Basic Arthropod Taxonomy

Arthropods include the insects, spiders, mites, ticks, ostracods, copepods, scorpions, centipedes, shrimps, and crayfishes. Of these, insects make up
> 50% of all the nominal species of organisms in the world. Insects and its allies or relatives whether pests or beneficials are part of rice ecosystems. Basic arthropod identification is important in ecological research to understand interactions, which are vital for developing better pest management tools and strategies.

This manual will focus on:

- Identification of different arthropod groups.
- Identification of major diagnostic features of the most common and important arthropod orders, families and species especially insects and spiders in the rice agricultural landscape using taxonomic keys.
- Handling and preserving arthropods for identification.

Manual content

Differences: Insects (Class Insecta) and Spiders (Class Arachnida, Order Araneae)

	Insects	Spiders
Body regions	3: head, thorax and abdomen	2: cephalothorax (fused head and thorax) and unsegmented abdomen
Eyes	2-3 compound eyes and 3 ocelli or simple eyes	0-8 (with some ground dwellers having no eyes)
Legs (no.)	3 pairs	4 pairs
Wings	Present	Absent
Antennae	Present	Absent

Summary of Insect Orders and Families and Spider Families covered in this workshop

Order	Family	Common name	Common species	Food habit
Odonata	Coenagrionidae	Damselfly	*Agriocnemis femina femina* (Brauer)	Predator (flying insects and hoppers)

			A. pygmaea (Rambur)	Predator (flying insects and hoppers)
Order	Family	Common name	Common species	Food habit
Odonata	Libellulidae	Dragonfly	*Diplacodes trivialis* (Drury)	Predator (stem borers, leaffeeders and planthoppers)
Orthoptera	Tettigoniidae	Long-horned grasshoppers	*Conocephalus longipennis* (de Haan)	Predator (rice bug, stem borers, and planthopper and leafhopper nymphs)
	Gryllidae	Crickets	*Euscyrtus concinnus* (de Haan)	Pest
	Acrididae	Short-horned grasshopper	*Oxya* spp.	Pest
	Gryllotalpidae	Mole crickets	*Gryllotalpa* sp.	Pest
Dermaptera	Chelisochidae	Earwigs	*Euborellia* sp.	Predator (leaffolder larvae)
Thysanoptera	Thripidae	Thrips	*Stenchaetothrips biformis* (Bagnall)	Pest
	Aeolothripidae			
	Phlaeothripidae			
Hemiptera	Mesoveliidae	Water treaders	*Mesovelia* sp.	Predator (stem borer larvae and hoppers)
	Veliidae	Broad-	*Microvelia* sp.	Predator (hopper

Order	Family	shouldered water striders or ripple bugs Common name	Common species	nymphs) Food habit
Hemiptera	Gerridae	Large water striders	*Limnogonus* sp.	Predator (hoppers, moths and insect larvae)
	Corixidae	Water boatmen bugs	*Micronecta* sp.	Predator
	Miridae	Plant bugs or leaf bugs	*Cytorhinus* sp.	Predator (hopper eggs)
	Notonectidae	Backswimmers	*Anisops* sp.	Predator
	Pleidae	Small backswimmers	*Plea* sp.	Predator
	Hydrometridae	Slender water striders	*Hydrometra* sp.	Predator
	Ochteridae	Velvety shore bugs	Ochterus *sp.*	Predator
	Saldidae	Shore bugs	*Saldula* sp.	Predator
	Coreidae	Leaf-footed bugs	*Cletus* sp.	Pest
	Lygaeidae	Seed bugs	*Geocoris* sp.	Predator
			Pachybrachius sp.	Pest
	Alydidae	Broad-headed bugs	*Leptocorisa* sp.	Pest
	Reduviidae	Assassin bugs	*Polytoxus fuscovittatus* (Stal)	Predator (moth and butterfly larvae)
	Nabidae	Damsel bugs	*Nabis* sp.	Predator
			Stenonabis sp.	Predator

Order	Family	Common name	Common species	Food habit
Hemiptera	Pentatomidae	Stink bugs	*Scotinophara* sp.	Pest
			Nezara sp.	Pest
			Pygomenida spp.	Pest and predator
			Zincrona sp.	Predator
	Belostomatidae	Giant water bugs	*Diplonychus rusticus* Fabricius	Predator
	Aleyrodidae	Whiteflies	*Aleurodicus* sp.	Pest
	Aphididae	Aphids	*Tetraneura* sp.	Pest
	Cicadellidae	Leafhoppers	*Nephotettix virescens* (Distant)	Pest
			N. nigropictus (Stal)	Pest
			N. malayanus Ishihara & Kawase	Pest
			Cofana spectra (Distant)	Pest
			Recilia dorsalis (Motschulsky)	Pest
	Delphacidae	Planthoppers	*Nilaparvata lugens* (Stal)	Pest
			Sogatella furcifera (Horvath)	Pest

Order	Family	Common name	Common species	Food habit
Hemiptera	Delphacidae	Planthoppers	*Laodelphax striatellus* (Fallen)	Pest
	Meenoplidae	Meenoplid planthoppers	*Nisia carolinensis* Fennah	Pest
	Dictyopharidae	Dictyopharids	*Chanitus* sp.	Pest
	Cercopidae	Froghoppers or spittlebugs	*Clovia* sp.	Pest
Coleoptera	Coccinellidae	Ladybird beetles	*Harmonia* sp.	Predator (planthoppers, small larvae and exposed eggs)
			Menochilus sp.	Predator (planthoppers, small larvae and exposed eggs)
			Micraspis sp.	Predator (planthoppers, small larvae and exposed eggs)
	Chrysomelidae	Leaf beetles	*Lema* sp.	Pest
	Carabidae	Ground beetles	*Ophionea* sp.	Predator (leaffolder larvae)
	Anthicidae	Ant-like beetles	*Formicomus* sp.	Predator
	Curculionidae	Snout beetles	*Sitophilus oryzae* Linnaeus	Pest
	Scarabaeidae	Scarab beetles	*Leucophilus*	Pest

Order	Family	Common name	*irrorata* (Chevrolat) Common species	Food habit
	Hydrophilidae	Water scavenger beetles	*Hydrophilus* sp.	Predator
	Dytiscidae	Predaceous diving beetle	*Cybister* sp.	Predator
Strepsiptera	Elenchidae	Twisted-winged parasitoids	*Elenchus* sp.	Parasitoid (planthoppers)
	Halictophagidae	Twisted-winged parasitoids	Halictophagus *sp.*	Parasitoid (leafhoppers)
Lepidoptera	Pyralidae	Snout moths	*Chilo suppressalis* (Walker)	Pest
			Scirpophaga incertulas (Walker)	Pest
			Cnaphalocrocis medinalis (Guenee)	Pest
			Marasmia patnalis Bradley	Pest
	Noctuidae	Noctuids	*Spodoptera litura* (Fabricius)	Pest
			S. mauritia acronyctoides (Guenee)	Pest
			Mythimna separata (Walker)	Pest

Order	Family	Common name	Common species	Food habit
	Satyridae	Satyrids	*Melanitis* sp.	Pest
			Mycalesis sp.	Pest
Lepidoptera	Hesperiidae	Skippers	*Parnara* sp.	Pest
			Pelopidas sp.	Pest
Diptera	Tipulidae	Crane flies	*Tipula* sp.	Detritivore/tourist
	Ceratopogonidae	Biting midges, punkies or no-see-ums	*Nilobezzia* sp.	Predator
	Chironomidae	Midges	*Chironomus* sp.	Detritivore/tourist
	Culicidae	Mosquitoes		Detritivore/tourist
	Asteiidae		*Astea* sp.	Tourist
	Dolichopodidae	Long-legged flies	*Syntormon* sp.	Predator
			Medetera sp.	Predator
			Dolichopus sp.	Predator
	Pipunculidae	Big headed flies	*Pipunculus* sp.	Parasitoid (leafhoppers)
			Tomosvaryella sp.	Parasitoid (hoppers)
	Ephydridae	Shore flies	*Brachydeutera* sp.	Pest
			Hydrellia sp.	Pest
			Notiphila sp.	Detritivore/tourist
			Paralimna sp.	Detritivore/tourist
			Psilopa sp.	Detritivore/tourist
			Scatella	Detritivore/tourist

Order	Family	Common name	*stagnalis* *Ochthera* sp. Common species	 Predator Food habit
	Empididae	Dance flies	*Drapetis (Drapetis)* sp.	Predator
			Drapetis (*Elaphropeza*) sp.	Predator
	Chloropidae	Frit flies or grass flies	*Mepachymerus ensifer* (Thompson)	Detritivore/tourist
	Muscidae	Muscids	*Musca domestica*	Detritivore/tourist
	Tachinidae	Tachinids	*Argyrophylax*	Parasitoid
			Carcelia	Parasitoid
			Sturmiopsis	Parasitoid
	Calliphoridae	Blow flies or bluebottles	*Calliphora*	Detritivore/tourist
	Sarcophagidae	Flesh flies	*Sarcophaga*	Detritivore/tourist
	Sciomyzidae	Marsh flies	*Sepedon* sp.	Parasitoid/predator
	Syrphidae	Hover flies, flower flies	*Sphaerophoria* sp.	Pollinator
			Eristalis sp.	Pollinator
Hymenoptera	Aphelinidae	Aphelinids	*Aphelinus* sp.	Parasitoid
			Encarsia sp.	Parasitoid
	Bethylidae	Bethylids	*Goniozus* sp.	Parasitoid
	Ceraphronidae	Ceraphronids	*Ceraphron* sp.	Parasitoid

			Aphanogmus sp.	Parasitoid
Order	Chalcididae Family	Chalcids Common name	*Brachymeria* sp. Common species	Parasitoid Food habit
Hymenoptera	Dryinidae	Dryinids	*Dicondylus* sp.	Parasitoid
			Pseudogonatopus sp.	Parasitoid
			Haplogonatopus sp.	Parasitoid
	Elasmidae	Elasmids	*Elasmus* sp.	Parasitoid
	Encyrtidae	Encyrtids	*Copidosomopsis*	Parasitoid
	Eulophidae	Eulophids	*Tetrastichus*	Parasitoid
			Euplectrus	Parasitoid
			Stenomesius	Parasitoid
			Hemiptarsenus	Parasitoid
			Pediobius	Parasitoid
	Eupelmidae	Eupelmids	*Neanastatus*	Parasitoid
			Eupelmus	Parasitoid
	Eurytomidae	Eurytomids	*Eurytoma*	Parasitoid
	Mymaridae	Mymarids	*Gonatocerus*	Parasitoid
			Mymar	Parasitoid
			Anagrus	Parasitoid
	Platygasteridae	Platygasterids	*Platygaster*	Parasitoid
	Pteromalidae	Pteromalids	*Trichomalopsis*	Parasitoid
	Trichogrammatidae	Trichogrammatids	*Oligosita*	Parasitoid
			Trichogramma	Parasitoid

Order	Trichogrammatoidea Family	Common name	Common species	Parasitoid Food habit
Hymenoptera	Scelionidae	Scelionids	*Psix*	Parasitoid
			Telenomus	Parasitoid
			Gryon	Parasitoid
			Idris	Parasitoid
			Baeus	Parasitoid
			Macroteleia	Parasitoid
	Braconidae	Braconids	*Cardiochiles*	Parasitoid
			Cotesia	Parasitoid
			Opius	Parasitoid
			Aulacocentrum	Parasitoid
			Tropobracon	Parasitoid
	Ichneumonidae	Ichneumonids	*Xanthopimpla*	Parasitoid
			Trichomma	Parasitoid
			Temelucha	Parasitoid
			Itoplectis	Parasitoid
	Formicidae	Ants	*Polyrachis*	Predator
			Solenopsis	Predator
	Apidae	Honeybees	*Apis*	Pollinator
	Vespidae	Vespids	*Eumenes*	Predator
			Ropalidia	Predator

	Anthoporidae	Bumble bees	*Xylocopa*	Pollinator
Order	Family	Common name	Common species	Food habit
Hymenoptera	Sphecidae	Sphecids	*Sceliphron madraspatanum conspicillatum* (Fabricius)	Predator

Spider families

Order	Family	Common name	Common species	Food habit
Araneae	Araneidae	Orb weavers	*Araneus*	Predator
			Argiope	Predator
	Lycosidae	Wolf spider	*Pardosa*	Predator
	Linyphiidae	Dwarf spiders	*Atypena*	Predator
			Erigone	Predator
	Oxyopidae	Lynx spider	*Oxyopes*	Predator
	Clubionidae	Sac spiders	*Clubiona*	Predator
			Cheiracanthium	Predator
	Salticidae	Jumping spiders	*Bianor*	Predator
			Harmochirus	Predator
			Myrmarachne	Predator
	Tetragnathidae	Long-jawed orb weavers	*Tetragnatha*	Predator
	Thomisidae	Crab spider	*Thomisus*	Predator
			Runcinia	Predator
	Theridiidae	Comb-footed spider	*Chrysso*	Predator

Order	Heteropodidae Family	Giant crab spiders Common name	*Olios* Common species	Predator Food habit
Araneae	Gnaphosidae	Ground spider	*Zelotes*	Predator

