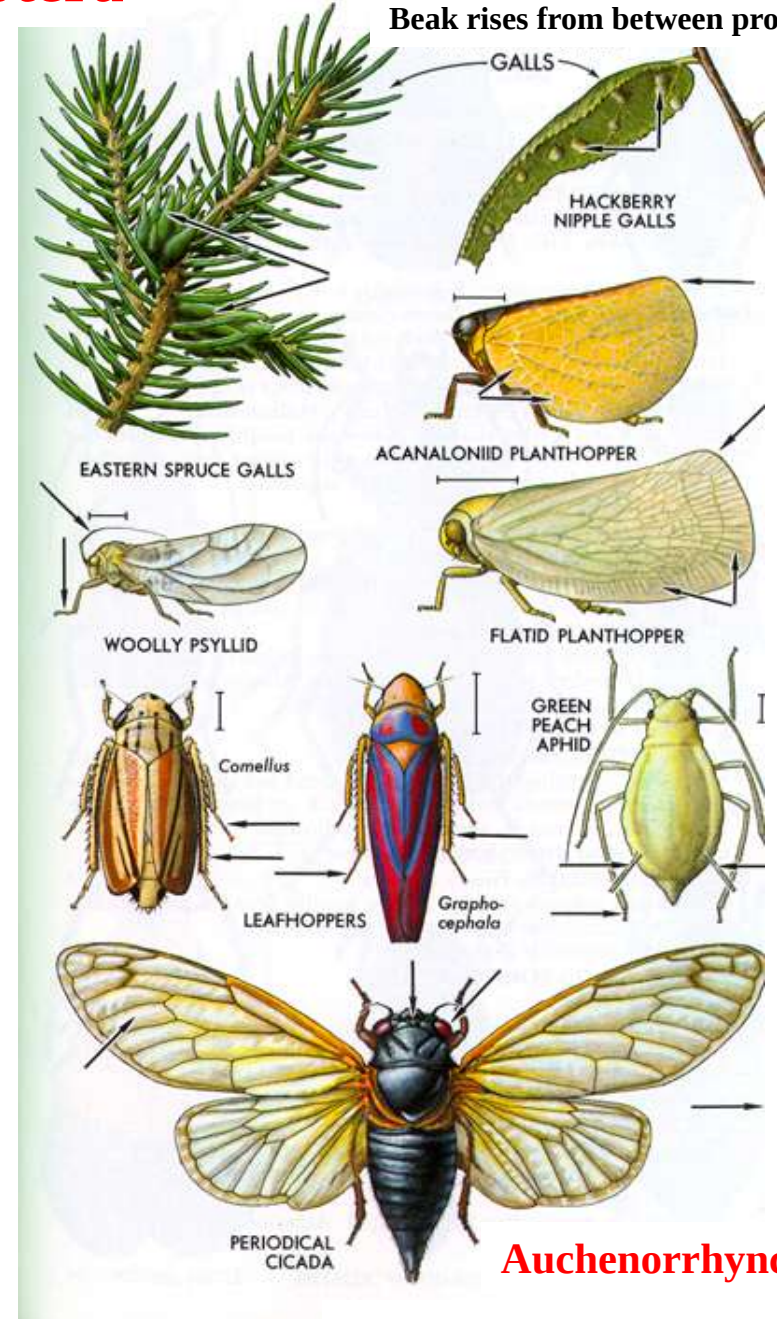


Beak rises from anterior part of head

Hemiptera

Sternorrhyncha

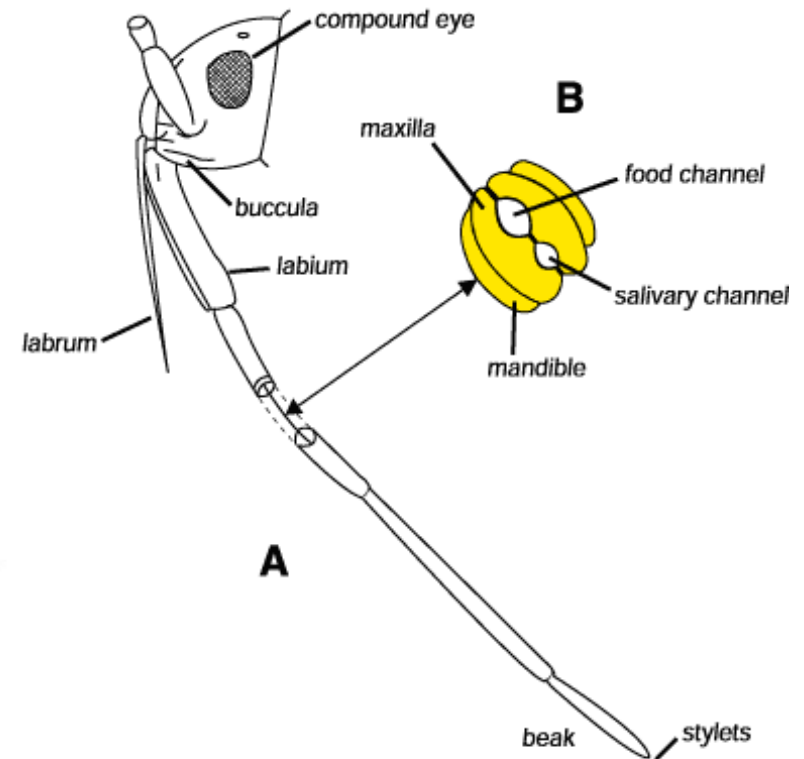
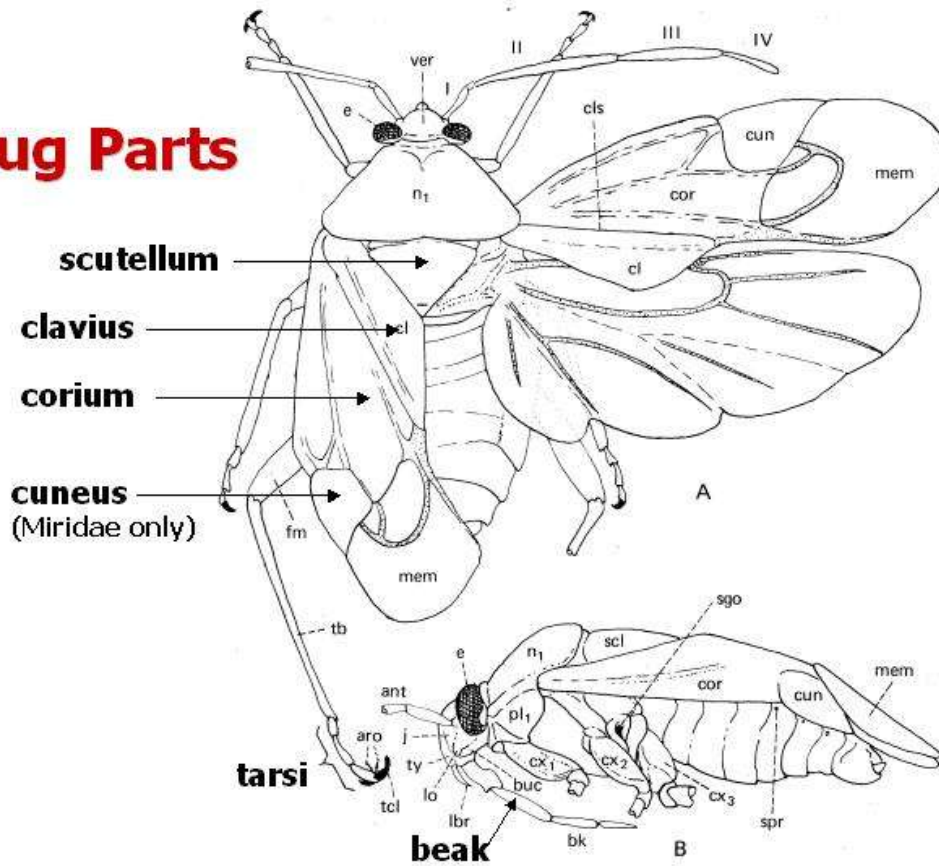
Beak rises from between procoxae



Auchenorrhyncha

Beak short, rises posteriorly

Bug Parts

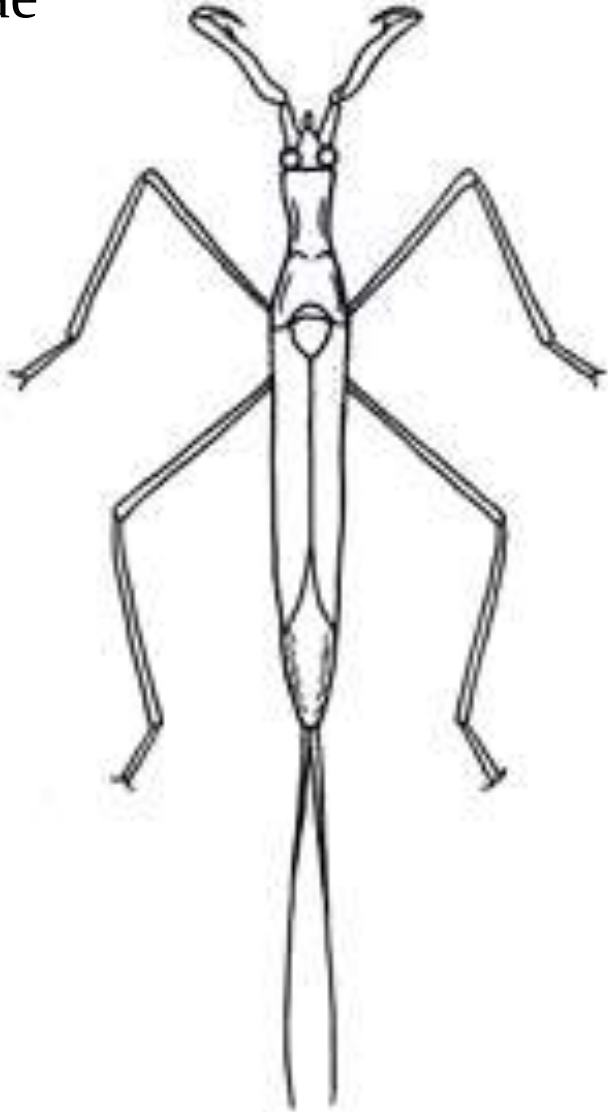


A, lateral view of the head showing beak, with the labrum detached from the front of beak

B, cross section of stylets

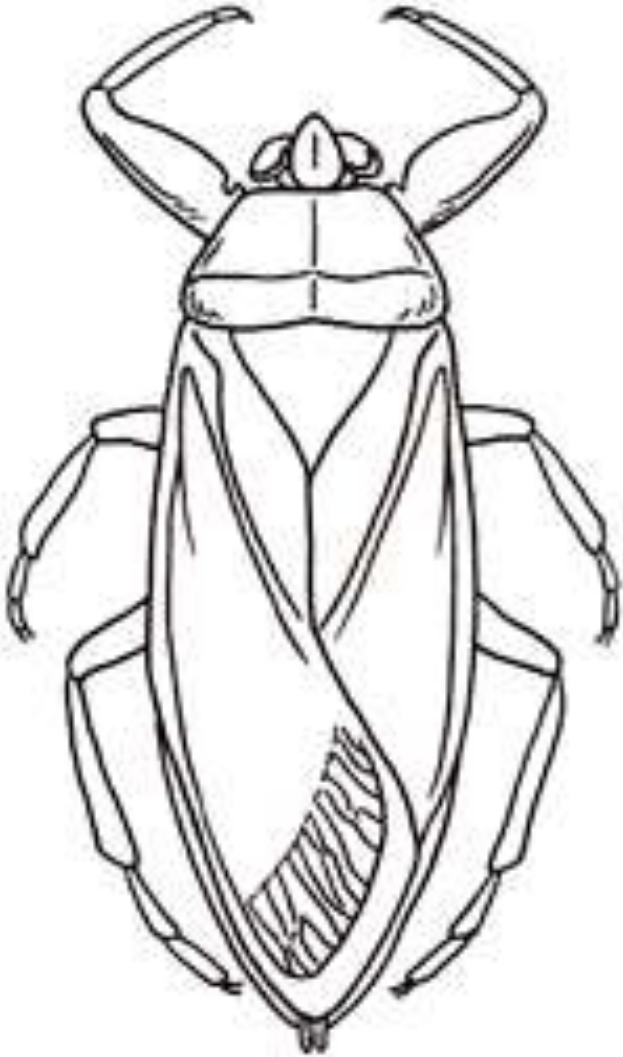
Hemiptera —
 Heteroptera
 Auchenorrhynca
 Sternorrhynca

Nepidae

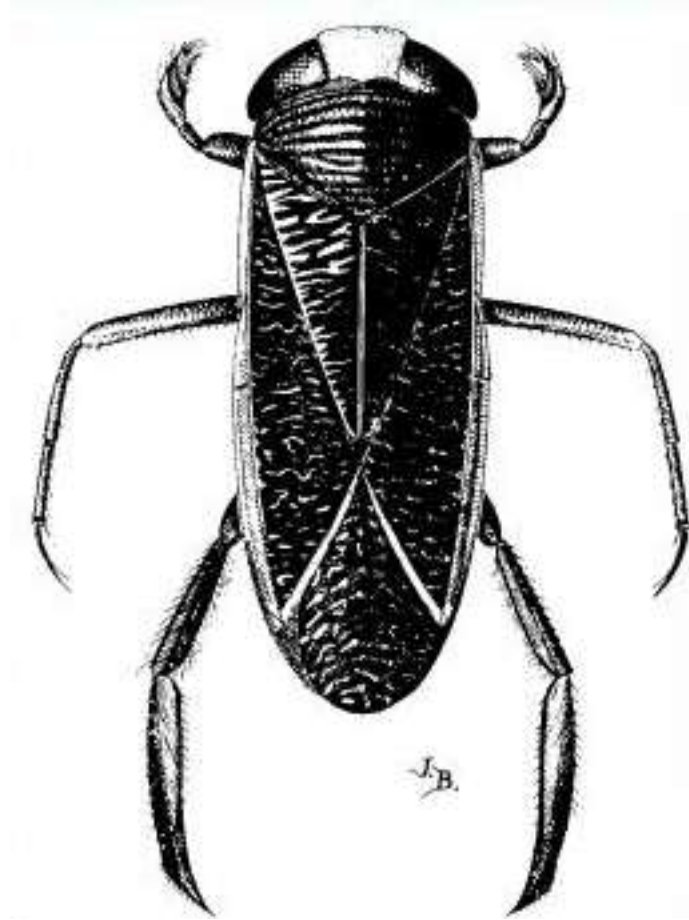


waterscorpions; front legs raptorial; terminal abdominal appendages long, slender, forming nonretractable breathing tubes

Belostomatidae

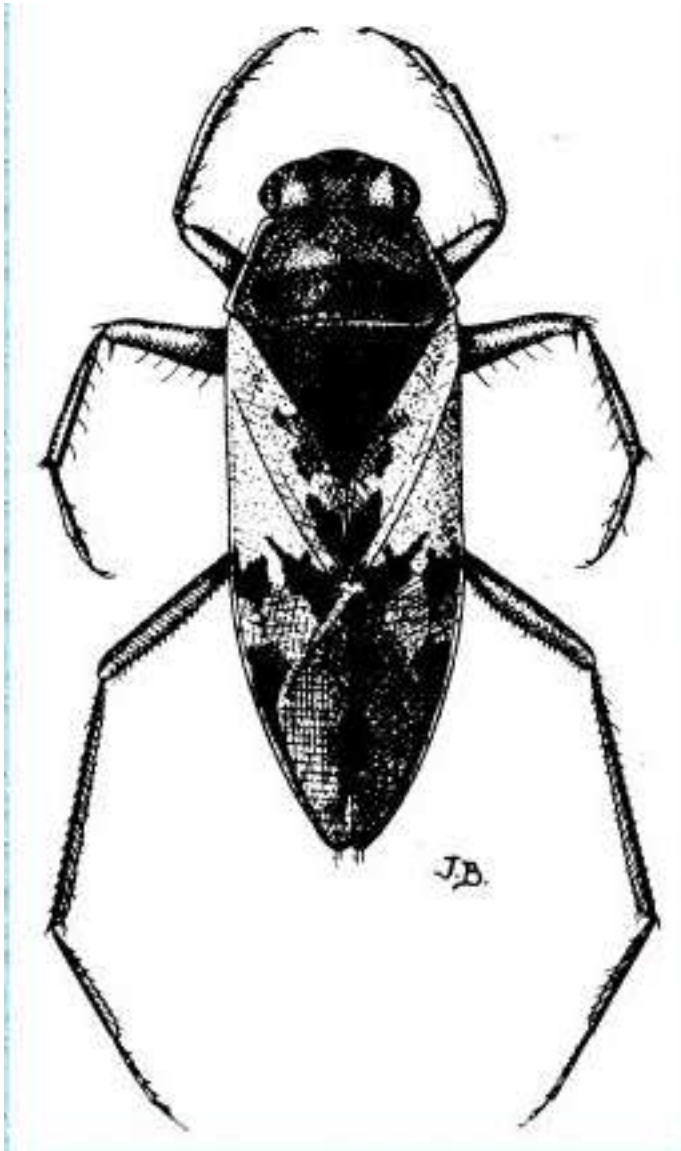


oval, flattened, large; raptorial front legs; hind legs flattened; terminal appendages short and retractable



Corixidae

water boatmen; elongate-oval; front legs short, tarsi 1-segmented and scooped; hind legs elongate and function as oars; dorsal surface flattened with narrow dark crosslines



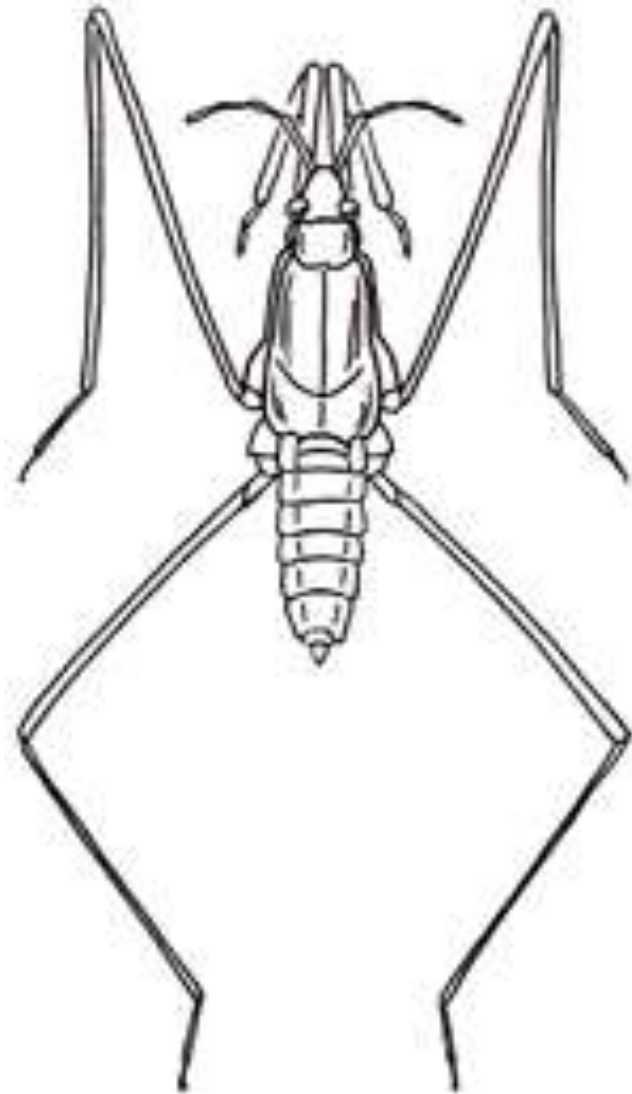
Notonectidae

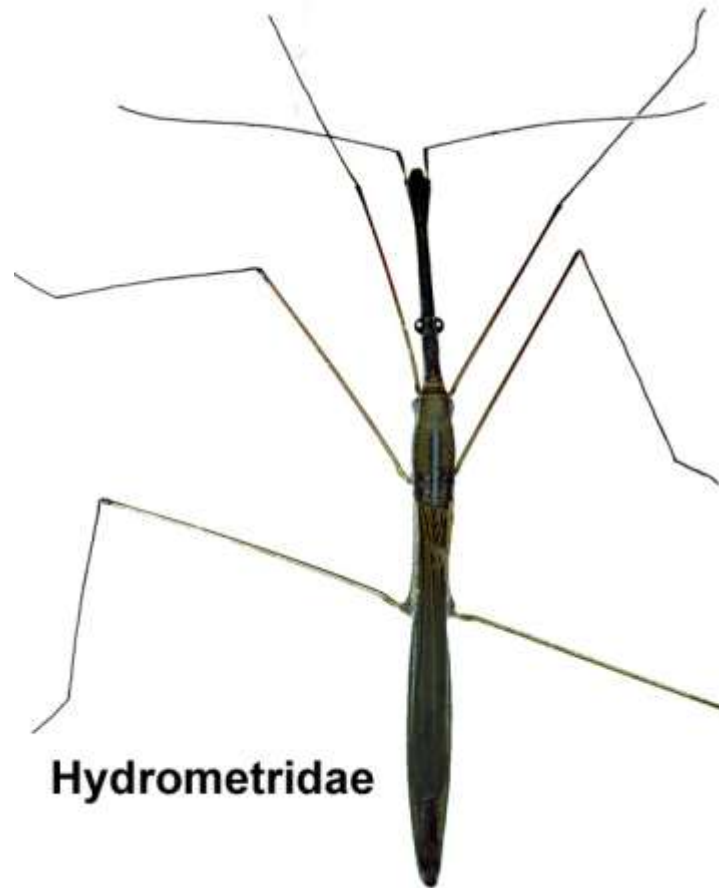
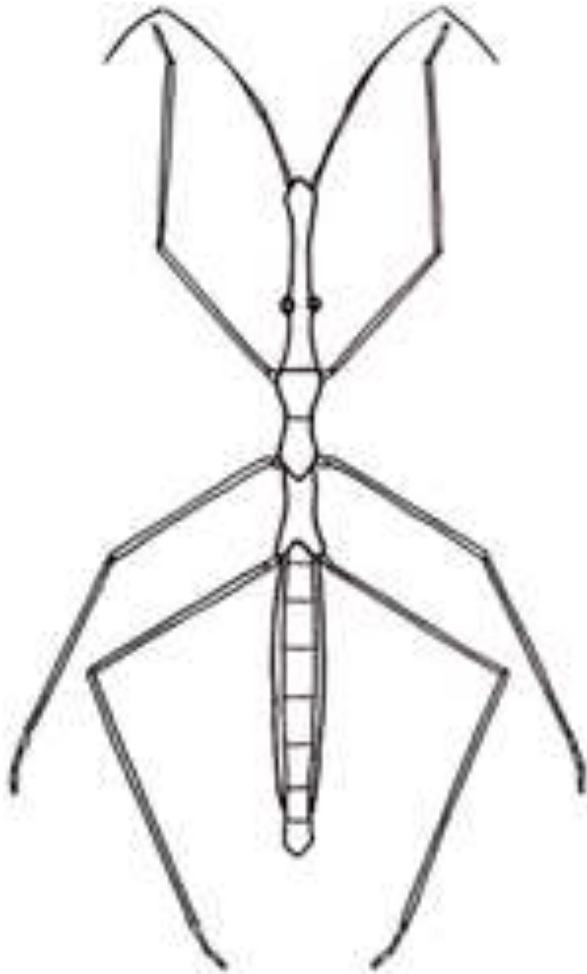
backswimmers; front tarsi not scooped; no dark crosslines



Gerridae

long legs; antennae exposed and longer than head; middle coxae closer to hind coxae than front coxae





Hydrometridae

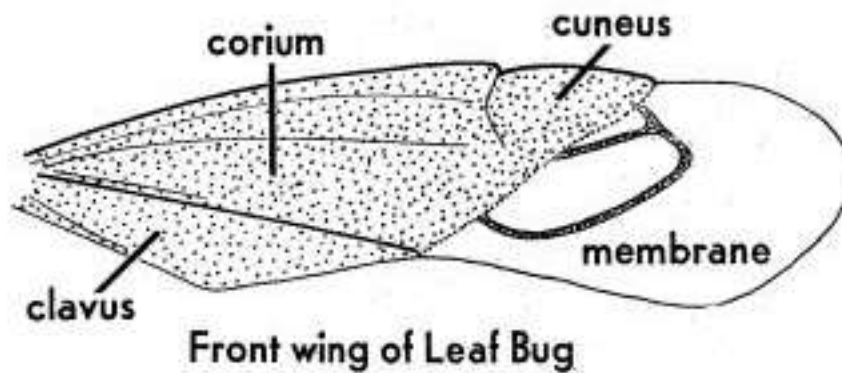
water measurers; very slender; head
elongate with conspicuous eyes
bulging laterally; usually wingless

Gelastocoridae

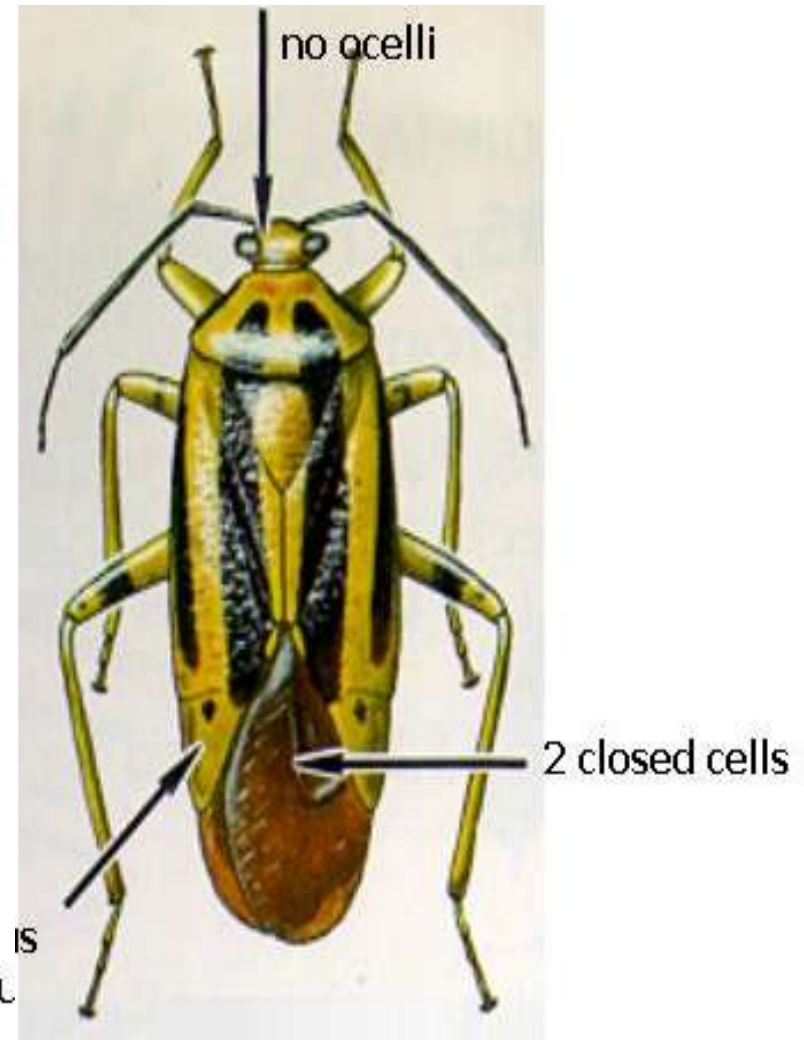


toad bugs

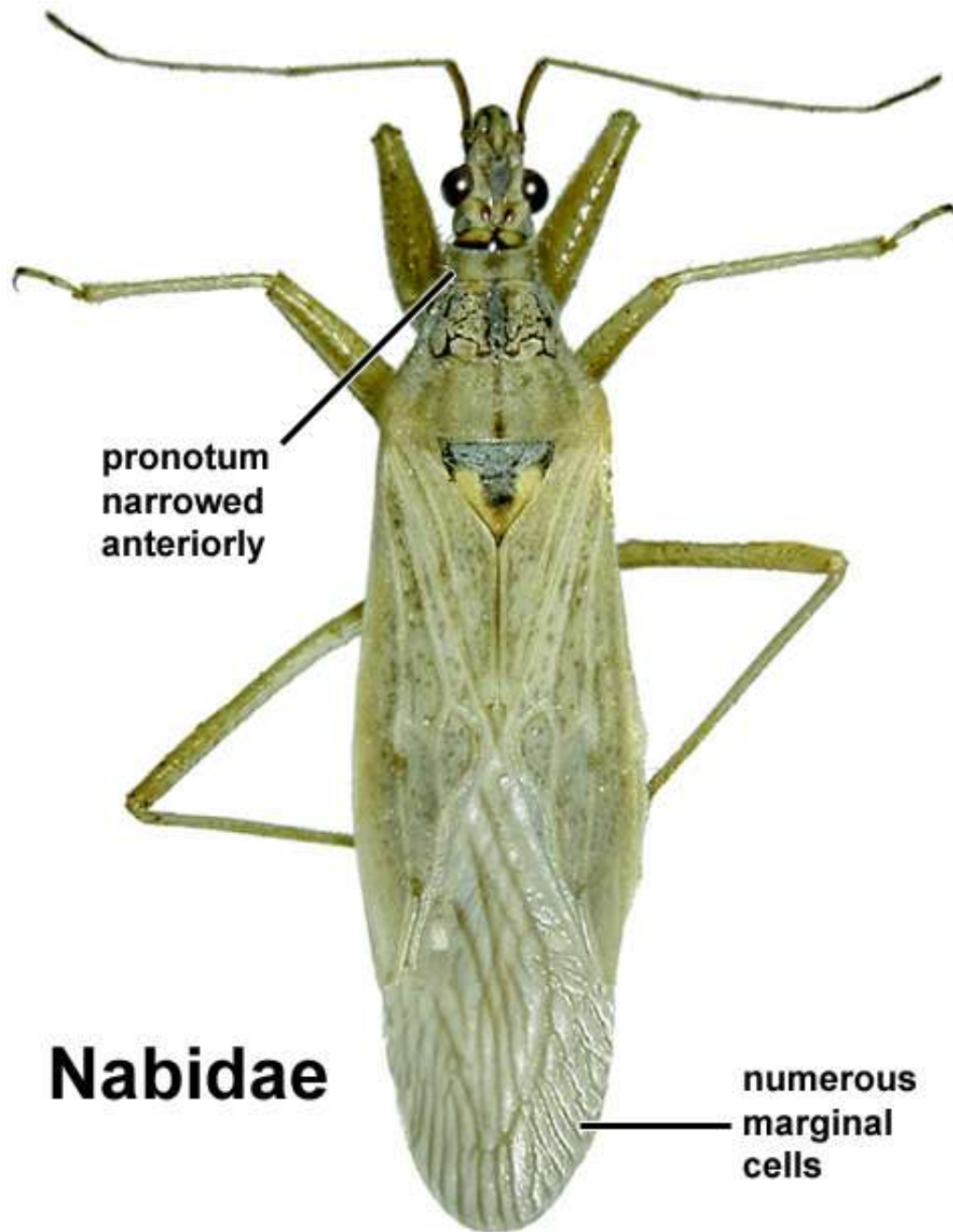
small, FW with a cuneus and membrane with 2 closed cells; ocelli absent; beak with 4 segments; tarsi with 3 segments



ae



Miridae



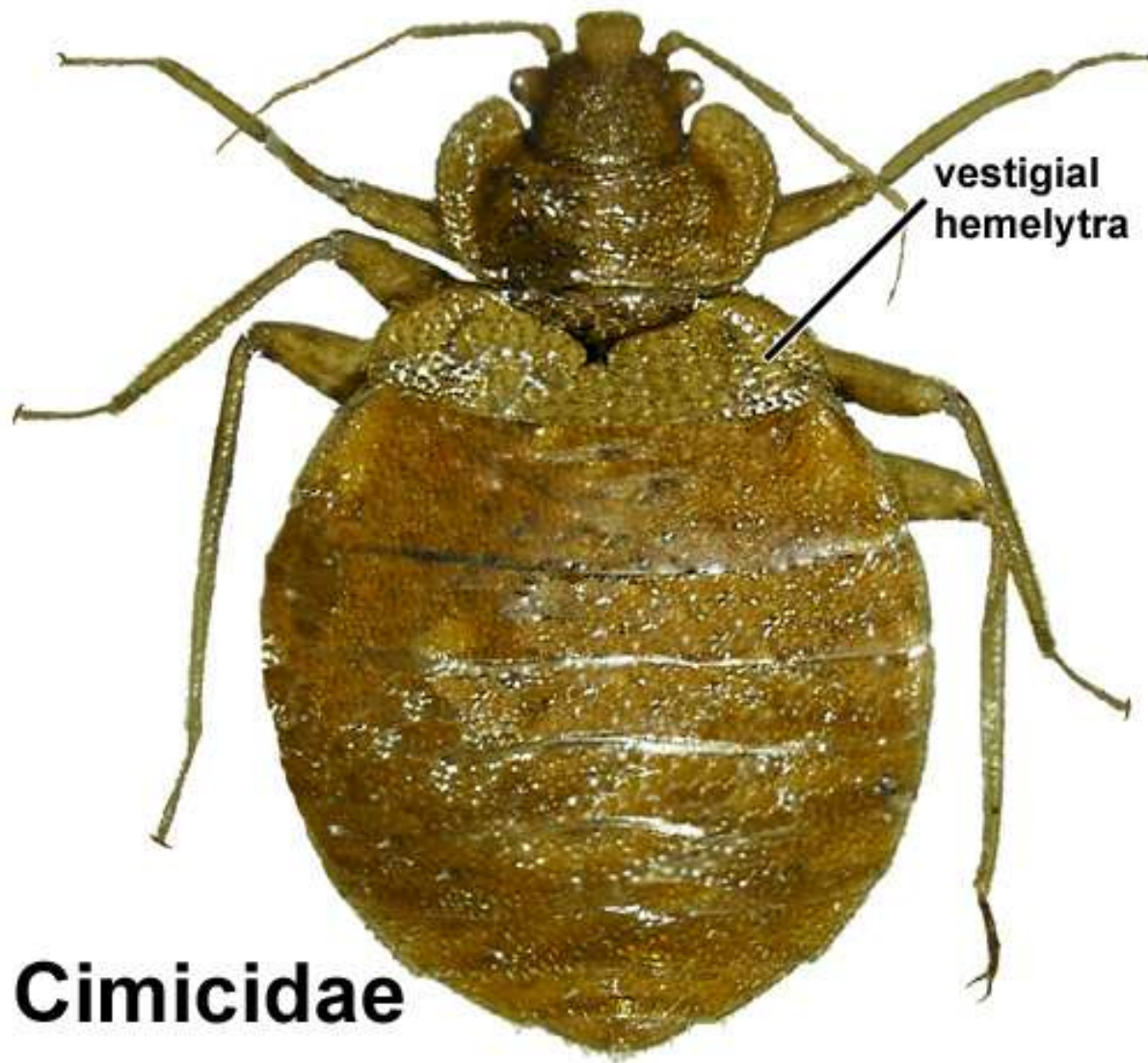
pronotum
narrowed
anteriorly

Nabidae

numerous
marginal
cells

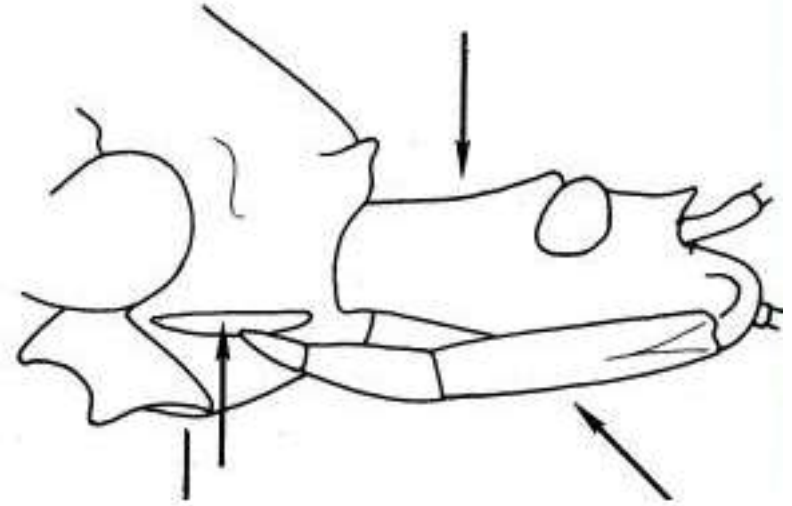
Anthocoridae





Cimicidae

Reduviidae: beak with 3 segments and fitting into a groove in prosternum; head elongate with transverse groove between eyes; edges of abdomen often extend laterally beyond wings; front femora thickened