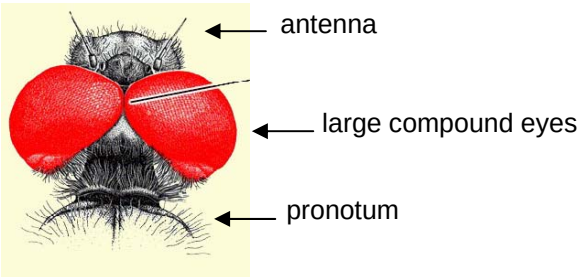
Other insect orders and families

Order	Family	Common name	Common species	Food habit
Collembola	Sminthuridae Entomobryidae Isotomidae	Springtails	*Sminthurus* *Entomobrya* *Isotoma*	Detritivore/tourist
Ephemeroptera		Mayfly		Detritivore/tourist
Mantodea	Mantidae	Mantids	*Mantis*	Predator
Phasmatodea		Walking sticks		Pest
Blattodea	Blattelidae	Cockroaches	*Periplaneta*	Detritivore/tourist

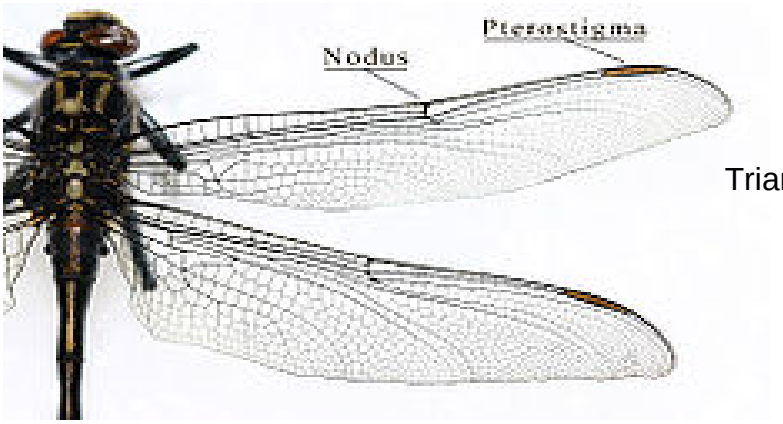
Identification of Insect Orders and Families

Order Odonata – dragonflies and damselflies (predator)

- Compound eyes large and many-faceted and often occupy most of the head



- Antennae very small and bristle-like
- Four wings elongate, many-veined, and membranous



Triangular vein

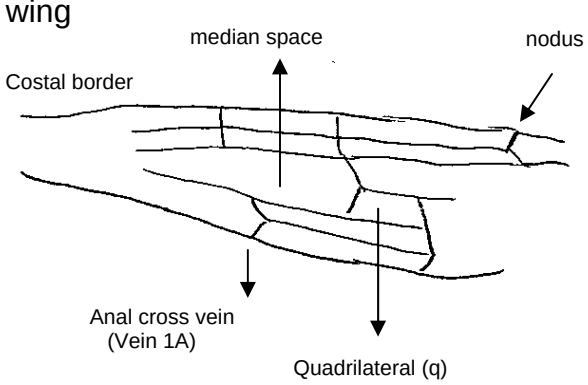
- Thorax relatively small and compact abdomen is long and slender
- Cerci 1-segmented and function as clasping organs in the male
- Chewing mouthparts

Family Coenagrionidae – damselflies

- Moderately small 18-32 mm long with slender body
- FW and HW are narrow, similar in shape and venation

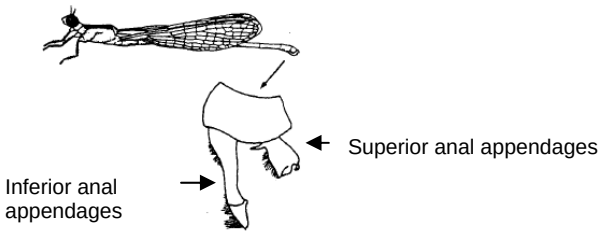
- Wings stalked
- Two antenodal cross veins
- M3 arising nearer nodus than arculus

Hind wing



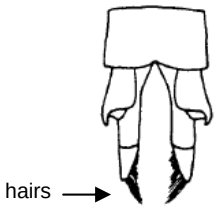
Agriocnemis femina femina(Brauer) (predator)

- Superior anal appendages shorter than inferioirs and 3-spined (2 apically and 1 basally)



Lateral view

- Inferior part parallel-sided dorsally and with hairs at inner side

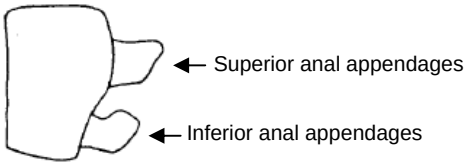


Dorsal view

- Lower sides of prothorax bluish green and blue on the anterior and posterior lobe
- FW with 5-6 postnodal nervures and 4 in the HW

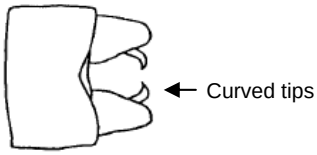
A. pygmaea(Rambur) (predator)

- Superior anal appendages longer than inferiors and without spines or tubercles



Lateral view

- Inferior part with inwardly curved tips

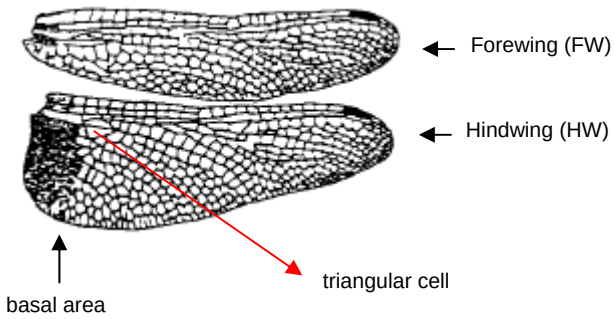


Dorsal view

- FW with 6-7 postnodal nervures and 5-6 in HW

Family Libellulidae – dragonflies

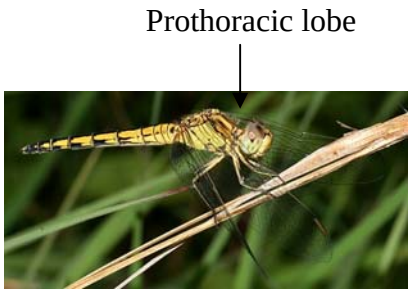
- Mandible very strong
- Antenna short and needle-like
- FW and HW rounded apically in both sexes
- HW broader than FW basally



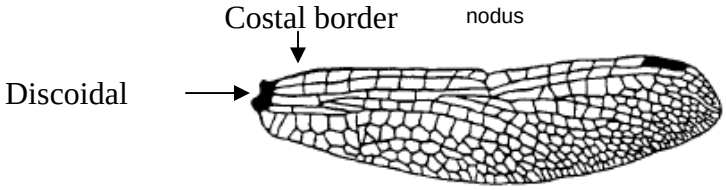
- Eyes large and globular or rounded

Diplacodes trivialis (Drury) (predator)

- Prothoracic lobe large and fringed with long hairs



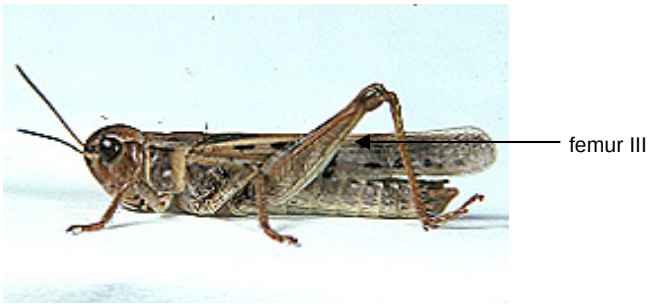
- Eyes contiguous for a short distance
- Frons not metallic dorsally
- Costal border of FW straight, discoidal field begins with a row of 2 cells



- FW triangle crossed

Order Orthoptera – grasshoppers, locust, katydids and crickets (predator and pest)

- Femur III greatly enlarged or swollen used for jumping or saltatorial
- FW generally long and narrow, many-veined, and somewhat thickened referred to as tegmina; in some familes, FW reduced to small scale-like structure
- HW membranous, broad, many-veined and at rest usually folded fanwise beneath FW
- Body elongate and cerci usually developed, either short or long
- Mandibulate mouthparts
- Long and short antennae or antennae slightly longer than head or longer than the body



- Cerci either short or long

Differences between families of Order Orthoptera

Family	Head	Antennae	Femur	Habit
Tettigoniidae	slant face	very long 2-3x abdomen	Femur III large	Predator
Acrididae	rounded	short	Femur III large	Herbivore
Gryllotalpidae	rounded	short	Femur I for digging (finger-like)	Herbivore
Gryllidae	rounded/slanted very long	very long	Femur III large	Predator/herbivore

Family Gryllotalpidae – mole crickets

Gryllotalpa (pest)

- Front legs broad or enlarged and modified for digging

Fore leg

- Fore tibiae with 4 dactyls and covered tympanum
- Tibiae and tarsi with powerful teeth

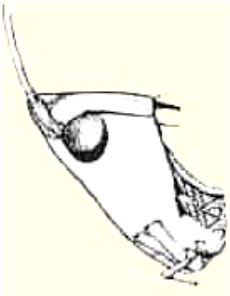
Family Acrididae – short-horned grasshopper

- Leg I relatively slender
- Short antennae (less than 30 segments, usually shorter than the body)
- All tarsi 3-segmented

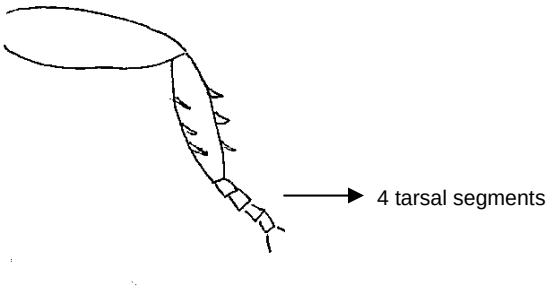
Oxya spp. (pest)

- Prothorax has brownish or greenish band
- FW base with green brown band
- Head subconical
- General coloration: green body with brownish to bluish latero-apically

Family Tettigoniidae – long-horned grasshoppers



- Leg I normal
- Long antennae (hair-like)
- Not well arranged spines on the legs or no regular pairings of spines on tibia III
- Tarsal segment 4-4-4

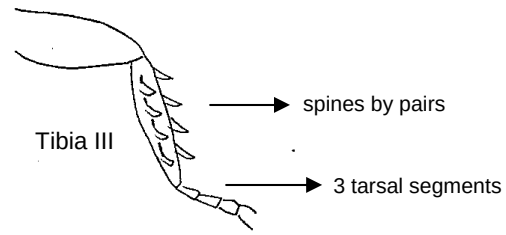


Conocephalus longipennis (de Haan) (predator)

- slant-faced
- green-bodied with yellowish part of abdomen

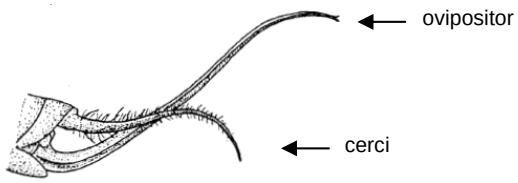
Family Gryllidae – crickets

- Leg I normal
- Long antennae (more than 30 segments)
- Paired spines on the dorsal area of tibia III
- Tarsal segment 3-3-3



Euscyrtus concinnus (de Haan) (pest) – dull yellow/straw-colored

- Very long antennae, 2-3x longer than body
- S-shaped, quite coiled ovipositor



- Yellowish brown body

- Slightly rounded face
- Anterior tibia with external and internal tympanum of equal size

- Posterior tibia serrulated between spines, long spines more than 6 pairs

Anaxipha longipennis (Serville) (predator)

- brownish/yellow
- simple ovipositor

Metioche vittaticollis (Stal)

- black with red markings
- simple ovipositor

Family Pyrgomorphidae

- Head or fastigium long and porrect (projected forward vertex)

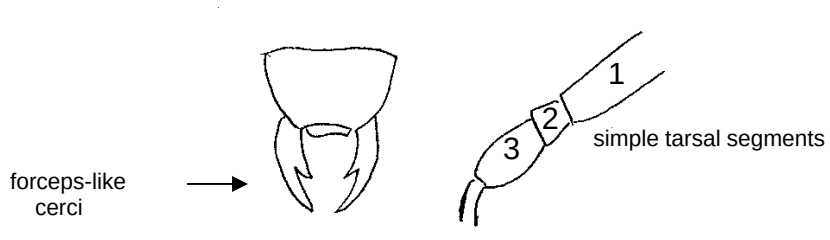
  Acrida sp., *Atractomorpha* sp.

Order Dermaptera – earwigs (predator)

- Forceps-like cerci
- Moniliform or bead-like antennae
- Flattened pronotum with edge hardened to support the head
- FW short, leathery, and veinless
- HW membranous
- Exposed abdominal segment
- Chewing mouthparts
- Slender insects

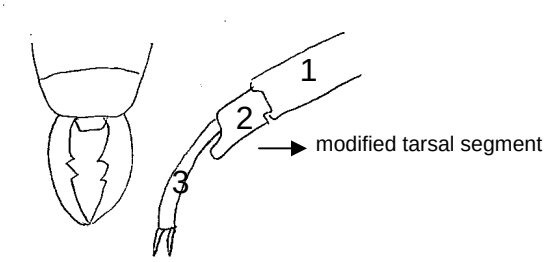
Family Labiidae

- Without modified tarsal segments



Family Chelisochidae

- With modified tarsal segment number 2



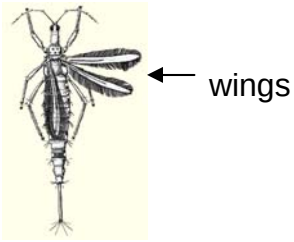
Euborellia sp. (predator)

- Shiny black-brown to black

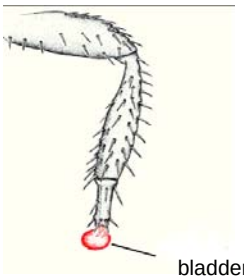
- Wings sclerotized
- White bands between abdominal segments
- Two antennal segments located near the tip are white
- Tip of forceps strongly overlap on top of each other
- 15 mm long

Order Thysanoptera – thrips (pest and predator)

- Minute and slender-bodied
- 4 wings when fully developed are very long and narrow with few or no veins, and fringed with long hairs



- Pretarsus has a bladder-like swelling



bladder-like swelling

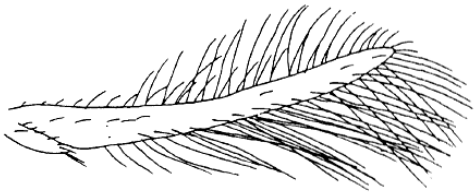
- Sucking mouthparts

Differences between families

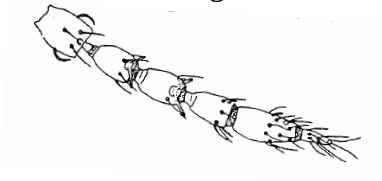
Family	Forewing	Terminal abdominal segment
Thripidae	No band	Simple or short, not tube-like
Phlaeothripidae	No band	Long and tube-like (with very long ovipositor)
Aeolothripidae	Banded	Long and tube-like

Family Thripidae

- Female with point of ovipositor directed dorsally
- Wings narrow usually pointed at apex



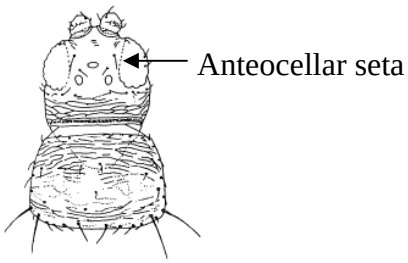
- Antennae 6-9 segmented



Stenchaetothrips biformis (Bagnall) (pest)

- Antennae 7-segmented with forked sense cone on segments III and IV

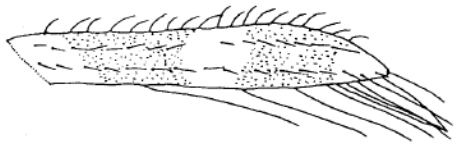
- Head with 1 pair of anteocellar setae



- FW uniformly dark grayish brown
- Tibiae brown

Family Aeolothripidae (predator)

- Female with point of ovipositor directed dorsally
- Banded wings
- Leg I normal or equal in size
- Wings broad and rounded at apex



- Antennae 9 segmented

Family Phlaeothripidae – giant thrips

- Rarely have banded wings
- Leg I robust
- Terminal abdomen tubular or pointed (seen as extension of the abdomen)

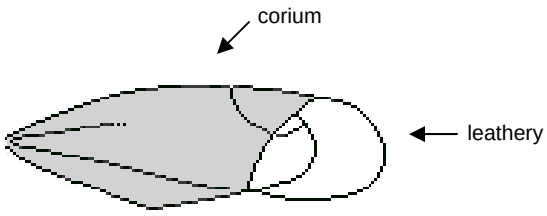
Order Hemiptera – bugs, hoppers, and etc., (pest and predator)

- Gradual metamorphosis
- Sucking mouthparts
- Maxillary and labial palpi absent
- Cerci absent
- 2 compound eyes
- Ocelli either present or absent

2 suborders

Suborder Heteroptera – true bugs

- FW with the basal portion thickened (corium) and leathery and the apical portion is membranous (hemelytron)



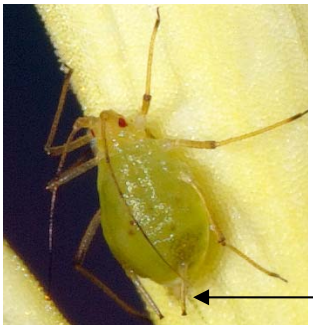
- HW is entirely membranous and slightly shorter than FW

- Wings at rest are held flat over the abdomen, with the membranous tips of FW overlapping

- Proboscis thick in the basal segment

Family Aphididae - aphids

- Slender antennae at least a quarter as long as body
- Head free
- Siphunculi elongate



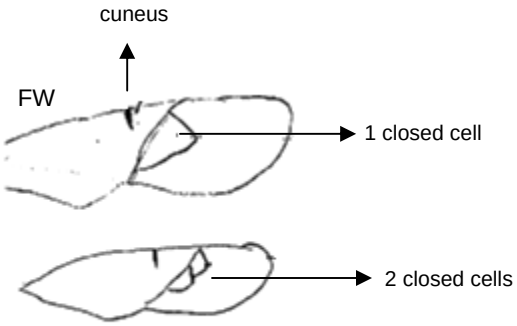
- Antennae 1-6 or 5-6 segments with last segment with elongate processus terminalis

Differences between Family Miridae and Family Lygaeidae:

Characters	Miridae	Lygaeidae
Ocelli	+	-
Closed cells in membrane	1-2	Most of the time absent
Legs with solid spines in femora	Without	Often with
Antennal segment I	Slender	Stout
Genitalia	Asymmetrical for male; symmetrical for female	Symmetrical for both sexes

Family Miridae – plant bugs or leaf bugs

- Ocelli absent
- Hemelytron of FW with a cuneus
- Membrane of hemelytron with 1 or 2 closed cells



- Legs without solid spines in femoral regions

Cyrtorhinus (predator) – green mired bug

- Rostrum reaching mid-coxae only
- 1st antennal segment as long as vertex
- 2nd antennal segment slightly longer than pronotal width at base
- End of 1st antennal segment greenish yellow
- Hemelytra and legs greenish
- Longitudinal median line of scutellum black
- All tibiae yellow

Halticus minutus Reuter – not a predator

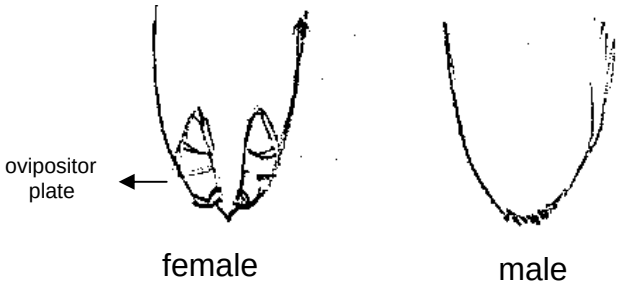
- Black or brown bug
- Sucking insect

Tytthus chinensis (Stal) – brown mirid bug

- With the same size as *Cyrthorinus*, found in legumes
- With brown markings on the edge of wings

Family Anthocoridae (predator)

- Ocelli present
- Hemelytron with a cuneus
- Labium 3 segmented (with thick base to carry its prey during predation)
- Claspers asymmetrical in male
- Ovipositor symmetrical in female



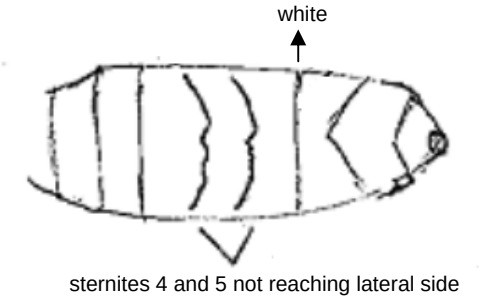
Orius tantillus (predator) - ovipositor is symmetrical in female

(clasper – male; ovipositor – female)

*Only Families Miridae and Anthocoridae have cuneus

Family Lygaeidae – seed bugs

- Abdominal sternites 4-5 not reaching or touching the lateral side



sternites 4 and 5 not reaching lateral side

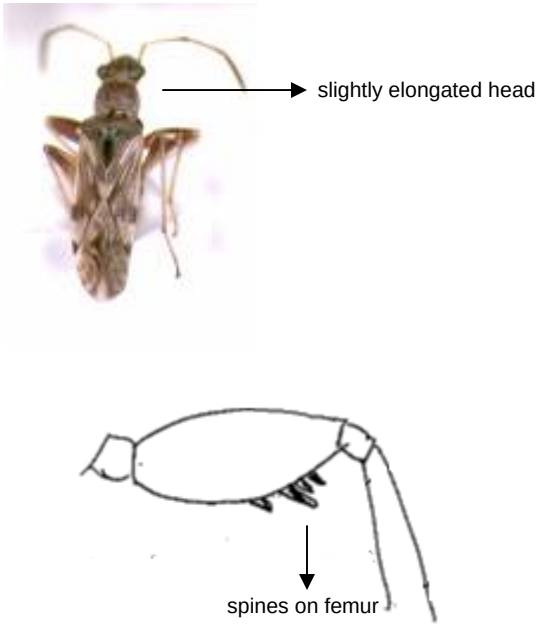
- Ocelli present
- Legs often with spines in femora
- Beak and antennae 4 segmented
- Antennae arise below line drawn through eyes

Geocoris (predator) – good predator in rice and legume

- Head at least as wide as base of pronotum
- Eyes very prominent, pedunculate or subpedunculate
- First three pairs of abdominal spiracles dorsal, the other 3 pairs ventral
- Transverse head with bulging eyes
- Triangular scutellum
- Black-bodied and shiny
- Red eyes

Pachybrachius (pest) – very important in South and Southeast Asia

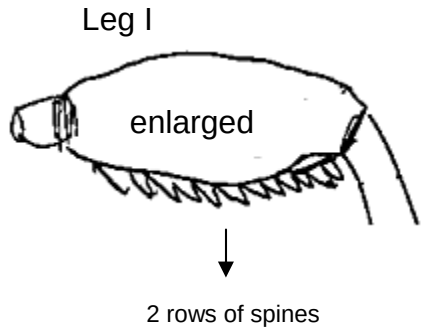
- Elongate bug



- Dull brown body
- Pronotum either brown, black reddish brown
- Pronotum strongly constricted behind middle with anterior and posterior constrictions (ring-like)
- Pronotal sides not thinned to produce keels

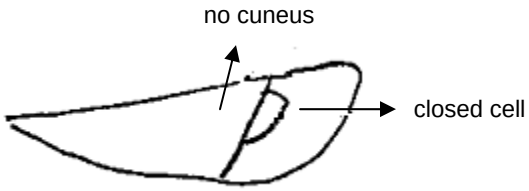
Family Nabidae – damsel bugs (reduviid-like, brown in color)

- Hemelytron without the cuneus
- Leg 1 enlarged with 2 rows of spines (for crushing the prey)



- Labium 4-segmented (with robust base to lift the prey for predacious bug)
- Claspers of male symmetrical

- Body > 6 mm long
- Front leg enlarged, raptorial and with spines
- Triangular head
- FW without cuneus and with 1 closed cell



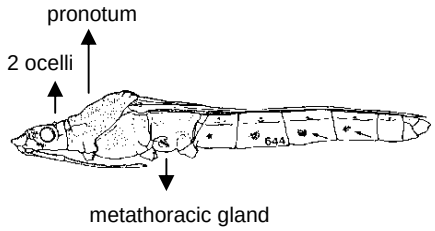
- Relatively small < 15 mm long (12 mm common)
- With a pair of brown band

Nabis (predator) – temperate species, not present in South and SE Asia

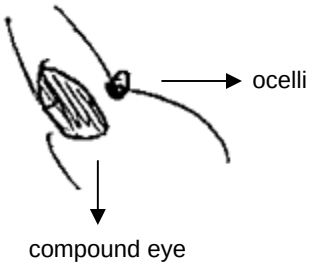
Stenonabis sp. (predator) – common in tropics (Asia)

Family Alydidae – Broad-headed bugs

- Narrow elongate body and legs



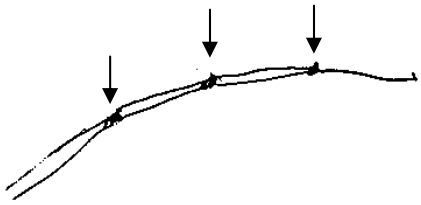
- Buccale short not reaching behind and rarely reaching level of antennifers
- Head more or less > than half as wide as base of pronotum
- 2 red ocelli



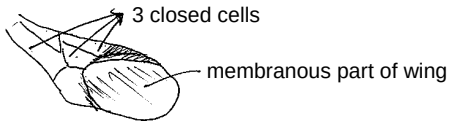
Leptocorisa – common rice bug (pest)

- 12 spots on sides of abdomen

- Antennal segments are dark



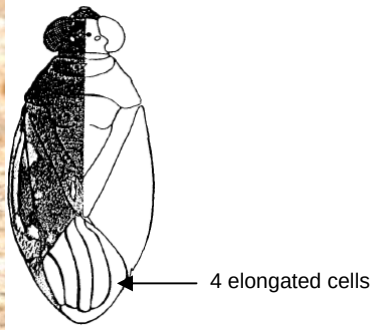
- Membranous half of entire wings



Family Saldidae – shore bugs

- Long labium up to coxa III
- Labium and femora without long spines
- Ocelli not on a tubercle (on flat surface)
- Eyes prominent, not pedunculate
- Membrane with 4 closed elongated cells

Saldula (predator)