Largidae



without ocelli and with
more veins in
membrane of FW



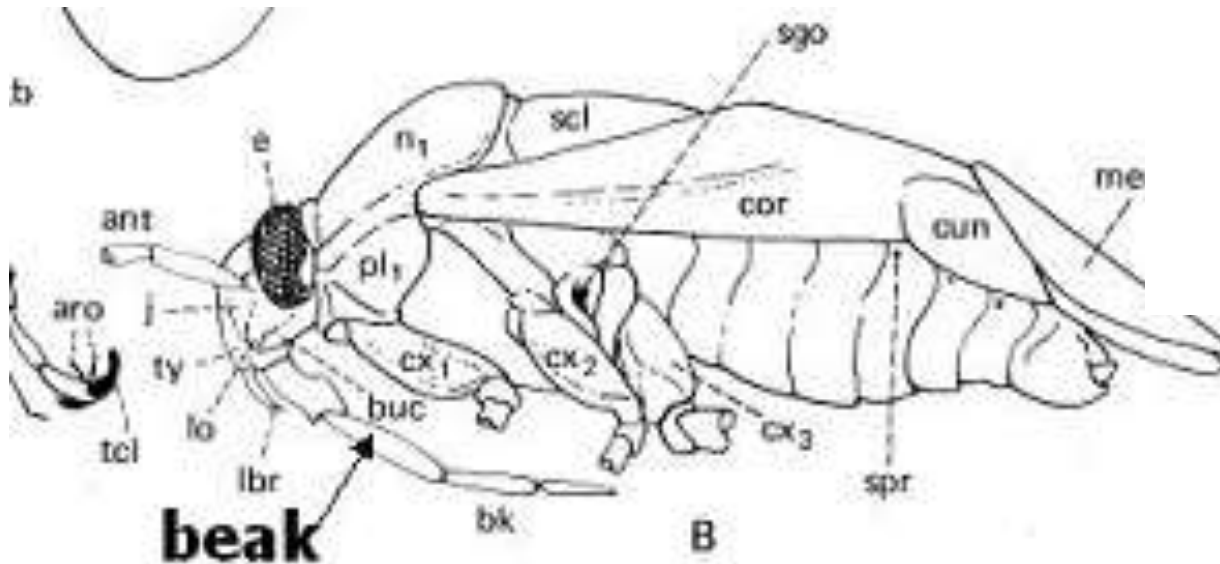
Lygaeidae

seed bugs; antennae and beak with 4 segments; tarsi with 3 segments and pad at base of each claw; membrane of FW with only 4 or 5 veins; all abdominal spiracles dorsal



Coreidae: leaf-footed bug; similar to Lygaeidae but with many veins in membrane of FW; head narrower and shorter than pronotum; hind tibiae sometimes leaf-like; scent glands on sides of thorax between middle and hind coxae

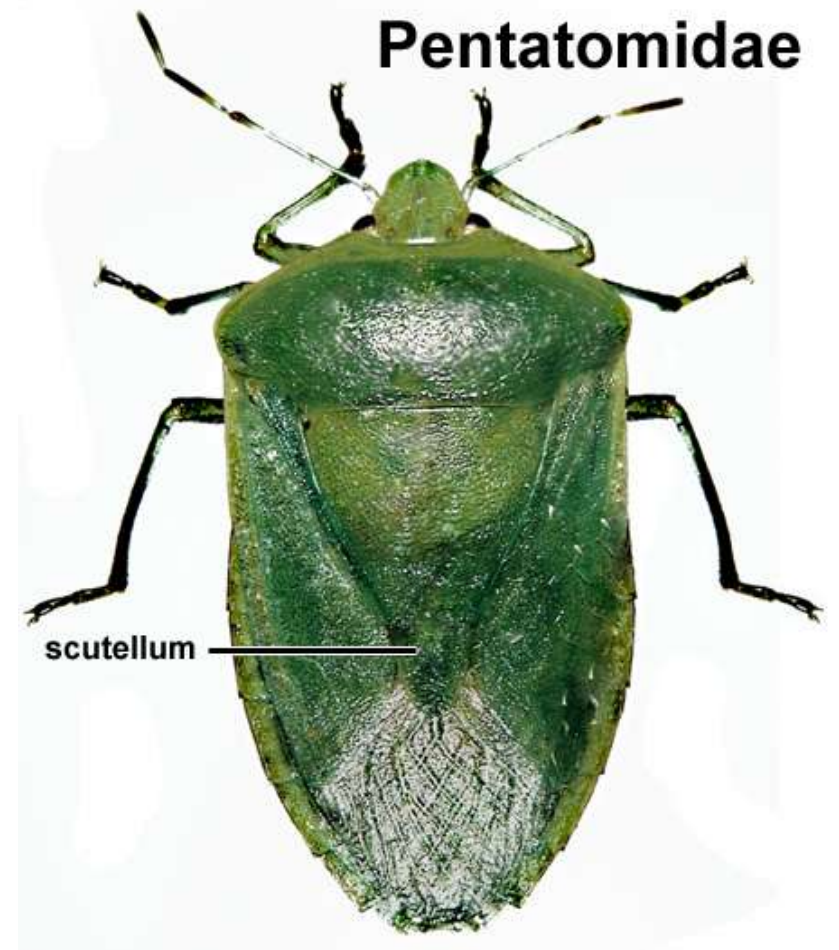
Coreidae



Rhopalidae
like coreids but
without scent glands

Pentatomidae:

antennae with 5 segments;
somewhat shield-shaped; scutellum large and triangular, but not reaching to apex of abdomen.



Suborder **Auchenorrhyncha**

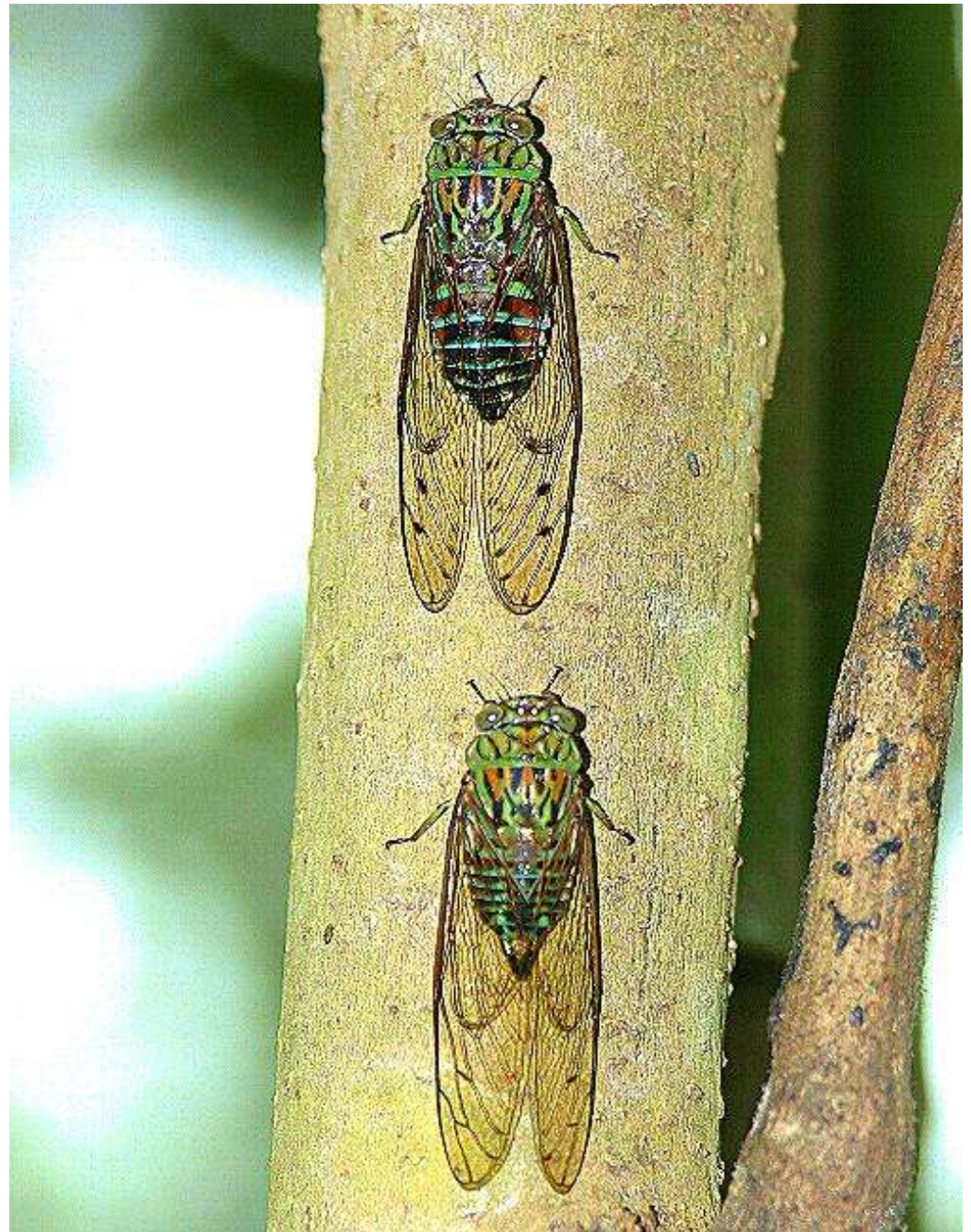


sucking mouthparts; beak short and rising posteriorly (appears like it comes from between front coxae); with and without wings; FW membranous or thickened; wings at rest usually held rooflike over body

Cicadidae



large insects; FW
membranous; 3 ocelli

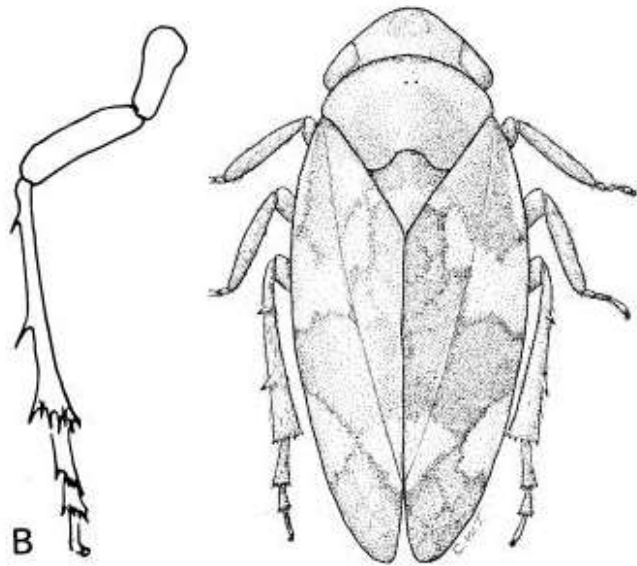




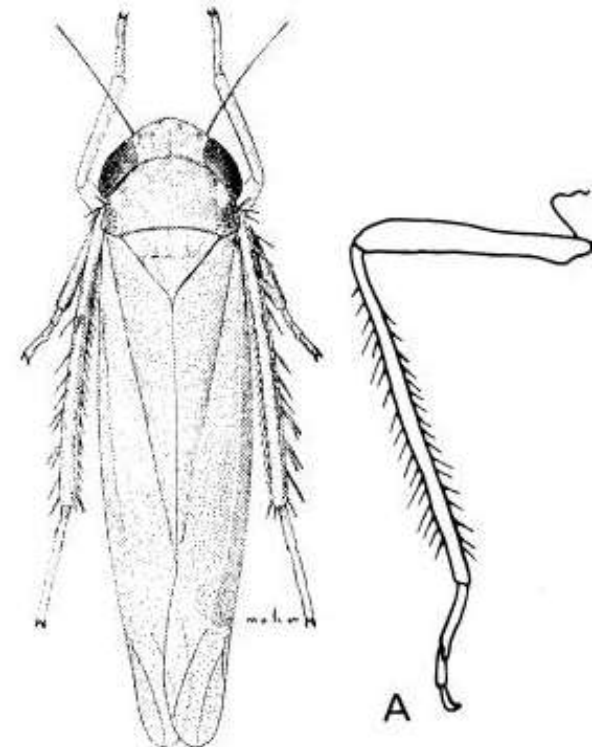
Membracidae



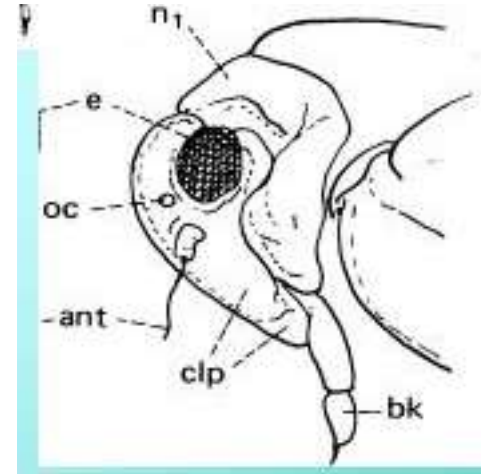
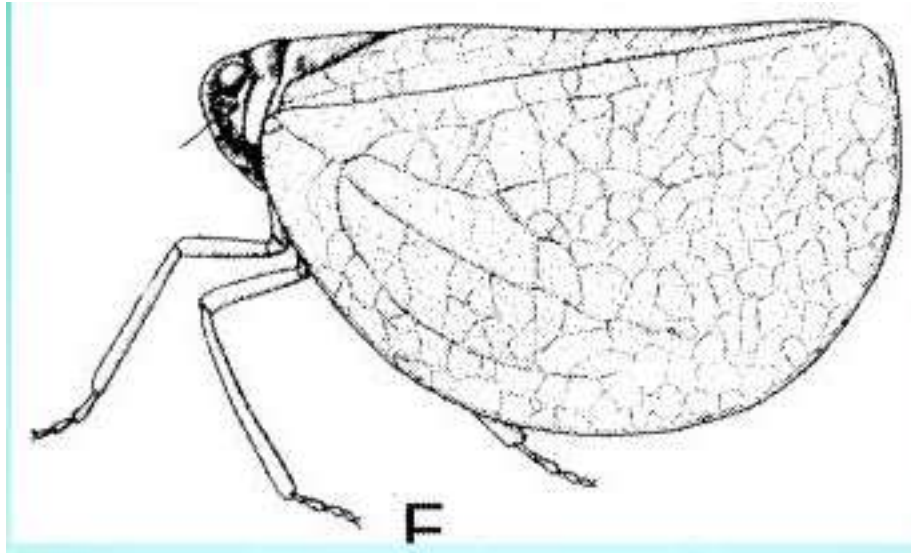
small (12mm or less); pronotum prolonged backward over abdomen



Cercopidae



Cicadellidae

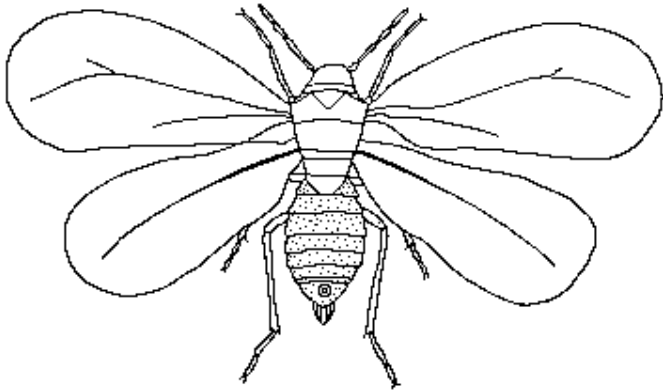


Fulgeroideae

antennae rise on sides of head beneath eyes; middle coxae elongate and separated; head often modified or elongated in front of eyes



Suborder Sternorrhynca: sucking mouthparts; beak short and rising posteriorly (appears like it comes from between front coxae); with and without wings (most common families without wings)



Aleyrodidae



Aphidae



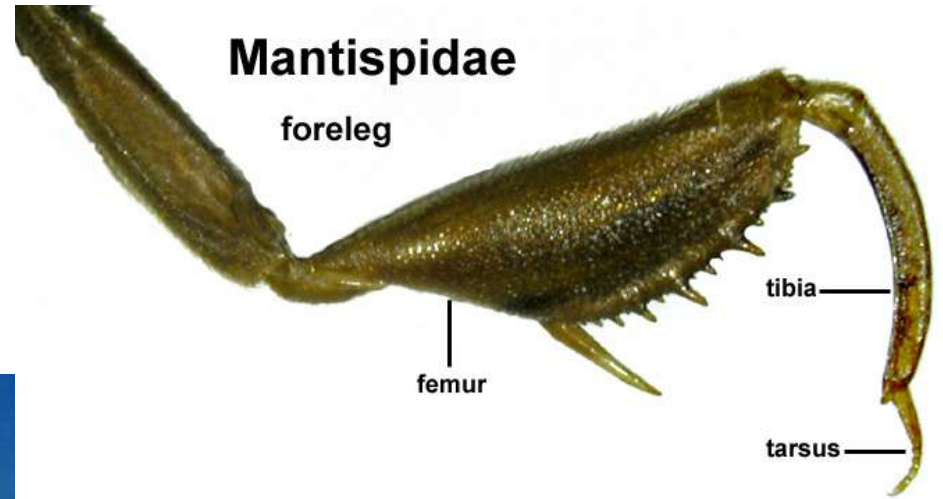
Coccidae

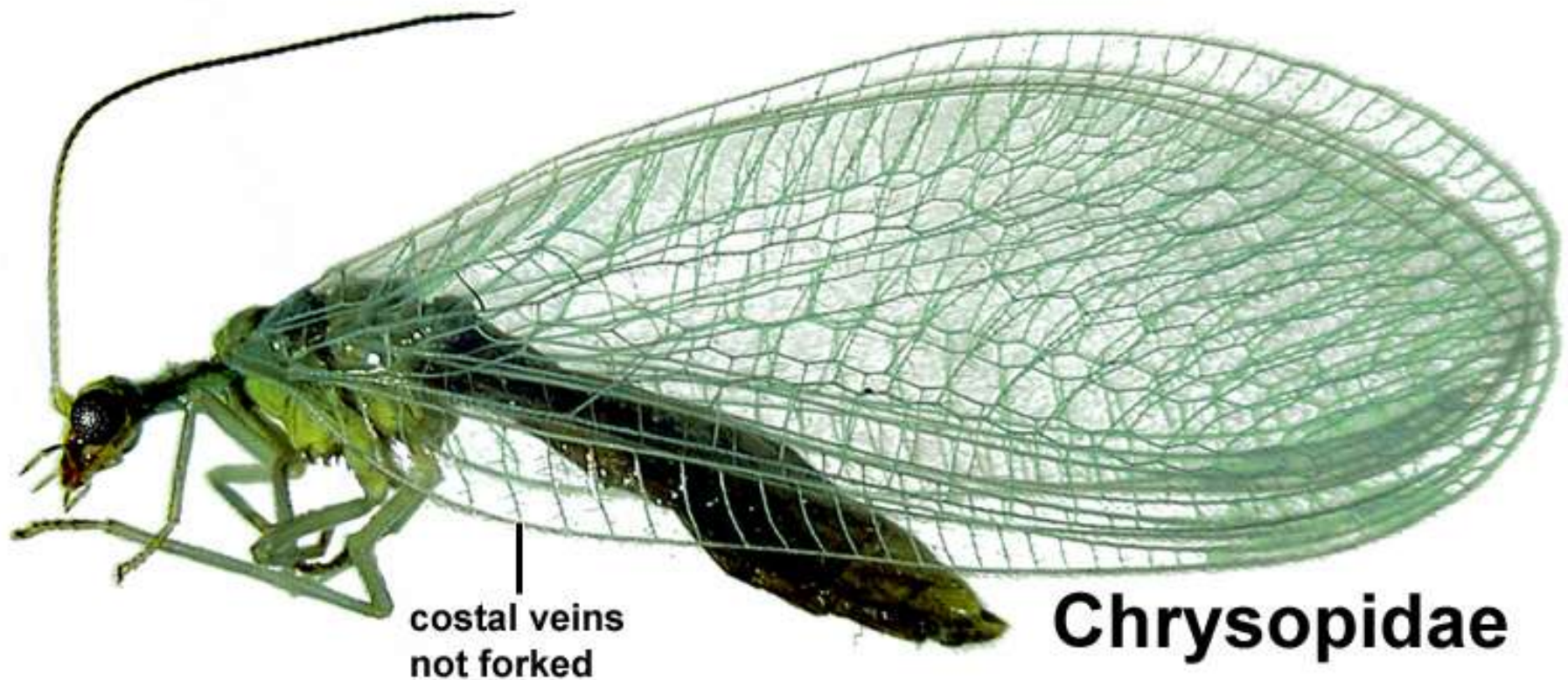


Neuroptera



4 membranous wings: FW and HW about same size or HW a little wider at base; wings usually held rooflike over body at rest; wings generally with many veins; antennae long, many segmented, tarsi 5-segmented.

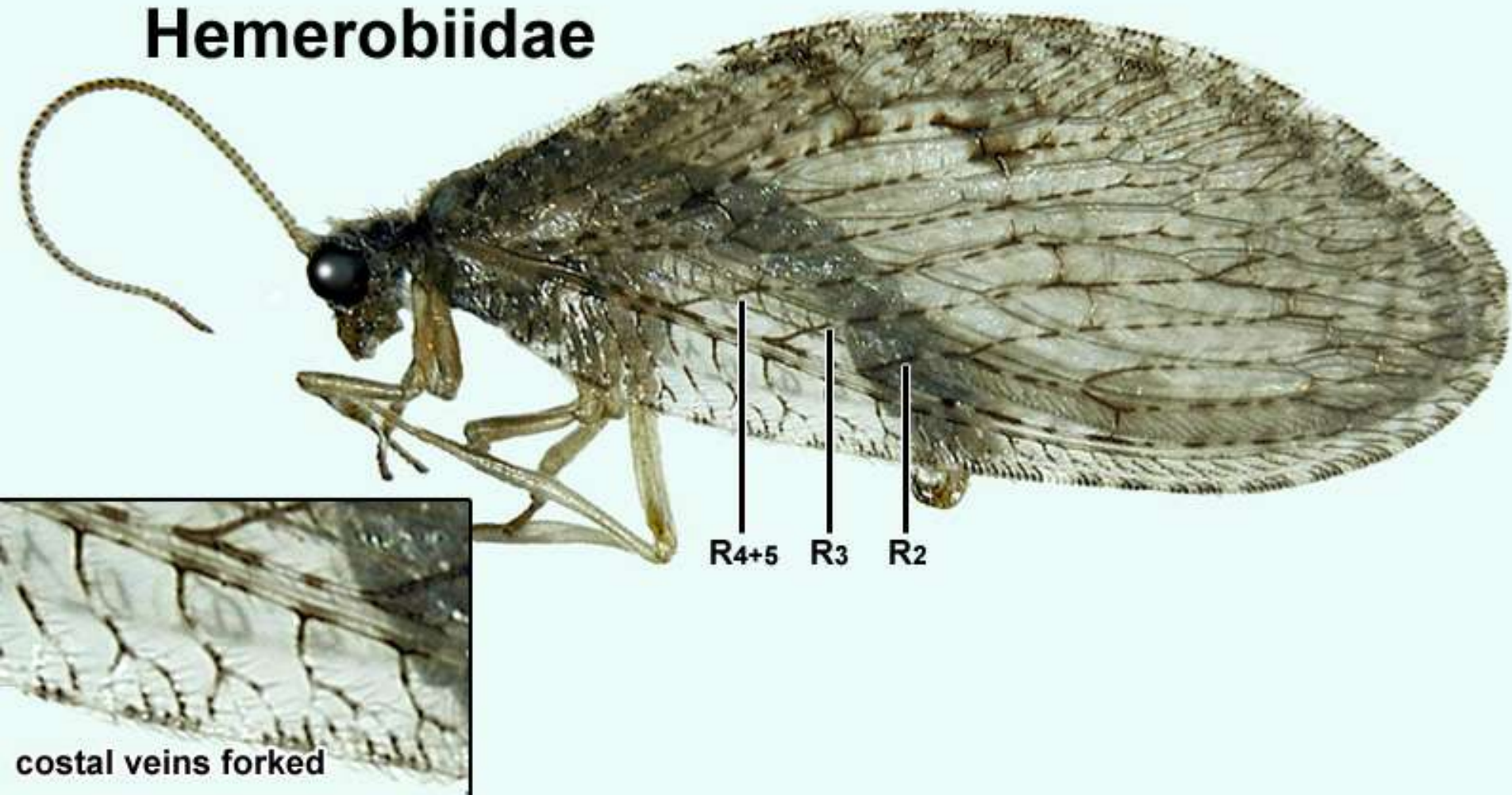


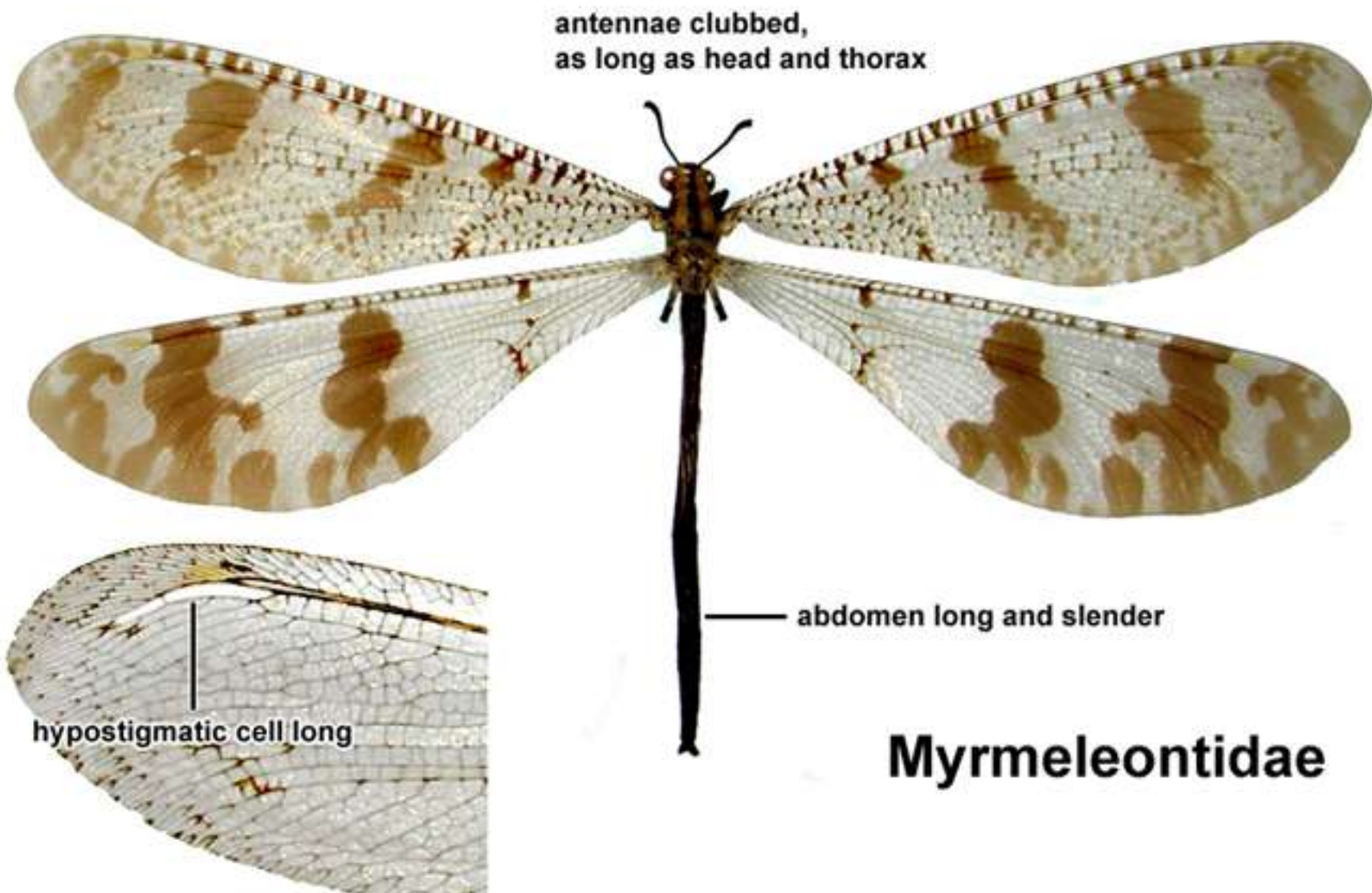


Chrysopidae

(lacewings): wings usually greenish and without bifurcate costal crossveins, eyes golden or copper-colored; Sc and R1 not fused at wing tip.

Hemerobiidae



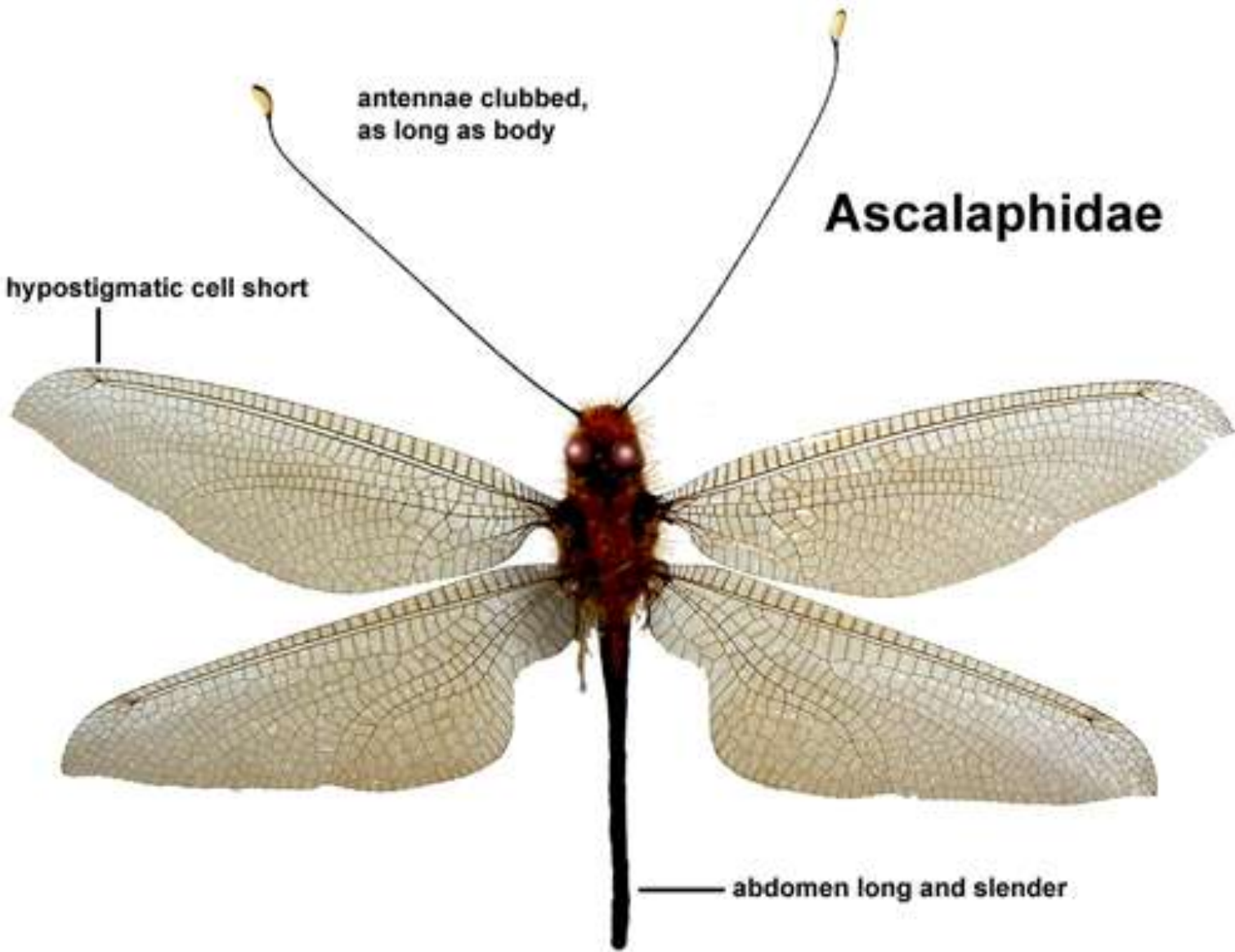


Ascalaphidae

antennae clubbed,
as long as body

hypostigmatic cell short

abdomen long and slender

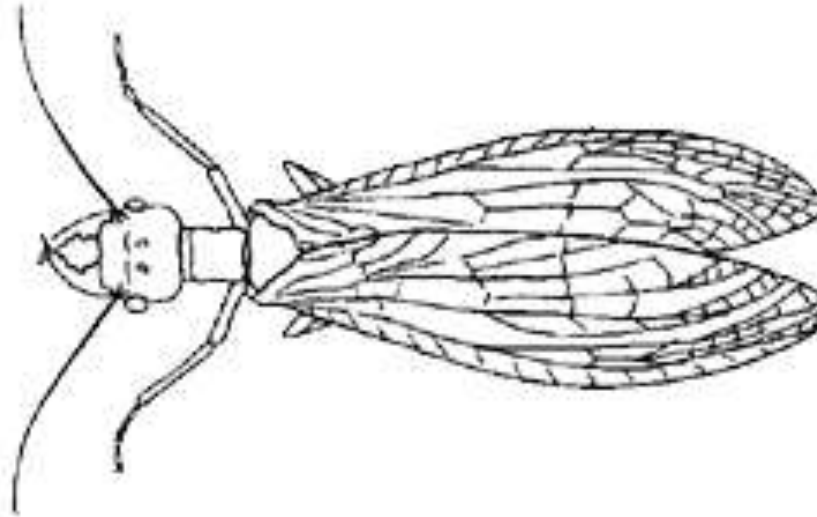


Megaloptera

HW broader at base than FW; 4th tarsal segment cylindrical; ocelli present; soft-bodied; males with greatly enlarged mandibles.