Family Reduviidae – Assassin bugs (large predaceous group with some species spinous in thorax and scutellum)

- With or without ocelli (most species in rice ecosystem, but in general, ocelli maybe present or absent
- Corium narrow and elongate

- Antennae 4 segmented
- Antennal scape thick and longer than head
- Basal segment of proboscis distinct and robust
- Small head
- Ocelli present or absent

Polytoxus (predator)

- Three pronotal spines

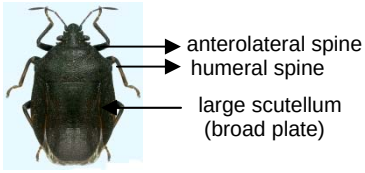
- 3 segmented labium

Family Pentatomidae – stink bugs

- Lateral margins of pronotum slender, pointed anteriorly towards compound eyes (with anterolateral spines and humeral spine)
- Very large scutellum almost covering entire abdomen
- Prosternum has no deep groove or canal
- Tarsi 3-segmented
- Transverse head particularly in the eye area
- Antennae 5 segmented

Scotinophara – black bug (pest)

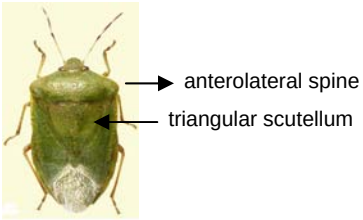
- U-shaped scutellum
- FW membrane hidden under scuttellum
- Callous (clavus) present
- With humeral spine
- Simple eyes present



right compound eye

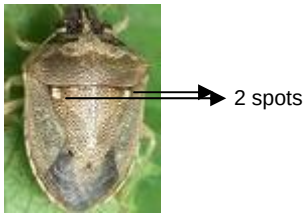
Nezara (pest)

- Green coloration with or without yellow marks
- Body elongate, parallel-sided, dorsally convex
- Humeral area of pronotum either rounded or pointed
- Scutellum triangular, apex narrowly rounded with lateral calli present; medial callus absent



Eysarcoris ventralis (pest)

- With 2 spots on scutellum



- Brown in color

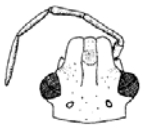
Pygomenida (pest and predator)

- Yellow-orange and black adult
- FW membrane exposed
- No lateral pronotal spines
- Tylus slightly exserted beyond juga
- Head with 5 pale ochraceous longitudinal stripes

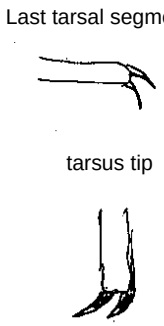
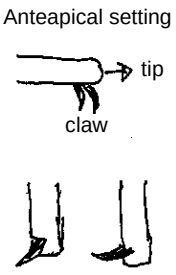
- 6th abdominal segment contracted medially
- Last ventral segment very large in male and bell-shaped

Zincrona (predator)

- Uniformly metallic blue with luster except brownish memebrane
- Lateral angle rounded without spine
- Pronotum, scutellum, clavus, corium and embolium with widely separated punctations
- 4th antennal segment shorter or as long as the distance between eyes, segment II > III



Differences between Family Mesoveliidae and Family Veliidae

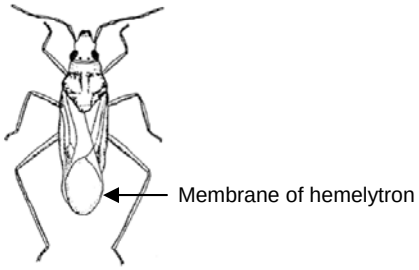
	Mesoveliidae	Veliidae
Tarsal claw		

Family Mesoveliidae – water treaders/water predator

- Last tarsal segment with claws on tip or with apical claws
- Elongate oval bugs over 2 mm long
- Winged or wingless
- Antennae longer than head
- Pronotum transversely narrow and rectangular
- Tip of scutellum truncate

Mesovelia (predator)

- Membrane of hemelytra without closed cells



- Corium with dark brown thickened veins forming 3 whitish cells
- Head acute frontally
- Eyes not convergent
- Antennae 4 segments with pedicel shorter than segment III or IV
- Ocelli present

Mesovelia orientalis – winged or unwinged

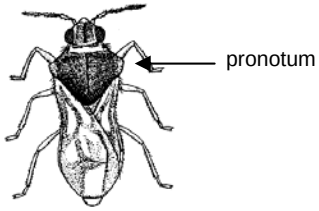
Family Veliidae – broad-shouldered water striders or ripple bugs

- Last tarsal segment with claws anteapical (arising before tip)
- Legs generally short
- Hind femora not extending beyond apex of abdomen
- Ocelli absent

Microvelia (predator) – winged or unwinged

- Black small water striders
- Tarsal claws all anteapical
- Antennal segment 4 with the last segment longer

- Head somewhat pointed or narrowed apically
- Pronotum black with a yellow transverse band



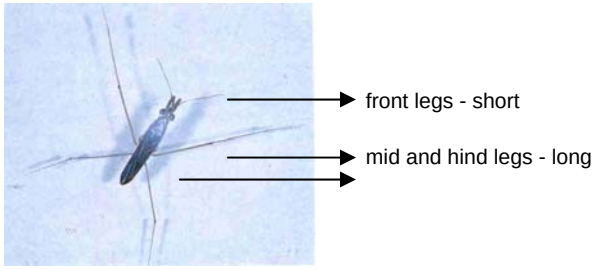
- Winged or wingless
- Body length more or less 2mm

Family Gerridae – large water strider

- Leg 1, tarsus I with the last tarsal segment having claws before the tip
- Front legs short, middle and hind legs long and slender
- Middle legs arising closer to the hind legs than to the front legs
- Antennae 4 segmented

Limnogonus (predator) – 2 spots

- Body long and thin



- Inner margins of eyes concave
- Pronotum with or without a yellow median longitudinal stripe

Gerris sp. – 0 or 1 spot

Family Hydrometridae – slender water striders

- Very thin bodied "small walking stick"
- Head long and slender, as long as thorax

- Mid coxa closer to fore coax than to hind coax
- Eyes situated a little below mid-length of head
- Body long, slender and cylindrical
- Narrow streaks, bands or stripes on FW

*Hydrometra (s*tick-like semi-aquatic bug) (predator)

Family Notonectidae – backswimmers (swim upside down)

- Leg III with mass of hairs for swimming
- Leg I short like a small tube
- Eyes large and close to one another

- Abdomen or stomach with a series of transverse lines or external plates overlapping each other

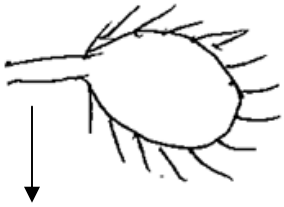
Anisops (predator)

- Eyes large with narrow vertex
- Tibia slightly flat with hairs
- Scutellum near apical 1/3 of body
- Pronotum midanteriorly tapering with posterior end concave

Enitares – with dorsal part of eyes almost touching

Family Corixidae – water boatmen bugs

- Leg I normal
- Head transverse, eyes wide apart
- Front tarsi scoop-like palae with a row of long hairs, never with 2 claws



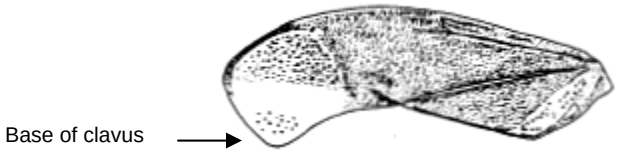
Foreleg I with tarsus I scoop-like

- Leg III with mass of hairs for swimming

Micronecta quadristigata (predator)

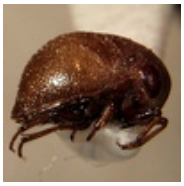
- Head yellow and moderately rounded at tip
- Pronotal disk brownish grey with procurved base

- Scutellum with a yellow transverse band at mid-half
- FW brownish grey except transparent membrane and base of clavus
- Membrane inwardly curved, tip truncated and apical margin brown
- Base of clavus lightly punctated



Family Pleidae – small backswimmers

- Hind legs short with 2 claws
- Hindi tibia cylindrical without long hairs
- Abdomen with a fine laminate ventral keel on segments 2-6
- Body length less than 4 mm
- Subglobose body



- Head and pronotum partially fused
- Membrane of hemelyton vestigial or absent

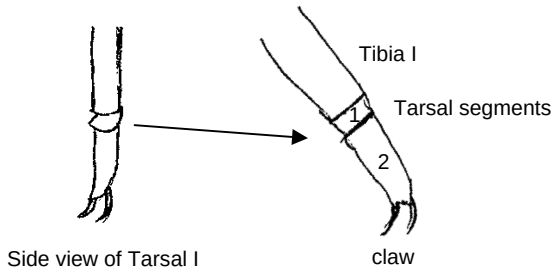
Plea (predator)

- Light yellow brown
- Head transverse with a broad vertex between eyes
- Anterior pronotum slightly convex, midposterior margin slightly straight to convex
- Scutellum visible at midlength of body

Family Ochteridae – velvety shore bugs

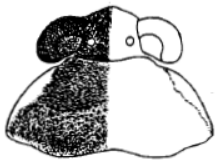
- Forelegs not raptatorial (predatory), similar in form to other legs
- Labium or proboscis long reaching at least to hind coxae
- Large base of proboscis (big and unique for this family)

- Very short tarsal I (basal segment very narrow and next segment very long)

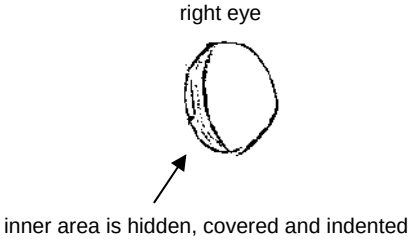


Ochterus (predator)

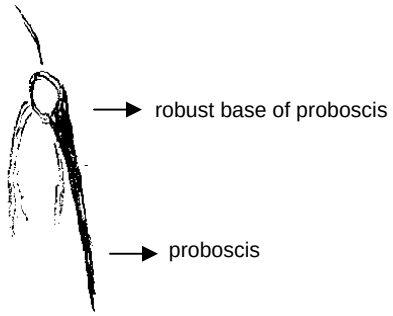
- Head transverse (wider than long)



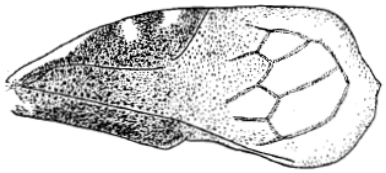
- Inner margins of eyes indented



- Antennae hidden underneath
- Long proboscis, reaching hind coxae
- Basal 2 segment of proboscis stout



- Body length 2x longer than width
- Yellow lateral margins of pronotum upcurved



- Hemelytra with 2 yellow spots and a moderately long yellow band at base of embolium-exocorium
- Bluish black with whitish tinges

Family Coreidae – leaf-footed bugs

- Without cuneus
- Robust and stout spines
- Legs thick
- Bucculae in proboscis extending to and usually behind level of antennifers
- Head much less than half as wide as base of pronotum
- Ocelli present
- Last antennal segment slightly swollen
- Membrane with many long lines

Cletus sp. (pest)

- FW dark to pale brown with a pair of small or tiny white spots

- Humeri longer, protruded laterally and sharply pointed

- Body more or less coarsely punctuate
- 8-12mm long

Family Belostomatidae – giant water bugs

- Head triangular
- Proboscis short visible between coxa I and II
- Tarsal claw very long and slender
- Males carry egg mass on their back

Diplonychus rusticus Fabricius (predator)

- Membrane hyaline with 6 rectangularly closed cells

- Tarsi 2 segmented
- Apex of abdomen with a pair of flat, retractile airstarpa
- Margins of pronotum and wings yellowish, thin, and rather flap-like
- Head snake-like in front and triangular dorsally

- Eyes small, slightly convex in the inner posterodorsal side

Ranatra sp.