Corydalidae

Corydalus cornutus
male



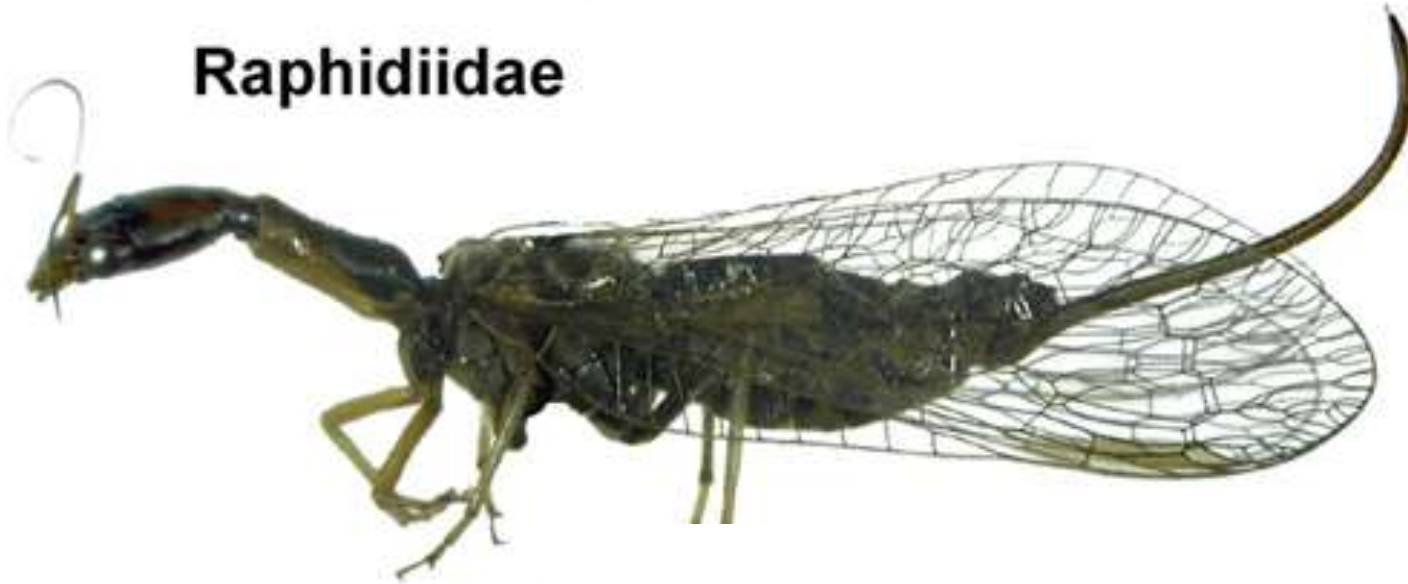
Corydalidae



Nigronia serricornis

Raphidioptera

Raphidiidae



prothorax elongate;
front legs rise from
posterior end of
prothorax and are
similar to other legs;
female with long,
slender ovipositor



Coleoptera

with elytra (modified FW)
meeting in a straight line
down the back and
covering HW; mouthparts
chewing; Holometabolous
(complete
metamorphosis); tarsi
usually 3-5 segmented





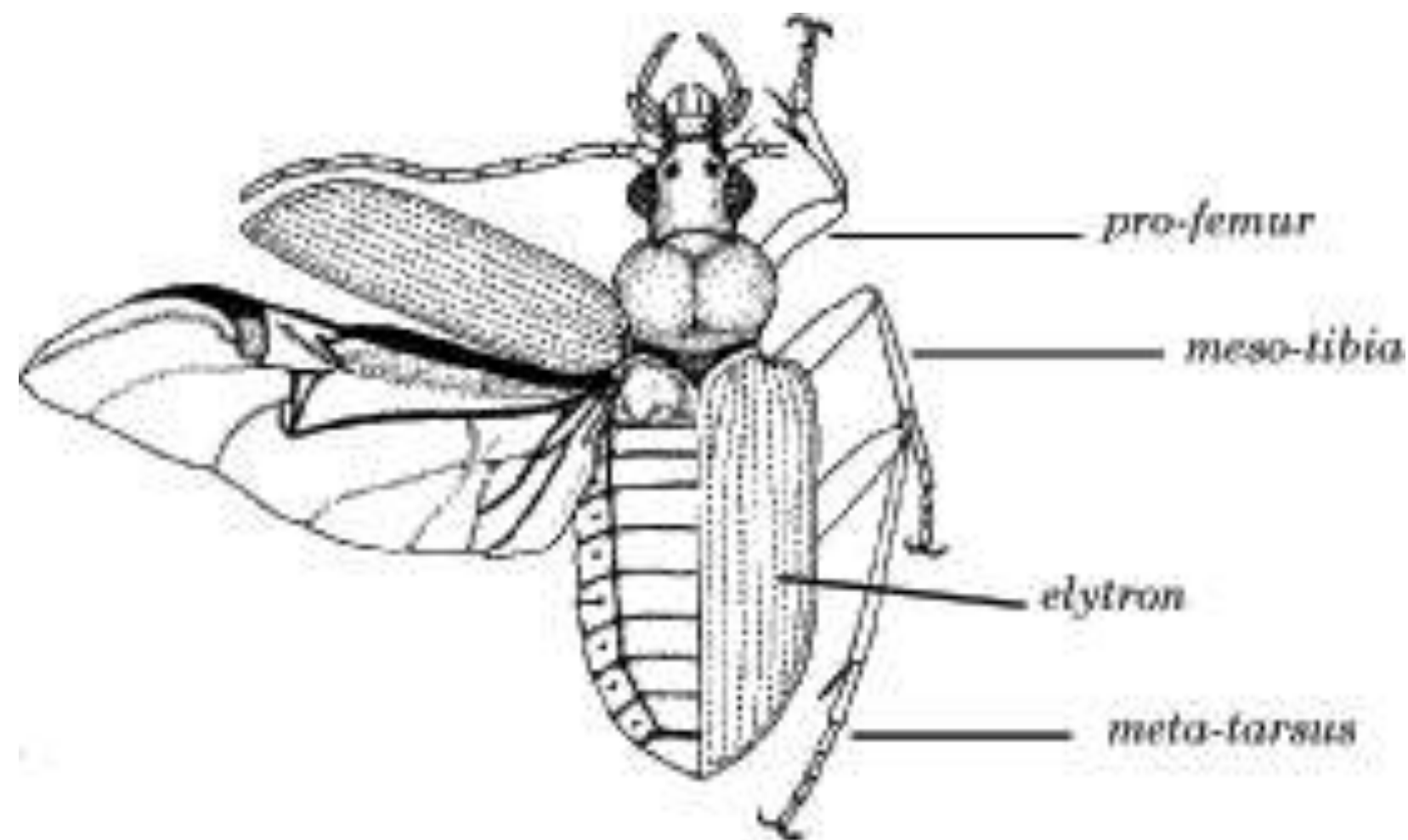
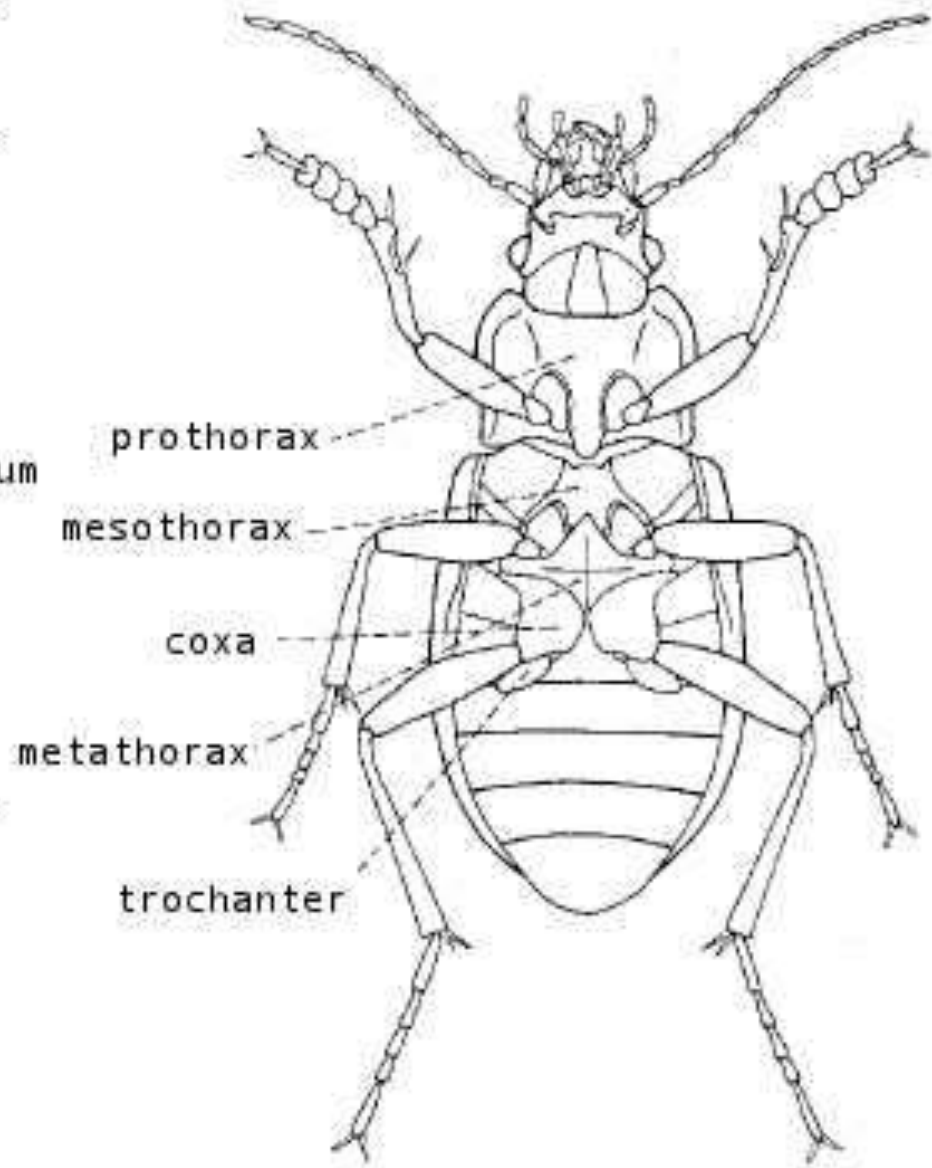
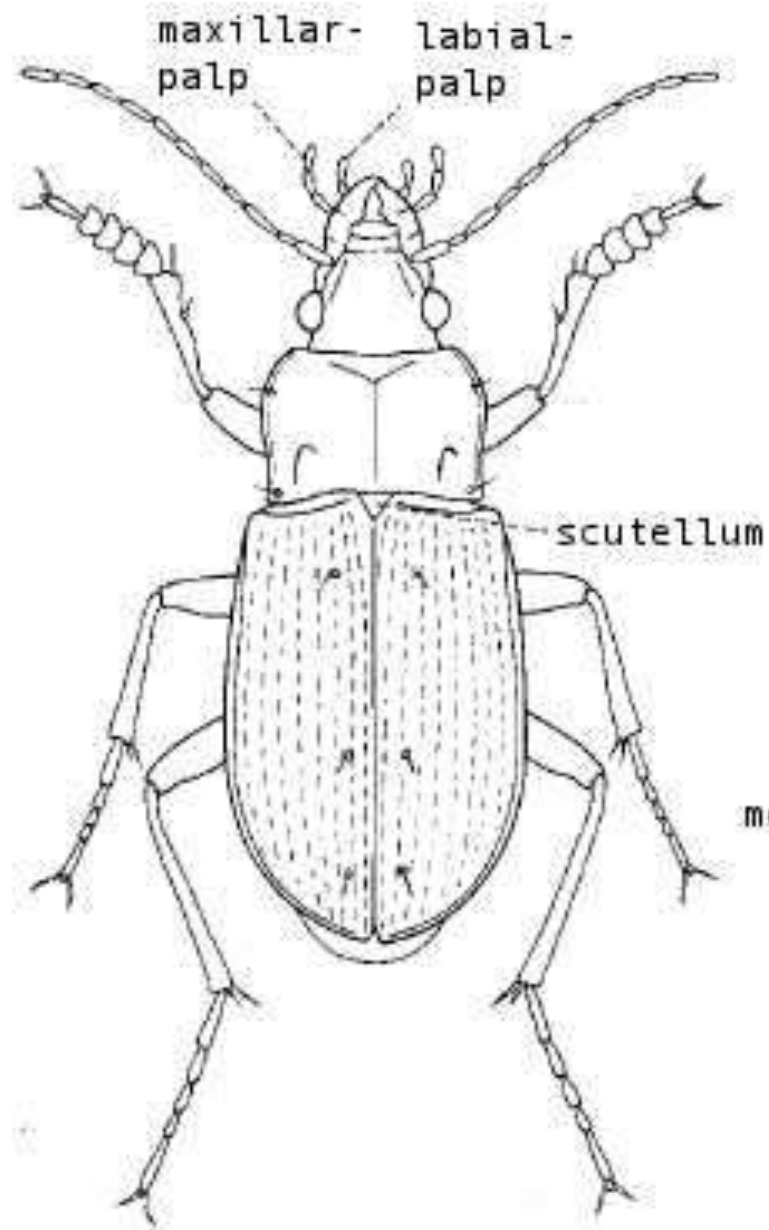
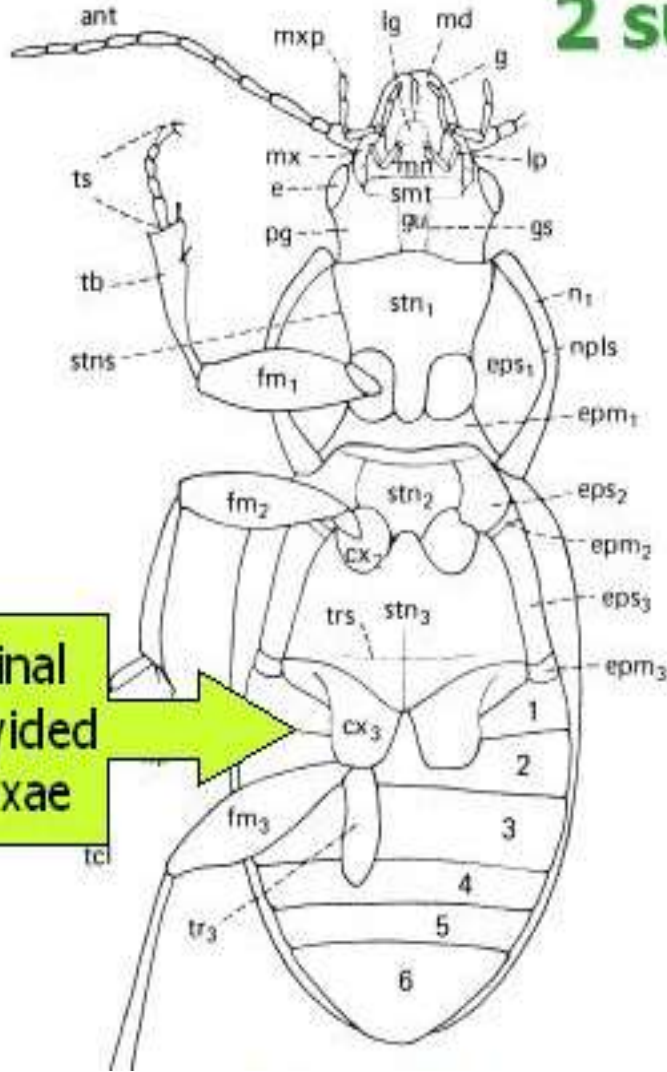


Fig. 3. Dorsal view of Adephaga beetle, Carabidae. Tarsal formula 5-5-5. Antennae filiform.



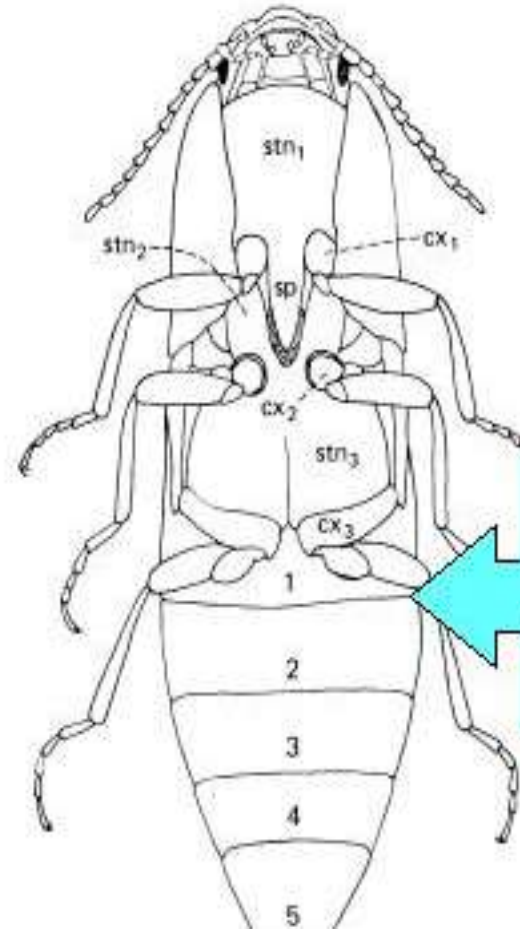


2 suborders of Coleoptera:



1st abdominal segment divided by hind coxae

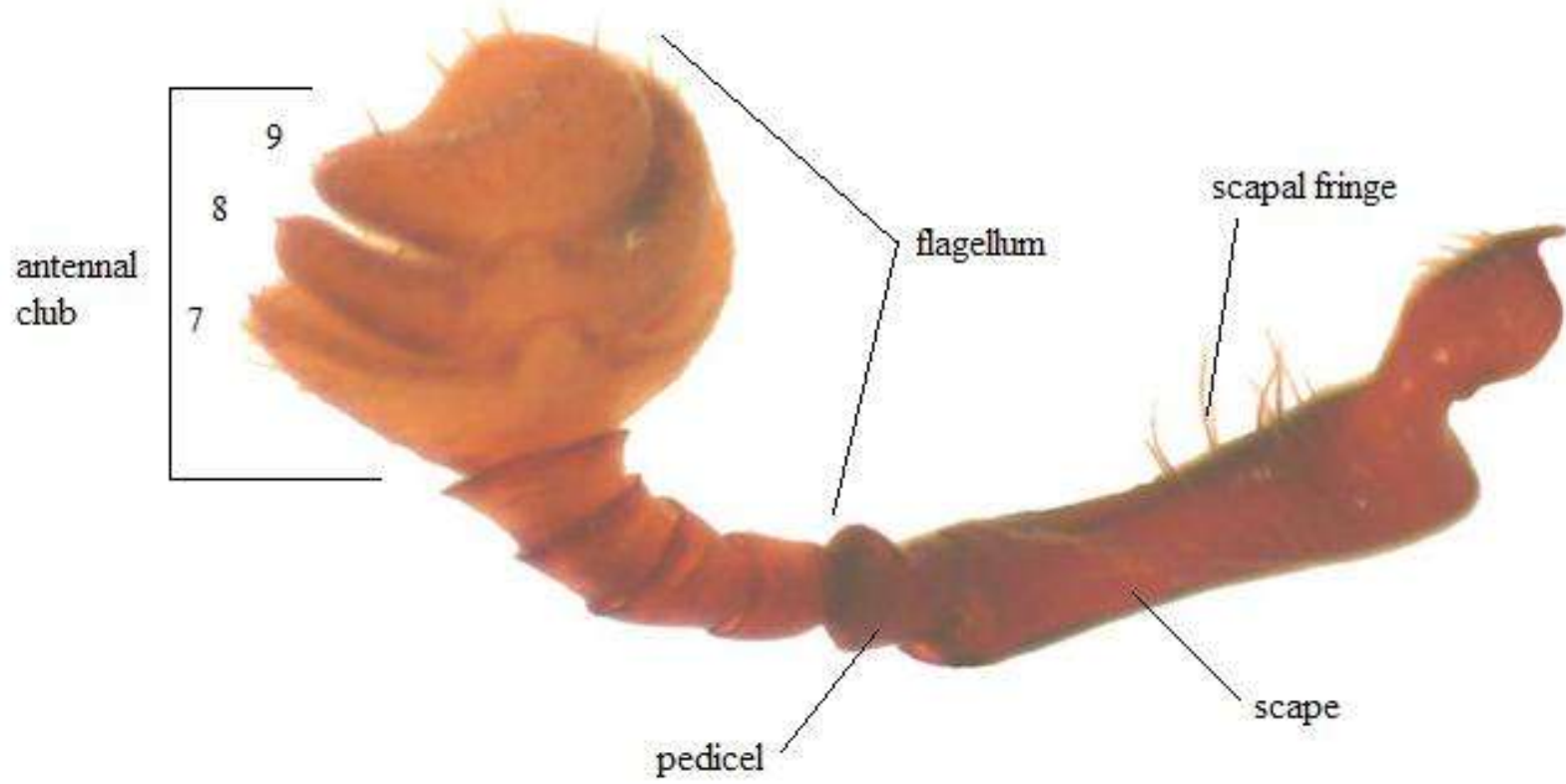
Adephaga

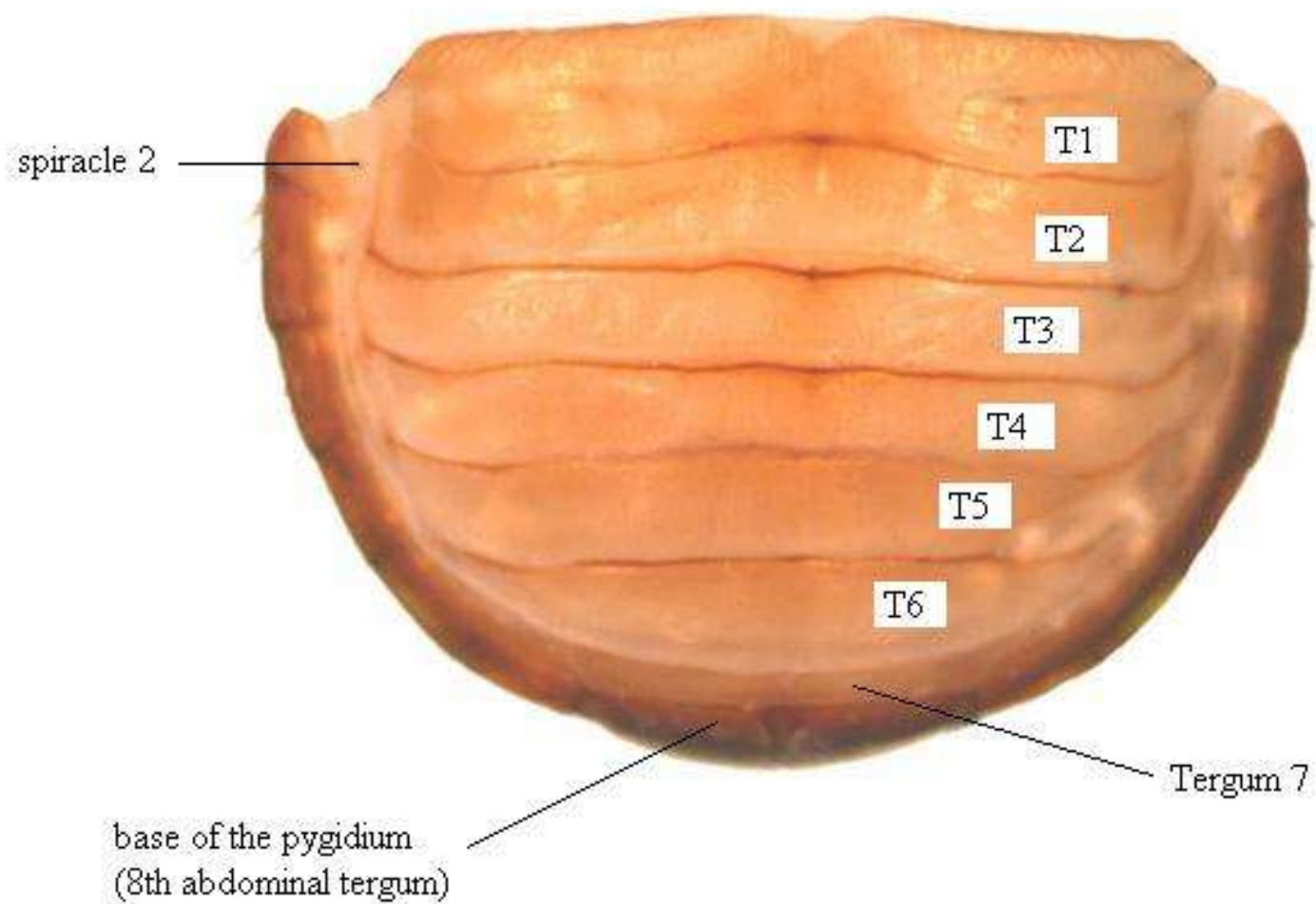


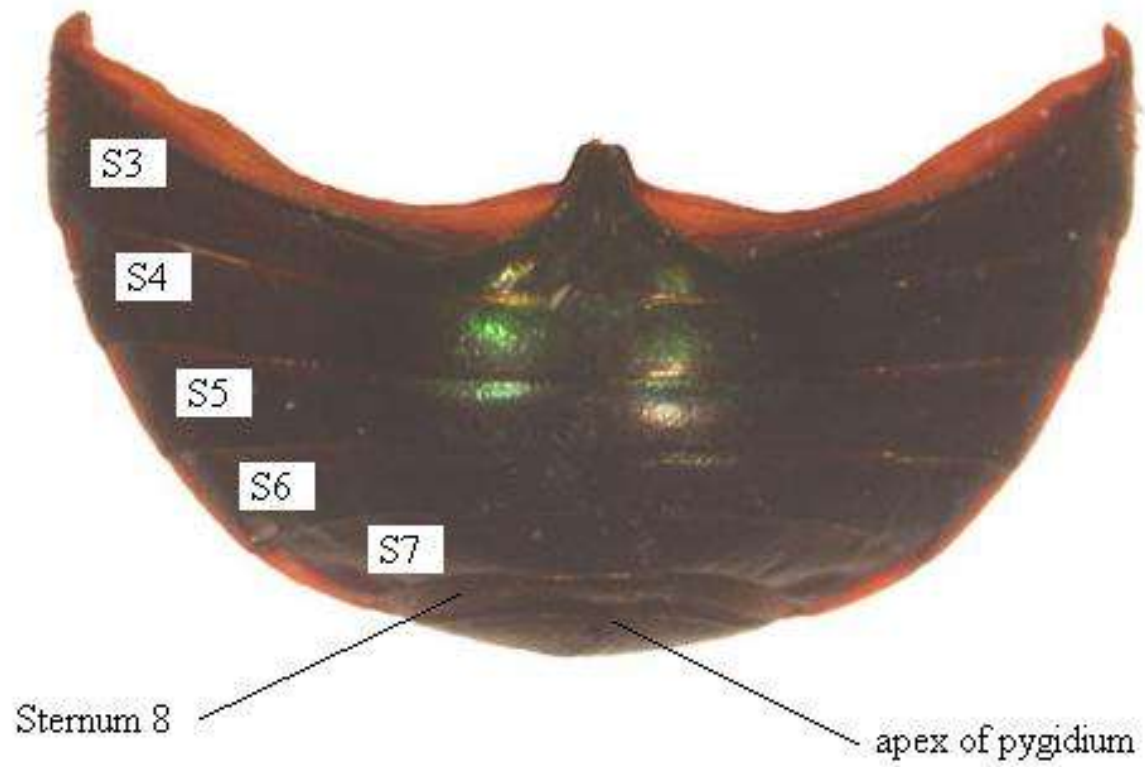
posterior margin of 1st ab segment extends completely across abdomen

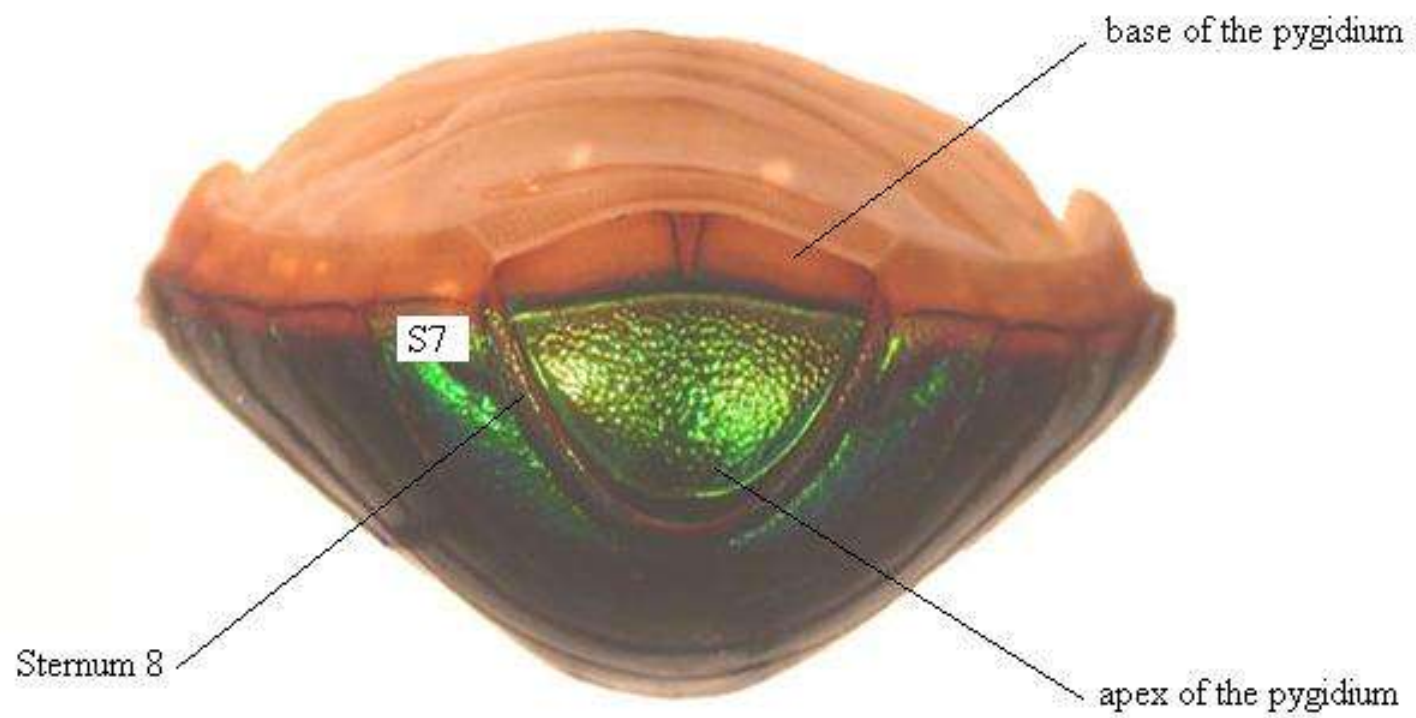
Polyphaga

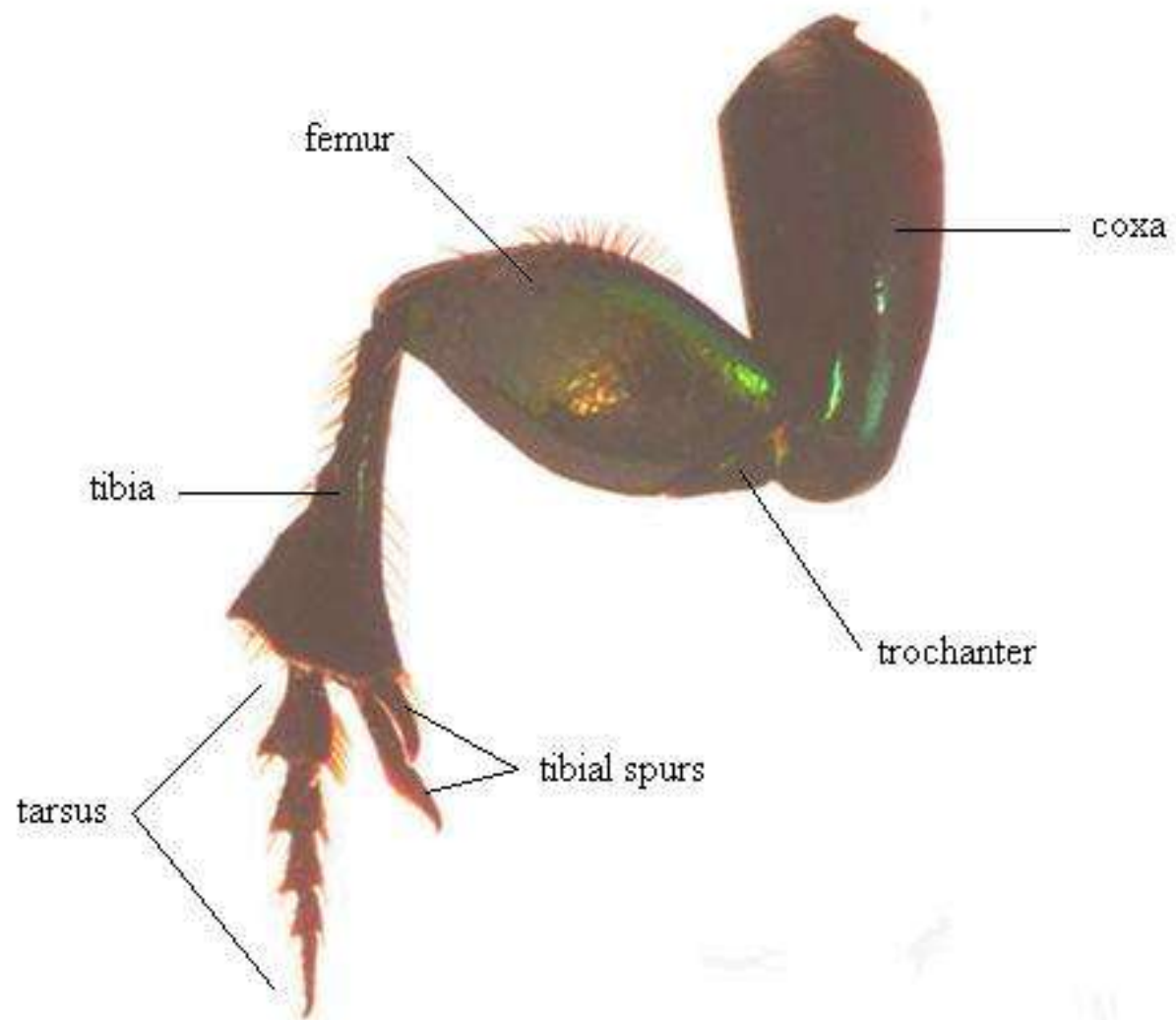












FRONT LEG

metatarsus

tibia

notch fringed with comb

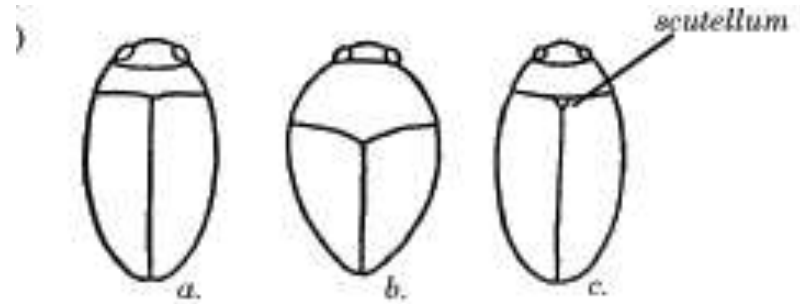


Fig. 8. Adult Dytiscidae and Noteridae. Note **scutellum** that is visible in many Dytiscidae (c.).



Fig. 27. Open behind and closed behind anterior coxal cavities.

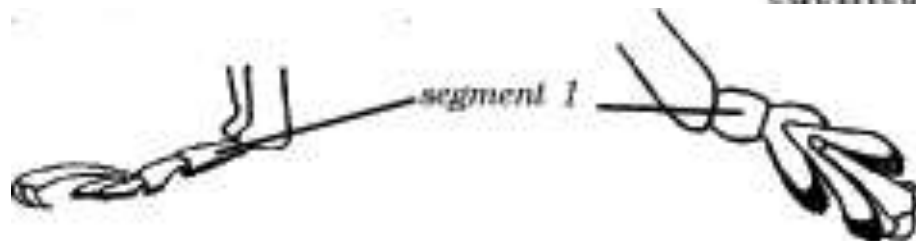


Fig. 15. Tarsus of Chrysomelidae. Apparently 4 segmented, with pads beneath each segment. Segment 3 deeply bi-lobed.

Photo: Stephanie Boucher



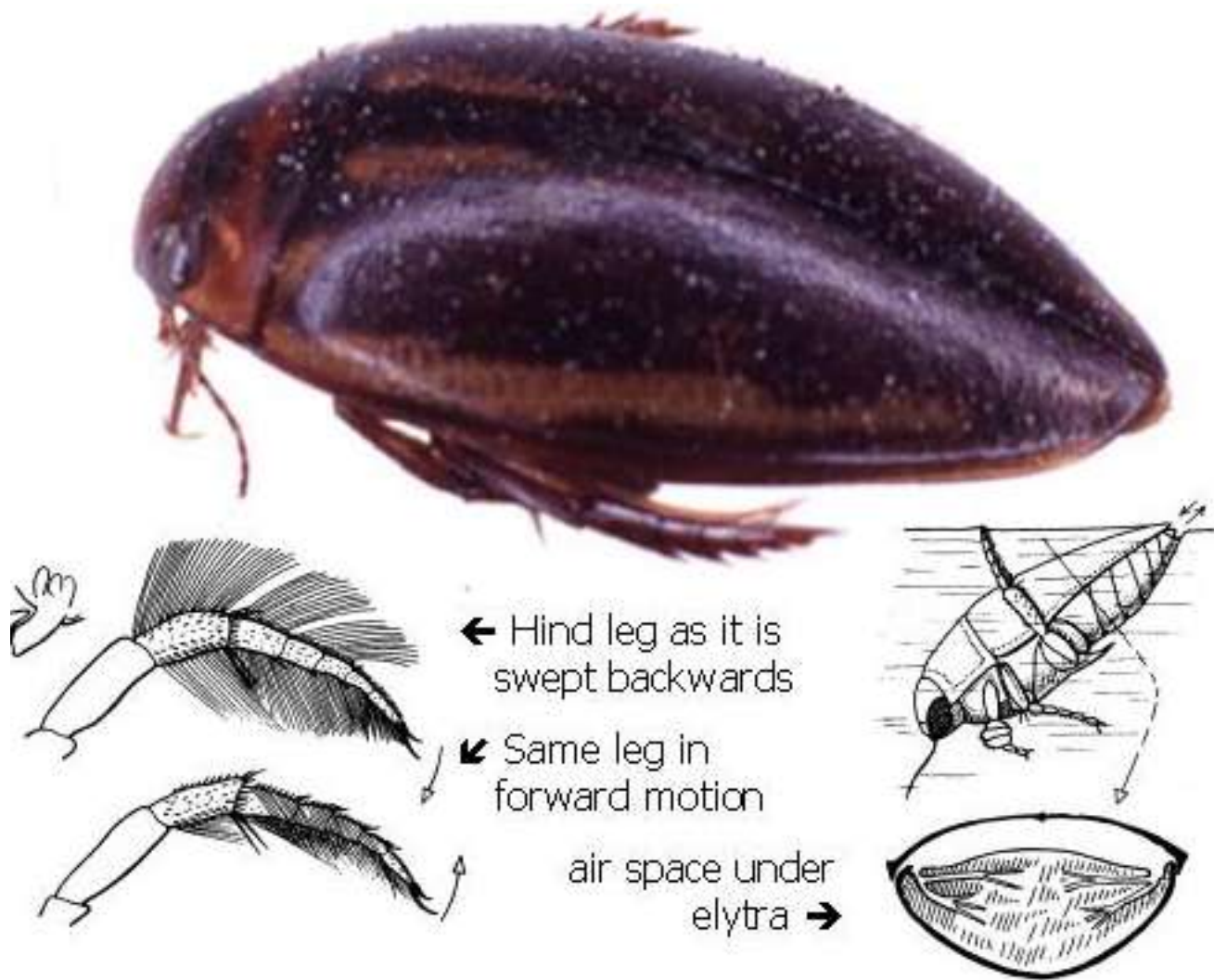
Carabidae



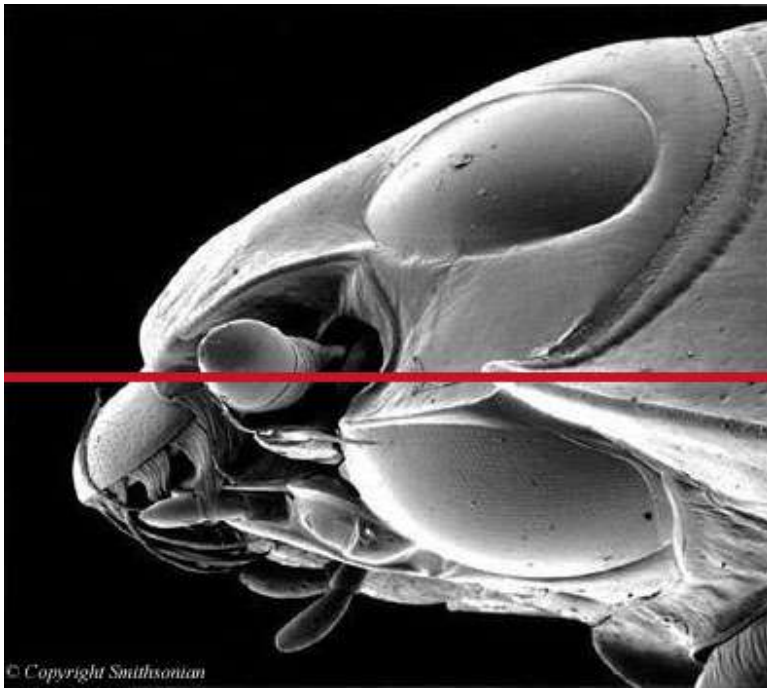


Cicindelinae

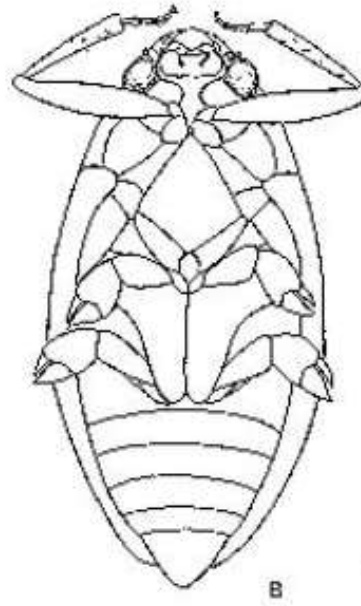
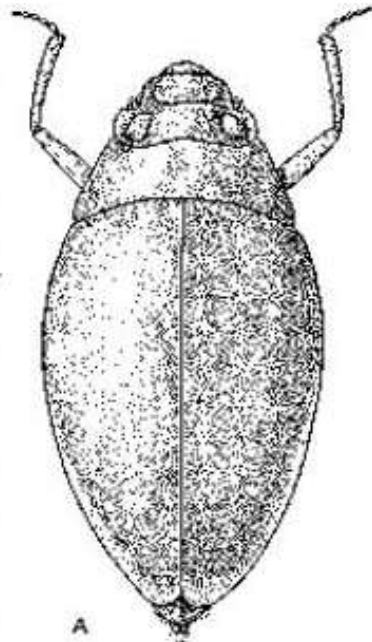




Dytiscidae



Gyrinidae



1st visible sternite

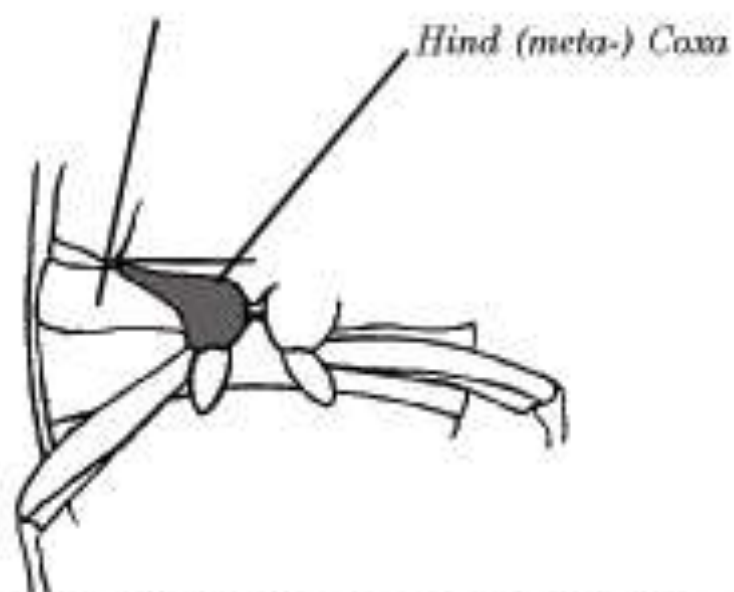


Fig. 1. *Adephaga* - coxa divides 1st visible sternite

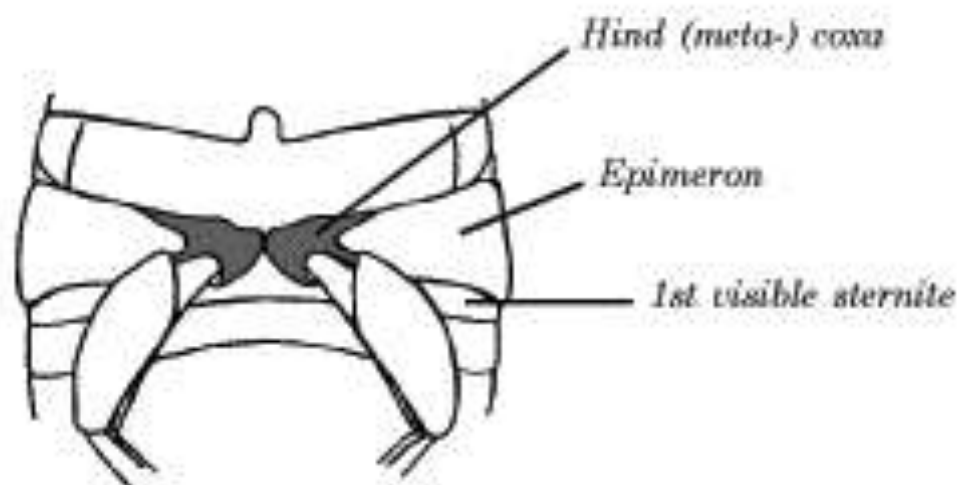


Fig. 2. *Polyphaga* - coxa does not divide 1st sternite; be sure not to confuse the epimeron with the coxae.



James L. Castner, U. Fla. Ent. Dep.

Silphidae

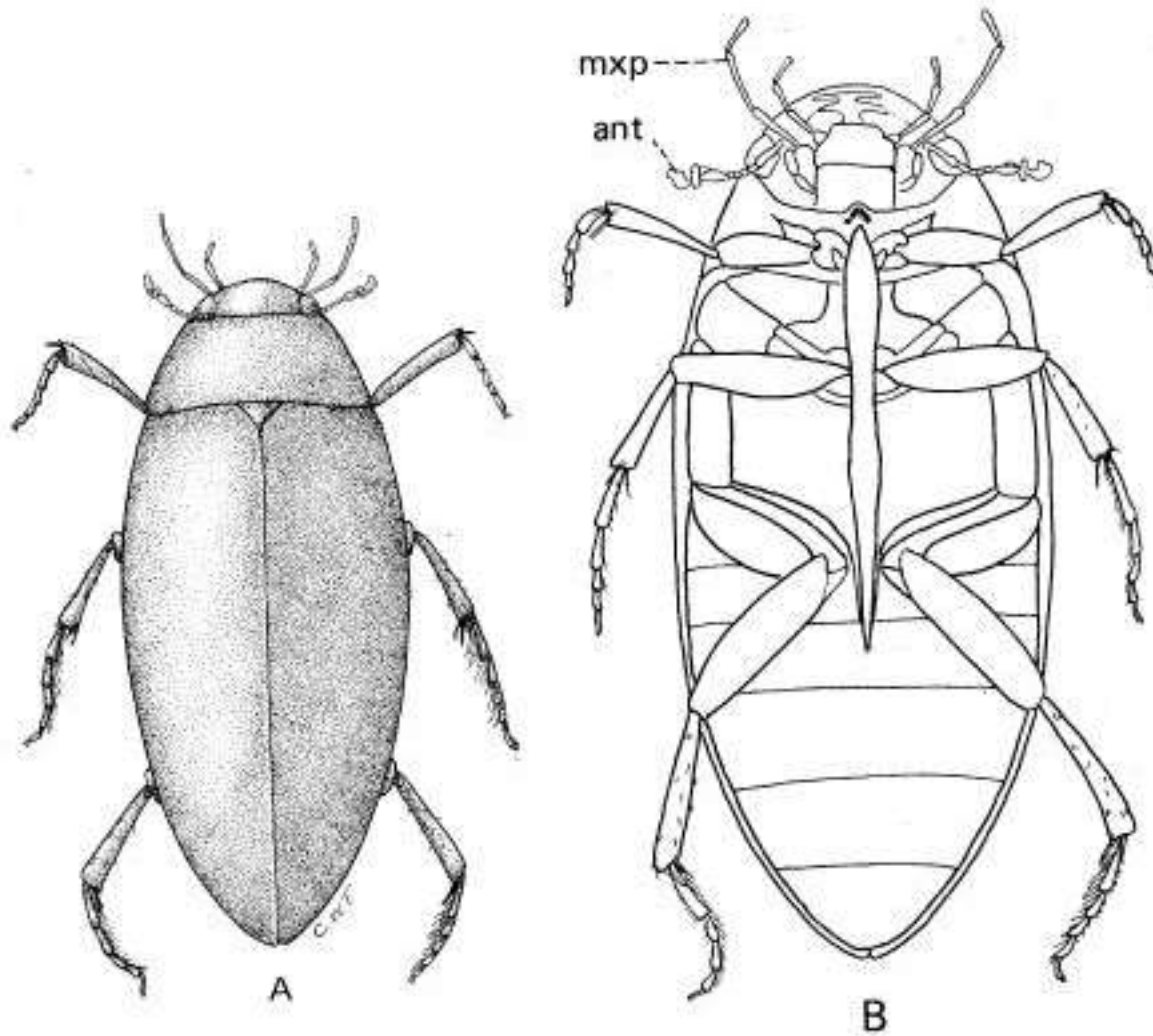
elytra broad posteriorly, often exposing 1-3 abdominal segments; palps visible, flexible; antennae clubbed, 9-11, tarsi 5,5,5, densely pubescent



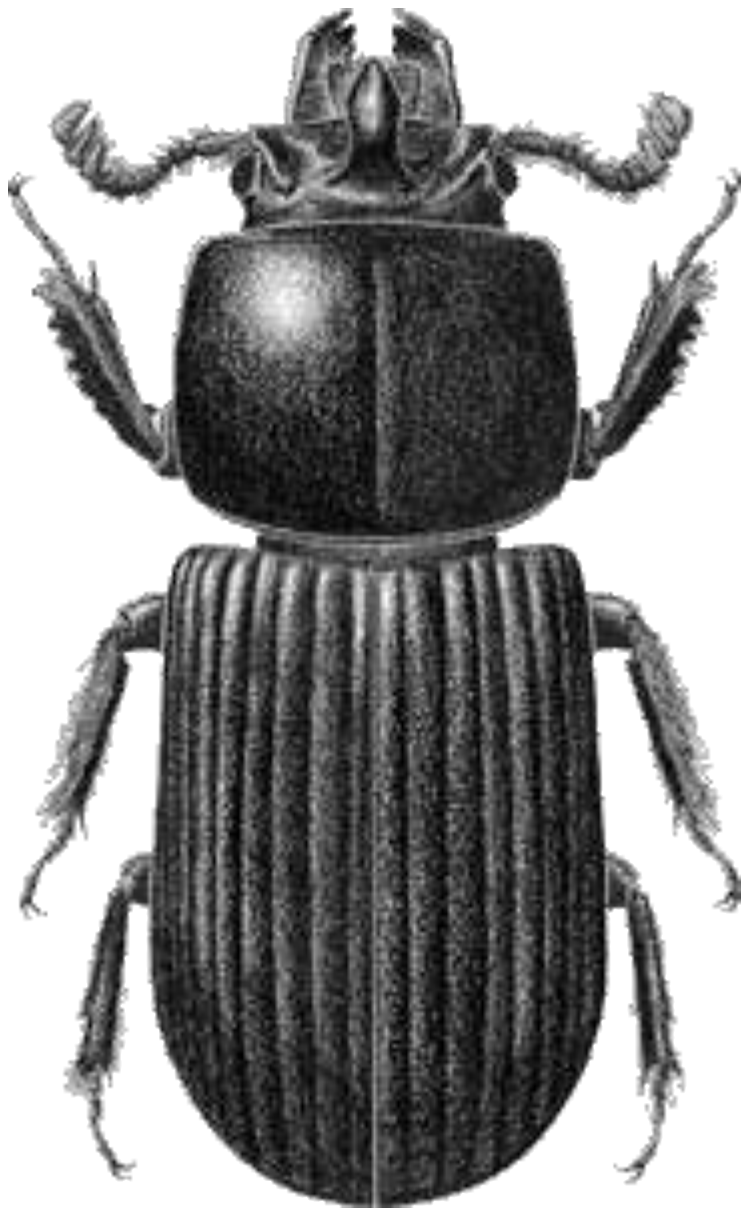
Necrodes litoralis (n. Reitter)



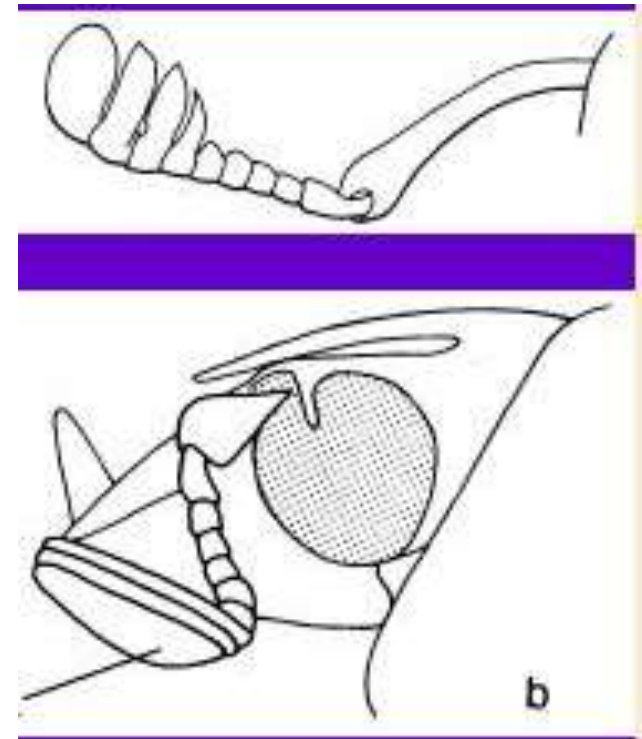
Staphylinidae



Hydrophilidae



Passalidae



Scarabaeidae

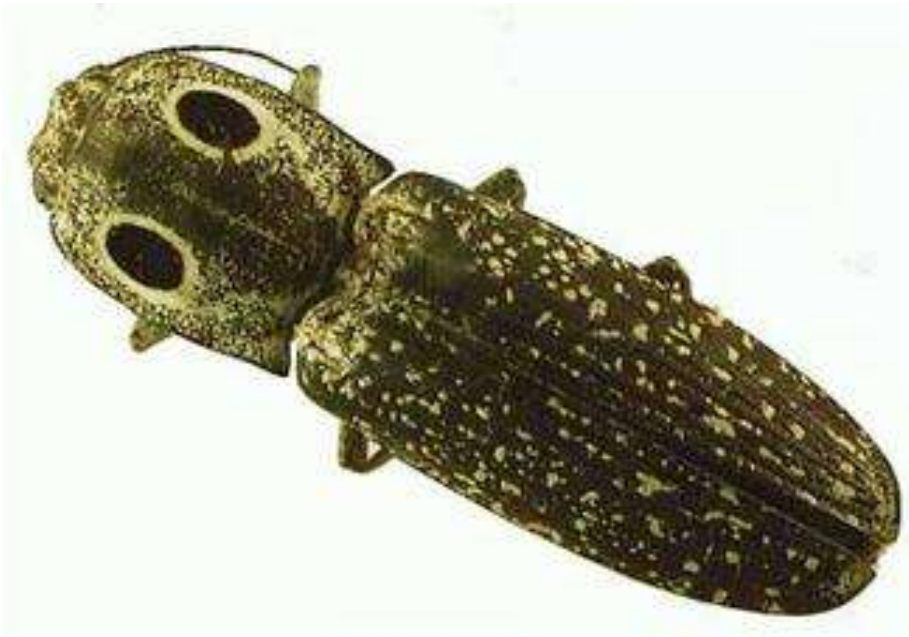


antennae lamellate with
3-7 leaves, 8-11 (usually
10), tarsi
(variable), 5, 5, 5 usually



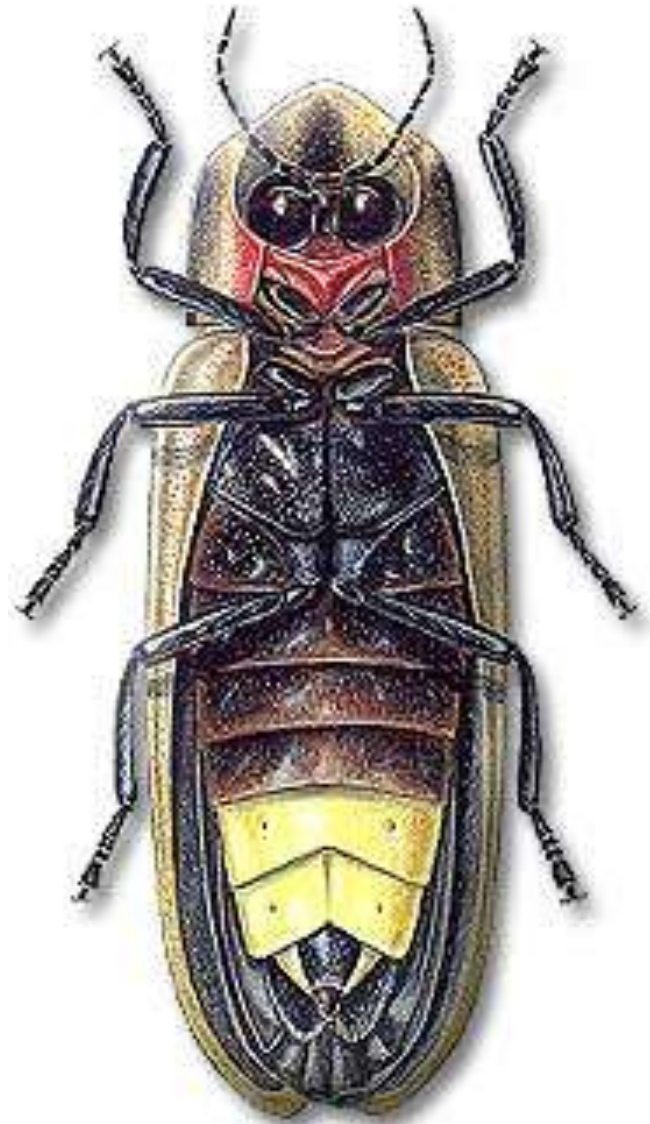
Buprestidae

usually metallic, head retracted into prothorax to eyes, metacoxae platelike, antennae short, slender, finely serrate, 11, tarsi 5,5,5



Elateridae





Lampyridae



TESC000000346. Image by M. Kmetz-Barrows, Dec '03



Cantharidae



Dermestidae



Cleridae





Melyridae





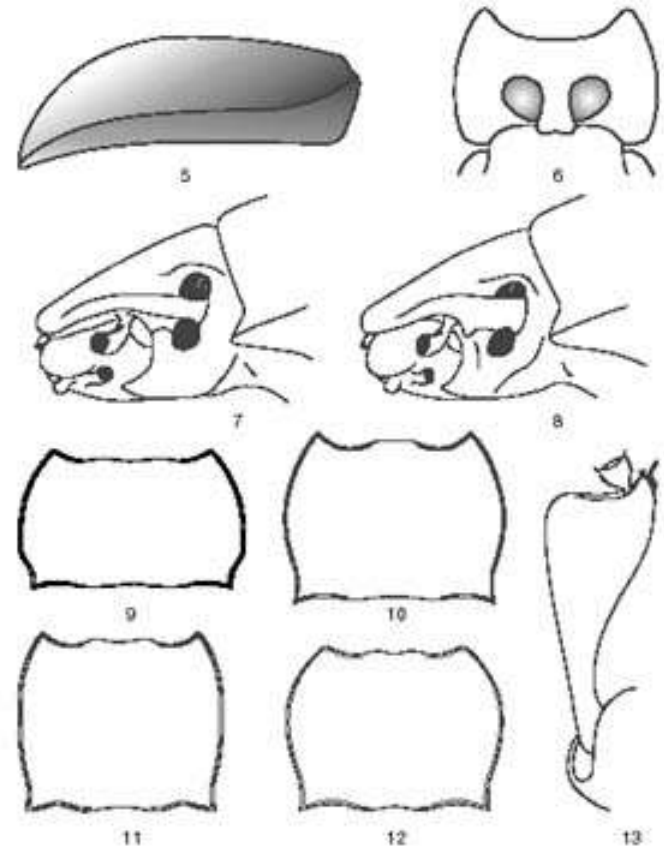
Coccinellidae

nearly
hemispherical but
some are more
elongate, head
retracted into
thorax, antennae
with 3-segmented
club, 11, tarsi 3,3,3

Tenebrionidae



Revisión del género *Phylan* Stephens, 1857



Figuras 5-13. Género *Phylan*: 5) elítrio en visión lateral; 6) prosternón. Cabeza en visión lateral de: 7) *Phylan* (*Litobonolus*) *gadeai* Español & Viñolas, 1981; 8) *Phylan* (*Litobonolus*) *collaris* (Mulsant & Rey, 1854). Pronotax de: 9) *Phylan* (*Phylan*) *gibbus* (Fabricius, 1775); 10) *Phylan* (*Litobonolus*) *gadeai* Español & Viñolas, 1981; 11) *Phylan* (*Litobonolus*) *collaris* (Mulsant & Rey, 1854); 12) *Phylan* (*Litobonolus*) *mulsanti* (Pochard, 1909). 13) Tibia de *Phylan* (*Litobonolus*).

mandibles short, eyes almost always notched,
antennae moniliform or clavate, 11, tarsi 5,5,4

Meloidae



elongate, head and elytra wider than pronotum, head constricted far behind eyes into a neck, legs long, antennae 11, tarsi 5,5,4, tarsal claws usually have a long appendage below them



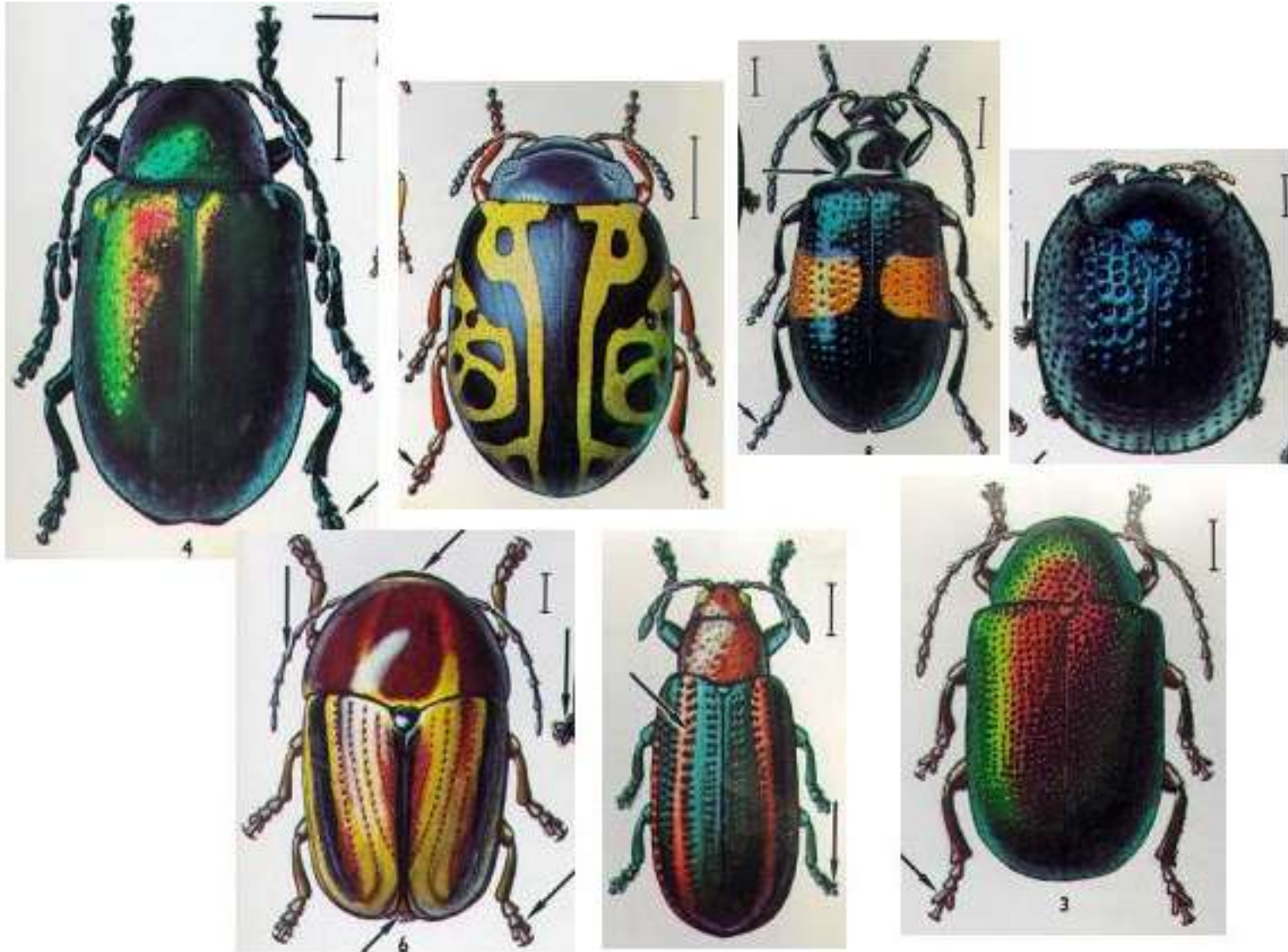
Cerambycidae (long-horned beetles): antennae usually 1-4 times the length of the body, sometimes serrate, sometimes moniliform, tarsi 5,5,5, 4th always small, 3rd deeply bilobed



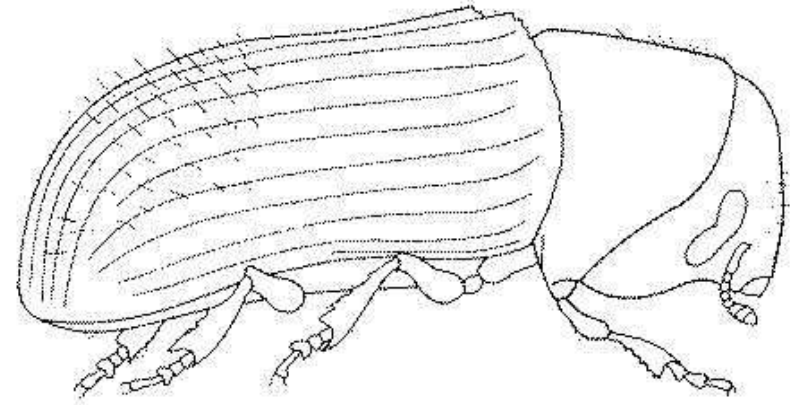
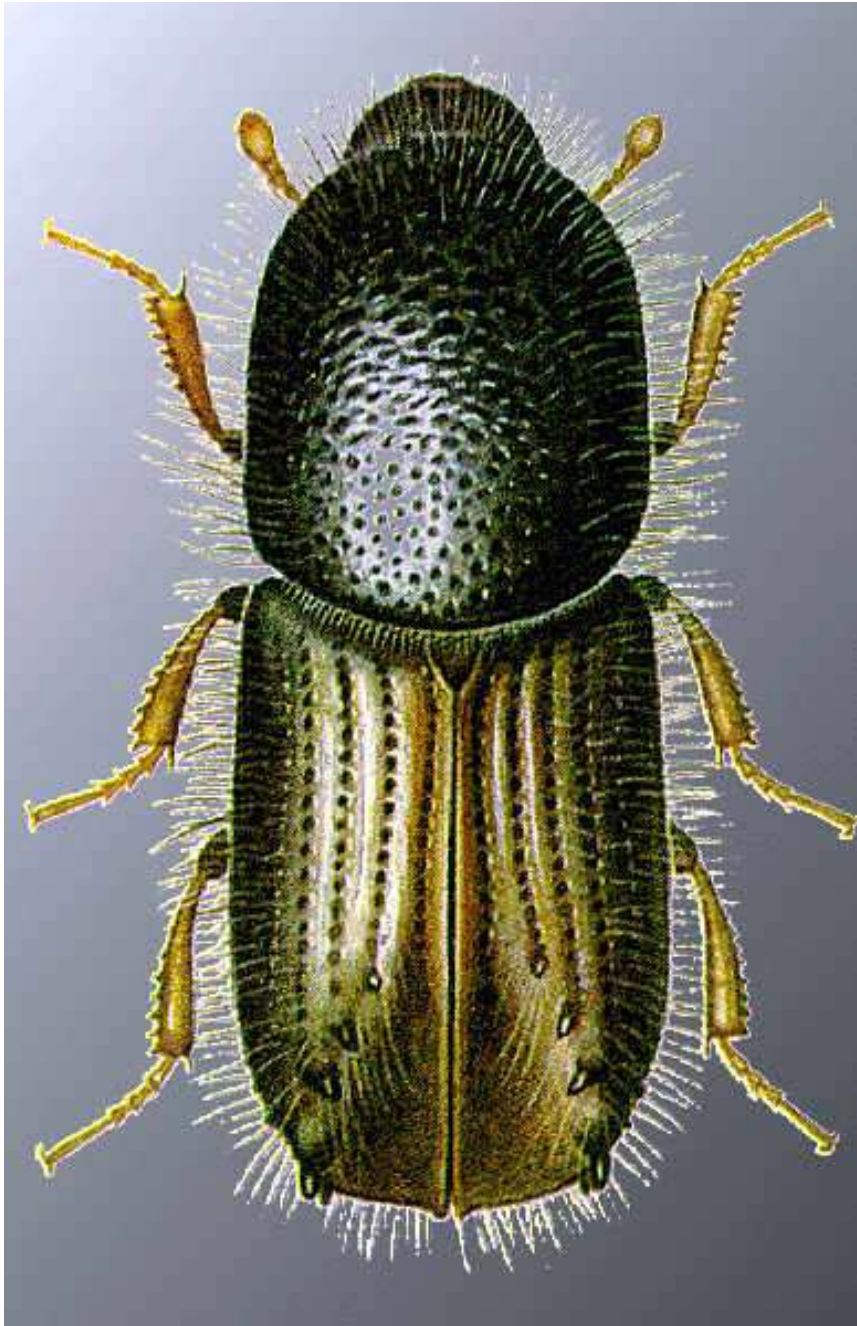
www.insecta.tv

Curculionidae (weevils): head with well-developed beak (often curved downward), antennae usually geniculate with a three-segmented club



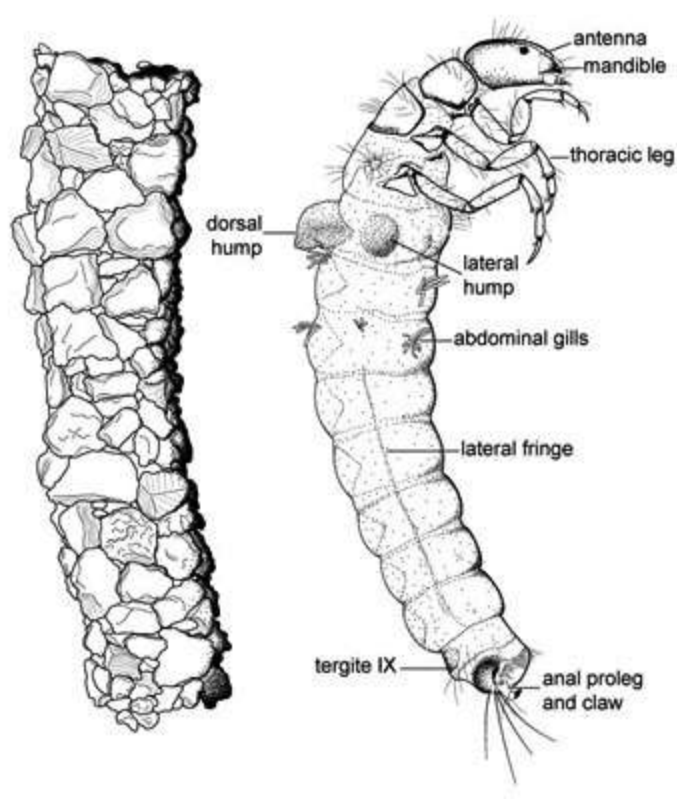


Chrysomelidae (leaf beetles): usually oval (but vary), antennae less than half length of body, tarsi appear 4,4,4