Family Aleyrodidae – whiteflies

- Wings opaque whitish with reduced venation and covered with a whitish powder
- HW nearly as large as the FW
- Antennae 7 segmented
- Proboscis elongate

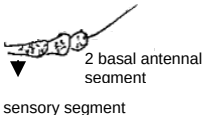
Aleurocybotus (pest) – a rice pest, which is yellowish in color in alcohol

Bemisia tabaci – legume whitefly

Suborder Homoptera – hoppers,

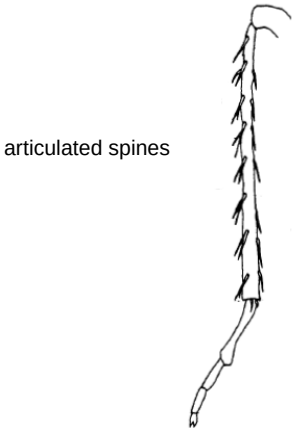
- FW with uniform structure without sharp distinction of membrane and corium
- HW membranous
- Wings held rooflike over body at rest
- Proboscis thread-like, slender and basal segment not thickened

Differences between Families Cicadellidae, Delphacidae and Meenoplidae

Criteria	Cicadellidae	Delphacidae	Meenoplidae
Tibial spur	absent	present	absent
Antennae		with sensory segment 	
Spines on tibia III	Comb-like (many)	only 1-2	
Wings	simple	with brown spot	bead-like

Family Cicadellidae - leafhoppers

- Tibia III with rows of articulated small spines, without tibial spur



- Antennal pedicel rarely thicker than scape, without wart-like sensillae
- Tegula lacking

Nephotettix virescens (Distant) – green leafhopper (pest)

- Vertex pointed without band

- Black spot on FW either present or absent

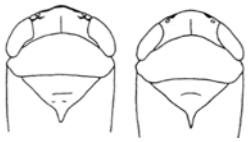
N. nigropictus (Stal) – green leafhopper (pest)

- Vertex with a complete transverse black band

- Black spot on FW present

N. malayanus (Ishihara & Kawase) – green leafhopper (pest)

- Vertex with comma-shaped transverse black band behind ocelli in males and absent in females



Cofana spectra (Distant) – white leafhopper (pest)

- Large pale whitish leafhopper
- Head with a median apical black spot

- Frontoclypeus swollen
- Ocelli on disc of vertex closer to hind margin than anterior margin

Recilia dorsalis (Motschulsky) – zigzag leafhopper (pest)

- FW with a black to dark brown longitudinal zigzag band

- Vertex and pronotum whitish

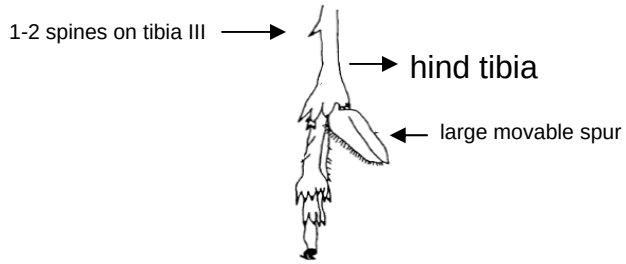
Erythroneura – black spot on head

Balclutha – greenish, host of Pipunculid if not on GLH

Exitianus indicus – with black band on head and vertex

Family Delphacidae - planthoppers

- Tibia III with large movable spur



- Pedicel enlarged, often bulbous with numerous wart-like sensilla
- Tegulae present on mesothorax

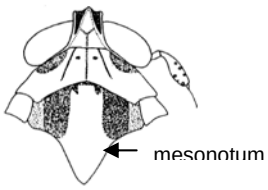
Nilaparvata lugens (Stal) – brown planthopper (pest)

- Mesonotum with 3 longitudinal yellowish brown bands
- Frons not excavated

- Median carina not intercepted
- Prominent fixed spines on basal segment of post tarsi

Sogatella furcifera (Horvath) whitebacked planthopper (pest)

- Mesonotum whitish medially with outer sides of lateral carinae dark brown



- FW with dark pterostigma

- 2 brown bands in the facial groove

  Sogatella vibix (formerly *S. longifurcifera*) – black check

  S. furcifera – light yellow check

  S. kolophon – black end to check

  Tagosodes pusanus – close to *S. furcifera*

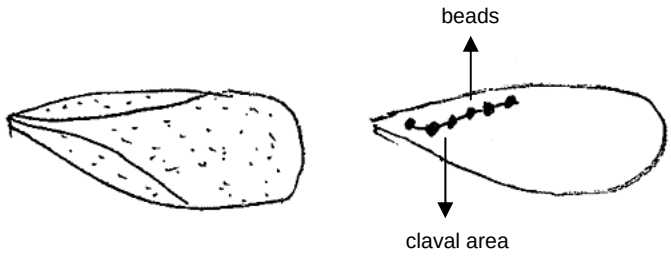
  All 4 species live on rice paddy.

Laodelphax striatellus (Fallen) smaller brown planthopper (pest)

- Genae black with yellowish brown lateral carinae
- Whitish or whitish yellow brown pronotum with black band below eyes
- Mesonotum entirely blackish brown

Family Meenoplidae – meenoplid planthoppers

- Beads on wings
- One or two claval veins granulated



- Apical segment of rostrum visibly longer than wide
- Double blade on face

Nisia atrovenosa (= carolinensis) (pest)

Family Derbidae

- Apical segment of rostrum W = L

Family Dictyopharidae – dictyopharids

- Head strongly prolonged frontally or forward
- Frons with 2-3 carinae (+ lateral carinae)
- No median ocellus

Chanitus (pest)

Family Cercopidae – froghoppers or spittlebugs

- Robust and brown
- Hind margin of pronotum straight to slightly curved
- Eyes about as long as wide

- Hind tibia with 1 or 2 stout spines, and usually a circlet of spines at apex
- Hindi coxa short and conical
- Two ocelli

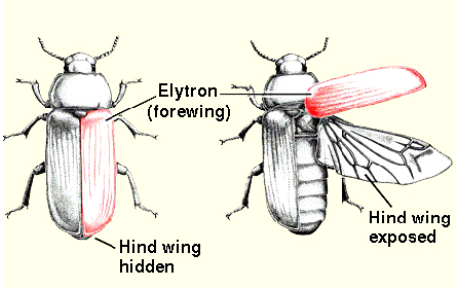
Clovia (pest)

Family Cixiidae –

- Head not prolonged, if so only a median carina present or none (excl. lateral margin)
- Median ocellus present

Order Coleoptera – beetles

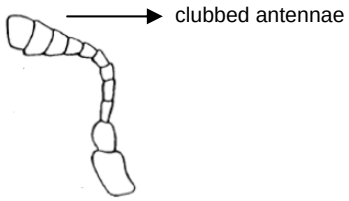
- Hard FW forming a thick plate called elytra
- FW covering the hindwings not true to all – except for parasitic beetles where HWs are extended beyond FWs
  Ex. Rhipophorid beetles
- HW membranous and soft, usually longer than FW and folded under the FW at rest



- Mandibulate or chewing mouthparts

Family Coccinellidae – ladybird beetles

- Broadly ovate or convex body
- Head with antennae and mouthpart hidden under prothorax
- 3 segmented tarsi with toothed claw
- Tip of antennae rounded but slant called clubbed



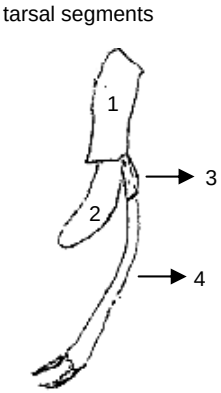
- Antennae 11 segmented (rarely 8) with a 3-segmented club

  Micraspis vincta

Brumoides sp. – common in Myanmar

- Less convex
- More elongate

Harmonia (predator)



- Each hard wings with five spots
- Spots more circular

Cocinella sp.

- Less spots
- Reddish than *Harmonia* sp.

Menochilus (predator of hoppers and whitefly)

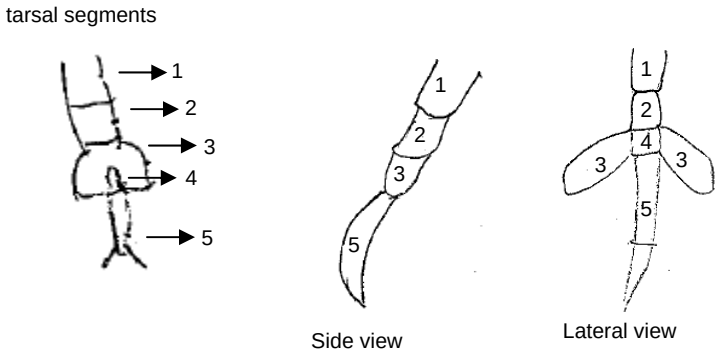
- Hard wings with 3 pairs of zigzag markings

Micraspis (predator)

- Oval and brightly colored in shades of red

Family Chrysomelidae – leaf beetles

- Tarsal formula is 4-4-4 but is actually 5-5-5, tarsus pseudotetramerous with the 4th segment small and hidden in the bilobed 3rd segment



- Antennal segment never clubbed but more segmented (bamboo-like)
- 11 antennal segments

Dicladispa armigera (Rice hispa)

- Very spinous/black

- With 8 forwardly directed spines

Dactylispa

- With long spines at base of antennae
- Branched spines are missing

- Shorter spines as in elytra spines

Chaetocnema basalis (Rice flea beetle) – black beetle/slightly compact

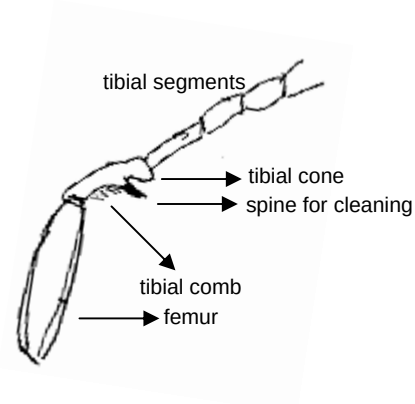
- Femur III enlarged
- 1.5 to 2.5 mm long

Lema sp. (pest)

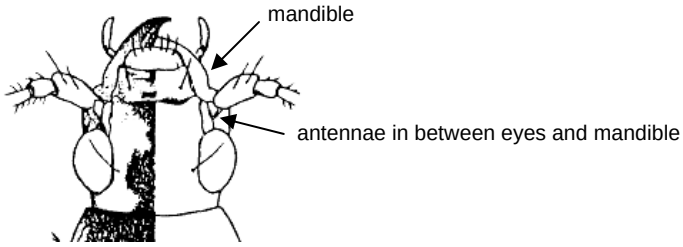
Oulema sp. – giant *Lema* sp., same color, found in rice and orchids

Family Carabidae – ground beetles

- Leg I with tibial comb

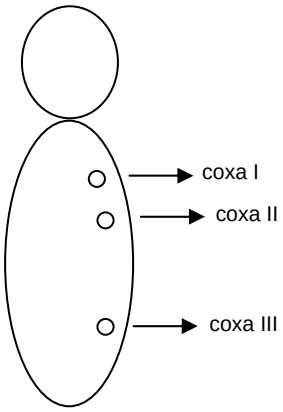


- With powerful mandibles
- Antennal segments usually 11, filiform or flattened arising between base of mandible and eyes

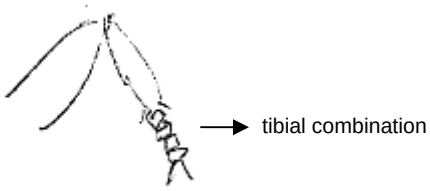


- Generally black and shiny but sometimes metallic or colorful
- Walking or running legs
- Elytra often with longitudinal grooves or rows of punctures

- Coxae 1 and II near to each other, coxa III farther



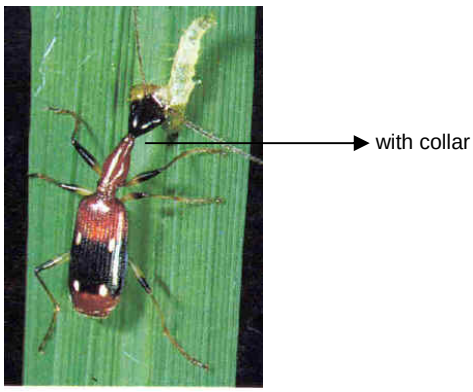
- Leg 1 with tibial combination



- Head including eyes usually narrower than pronotum

  Ophionea nigrofasciata (predator) – good hunter of rice leaffolders

  - Slender prothorax
  - Elongated pronotum
  - Elytra with striations and 4 white spots



  - Slender legs
  - Head widest at eye area

- 11 segmented antennae
- Strong mandibles
- Basal ½ of leg or femur red and apical ½ of leg bluish

Ophionea indica – with 2 white spots

Drypta geniculata – Ophionea-like but dark brown

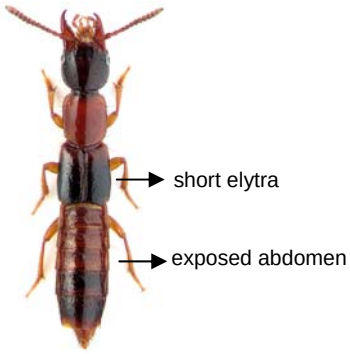
- Longer prothorax

Archicolliuris – good predator

- Longer and slender pronotum
- Pronotum bluish
- Slender

Family Staphylinidae – rove beetles, moving fast

- Short elytra
- Abdomen exposed



- Elongated body
- Pronotum semi-circular
- 11-12 antennal segments, which is broad to the tip

Paederus fuscipes

- Legs yellow except brownish/blackish tibiae

- Brownish/blackish elytra

- Abdomen with 5 visible sternites

Paederus tamulus

- Legs all black

Family Anthicidae – ant-like flower beetles, moves like an ant

- 11 antennal segment
- Without node on abdomen
- Pronotum rounded medially
- Basal segment of antennae like bamboo but towards tip short and wide
- Femur rounded and long like a baseball bat

Anthicus

- Brownish with banded black markings on elytra

- With shining white hairs on elytra
- Less than 5 mm long

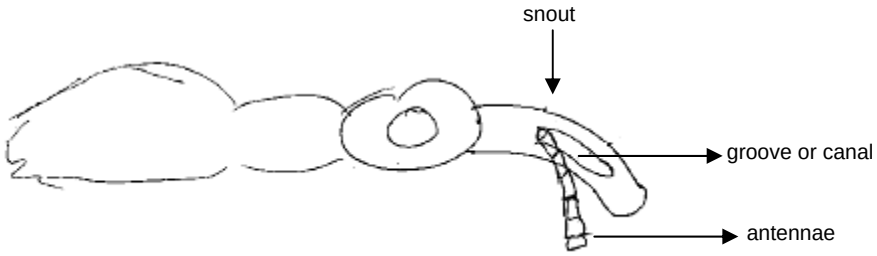
Formicomus (predator)

- Bluish black with red markings or bands on posterior end of each elytra
- Rounded pronotum

Family Curculionidae – snout beetles (one of the biggest in the group of beetles)

- Head prolonged into a distinct beak or snout

- Antennae on the snout
- Antennae inserted on the snout where there is a canal



Sitophilus oryzae (pest) (attacks wooden chair, orchard, trunk or fruits)

Curculionid species which are used as biocontrol agents for weeds – *Bagous*, *Apion*

Bagous sp.

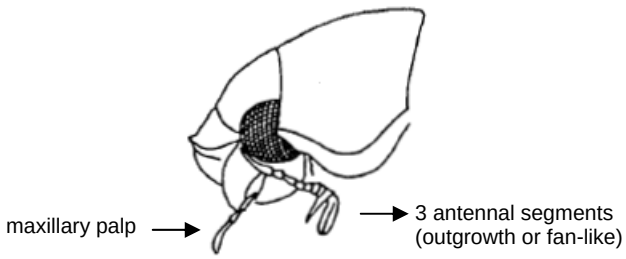
- Body clumped

- Many hairs or white hairs on the body
- Brown/black body

Apion sp.

Family Scarabaeidae - scarab beetles

- 10 or fewer antennal segments

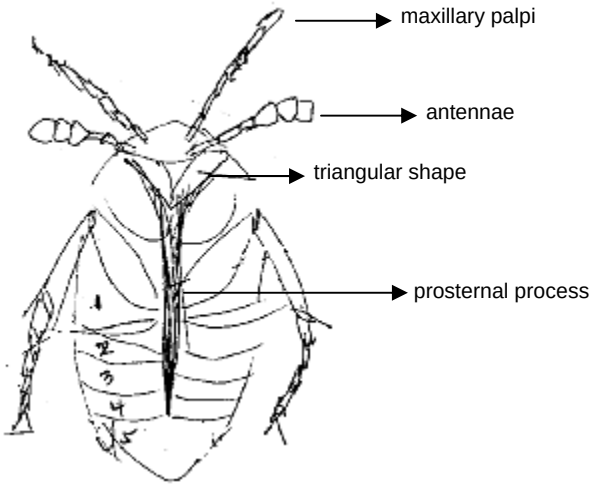


- 3-7 movable elongate club
- 5-6 visible sternites (lines under the body)
- Legs always exposed
- Tarsi with a setose empodium between tarsal claws
- Pygidium or the last segment exposed

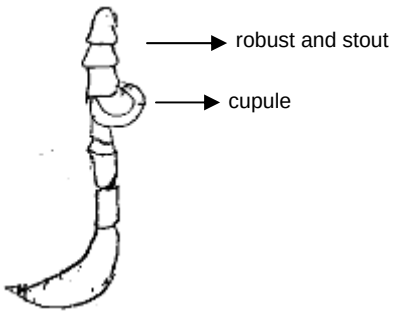
Leucophilus irrorata (pest) – June beetle

Family Hydrophilidae – water scavenger beetles

- Maxillary palps as long as or longer than antennae
- Prosternal process prominent



- Tarsi 5-5-5 (for rice pests) or 4-4-4 (no genus yet in the collection)
- Antennae with the last 3 segments robust or stout and its base has 3 clubbed antennae with large plate or circular plate called cupule



- Fore coxae not hidden in the prosternum

- Abdomen with 5 visible sternites

Hydrophilus (predator)

- Black

Berosus sp.

- Black or gray

- 8 mm long
- With short spines on elytra

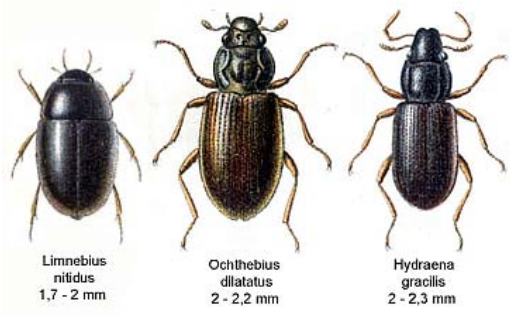
Sternolophus sp. (both adult and larvae are predators)

- Brown
- < 8 mm long
- With spine at tip of abdomen

Family Hydraenidae – similar to Hydrophilidae

- Antennae as long as or longer than
- 5 antennal segment, not clubbed or clubbed???

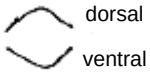
- No cupule on antennae
- Very small and very flat



- Squarish or rectangular pronotum
- Weak prosternum
- Elytra with punctuations

Family Dytiscidae – predaceous diving beetles (strong swimmers)

- Hind leg hairy and adapted for swimming
- Dorsal surface hardly more convex than ventral surface



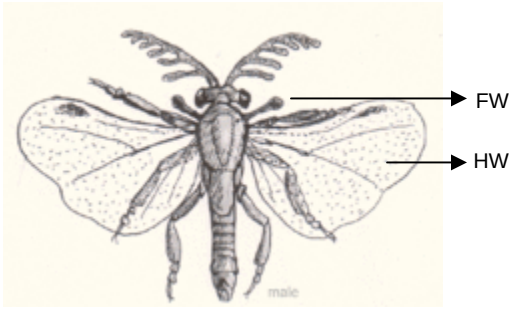
cross section

- Scutellum usually visible
- Coxa I and II near each other
- Coxa III very far from coxa I and II
- Prosternal process absent
- Broad and flattened hind legs with hairs

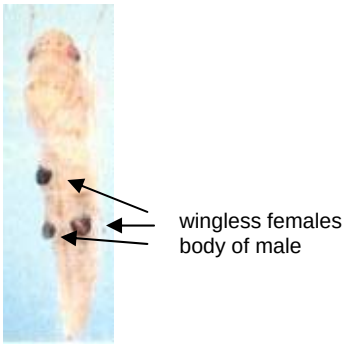
Cybister (predator)

Order Strepsiptera – twisted-winged parasitoids (placed under Coleoptera in the earlier system of classification)

- Minute insects (0.5-4.0 mm)
- Male: free-living and winged
    - somewhat beetle-like in appearance
    - FW reduced to club-like structure that resembles the haltere of Order Diptera
    - HW large and membranous, fan-like with reduced venation



- Female: wingless
    - often legless and do not leave the host
    - with distinct head
    - with simple 4- or 5-segmented antennae
    - with chewing mouthparts
    - with compound eyes



female of strepsiptera inside the body of *Cofana spectra*

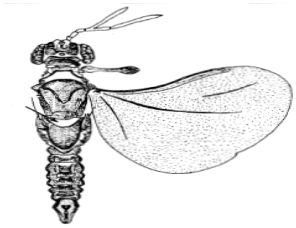
Thousands of triangulins of Strepsiptera inside the host

- Female of parasitic species usually lacks eyes
    - without antennae
    - head and the thorax are fused.

Parasitized hopper – smaller, skin smooth and hard, and with eye spots
Female: globular and larger than male
Male: flat and smaller than female and always winged; always emerging from the host.

Family Elenchidae – found in planthoppers

- Four antennal segments
- 3rd antennal segment laterally flabellate or Y-shaped because of the fusion of true 3rd segment with other components of the antennae



- Few veins on wings
- Two segmented tarsi

Elenchus (parasitoids of BPH, SBPH, *S. furcifera, S. vibix, T. pusanus)*

Family Halictophagidae (primitive form) –found in leafhoppers and in *Amrasca* on mungbean and peanut

- 7 antennal segments
- 3rd antennal segment prolong laterally
- More veins on wings
- Tarsus 3 segments

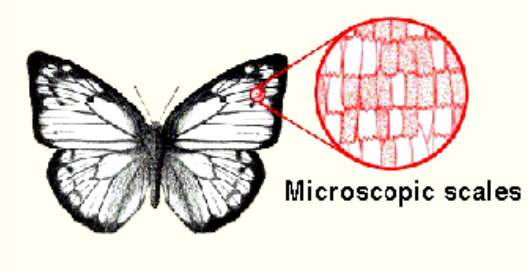
Halictophagus (parasitoid of *N. virescens, N. malayanus, N. nigropictus, N. parvus*)

Hosts of Strepsiptera:

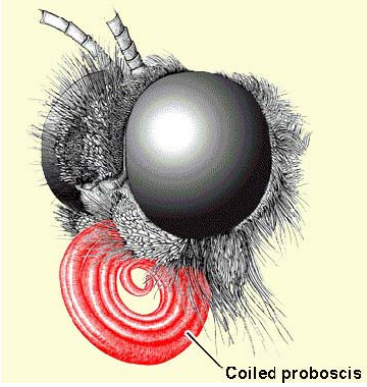
1. Sphecidae – *Corioxenes* and *Mengenilla*
2. Gryllid (*Euscyrtus concinnus*) – *Stereoxenos*
3. BPH
4. SBPH
5. WBPH- *S. furcifera, S. vibix, Tagosodes pusanus*
6. Meenopliid leafhopper – *Nisia carolinensis*
7. Taro planthopper – *Tarophagus proserpina*
8. Leafhoppers – *N. virescens, N. nigropictus, N. malayanus, N. parvus*

Order Lepidoptera – butterflies and moths

- scales on the wings



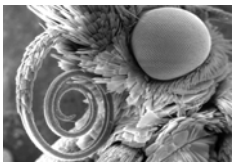
- most of the body and legs are also covered with scales
- sucking mouthparts with coiled proboscis



Family Pyralidae – snout moths

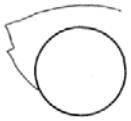
- Tympalic organ at base of abdomen is embedded inside
- Sc separates from R1
- R3 and R4 branch very distinct
- Vein R1 and R2 split or merging at mid length

- Sexy moths, slender bodied,
- No thick hair tuft behind the head or at the junction of wing toward the pronotum unlike in Noctuidae
- Rounded wings



Chilo suppressalis (Walker) – striped stem borer (pest)

- straw colored moths with black spots
- with pointed head



- abdomen pointed at tip
- ventral tip of abdomen with no dense mat of hairs

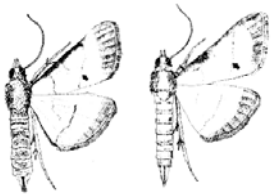
Scirpophaga incertulas (Walker) – yellow stem borer (pest)

- yellow with a black spots on FW in females and ochreous with minute markings in males

- rounded tip of head
- abdomen with blunt end
- with thick mats of hairs on ventral tip of abdomen

Cnaphalocrocis medinalis (Guenee) – leaffolder (pest)

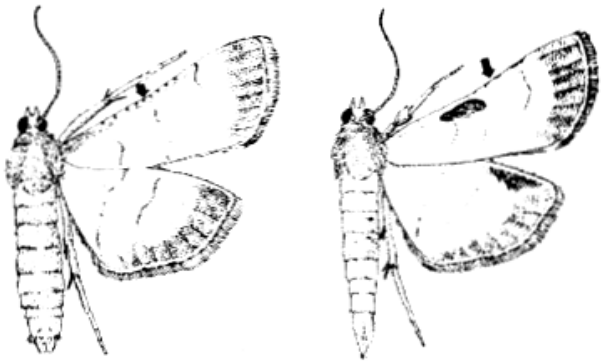
- FW with 2 complete bands and an incomplete middle band
- with thick and short hairs on Sc



- female moth has thicker band on a blunt abdominal tip
- male moth has an elongate and pointed abdominal tip with band

Marasmia patnalis Bradley – leaffolder (pest)

- FW has an incomplete third or bottom band which connects the middle band
- With thin and longer hairs on Sc



female male

- female moth has triangular abdominal tip with faint band
- male has bearded and shaded abdominal tip

Family Noctuidae – noctuids

- Haustellum strong
- Maxillary palpi1 segmented
- Forewings with areole
- Sc+R1 shortly fused with Rs near base

Spodoptera litura (Fabricius) – common cutworm (pest)

- FW dark brown forewings with distinct black spots and white and yellow wavy stripes
- HW whitish with gray margins and somewhat iridescent

Spodoptera mauritia acronyctoides (Guenee) – swarming caterpillar (pest)

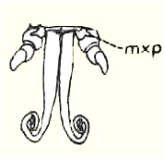
- grayish black
- FW with black markings

Mythimna separata (Walker) – ear-cutting caterpillar (pest)

- more than 15.0 mm in length
- FW pale red-brown with two pale round spots
- HW dark red-brown on top and white underneath

Family Satyridae – satyrids

- Antennae approximated at base, clubbed distally without hooked tip
- FW more or less triangular, some with veins especially Sc swollen at base, radius 5-branched
- 1 segment of maxillary palp

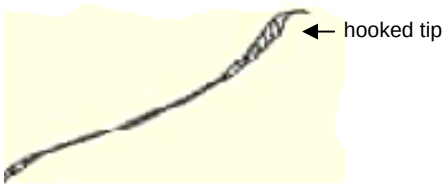


- Front leg reduced
- Epiphysis of froe tibia absent
- Moths usually brownish or grayish with circular spots

Melanitis and Mycalesis (pest) – with eye spots

Family Hesperiidae – skippers

- Small to medium-sized
- Antenna widely separated at base, scape with scale-tuft, flagellum with tip dilated apically forming a hooked club or tip



- Ocelli absent
- Chaetosemata present
- Haustellum present
- Maxillary palpi absent
- Epiphysis of fore tibia present
- FW without retinaculum, veins arising separately from discal cell, CuP absent
- HW without frenulum, humeral vein present, Sc connected to Rs near base by R1
- With glass spots on wings