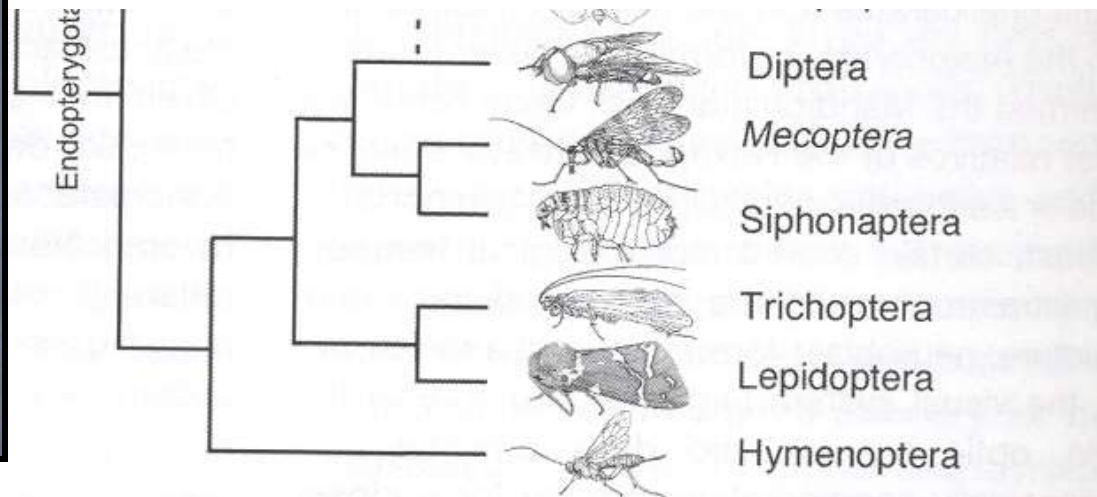


Scolytidae (bark beetles):
small, cylindrical and
compact with short legs
(look like miniature bullets),
antennae geniculate with a
compact club, tarsi 5,5,5

TRICHOPTERA: Slender, elongate and mothlike; long, filiform antennae (as long as body or longer); 4 membranous wings; HW a little shorter than FW; wings held rooflike over body at rest; reduced mouthparts



Lepidoptera 4 membranous wings;
HW a little smaller than FW; wings
largely or entirely covered with scales;
mouth parts sucking, with proboscis
usually in the form of a coiled tube



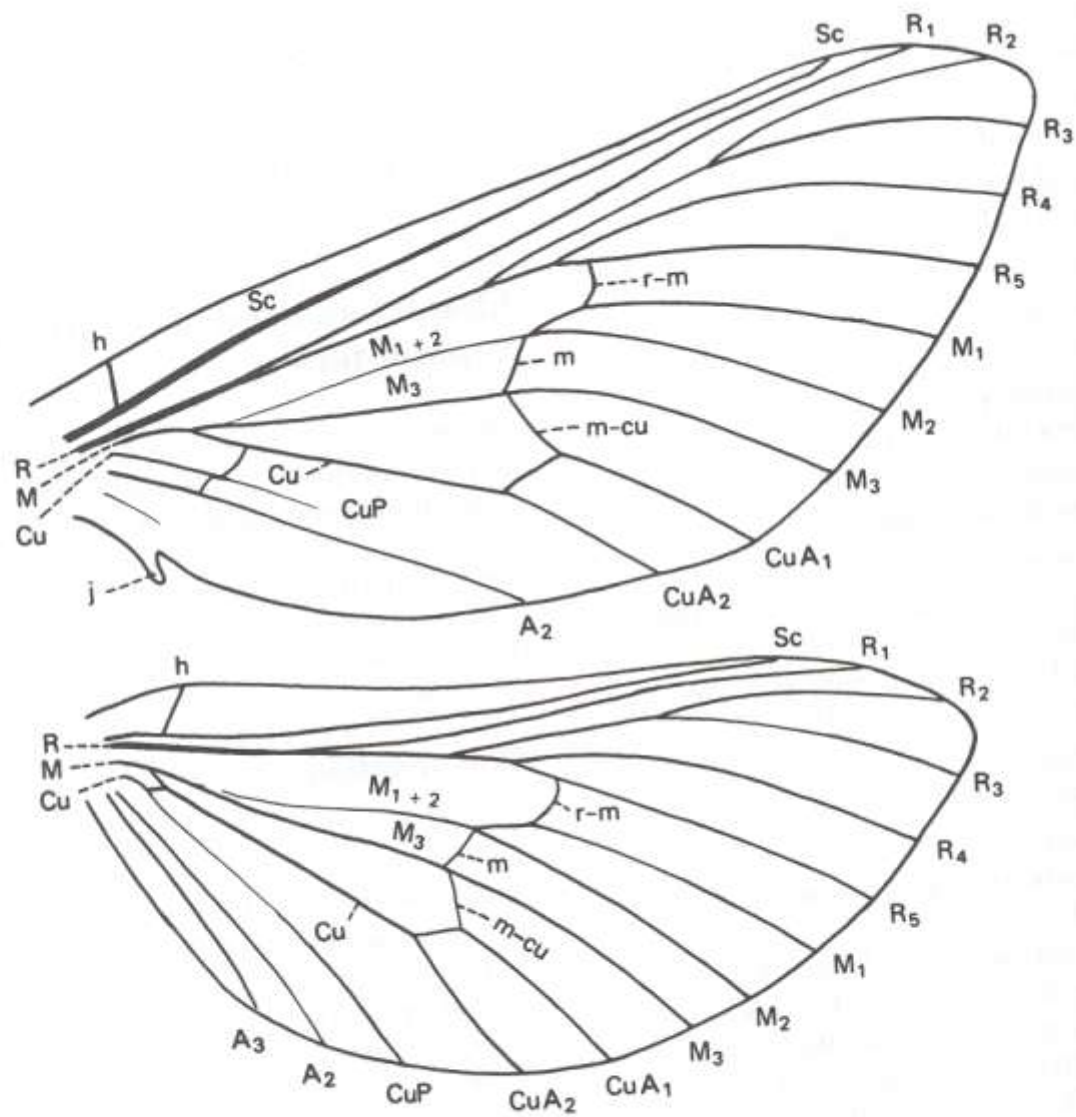


Figure 30-5 Homoneurous venation of *Sthenopsis* (Hepialidae). j, jugum.

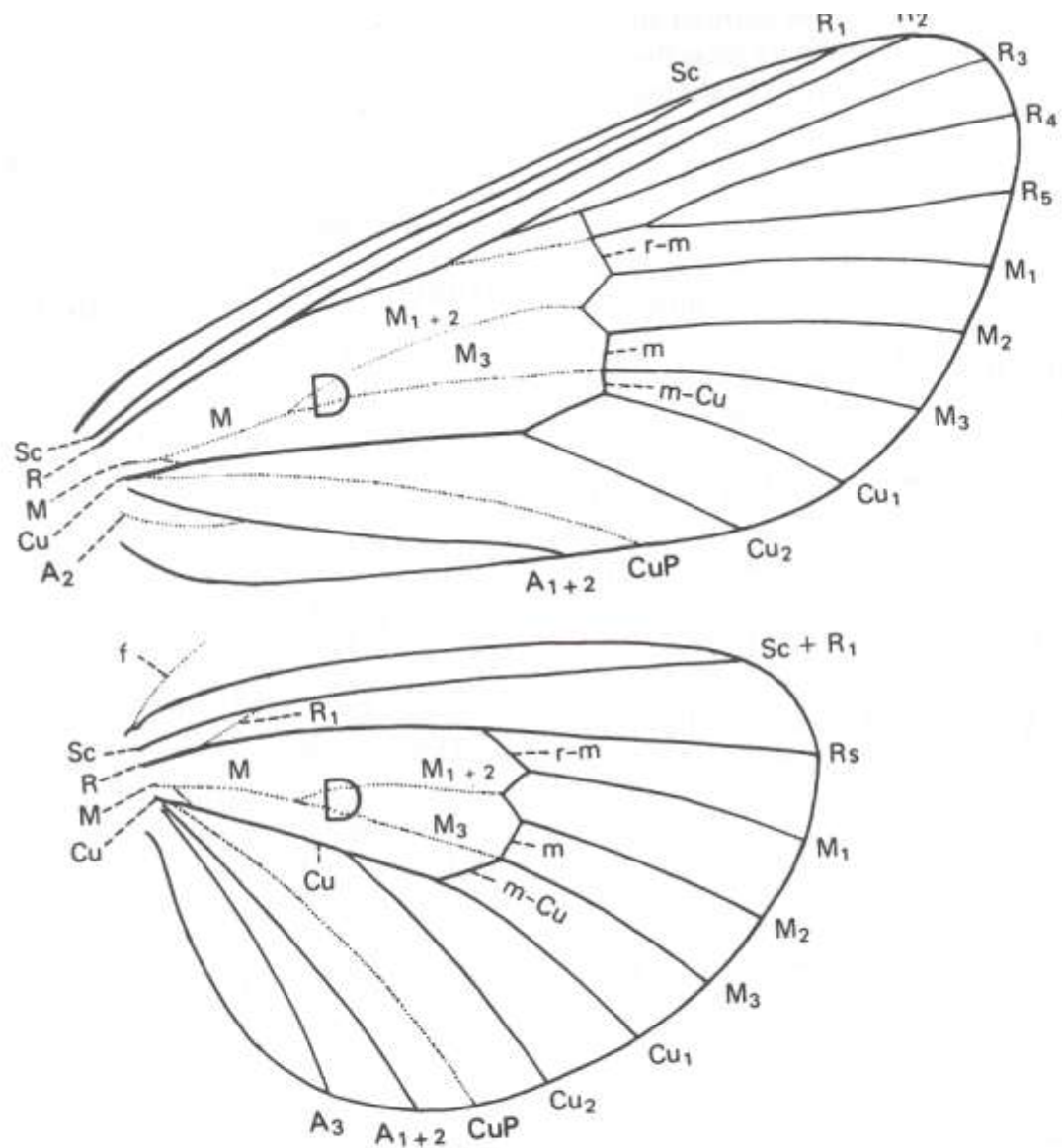


Figure 30-6 Generalized heteroneurous venation. The veins shown by dotted lines are atrophied or lost in some groups. *D*, discal cell; *f*, frenulum.

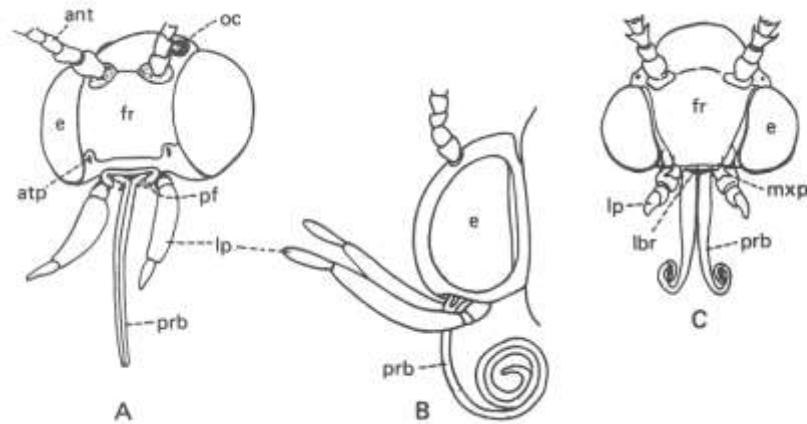
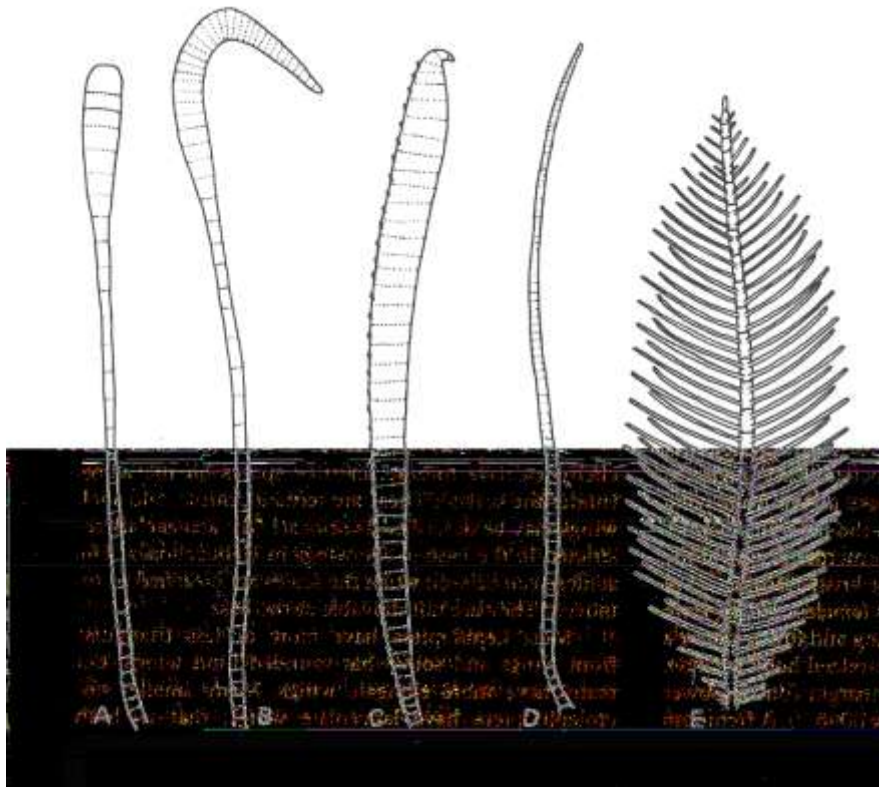


Figure 30-2 Head structure in Lepidoptera. A, *Synanthedon* (Sesiidae), anterior view; B, same, lateral view; C, *Hyphantria* (Arctiidae). ant, antenna; atp, anterior tentorial pit; e, compound eye; fr, frons; lbr, labrum; lp, labial palp; mxp, maxillary palp; oc, ocellus; pf, pilifer; prb, proboscis. (Redrawn from Snodgrass.)

Sessiidae



© E. Knudson

greater part of both wings lack scales; transparent areas on all wings; FW with reduced anal area; HW with well-developed anal area; wasplike

Pyralidae



small; FW narrow and elongate or somewhat triangular; HW broad w/ 3 anal veins; Cu appearing four branched in FW; Sc and R veins may be fused or parallel opposite the discal cell in HW; scaled proboscis.



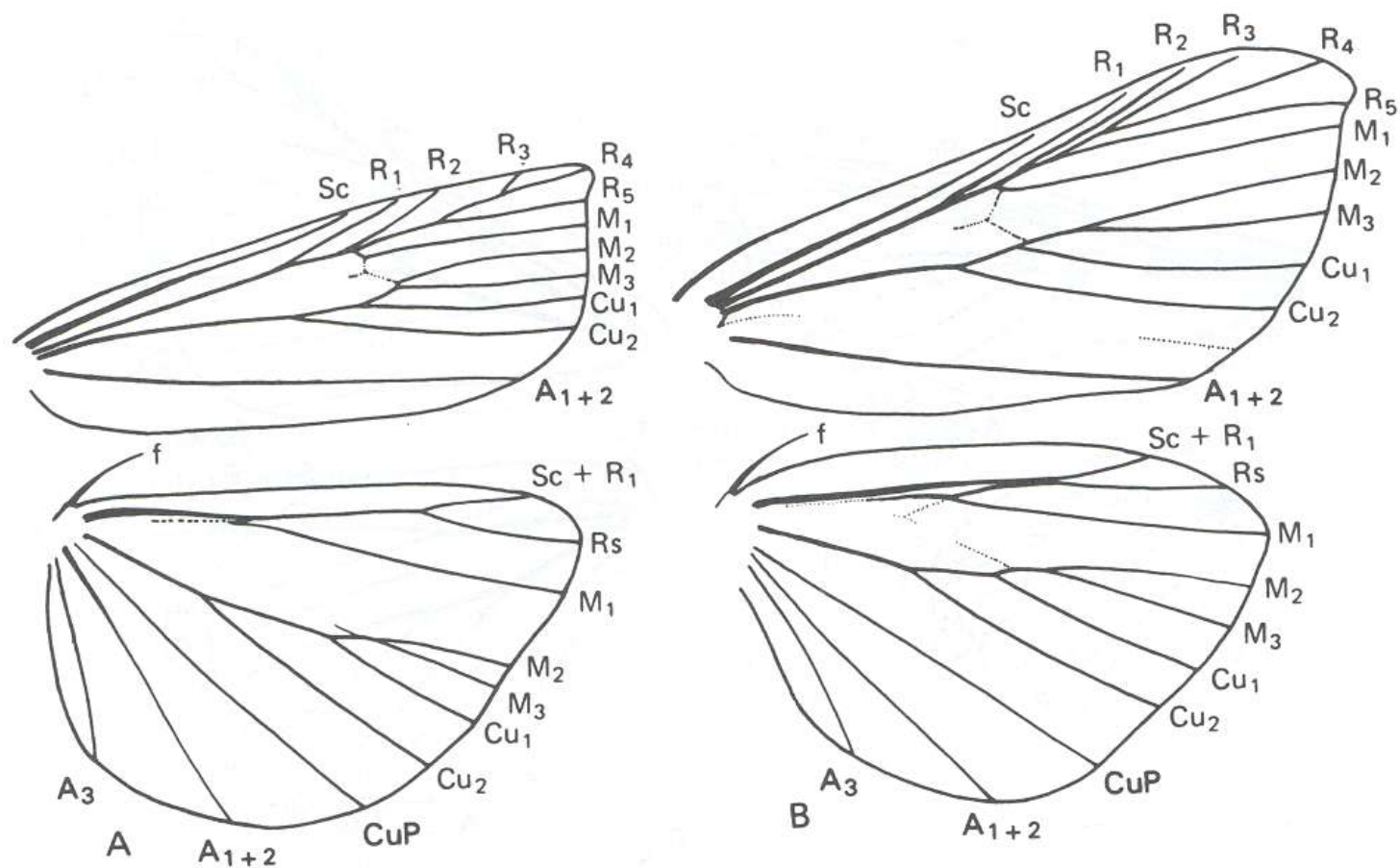


Figure 30-15 Wings of Pyraloidea. A, *Crambus* (Crambidae, Crambinae); B, *Pyralis* (Pyralidae, Pyralinae). f, frenulum.



Hesperiidae



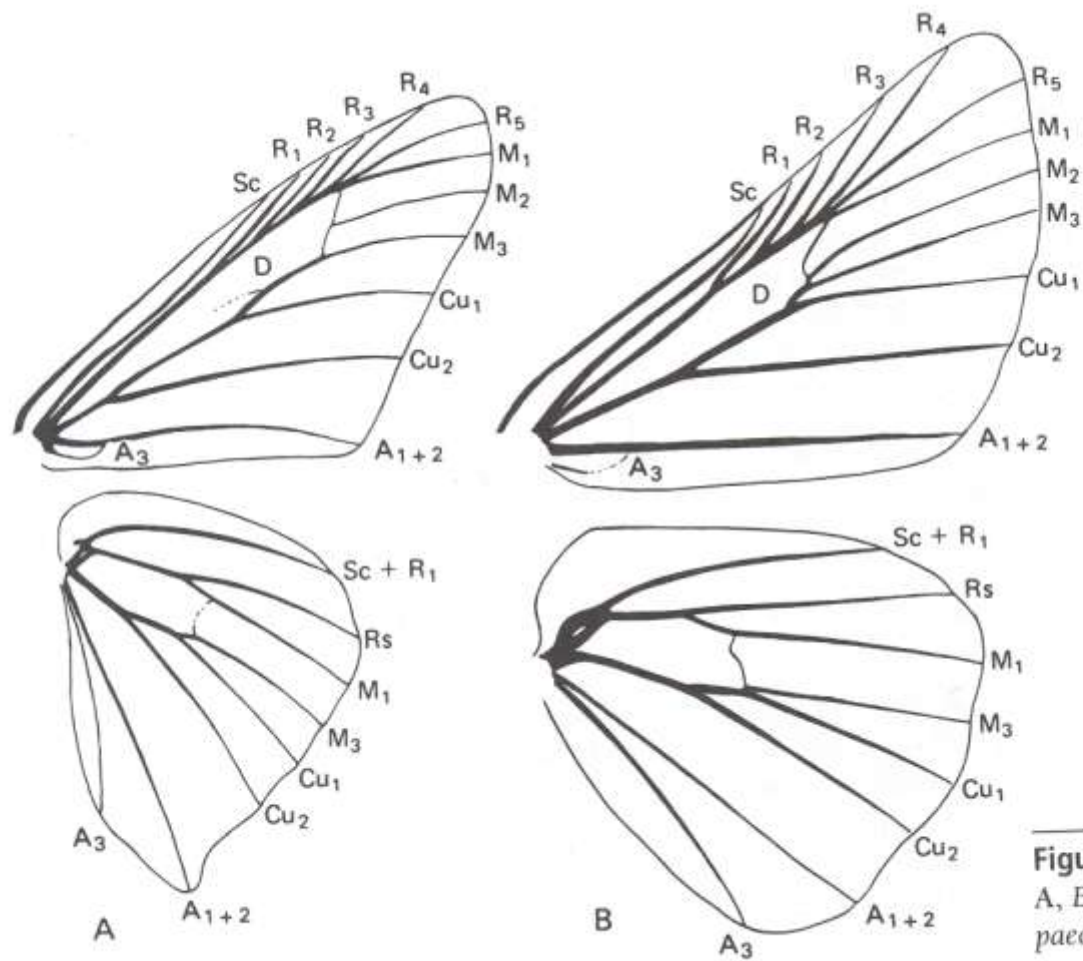


Figure 30-8 Wings of Hesperidae. A, *Epargyreus* (Pyrginae); B, *Pseudocopaodes* (Hesperiinae). D, discal cell.



Papilionidae

FW with 5-branched R vein; HW with 1 anal vein and usually a tail-like prolongation

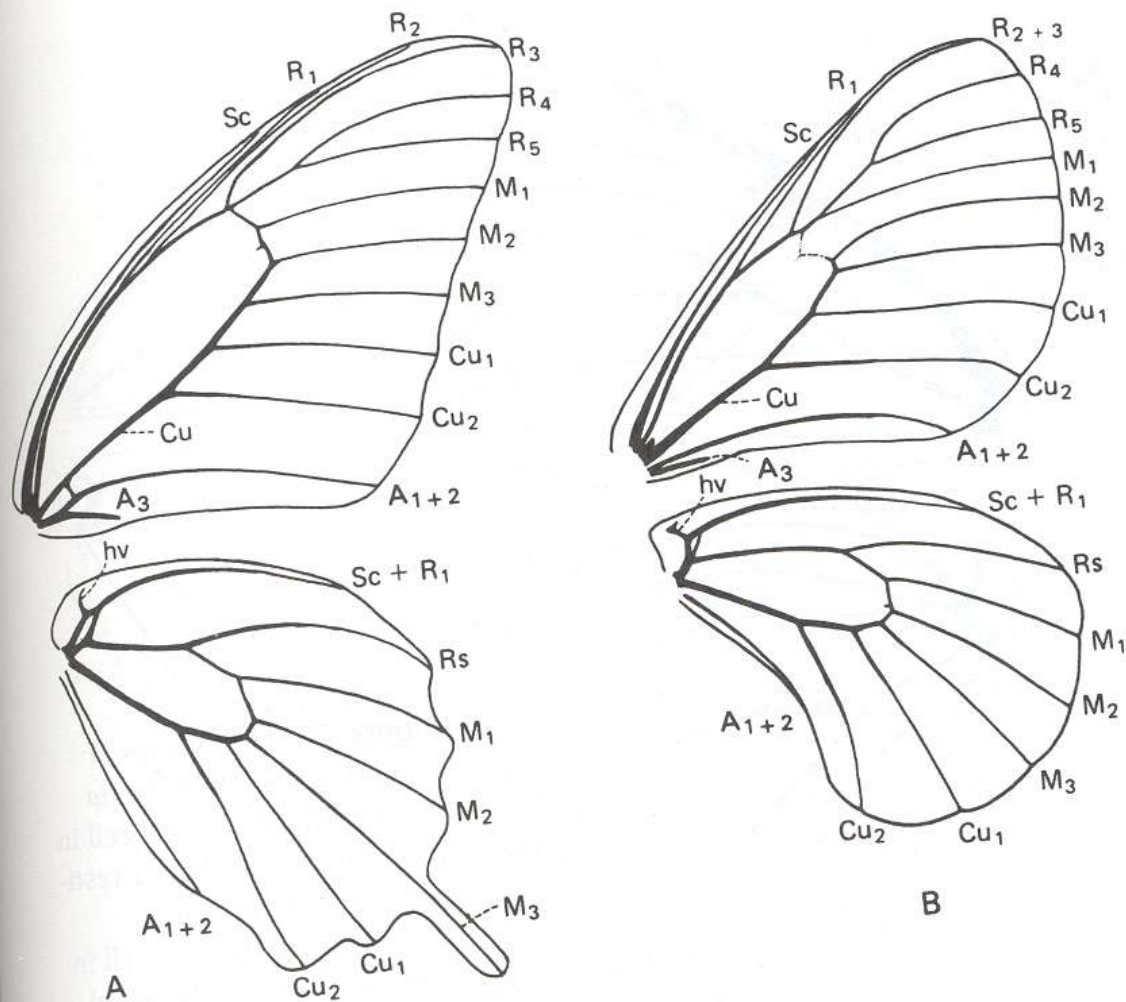


Figure 30-9 Wings of Papilionidae. A, *Papilio* (Papilioninae); B, *Parnassius* (Parnassiinae). hv, humeral vein.



Pieridae: usu white, yellow or orange with black marks, tarsal claws forked; FW with R 3- or 4-branched

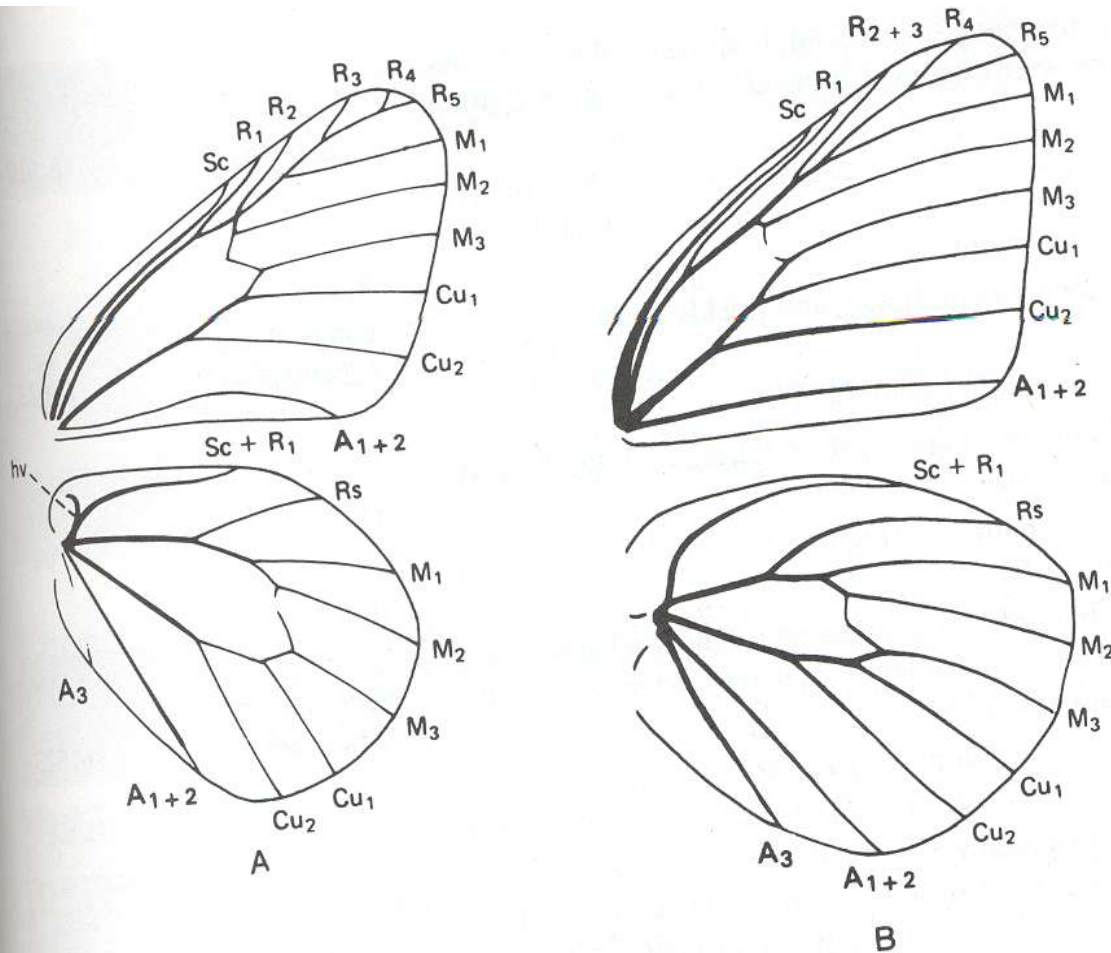


Figure 30-13 Wings of Pieridae. A, an orange-tip (*Euchloe*); B, a sulphur (*Colias*). hv, humeral vein.

Olive Hairstreak, APR 2004
Montgomery CO MD
Dave Czaplak



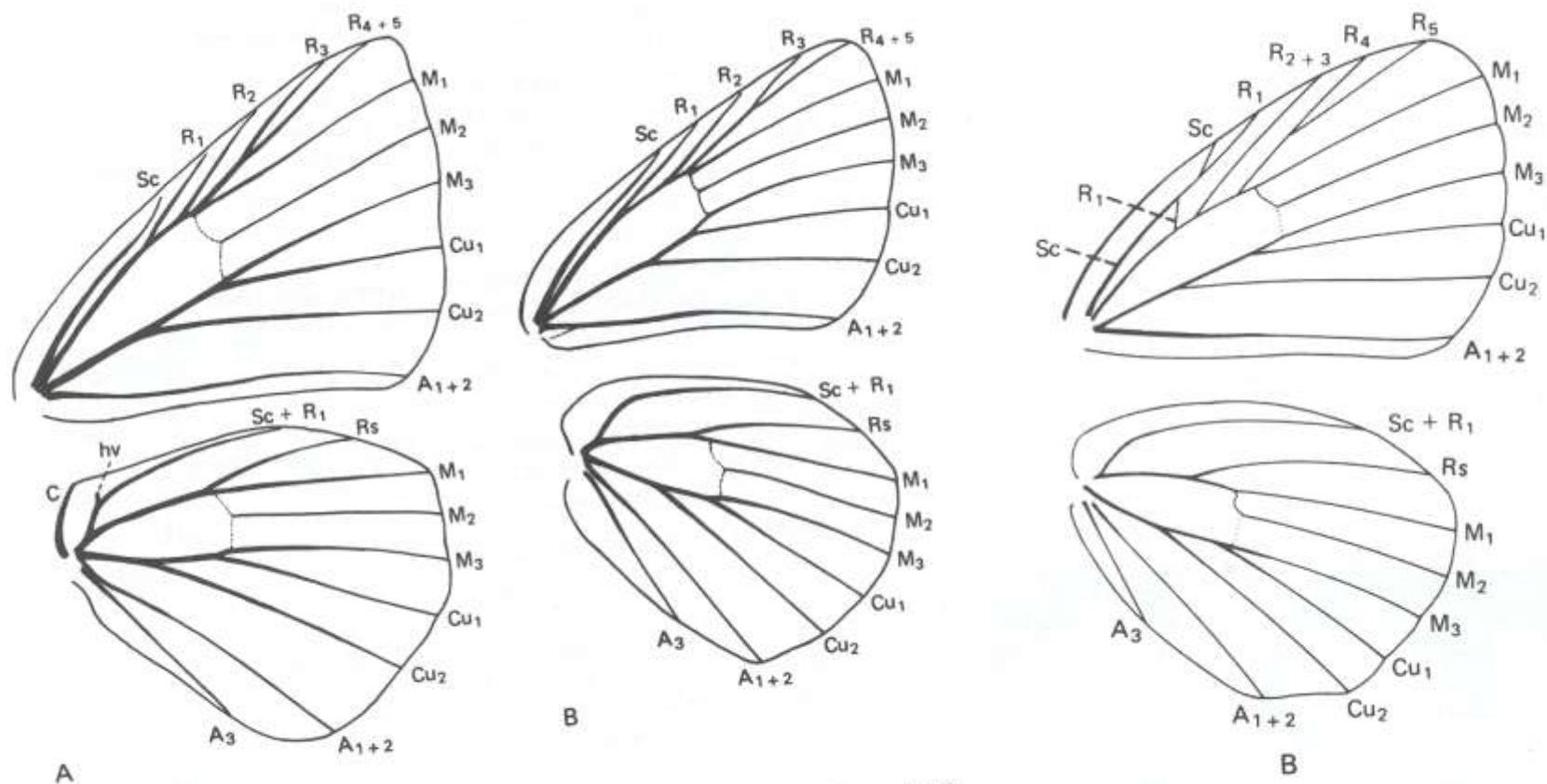


Figure 30-14 Wings of Lycaenidae. A, *Lephelisca* (Riodininae); B, *Lycaena* (Lycaeninae).
 hv, humeral vein.

Nymphalidae: variable in size and color;
front legs often very reduced, some veins
swollen at base



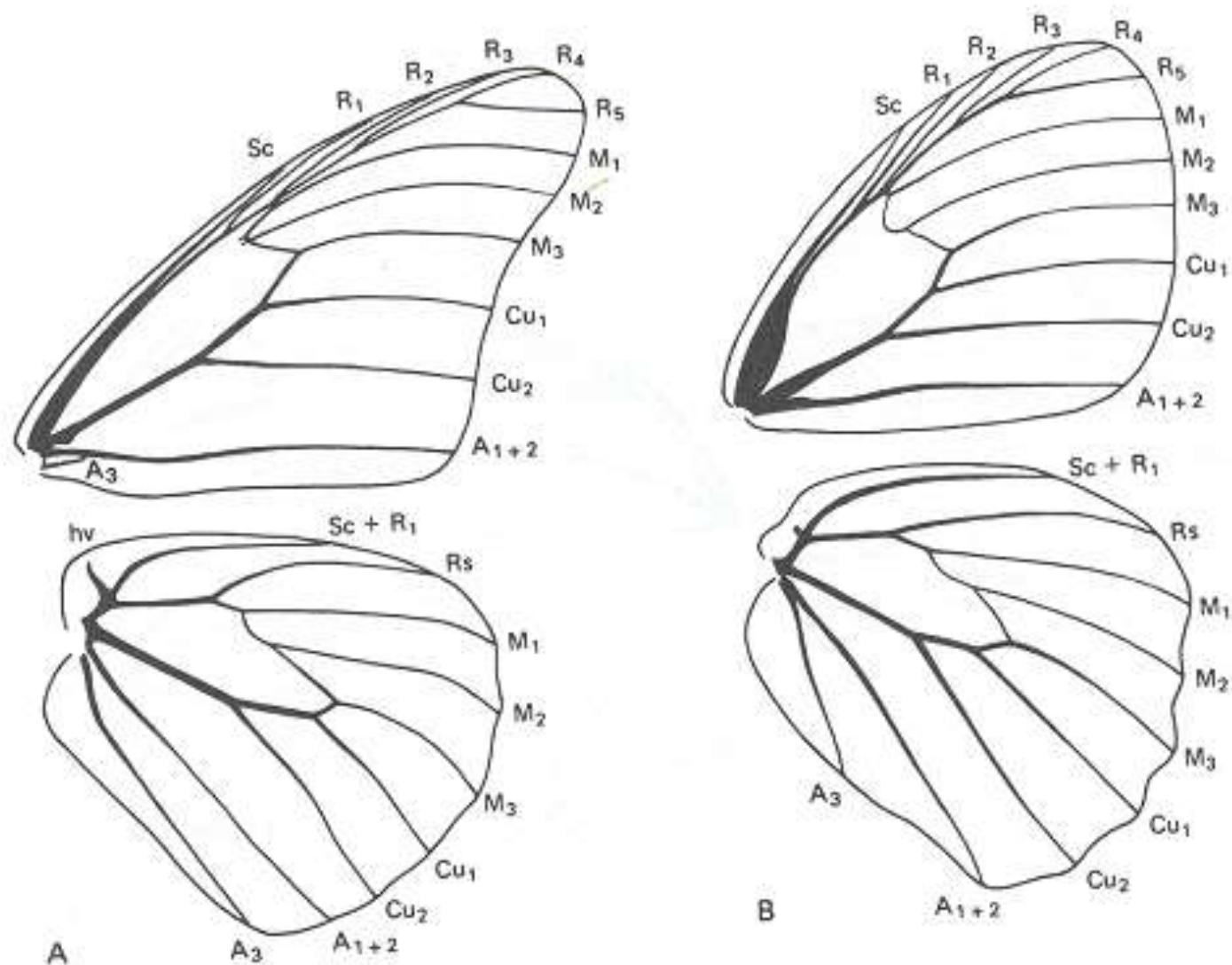


Figure 30-10 Wings of butterflies. A, *Danaus* (Nymphalidae, Danainae); B, *Cercyonis* (Nymphalidae, Satyrinae). hv, humeral vein.





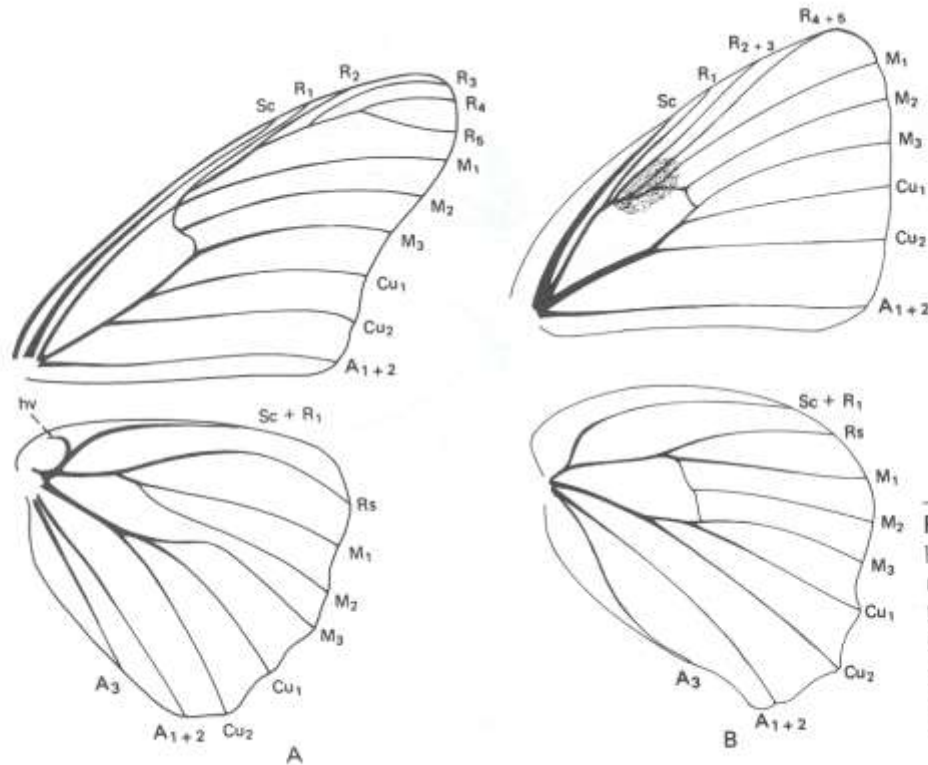


Figure 30-12 Wings of butterflies. A, *Agraulis* (Nymphalidae, Heliconiinae); B, *Thecla* (Lycaenidae, Lycaeninae), male. The dark spot near the end of the discal cell is a scent gland. hv, humeral vein.

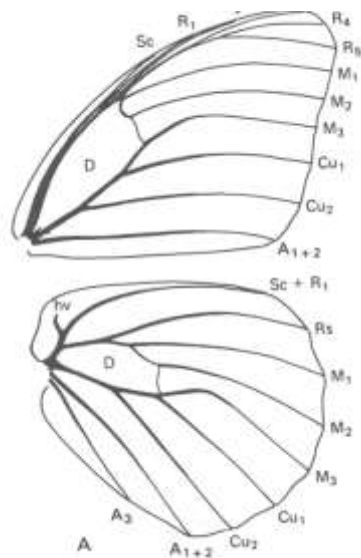


Figure 30-11 Wings of Nymphalidae. A, *Speyeria* (Heliconiinae) (discal cell in hind wing closed by a vestigial vein); B, *Limenitis* (Limenitinae) (discal cell in hind wing open). D, discal cell; hv, humeral vein.









Geometridae



Basal part of Sc vein in HW makes abrupt bend into the humeral angle; Cu in FW appears 3-branched

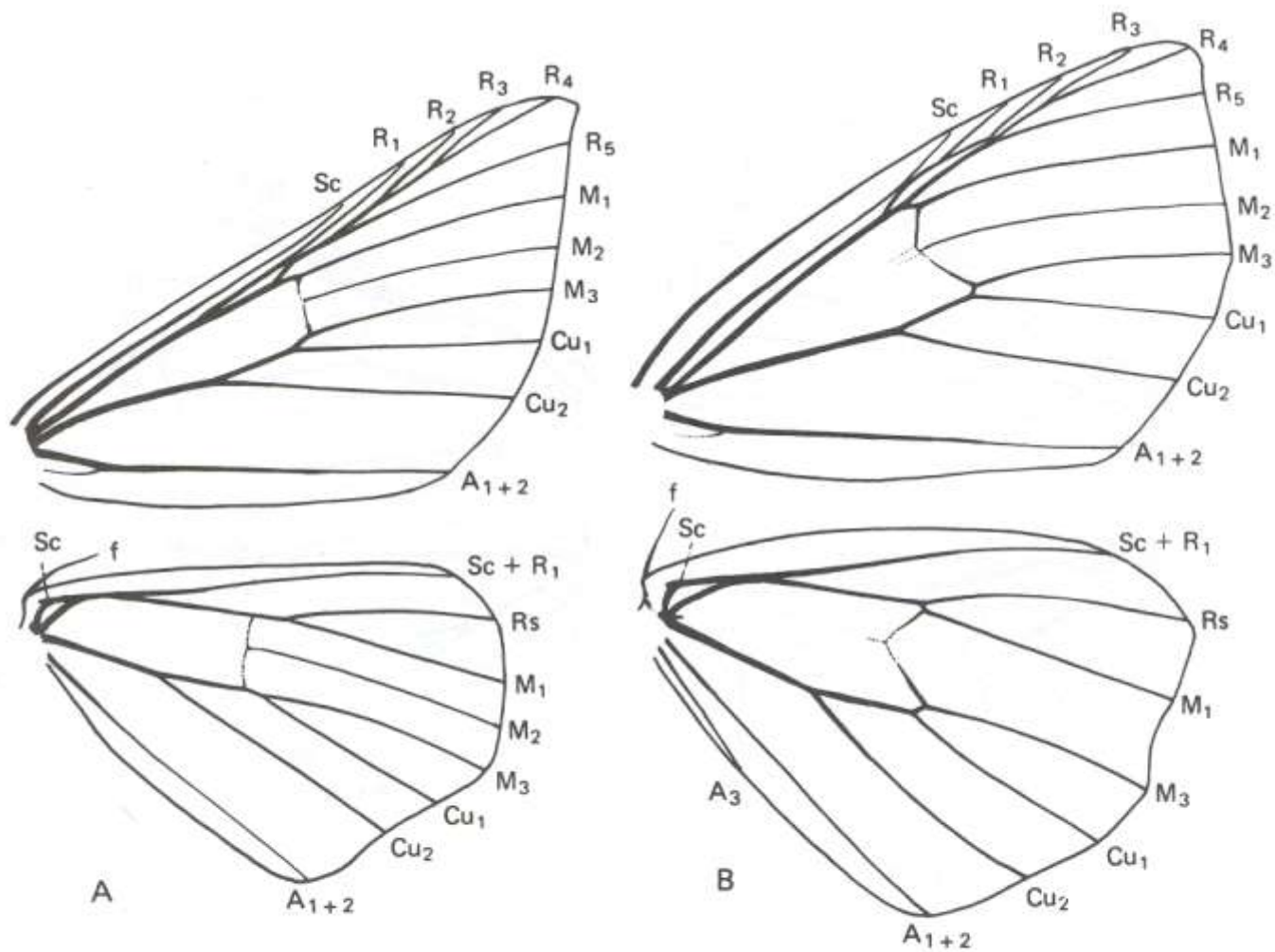


Figure 30-20 Wings of Geometridae. A, *Haematopsis*; B, *Xanthotype*. f, frenulum.



Saturniidae: large with feathery antennae; wings broad, usually with eyespots

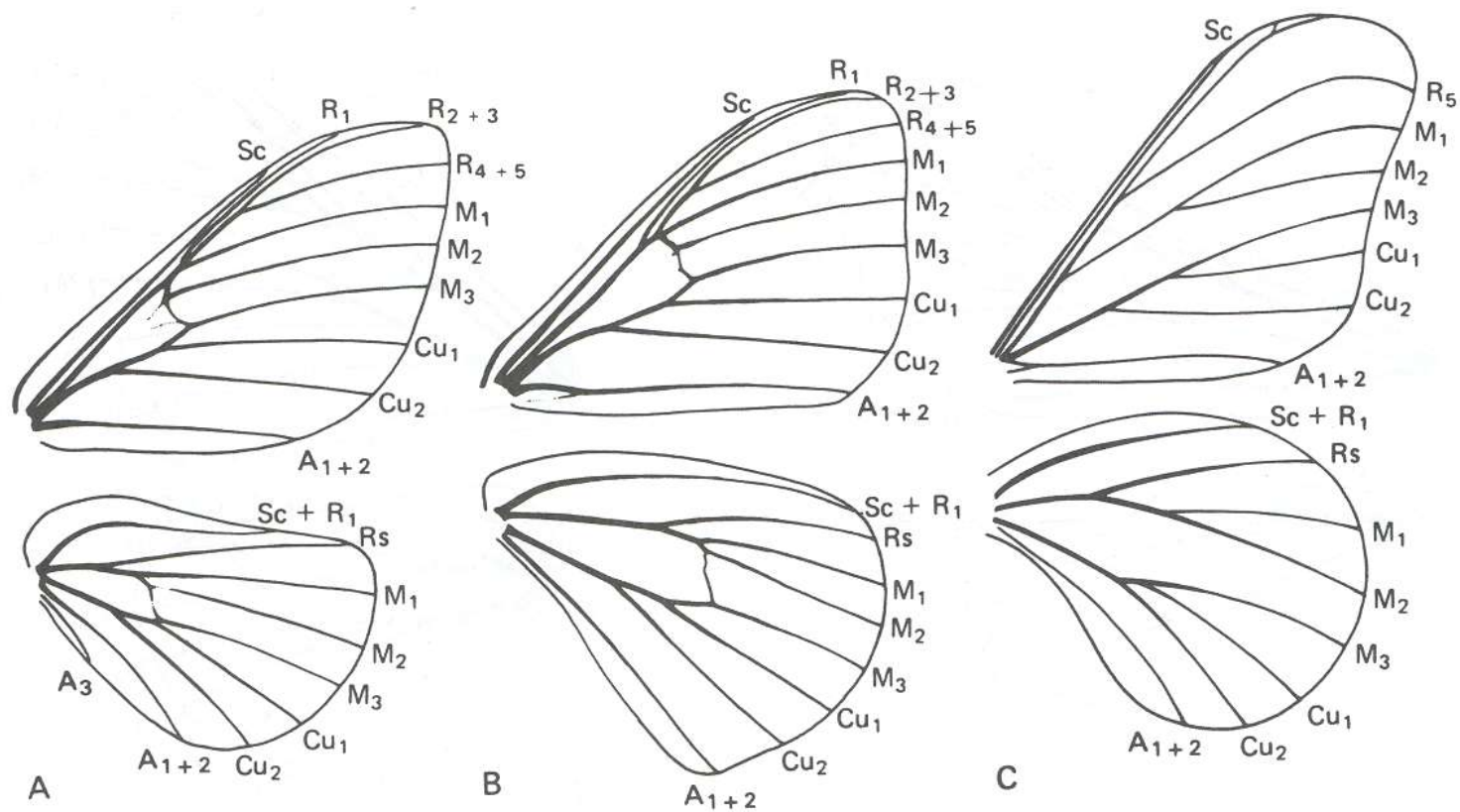


Figure 30-22 Wings of Saturniidae. A, *Anisota* (Ceratocampinae); B, *Automeris* (Hemileucinae); C, *Callosamia* (Saturniinae).

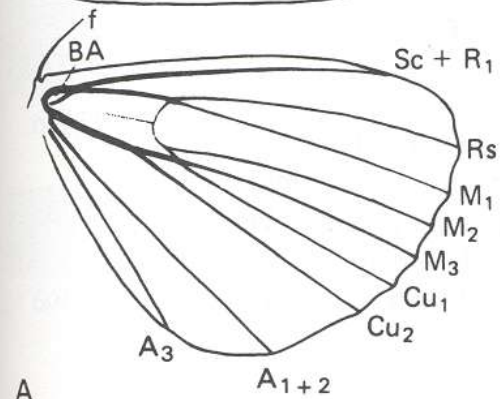
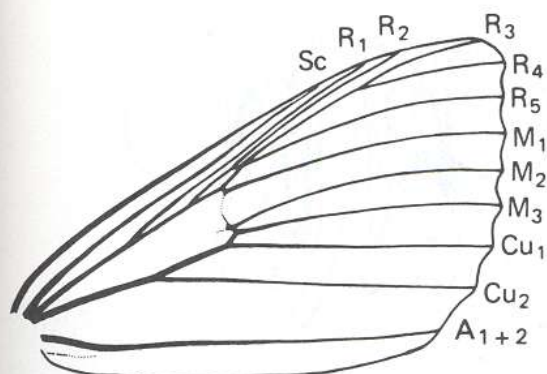


Sphingidae: Large, heavy-bodied, wings small and narrow, FW much longer than HW, antennae spindle shaped

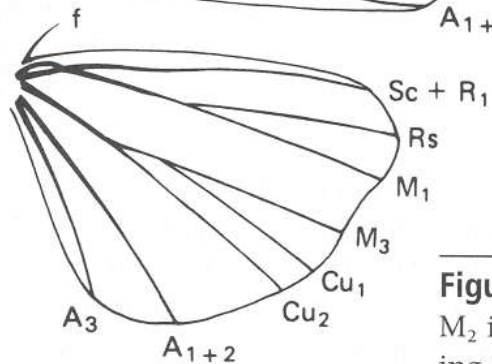
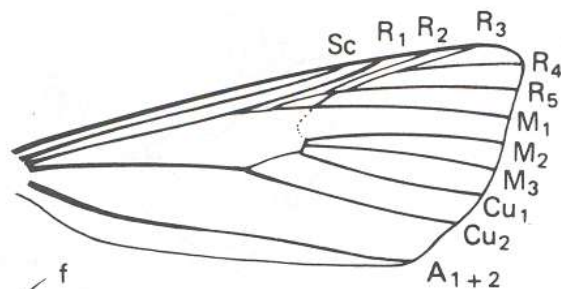


Noctuidae: labial palps usually long; thread-like antennae, Cu in FW appears 4-branched, often dark colored or grey





A



B

Figure 30-27 Wings of Noctuidae, with M_2 in hind wing present and Cu appearing 4-branched (A), and M_2 in hind wing absent and Cu appearing 3-branched (B). BA, basal areole.



Erebidae, Arctiinae: (tiger moths) heavy-bodied, bright spots and bands common; Sc and R fused until about the middle of the discal cell

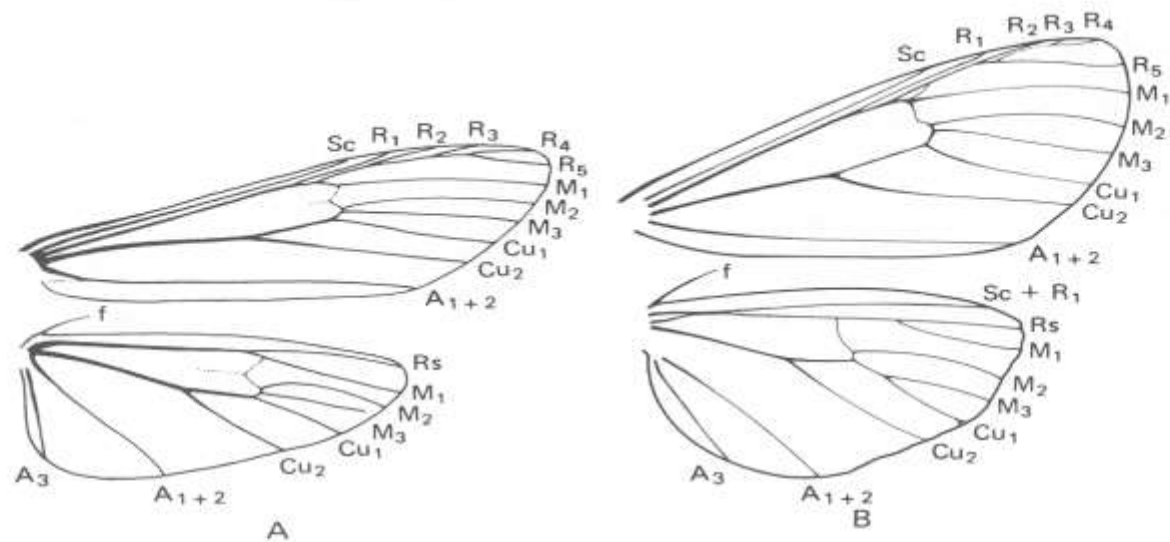


Figure 30-25 Wings of Arctiidae. A, *Cisseps* (Arctiinae, Ctenuchini); B, *Gnophaela* (Arctiinae, Pericopini). f, frenulum.

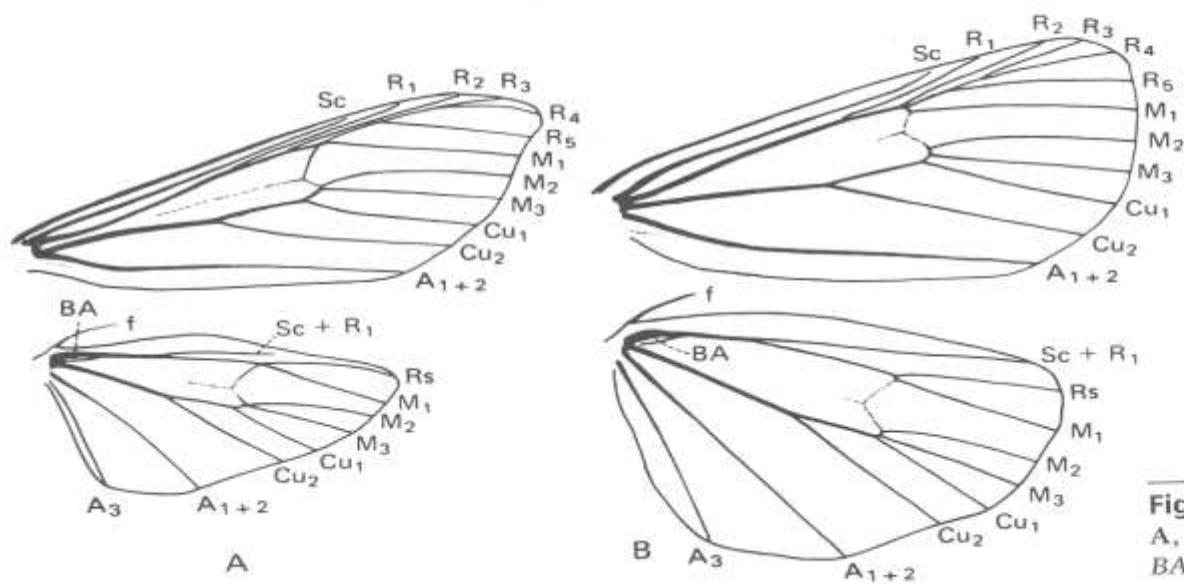


Figure 30-26 Wings of Arctiidae. A, *Halisidota*; B, *Apantesis*. BA, basal areole; f, frenulum.





**Suborder Symphyta
(abdomen broadly
joined to thorax)**



JL Foltz

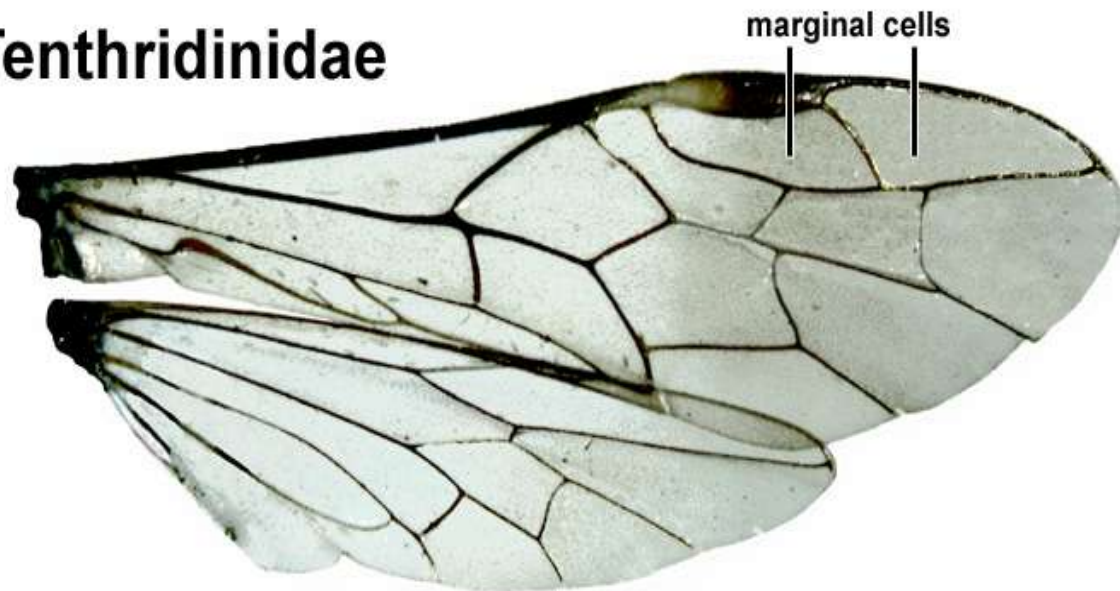




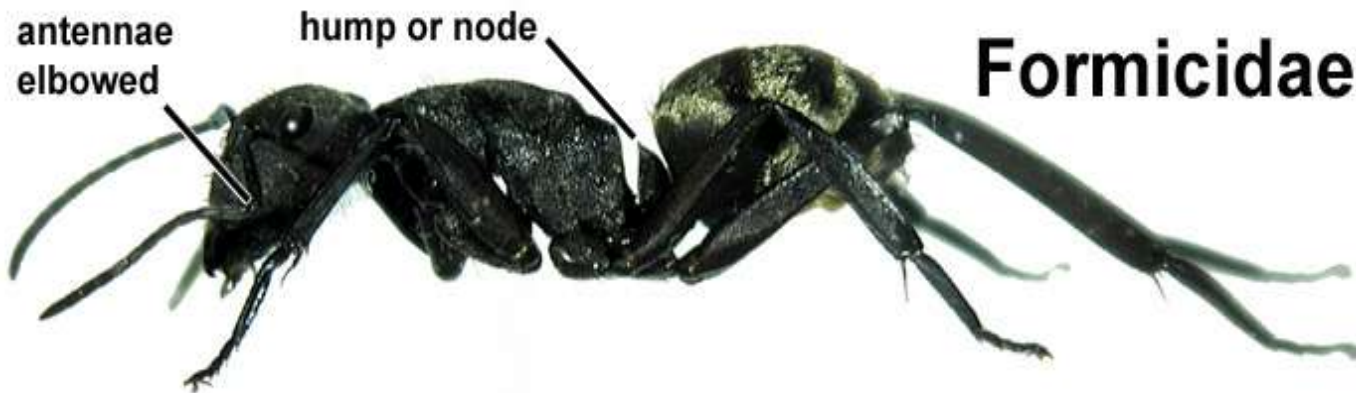
Tenthredinidae



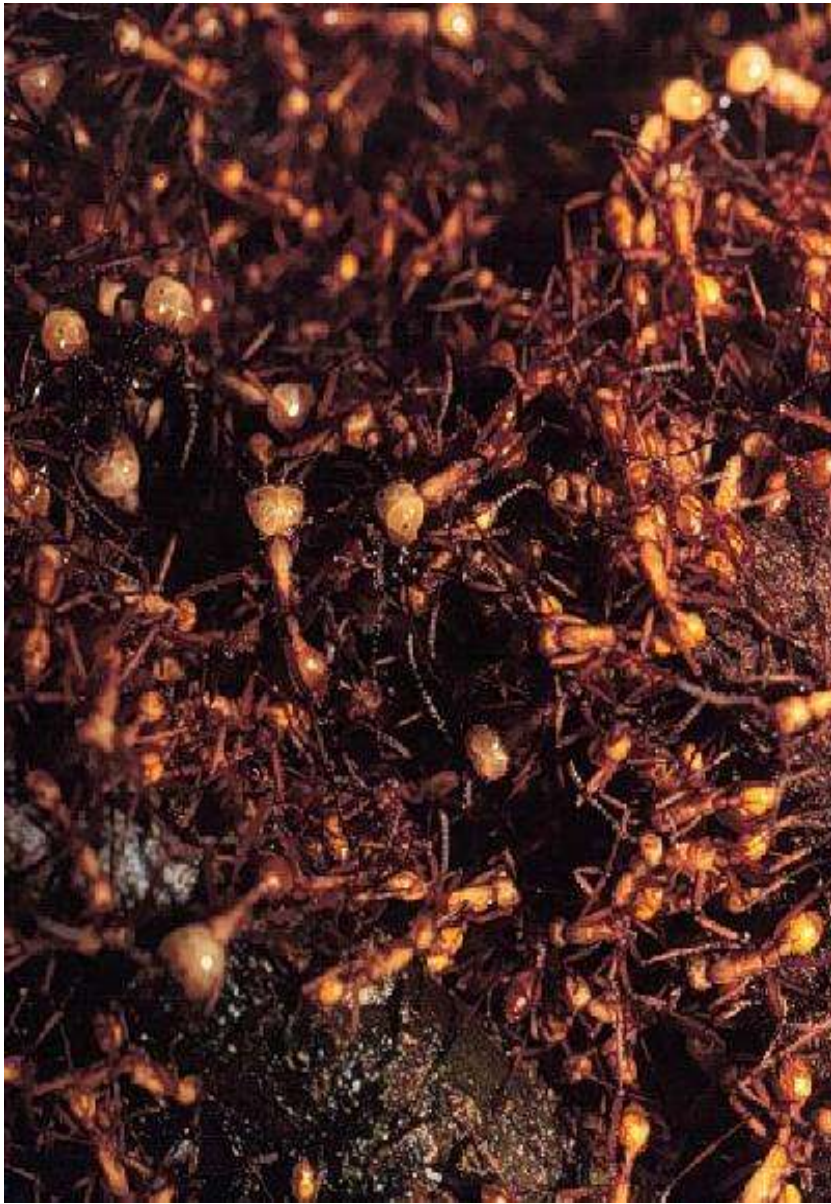
Tenthredinidae



Family **Formicidae** (Ants): 1st abdominal segment nodelike or with a dorsal hump, differing from remaining segments, antennae with 6-13 segments and strongly elbowed in females, the 1st segment very long, venation of winged forms is usually slightly reduced.



Formicidae



Eciton sp. (Army ants)

Sphecidae

pronotum with rounded lobe

pronotum often
collarlike

Venation complete (or almost), unbranched or little hair on body, hornet-like

pronotum with rounded lobe

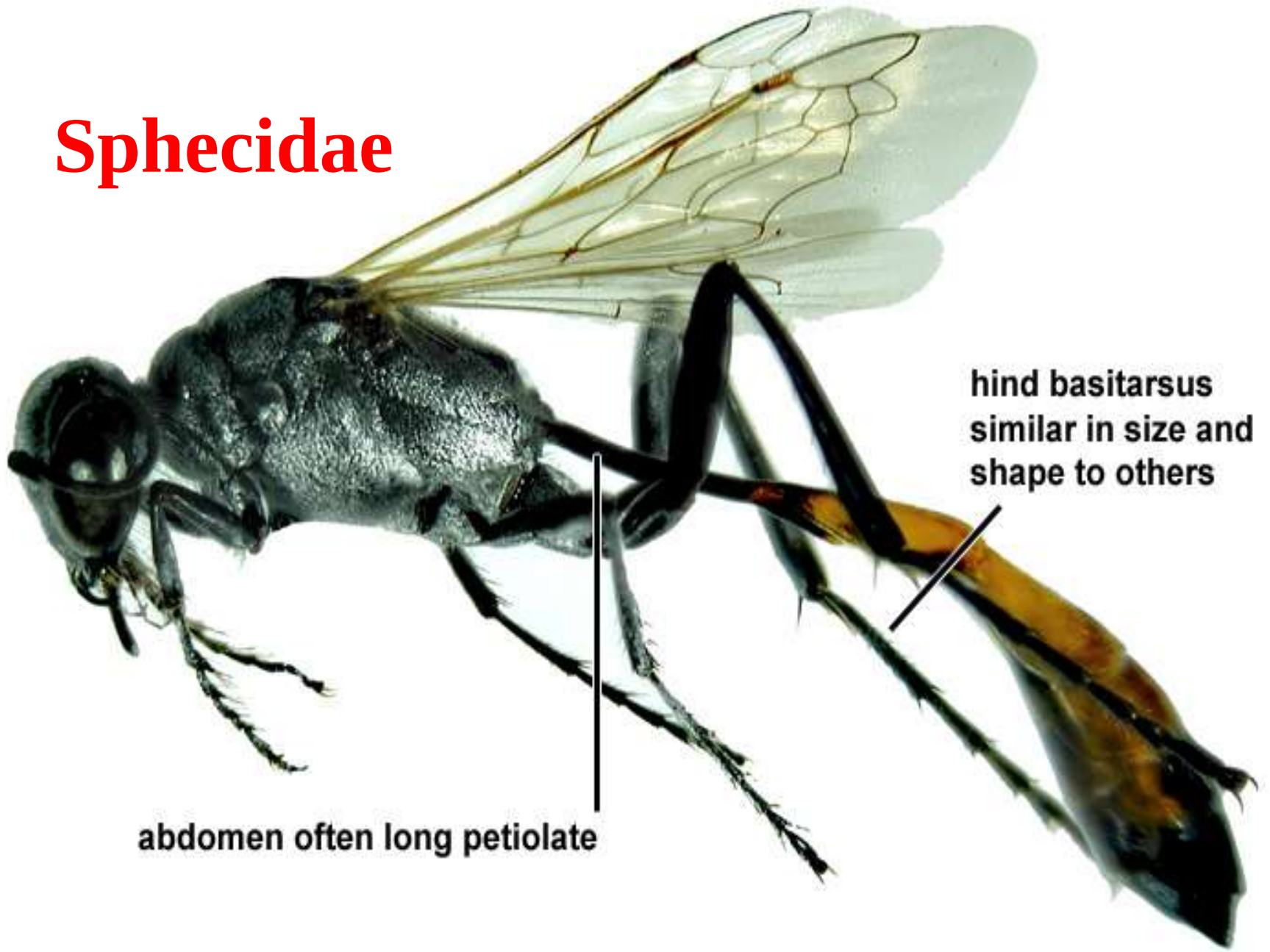
pronotum often
collarlike

Sphecidae

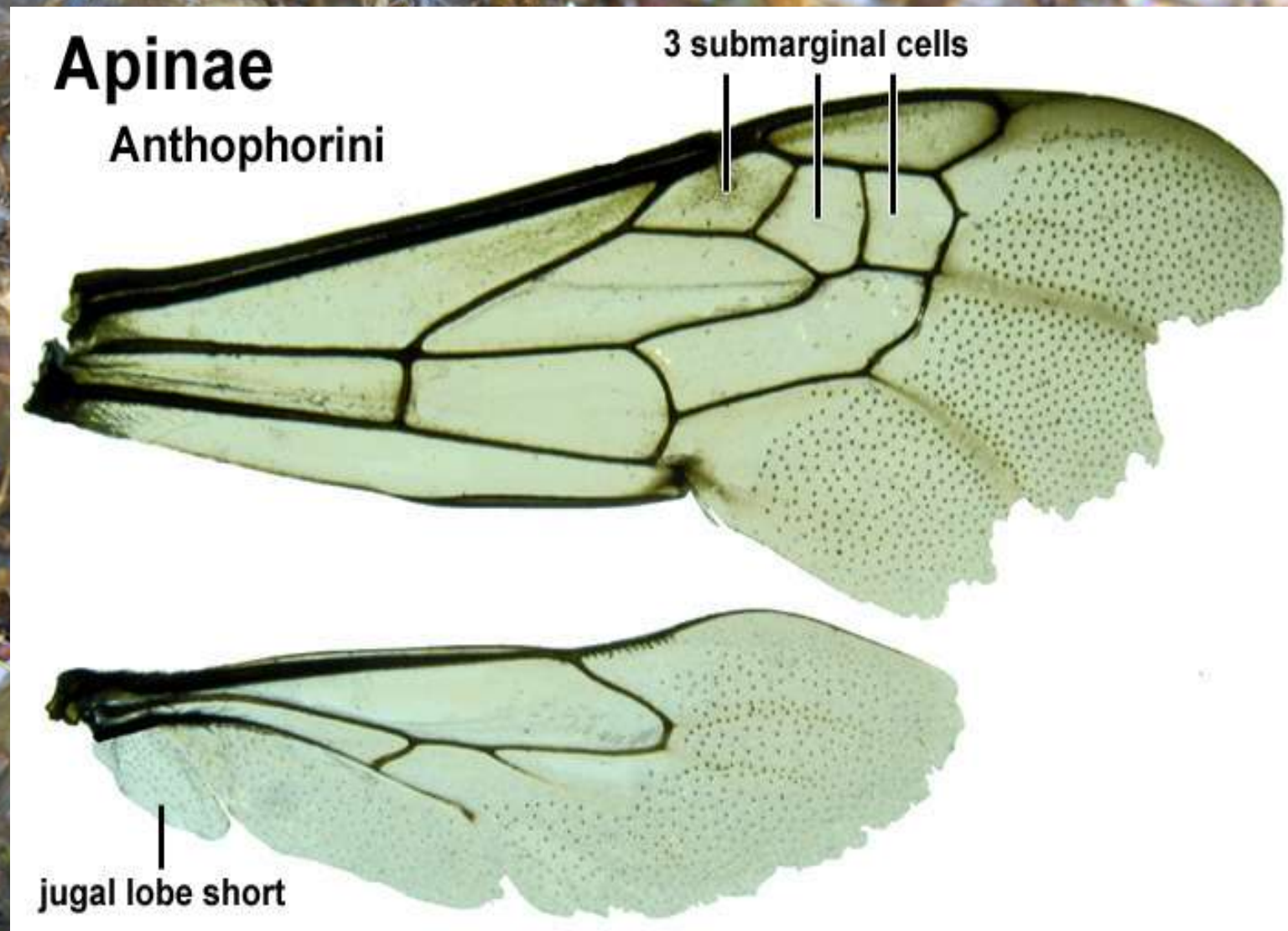


Sphecidae

Sphecidae

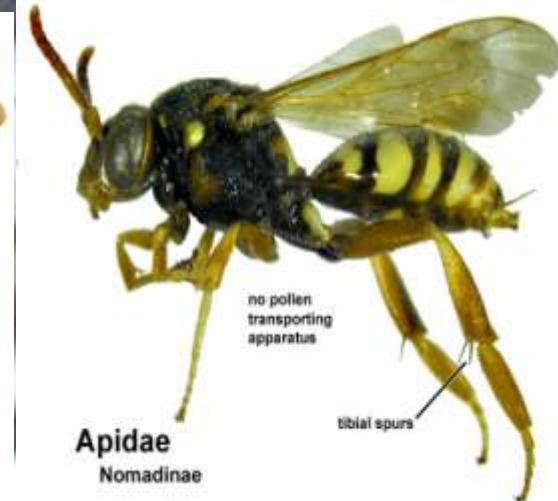


Apidae (Bees): jugal lobe on hind wing shorter than basal cell, usually 3 submarginal cells, first two segments of labial palps elongate and flattened