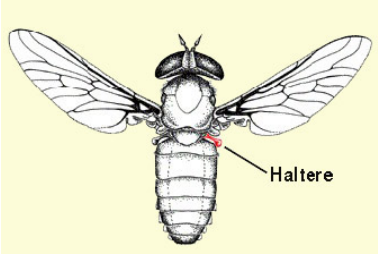
Parnara and *Pelopidas* (pest)

Family Papilionidae - swallowtail

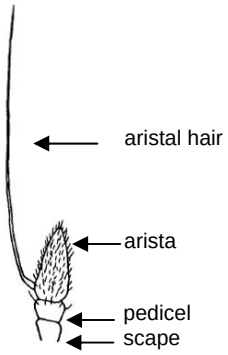
- Long coiled proboscis
- Bottom part of HW wavy

Order Diptera – flies (pest, predator and detritivore/tourist)

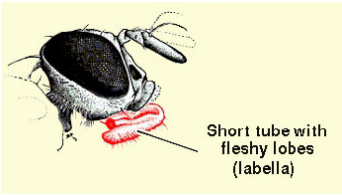
- only one pair of wings
- FW developed
- HW reduced to small knobbed structures – haltere (for equilibrium)



- Antennal segments: scape, pedicel, and aristal hairs

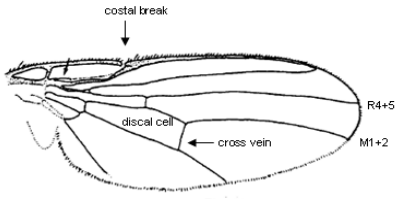


- sucking mouthparts with labella



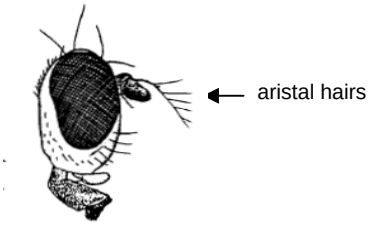
Family Ephydridae – shore flies

- Discal cell large



- Cross vein near wing margin

- One row of dorsal aristal hairs from 3-16 hairs



- Wings with costal break and no anal cell
- M1+2 curved upward and near R4+5

Brachydeutera (pest)

- Smaller version of *Hydrellia*

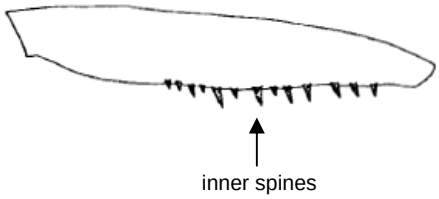
- Small to large shore flies, 1.45-5.35 mm
- Costal vein extends only to R4+5
- The section apicad of cross vein dm-cu is conspicuously weaker or evanescent

Differences between *Notiphila* and *Hydrellia.*

	Humeral spine	Aristal hair	Tibial spines	Size	Size of discal cell	Tibia I (venter)
Notiphila	+	12-15	1-4	>5mm	large	w/o spine
Hydrellia	-	7-10	0	3-4.5mm	small	10-12 spines

Hydrellia (pest)

- No spine, subcostal close to R1
- Inner portion of femur I with inner spines



- Tibia II without spines

Notiphila (detritivore/tourist)

- With 1 subcostal spine
- Femur I without spines
- Tibia II with 3-4 spines

Paralimna (detritivore/tourist)

- Femora black

- Tibiae black or dark brown
- Subcostal spine near R1 present
- Cross veins pigmented and clear

Psilopa (detritivore/tourist)

- Femora yellow
- Tibiae yellow
- Subcostal spine near R1 present
- Cross veins transparent

Scatella stagnalis Fallen (detritivore/tourist)

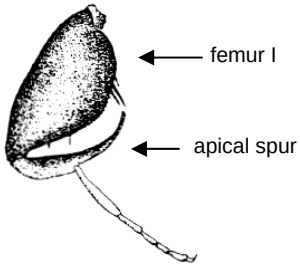
- Flecks or transparent spots on the wings

- Short antennae, reddish eyes and black body

Ochthera sauteri (predator)

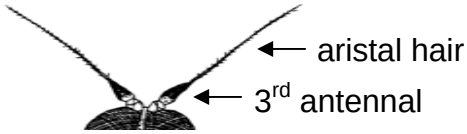
- Predatory

- Without hairs before base of abdomen (unlike in *O. brevitibialis* with hairs in the base of dorsal of abdomen
- Leg I mantis-like, enlarged femur with spines and tibiae with apical spur



Family Empididae – dance flies (on nymphs of leaf and planthoppers)

- Arista in front of 3rd antennal segment
- 3rd antennal segment long and pointed at tip

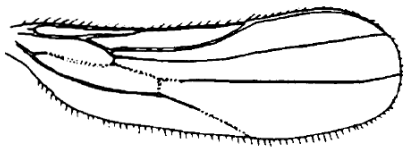


- Very weak or absent vertical hairs on wings
- Subcostal vein far from wing margin
- With markings or bands on the dorsal segments of abdomen
- Cross vein and discal cell shorter
- Male has thrown-out last abdominal segment

Drapetis (Drapetis) sp. (predator)

- Black body
- Whitish yellow legs

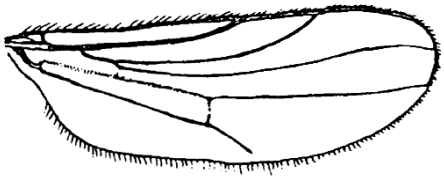
- Head and antennae black
- Hindi tibiae without extensor bristles
- Postical vein erased in apical half



- Mandible pointed, long and vertical

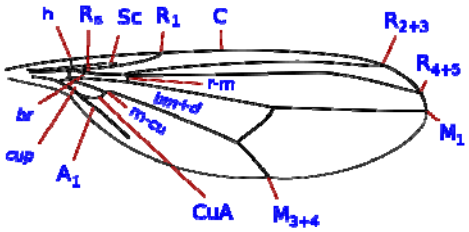
Drapetis (*Elaphropeza*) sp. (predator)

- Brownish red body
- Yellowish brown legs
- Head and antennae reddish brown
- Hindi tibiae with two extensor bristles
- Postical vein prominent, not erased
- Mandible pointed, long and vertical



Family Dolichopodidae – long-legged flies

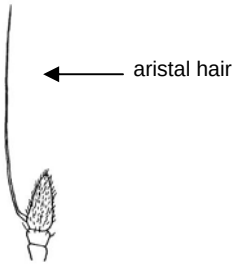
- Metallic blue bands
- Discal cell is longer or bigger than Empididae



- Body color is metallic blue
- Male has genitalia curved inside
- Subcostal vein close to the wing margin or tip

- Head has strong vertical hairs
- Antenna with fine and long arista

- Arista dorsal of cone-shaped 3rd antennal segment



Syntormon (predator)

Medetera (predator)

Dolichopus (predator)

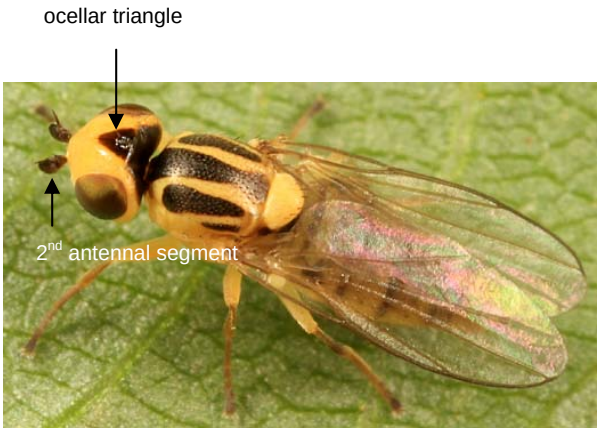
Family Chloropidae – frit flies or grass flies

- Yellow or black and appearing shiny due to the virtual absence of any hairs
- Ocellar triangle highly developed

Ocellar triangle

- Round or globular 2nd antennal segment
- Scutellar end with a pair of spines
- Palpi elongate

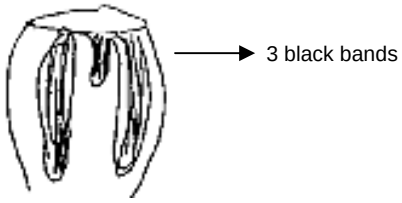
Mepachymerus ensifer (Thompson) (detritivores/tourist)



- Yellowish fly
- Bands on ventral sides of thorax
- With triangular black bands between coxa I and III

Chlorops oryzae - similar to *Mepachymerus ensifer* (can be a pest in some area)

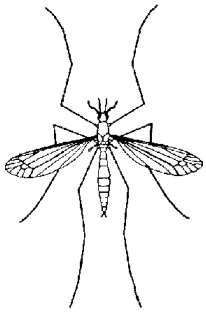
- Has 3 strong black bands in the thorax



- Without bands on lateral sides

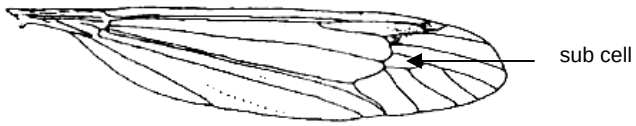
Family Tipulidae – crane flies

- Pronotum strongly symmetrical (there is a dividing line in the middle), semi-hump backed
- Strong V-shaped mesonotal suture



Tipula sp. (detritivore/tourist) – with curved ovipositor

- FW with 5-6 closed cells toward wing margin
- Curvature on the FW (baes) near wing attachement
- Discal cell with a sub cell and 3-5 branches towards tip

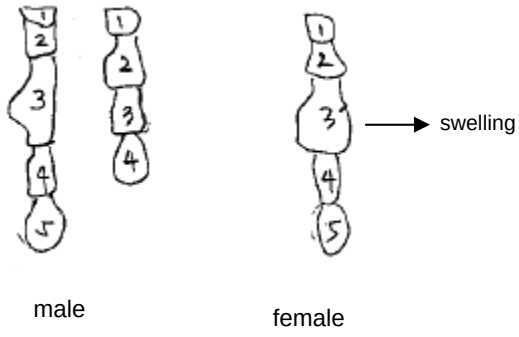


- Brown-spotted
- Elongated body with abdomen greater or larger than FW

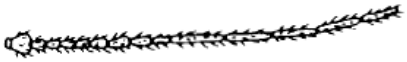
Family Ceratopogonidae – biting midges, punkies or no-see-ums
(predator of chironomids, nymphs of planthoppers and leafhoppers particularly the 1st instar and in few cases the 2nd instar0

- With piercing mouthparts, which is triangular being predaceous
- Male's antennae bead-like (basal segment is bead-like and then it elongates)

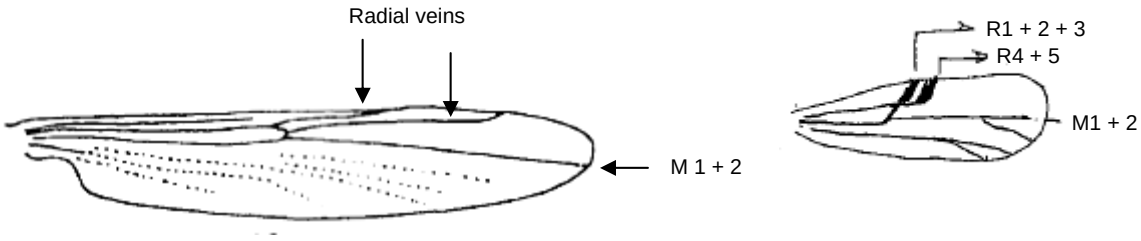
- Tarsal claw well-developed (sickle-shaped)
- Male antennae beaded and elongate
- Maxillary palp of male with sensorial structures



- Female antennal segments 1, 2, 3 with modifications



- Radial veins short usually meeting costa well before apex of wing and enclosing 1 or 2 radial cells



- M1+2 both present

Culicoides sp.

- Subcostal humeral developed
- Wings with marks or spots

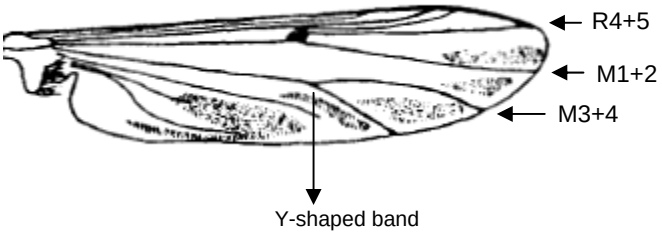
Nilobezzia sp. (predator) (may prey on 1st instars of newly hatched YSB, SSB, and RLF

- Blackish brown
- Fore and middle legs yellow
- Anterior part of femora II and III, tibiae II, and dorsal side of tibiae III with a series of long hard spines
- Tarsal segments long
- Claws long

Family Chironomidae – midges (brownish or black, green, reddish or yellow)

- Simple or sucker type mouthparts
- Claws not well-developed
- Wings sometimes hairy and sometimes with dark markings
- Non-piercing mouthparts
- Males have plumose antennae

- Antennal segments shorter and basal part is not bead-like
- Radial veins longer, R4+5 close to wing tips



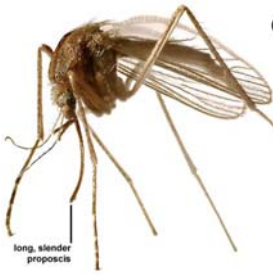
- With bands on the thorax

Chironomus sp. (detritivore/tourist)

- Greenish body
- Yellow brown bands on scutum or notum

Family Culicidae – mosquitoes (detritivore/tourist)

- Proboscis long, extending far beyond clypeus

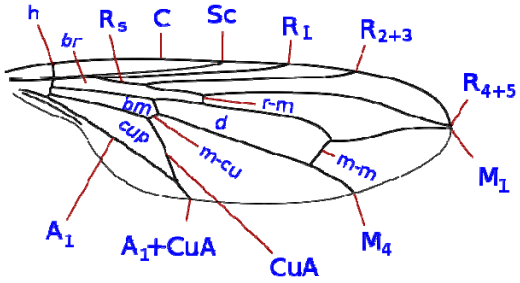


- Scales present on wing veins and wing margin and usually also on body

Family Pipunculidae – big headed fly

- Eyes almost occupy the whole head
- Ocellar triangle very prominent
- Antennae with a pointed elongate segment III

- R4+5 unbranched and very near M1
- Anal cell is usually long and closed near the wing margin



Pipunculus sp. ((parasitoid)

- No bands on wings
- Stigma on wings present
- Humeri grey to black
- No yellow band on the coastal of wings

Tomosvaryella (parasitoid)

- Stigma on wings absent
- Yellowish
- Female ovipositor straight

Differences between Tachinidae, Muscidae, Calliphoridae, and Sciomyzidae.