Apinae
Euglossini

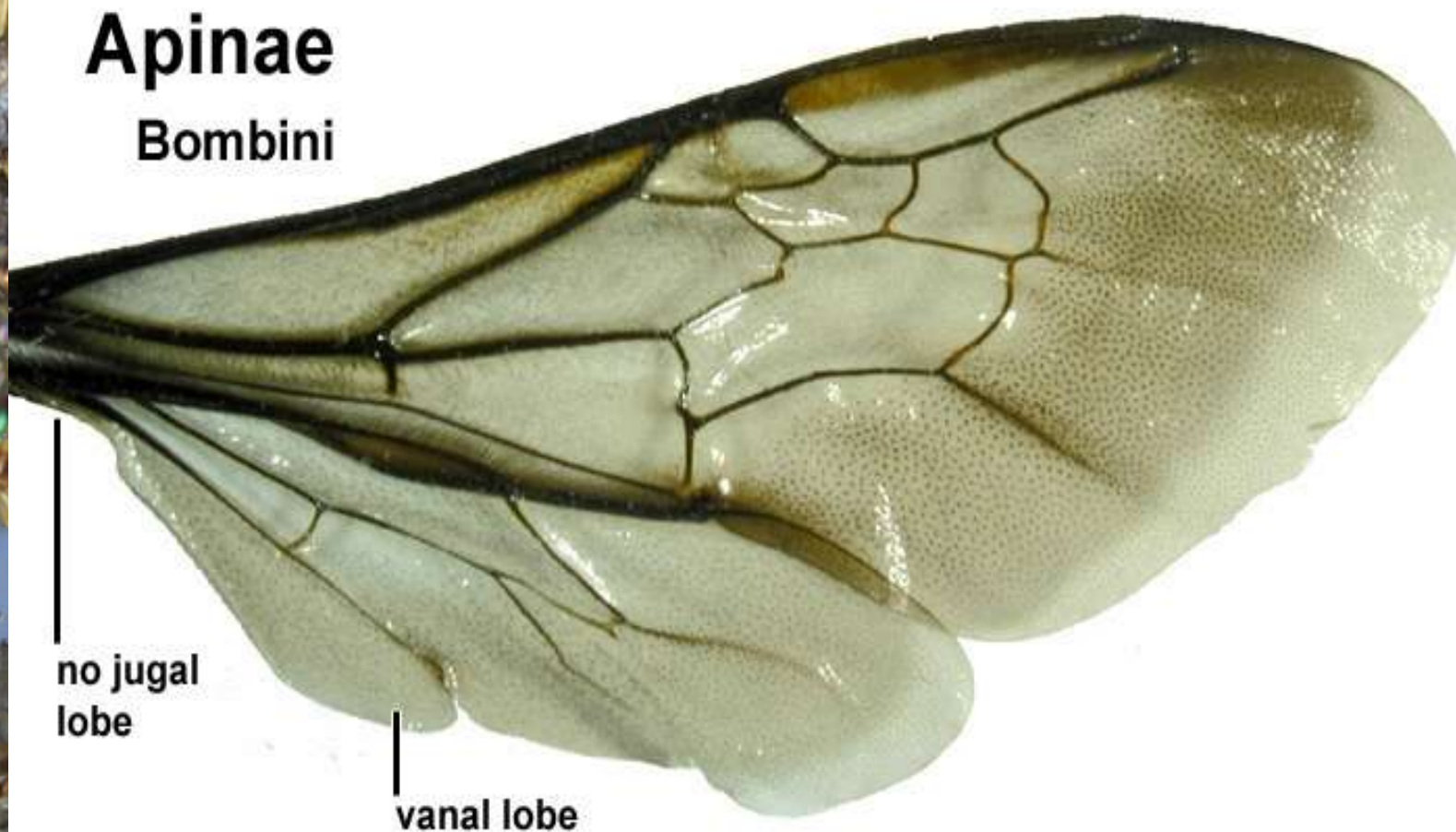


Apidae
Nomadinae

no pollen
transporting
apparatus

tibial spurs

Apinae
Bombini



no jugal
lobe

vanal lobe

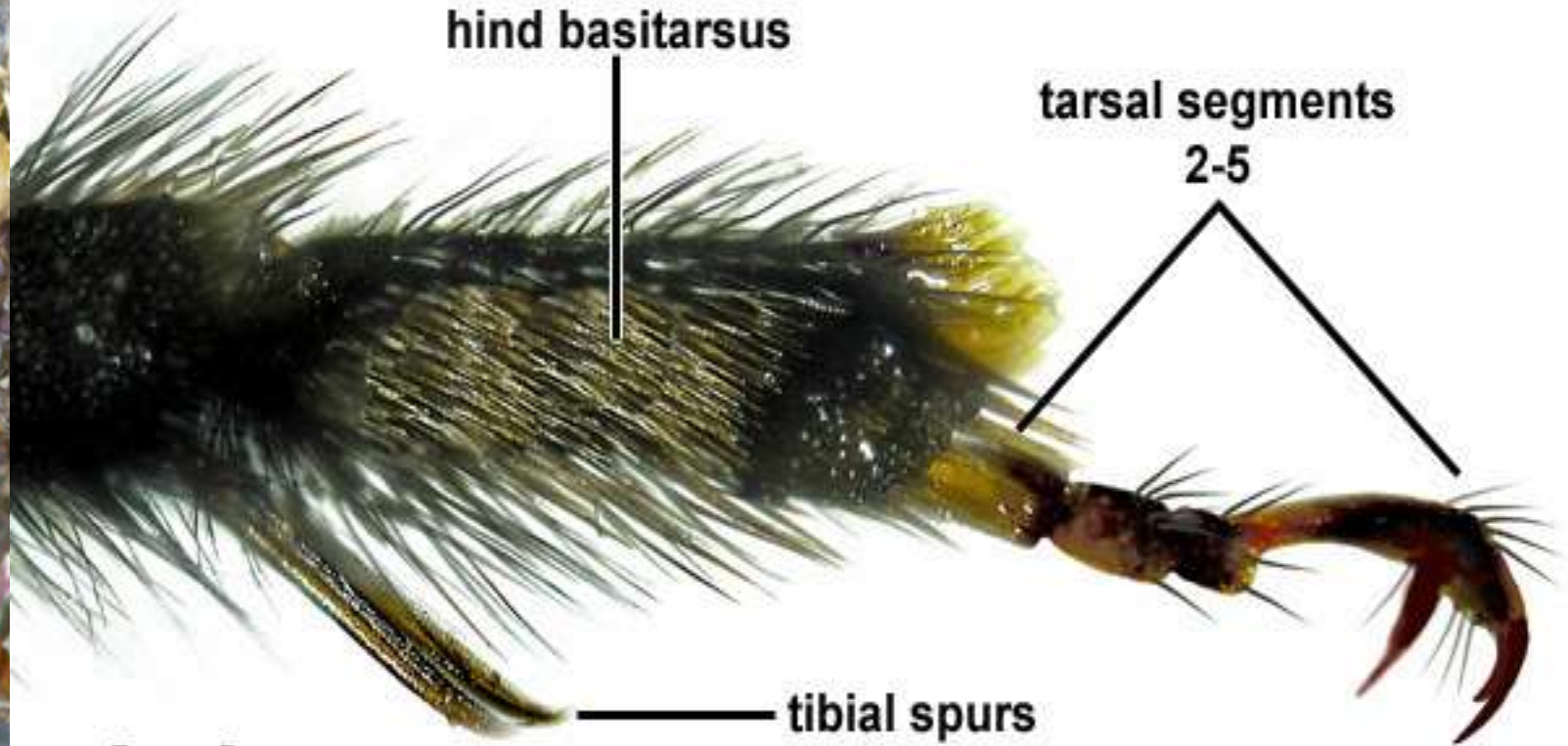
enlarged, flattened
hind basitarsus

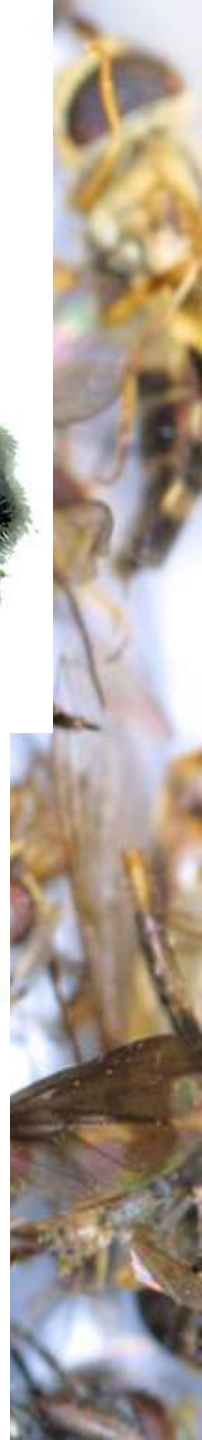
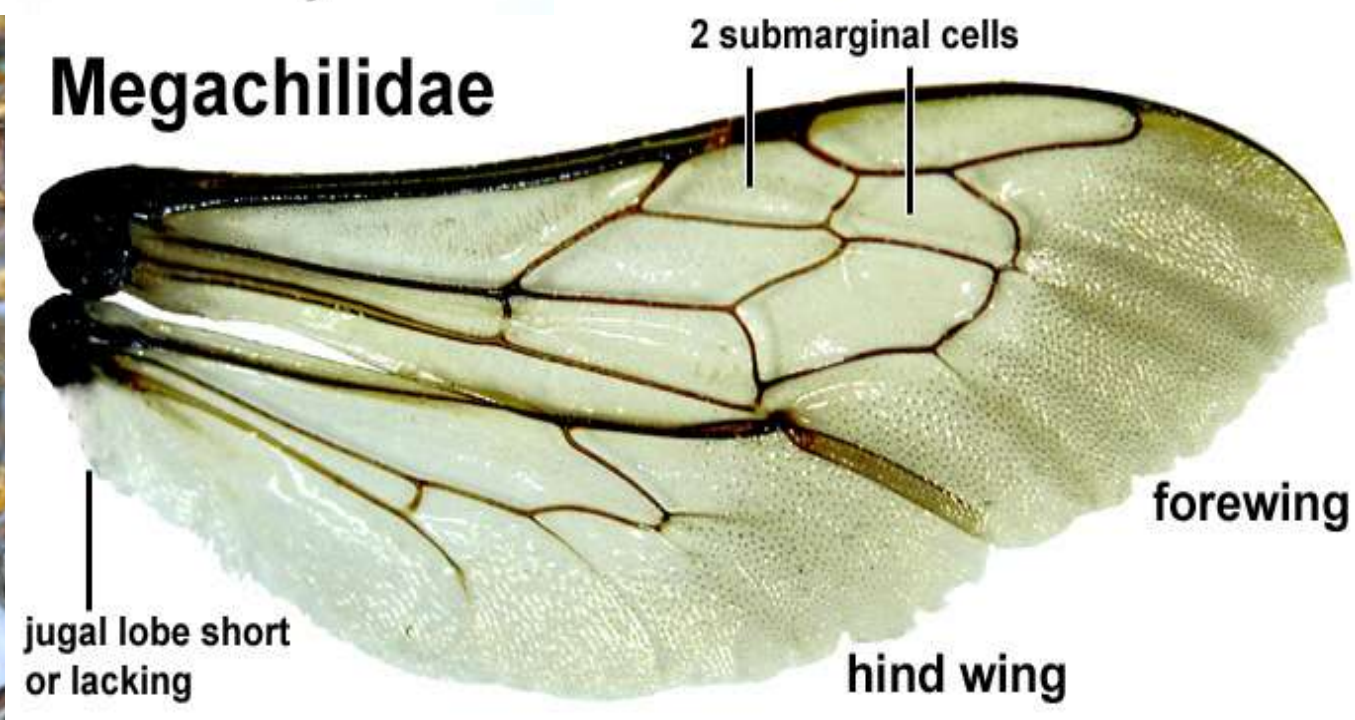
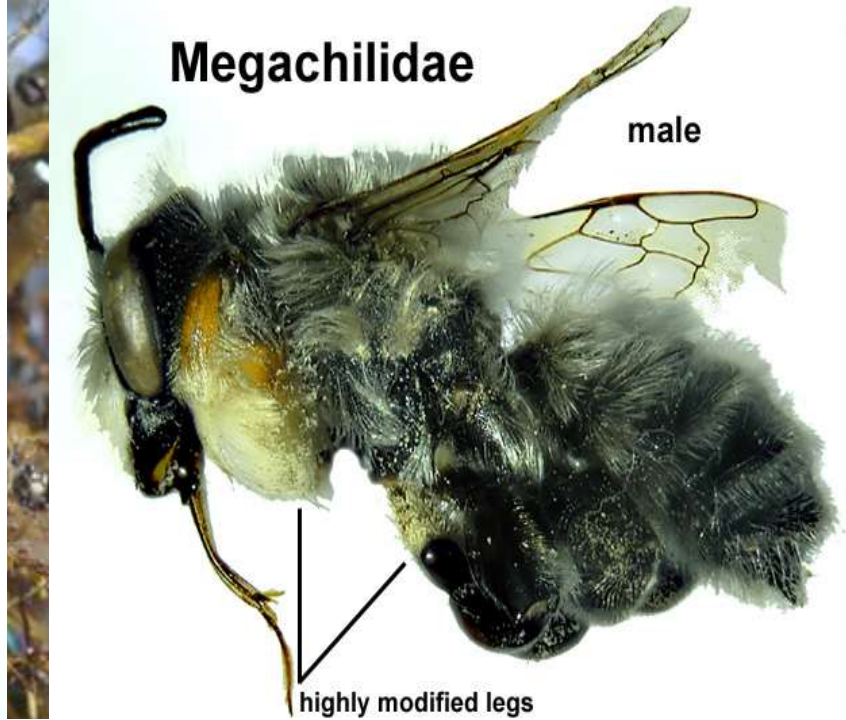
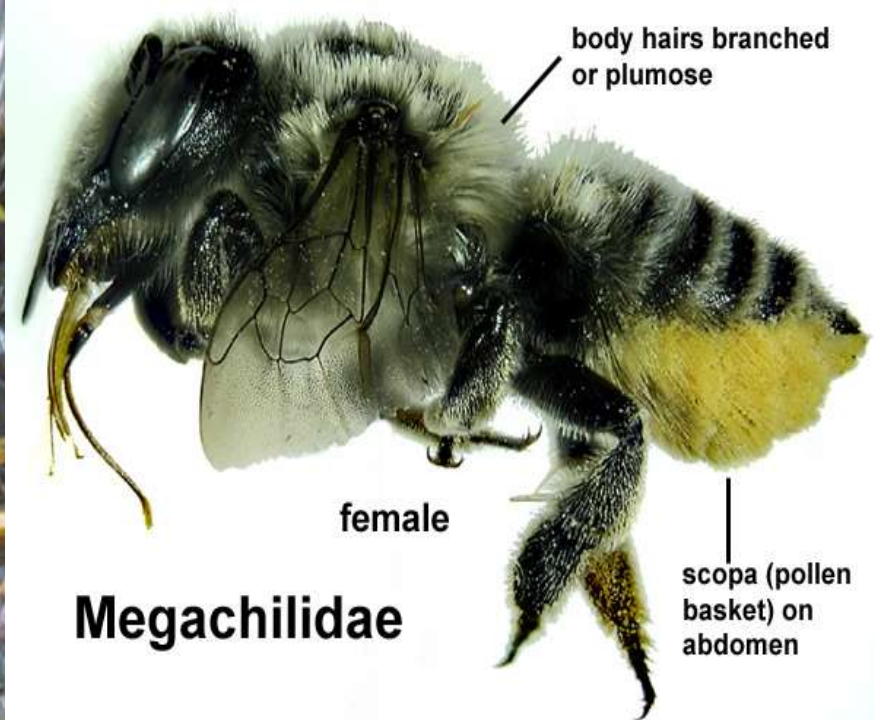
tarsal segments
2-5

tibial spurs

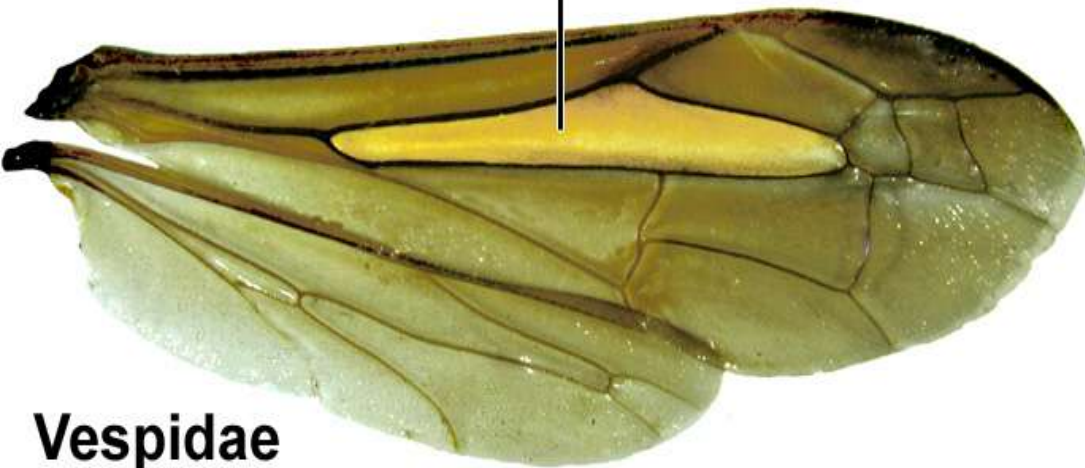
Apinae

Anthophorini

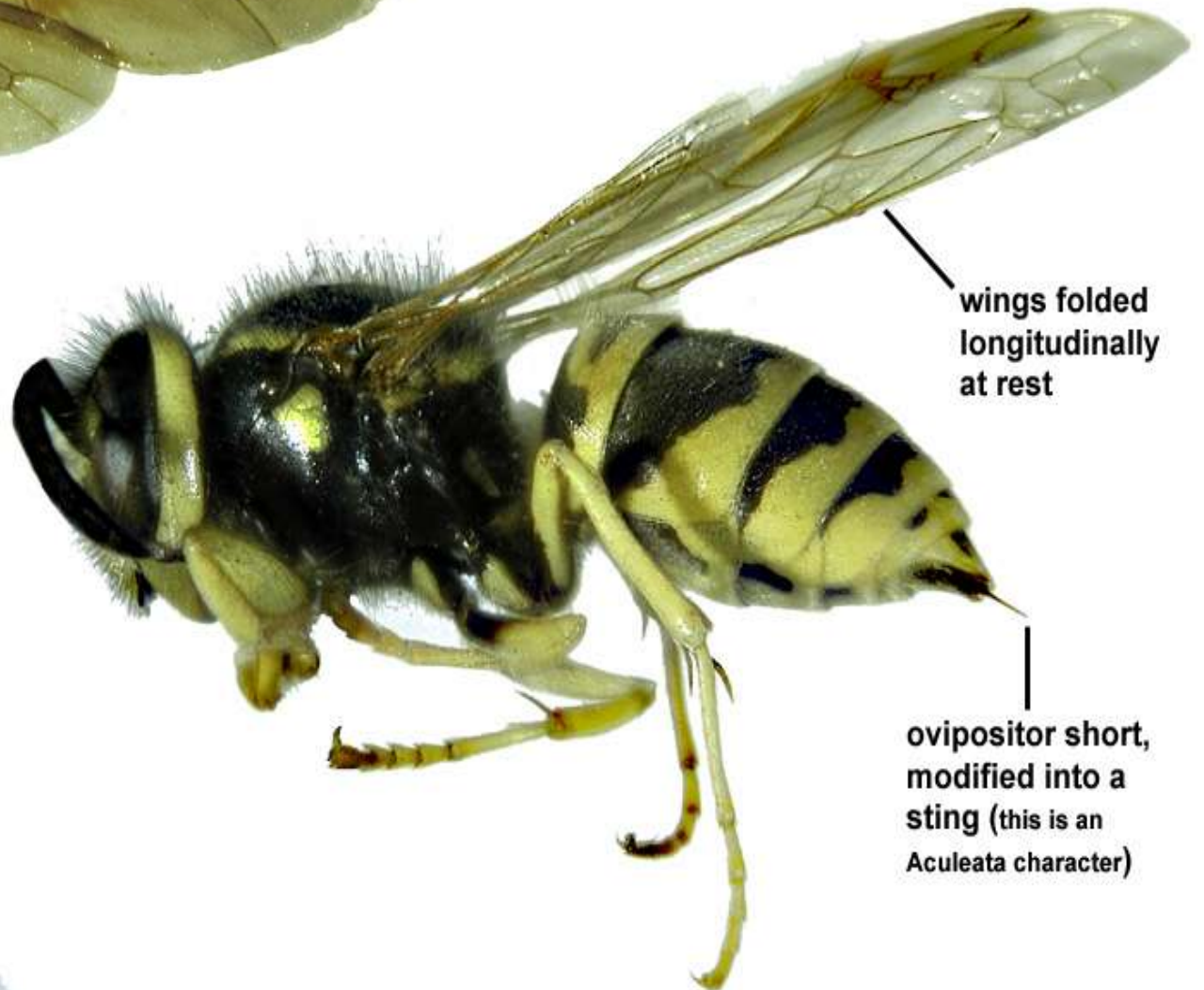




1M cell (1st discoidal) very long



Vespidae



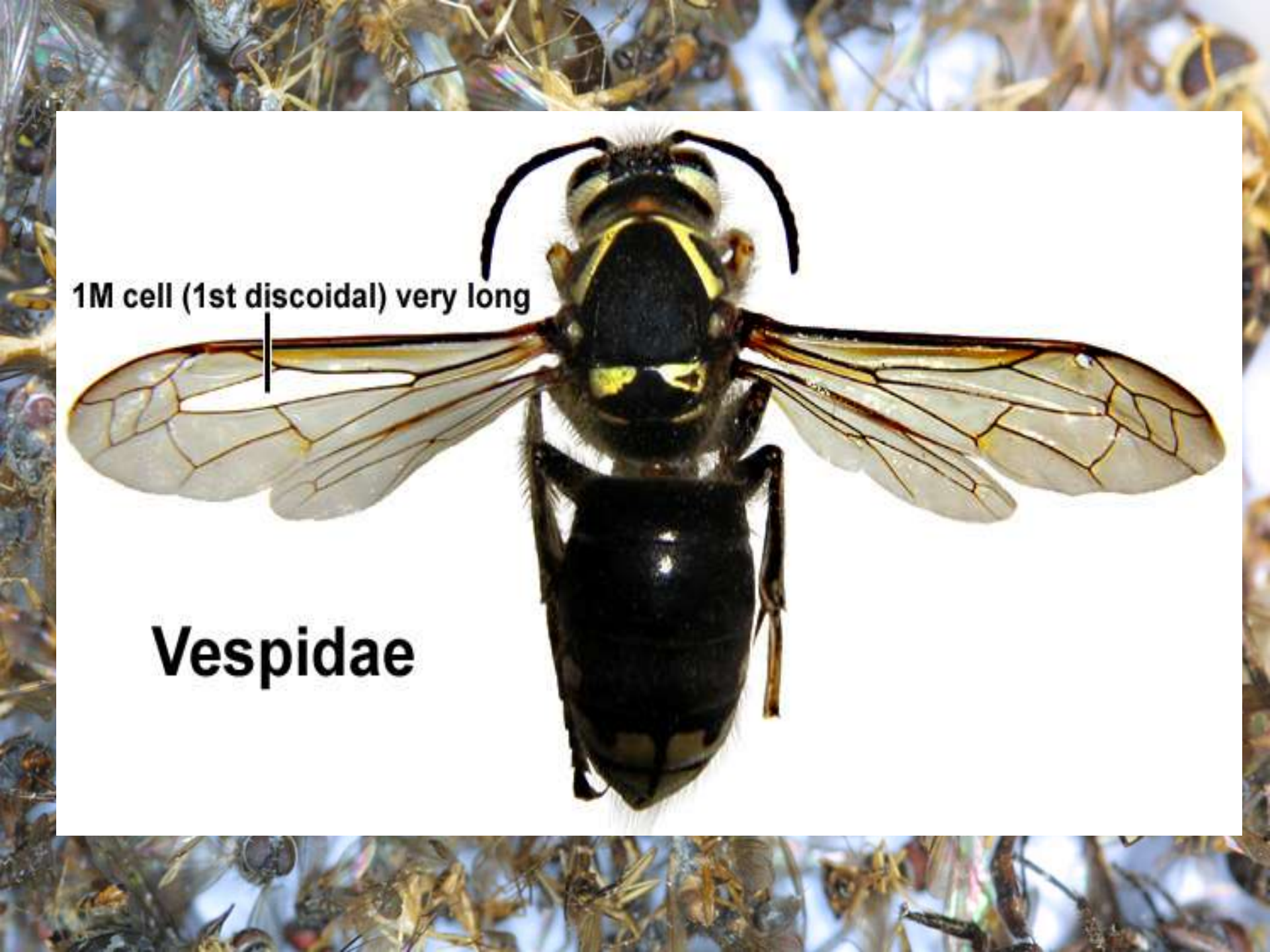
wings folded
longitudinally
at rest

ovipositor short,
modified into a
sting (this is an
Aculeata character)



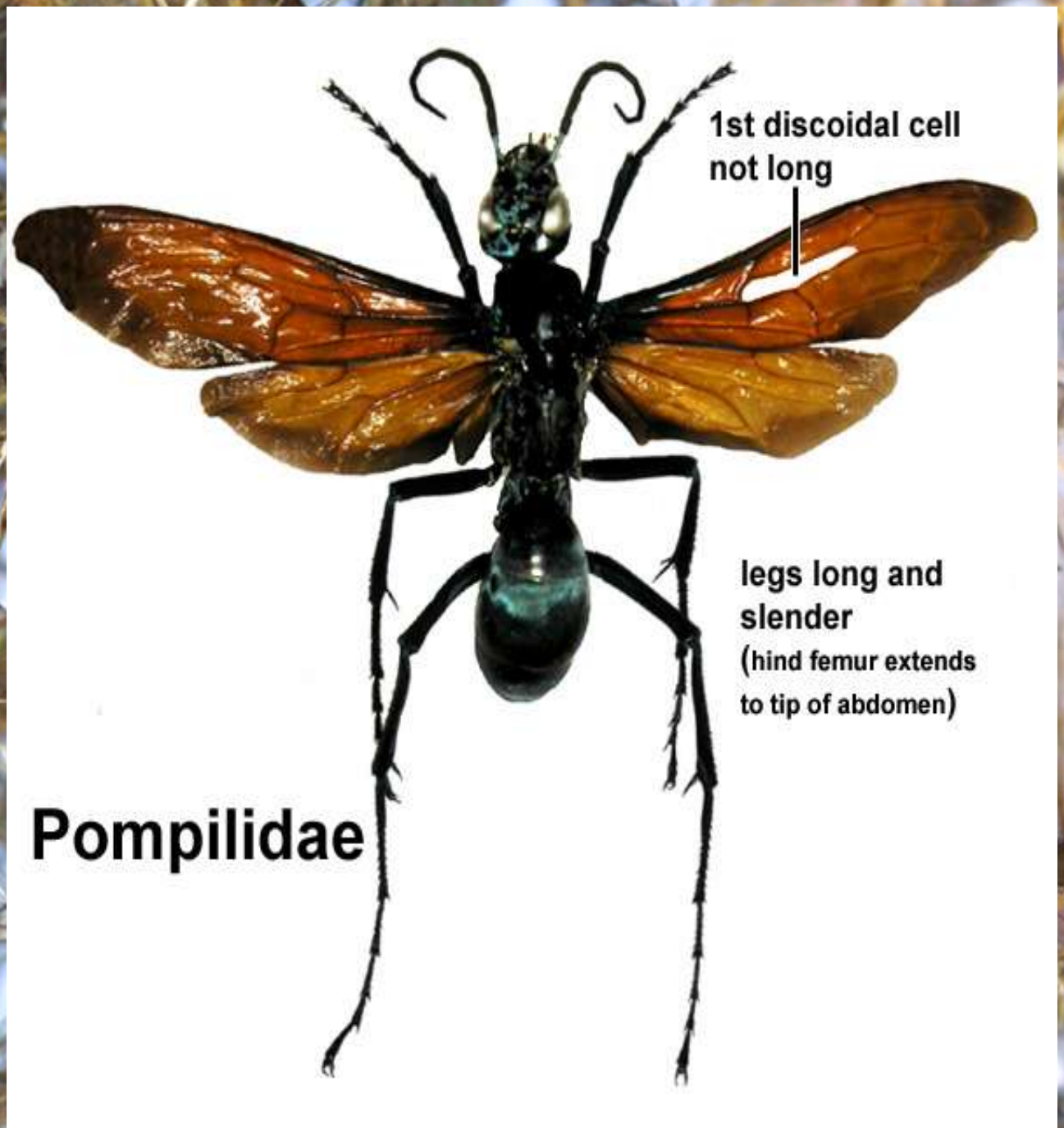
VESPIDAE

(Hornets, Yellow Jackets): Notched eyes and clavate antennae, wings fold longitudinally (like a fan) when not flying, 1st discoidal cell in FW very long (1/2 as long as wing)



1M cell (1st discoidal) very long

Vespidae

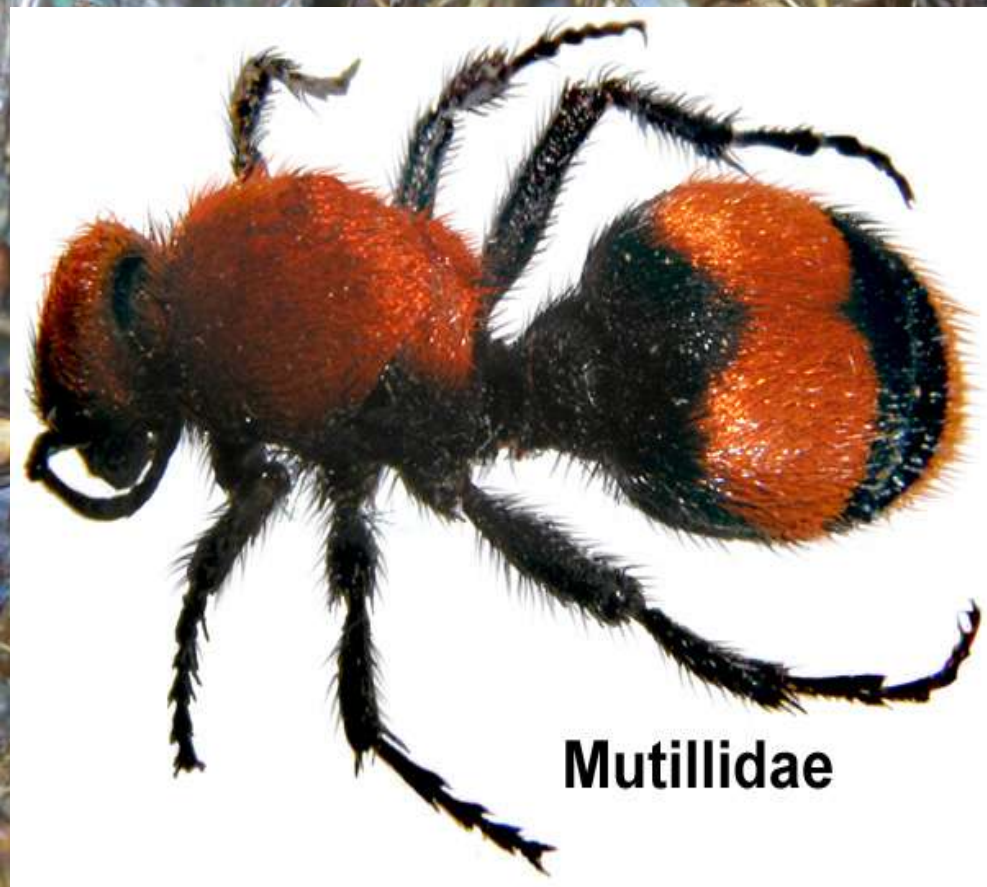


Pompilidae

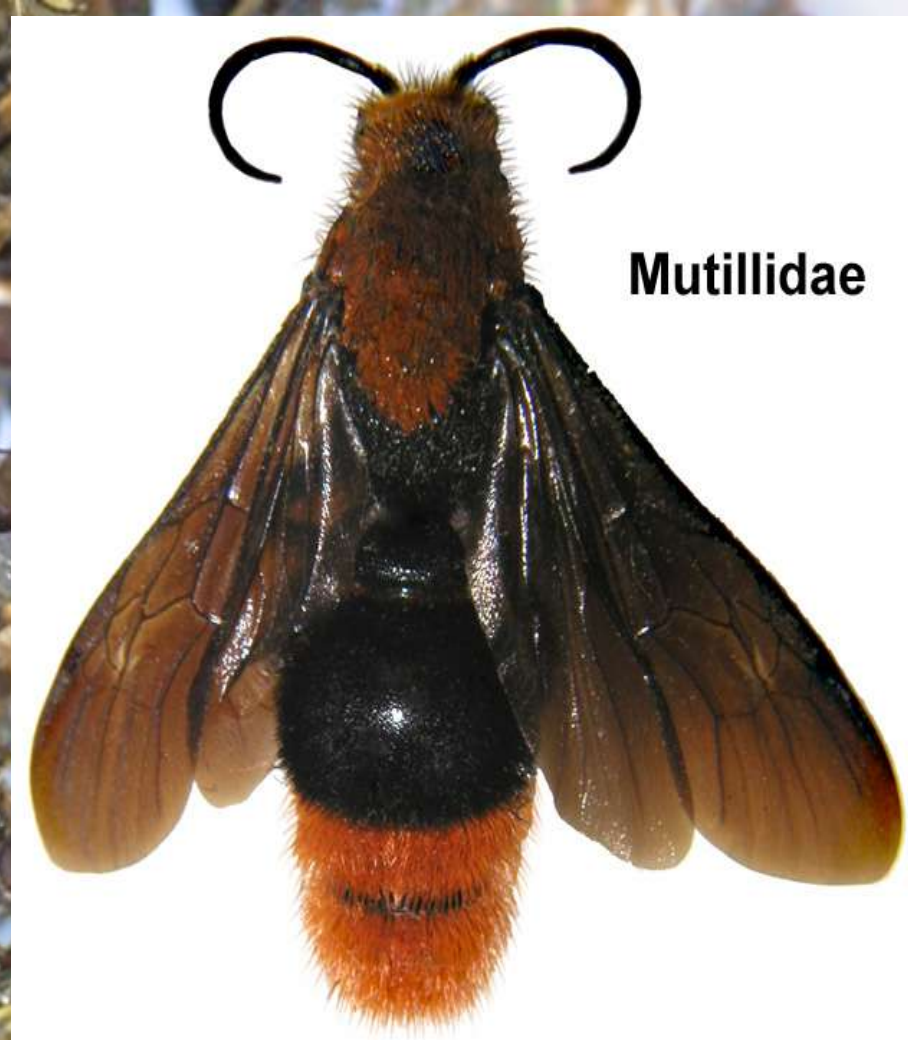


Pompilidae

mesopleuron with
transverse sulcus



Mutillidae



Mutillidae

Mutillidae

(Velvet Ants): very hairy and often brightly colored, male winged, female wingless with very painful sting

Parasitoids

Braconids

Emerging from hawkmoth larva



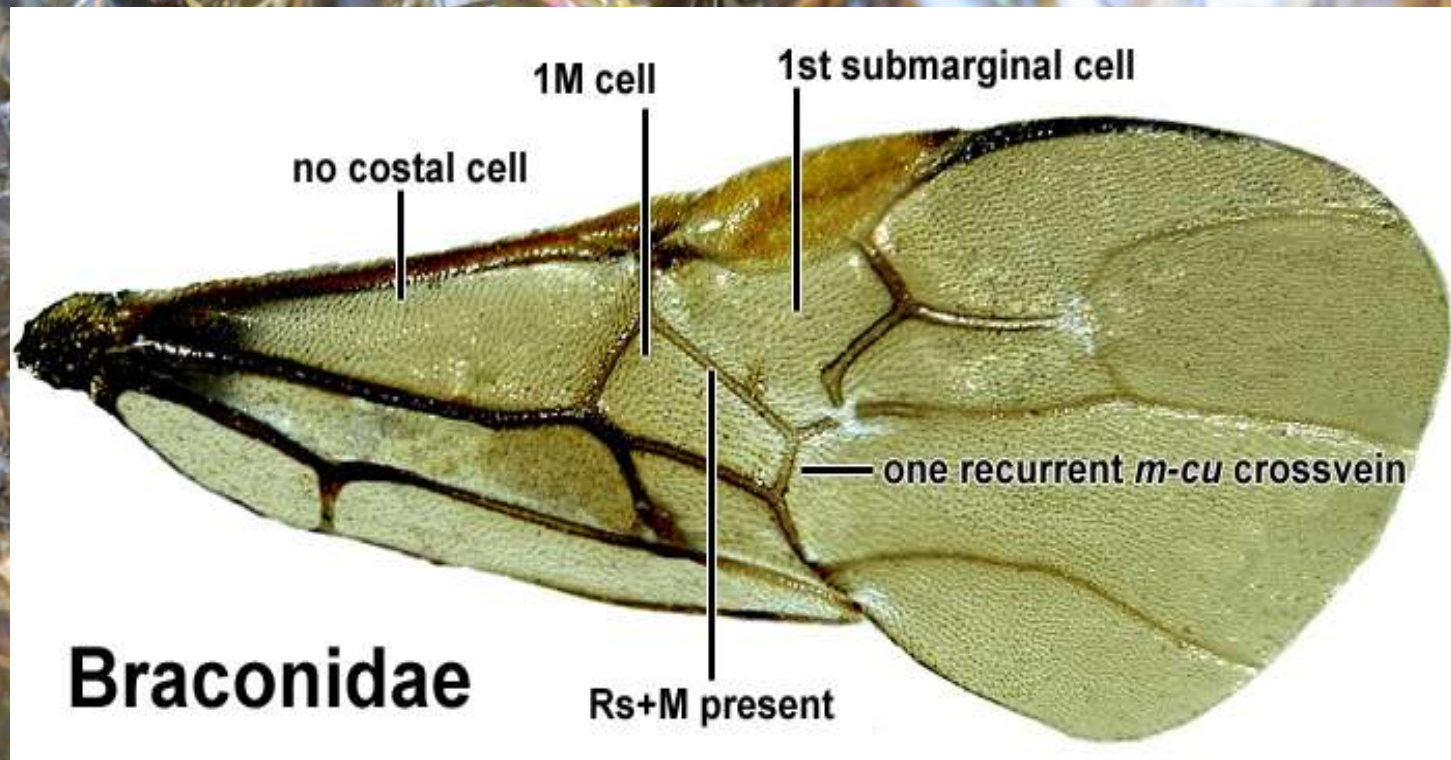
Attacking fruit boring moth



Chalcid

Ichneumonid





Braconidae

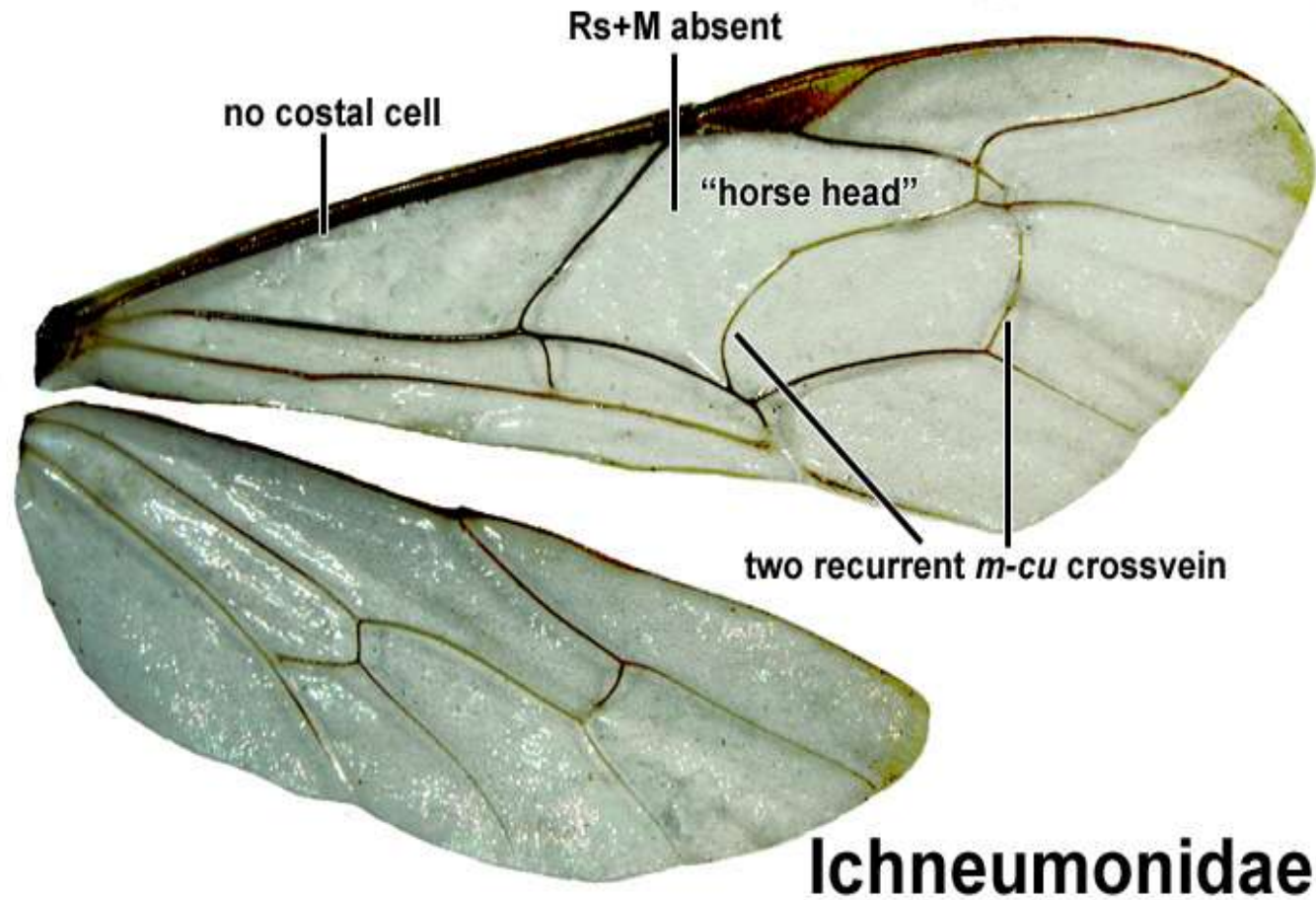
1 *m-cu* crossvein or none (no second *rv*), antennae long

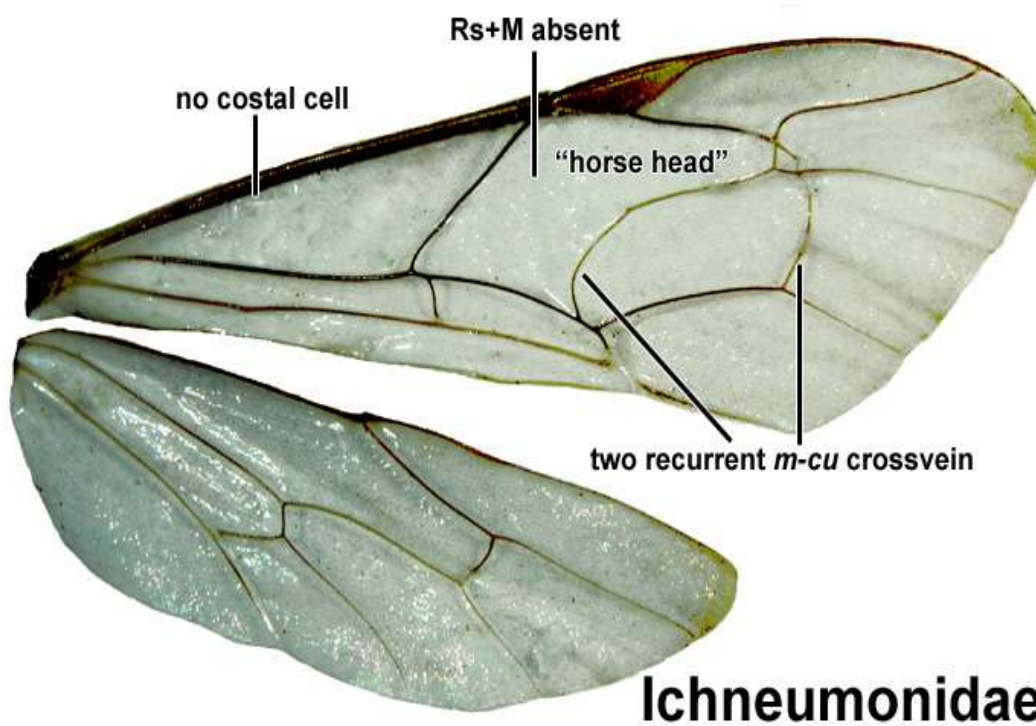
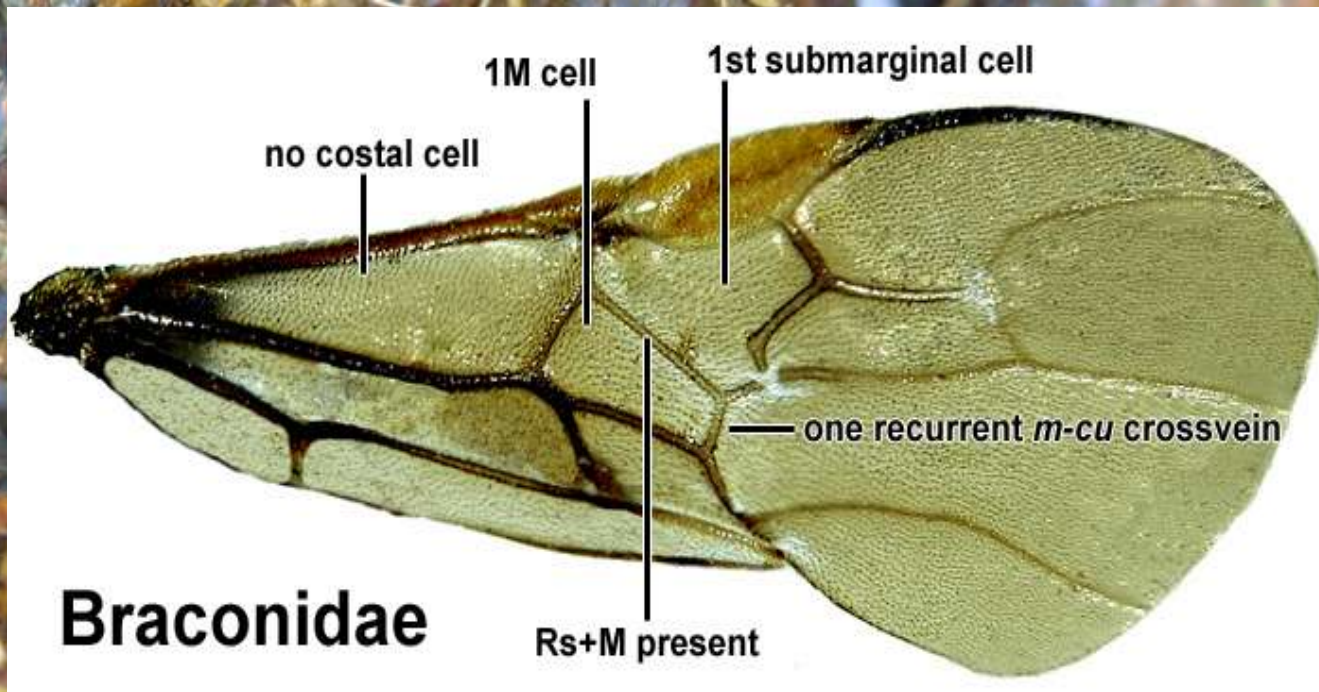
Braconidae





Ichneumonidae: 2 m-cu crossveins,
2nd submarginal cell small or lacking, antennae
with 16 or more segments and usually at least
half as long as the body, base of cubital vein
lacking, often with long ovipositors, possibly the
largest family of insects





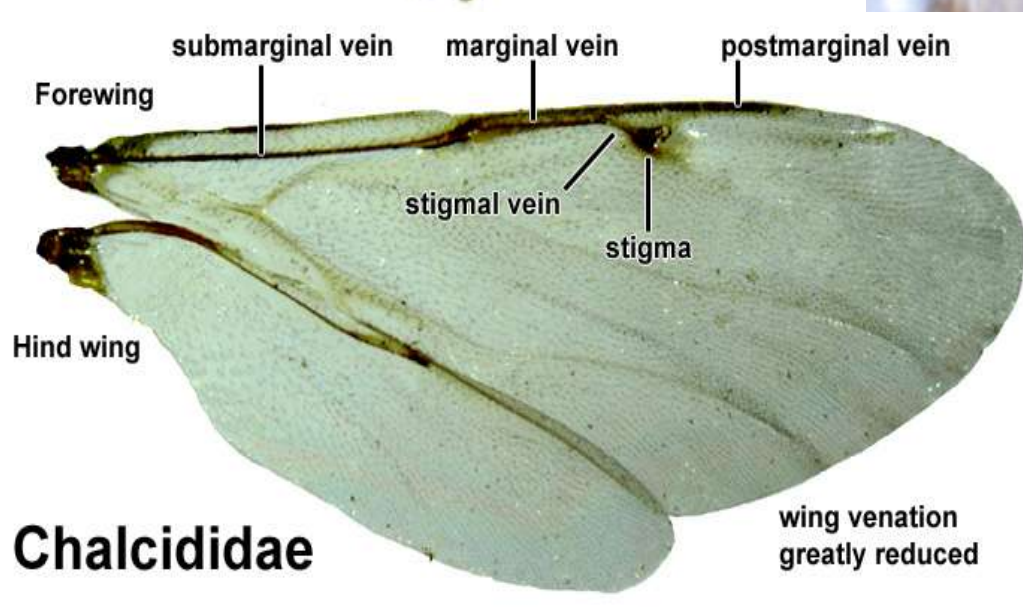


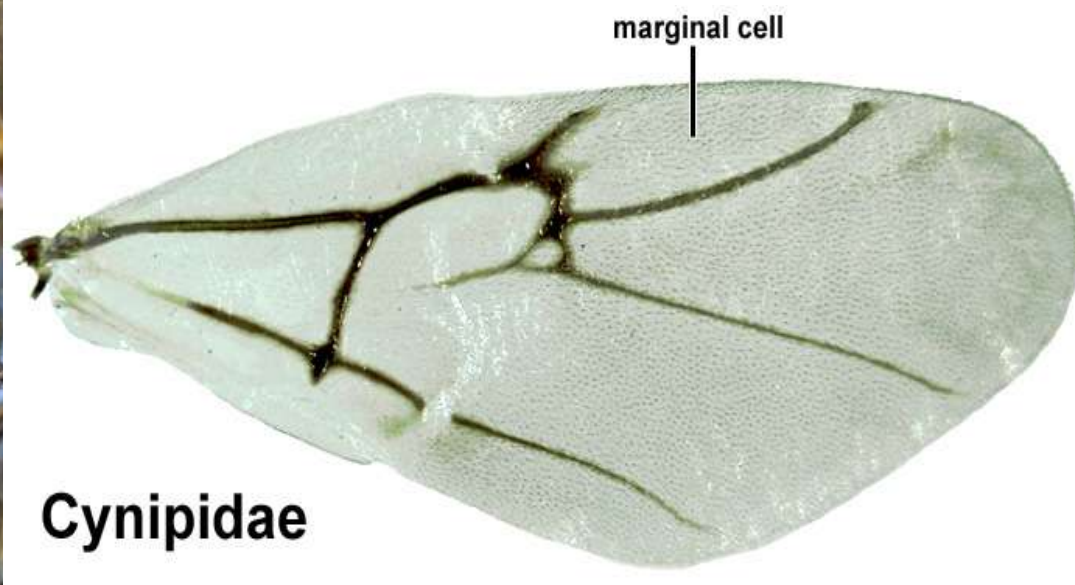
Chalcididae



enlarged
hind femur

Chalcididae





Cynipidae





Chrysididae (cuckoo wasps) - Body metallic blue or green, usually with coarse sculpturing. Abdomen concave beneath, allowing chrysidids to curl into a ball when disturbed.

The thing ants fear most (even the Bala ant): Flies (Diptera)



Phorid fly

- Parasitoid

- attack wounded (or otherwise occupied) ants like *Atta*



- Larvae move into ant's head to finish development



Tabanid (Horsefly)

Simulid (puruja or Blackflies)

Mosquitos

- misery
- pestilence
- pollinators

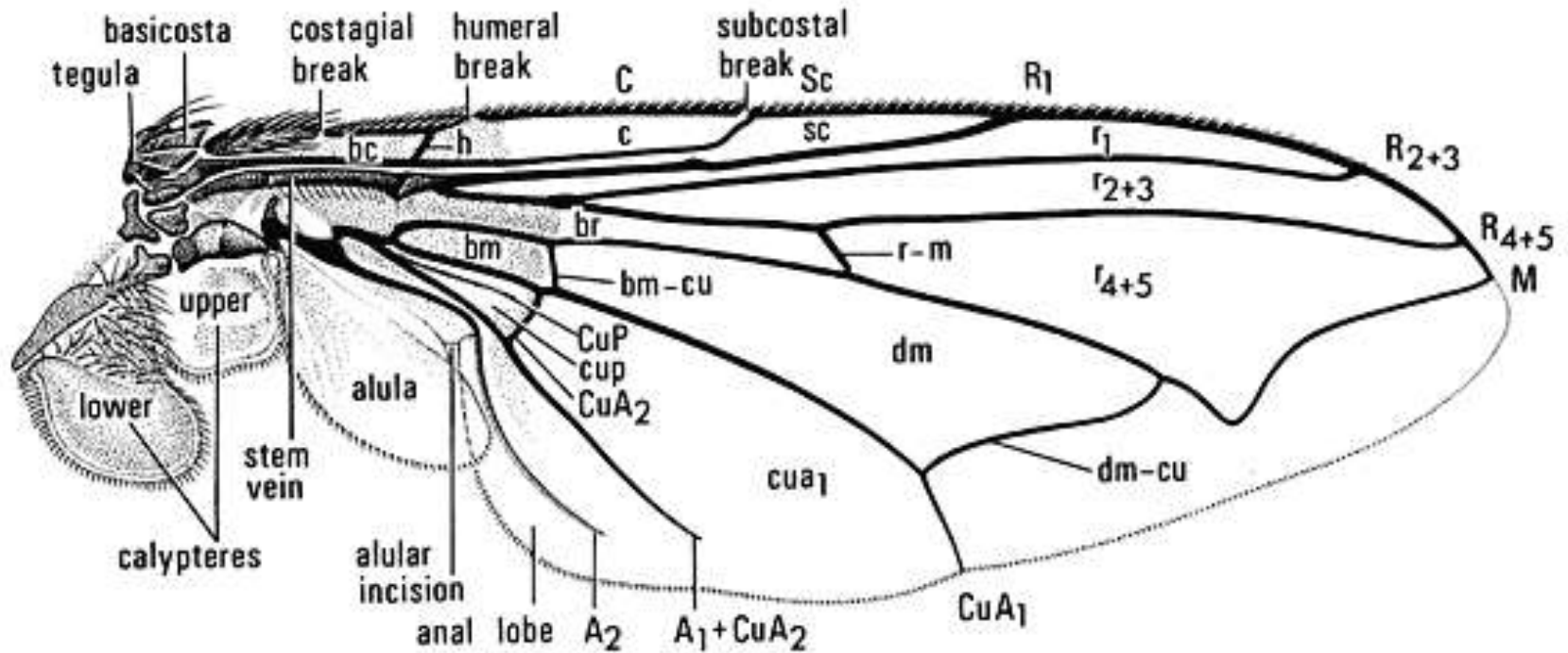
Bloodsuckers



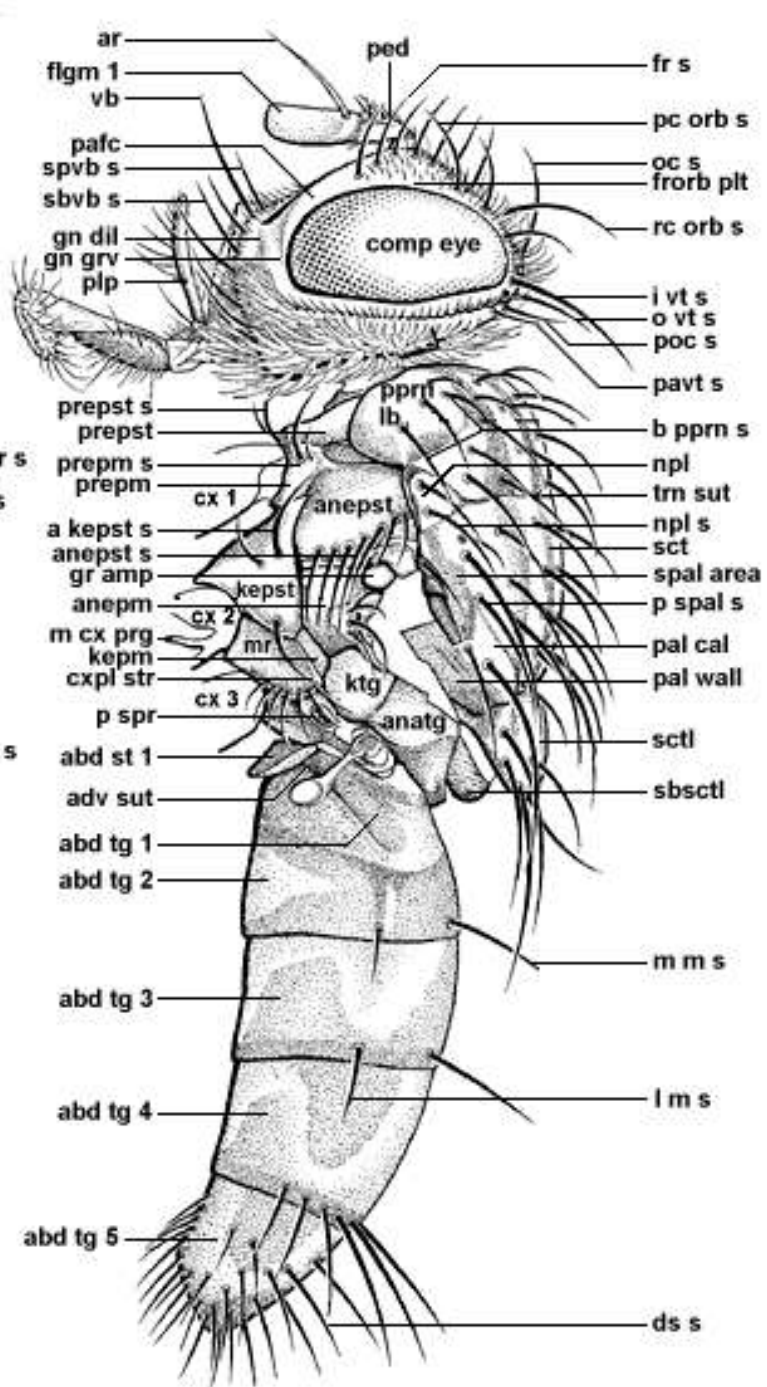
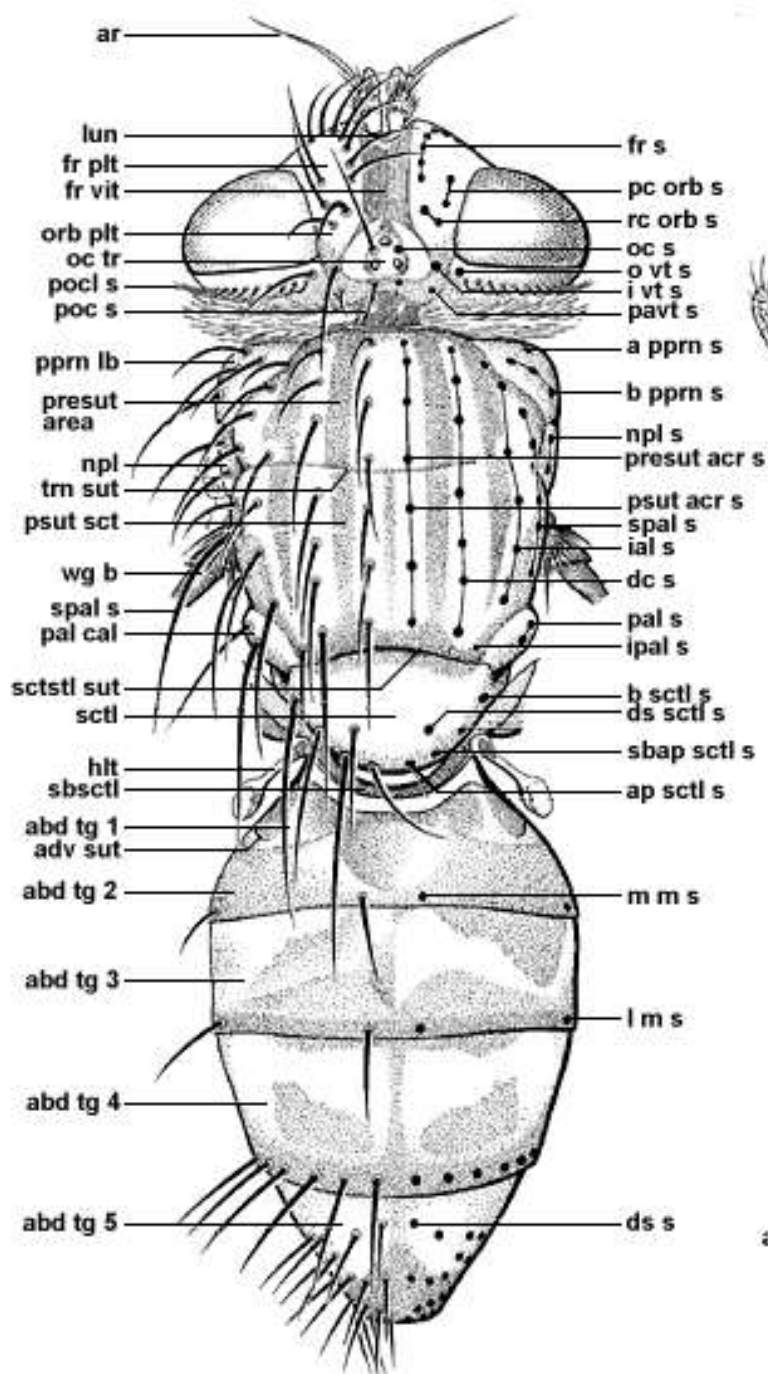
An unfortunate colleague's arm



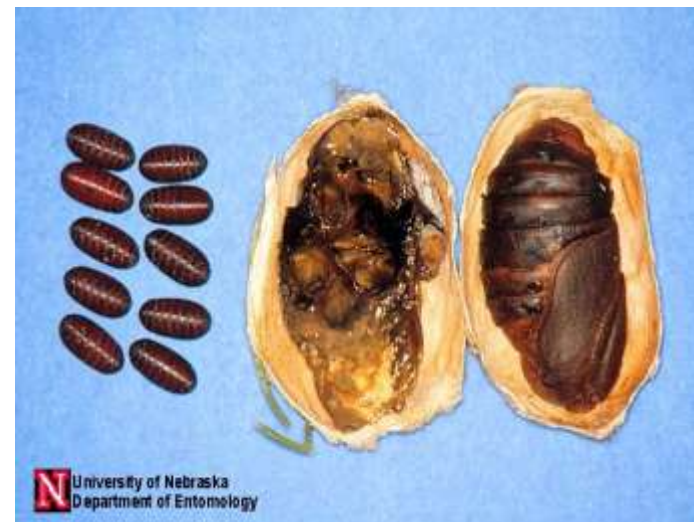
Tachnidae: Postscutellum well developed, R5 narrowed or closed distally, arista usually bare



Tachnidae: Postscutellum well developed, R5 narrowed or closed distally, arista usually bare



Tachinid Flies

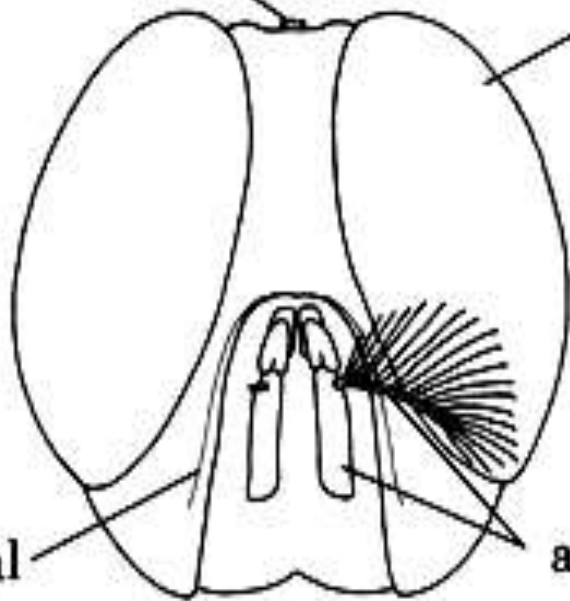


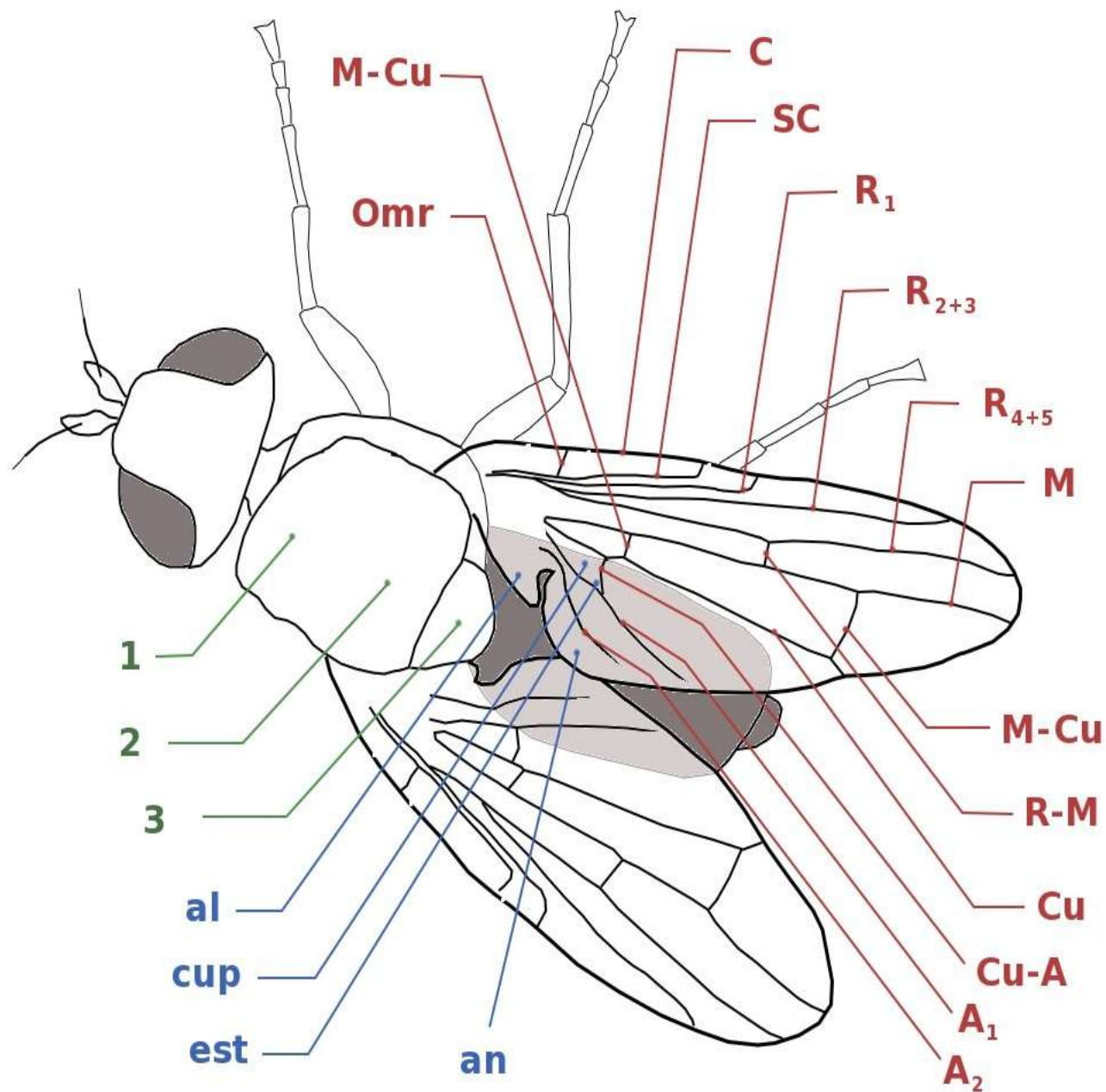
simple eyes

compound
eye

ptilinal
suture

antenna









James L. Castner, U. Fla. Ent. Dep.



Culicidae (Mosquitoes): wings long and narrow with scales along veins and wing margin, ocelli absent



Xylophagus sp.
Xylophagidae



Tabanus sp.
Tabanidae



Crysops sp.
Tabanidae

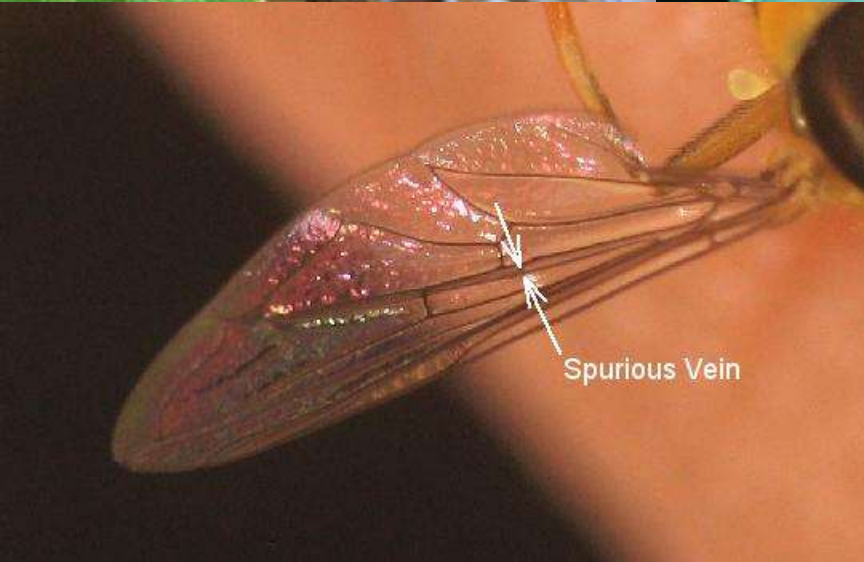
Antenna (Diptera)



Tabanidae (Horse or Deer Flies): stout bodied, large, 3rd antennal segment elongate and subdivided, tarsi with 3 pads, calypters large



Asilidae (Robber Flies): long legs, thorax stout and abdomen usually long and tapering, top of head hollowed out between eyes



Syrphidae (Flower Flies): beelike or wasplike, spurious vein





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Calliphoridae (Blow Flies): often metallic, hypopleural and pteropleural bristles, 2-3 bristles on mesothorax