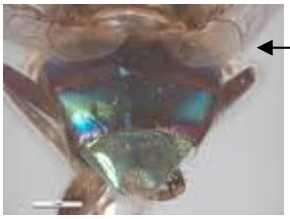
Characters	Tachinidae	Muscidae	Calliphoridae	Sciomyzidae
Postscutellar plate	Strongly developed	Absent	Absent	Absent
Sternopleural spines	Well-developed	Poorly developed	Absent	Absent
Feeding behavior	Parasitoid	Tourist/scavenger	Scavenger/parasitoid (snails)	Parasitoid (snail)
Wing bands	absent	absent	absent	present
Body color	Blackish to gray	Blackish	Metallic blue	Reddish brown
Body length	short	short	short	short
Body features	Spinous/abdomen	Regular/less spinous	Less spinous	Not spinous
Antennae	With groove			Pedicel larger than scape
Mouthpart	Short base	Short base	Short base	Long base

Differences between Muscidae and Tachinidae

Characters	Muscidae	Tachinidae
Scutellar plate	none	present
Jugal part of wing	none	present
Sternopleural setae	none	2-3 (found above coxa II)

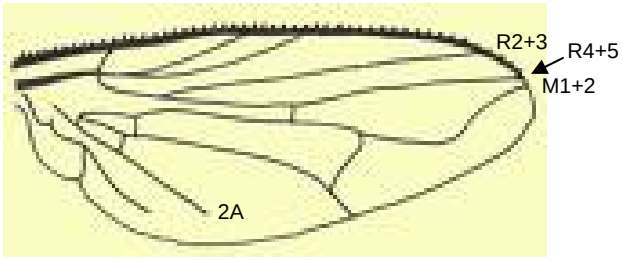
Family Muscidae – muscids

- Antennae 3-segmented with arista usually plumose for the entire length
- 2 longitudinally broad bands on notum
- Hypopleuron usually without bristles
- Calypters well-developed



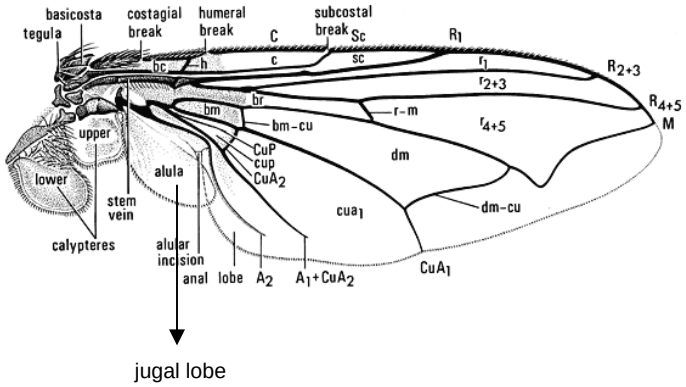
- R5 cell either parallel sided or narrowed distally
- Vein 2A short and not reaching wing margin
- Portion of M1+2 rounded curved at midhalf

Musca (detritivore/tourist)

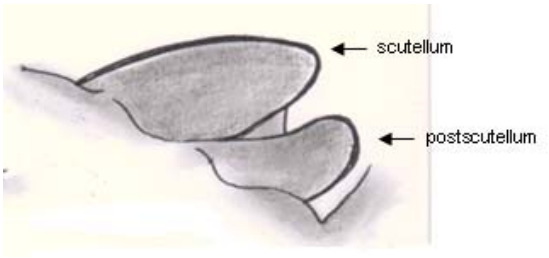


Family Tachinidae – tachinids

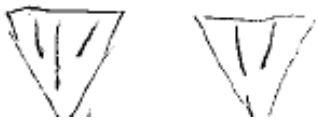
- Stout body and strongly bristled
- Distinct jugal lobe



- Prominent or strongly developed postscutellum or subscutellum



- Hypopleural and pteropleural bristles developed
- Sternopleural setae 2-3



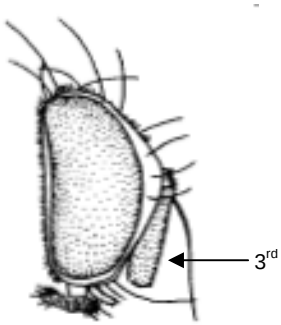
- Long 3rd antennal segment with aristal hairs on basal dorsal 1/3

  Halydaia sp.- rice skipper parasitoid

  - Red in color
  - Spinous
  - Posscutellar present
  - With sternopleural spines

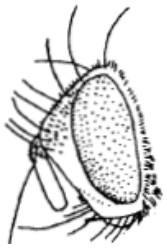
Argyrophylax (parasitoid)

- Eyes bare or without hairs
- Third antennal segment reaching epistome
- Palpi yellow
- Head generally dark to blackish red except silvery white tinge along parafacial and facial ridge



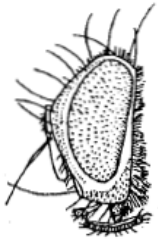
Carcelia (parasitoid)

- Eyes haired
- Post dorsocentral with 4 setae
- 3rd segment not reaching epistome



Sturmiopsis (parasitoid)

- Parafacials entirely clothed with strong hairs
- Antennae far from epistome, yellow brown



Family Calliphoridae – blow flies, bluebottles

- Metallic blue or green
- Almost all have antennal arista plumose
- No longitudinal band in prothorax

Calliphora (detritivore/tourist)

Family Sarcophagidae – flesh flies

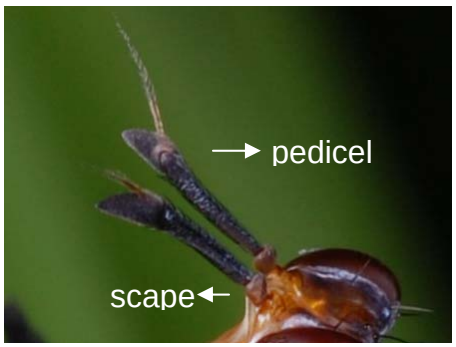
- Generally blackish
- Plumose arista or bare
- Thorax with 3 longitudinally broad bands never metallic
- M1+2 with a basally swollen or pointed portion near apex of cross vein
- Abdomen with alternating pattern of silver-grey and black patches
- Sternopleural bristles 1:1:1 or 2:1

Sarcophaga (detritivore/tourist)

Family Sciomyzidae – marsh flies (parasitic on snails)

- Leg I with basal sement (segment I) wide, 2 and 3 slender and long (to push forward)
- Male has rounded abdominal tip where part of it slides on other side

- Female is slightly pointed with narrow plates
- Prominent eyes
- Prominent-forward pointing antennae with pedicel larger than scape



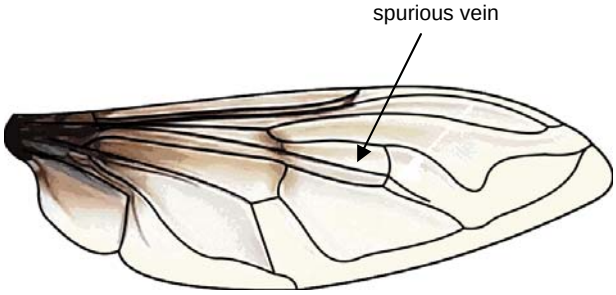
- Wings often mottled with various light brown markings
- Vibrissae (stiff hairs) absent on face
- Tarsal segment 5-5-5
- Tibia with preapical dorsal bristle

Sepedon (predator or parasitoid of snails)

- Black fly with light brown FW
- Head black
- Femur yellow to reddish yellow
- Femur III with ventral spines towards apex

Family Syrphidae – hover flies, flower flies

- With spurious vein in the wing between radius and media



- Many with characteristic markings on body
- With waisted abdomen

Sphaerophoria sp. (pollinator)

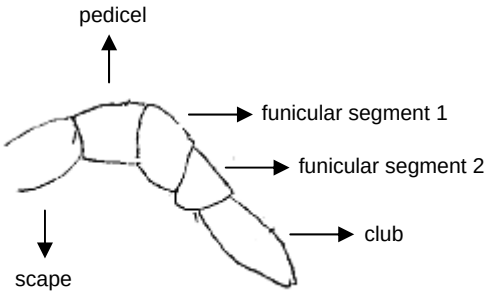
Eristalis sp. (pollinator)

Order Hymenoptera – sawflies, ichneumons, chalcids, ants, wasps, and bees (parasitoid, predator)

- Four membranous wings with the HW smaller than the FW and have a row of tiny hooks or hamuli on anterior margin by which the HW attaches to the FW
- Few veins or reduced venation in many members of families
- Mandibulate mouthparts
- Abdominal segment I usually without sternite and in close association with metathorax
- Marked constriction between abdominal segment 1 and 2 in most species
- Tarsi 3-5 segmented

Family Trichogrammatidae – trichogrammatids (parasitoid)

- Tarsi 3 segmented
- Five antennal segment: scape, pedicel, 2 funicular segments, clubbed segment



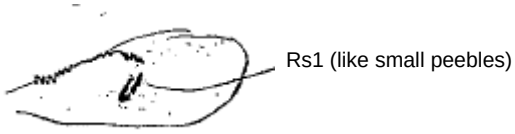
- Female with 2 funicular segment (excluding anelli)
- FW without post marginal vein, discal setae arranged in longitudinal lines
- Abdomen sessile and broadly attached to thorax

Oligosita (parasitoid)

- FW with marginal fringe at least half maximum wing width
- Discal ciliation usually in rows but sparse
- Female antennae 2-segmented (ring and funicle)

Trichogramma (parasitoid)

- FW with short marginal fringe
- Vein track RS1 of FW like small peebles



- Antennal club of male 1-segmented with unsegmented flagellum but with 2 slight constrictions below in the region of funicular segments

Trichogrammatoidea (parasitoid)

- Vein track of radial sector (RS1) absent
- Antennal club of male 3-segmented with 2 funicular segments
- FW with long marginal fringe
- Stigmal vein elongate

Megaphragma sp. – parasitoid of scale insects

Family Eulophidae – eulophids

- 4 tarsal segments
- Antennae 7 antennal segments + 2 rings (composed of scape, pedicel, 4 funicular segments, 2 anelli rings and 2-3 club ends counted as 1)

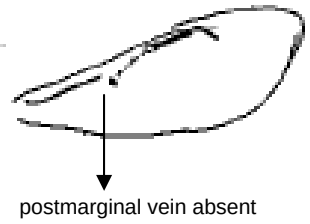
- Long marginal and stigmal veins
- Mesonotum with 2 longitudinal lines

Differences between *Tetrastichus, Pediobius and Hemiptarsenus*

Eulophidae	Notaular lines	2 long lines	Body punctures	Post marginal vein
Tetrastichus	complete	complete	Smoothly punctured	absent
Pediobius	complete	+/-	Rough/clear; roughly punctured	
Hemiptarsenus	complete	+/-	Fine/minute	

Tetrastichus (parasitoids)

- Body shining green with bluish luster to uniformly black or pale yellow
- Post marginal vein absent

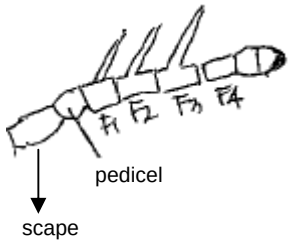


Pediobius (parasitoids)

- Black with dark faint greenish tinge along sides of thorax, propodeum and anterior part of tergite I.

Hemiptarsenus (parasitoids)

- Hindi tibia with 1 apical spur
- Male antennae with 3 long rami, female with 2 anelli or rings, 4 funicular segments with the 2nd segment the longest and nearly 3x length of pedicel, club 3-segmented



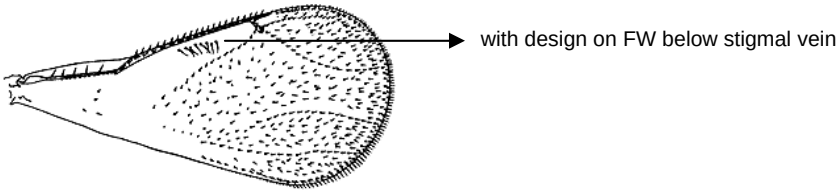
Euplectrus (parasitoids)

- Abdomen ovoid or subpetiolate with basal half yellow with or without 2 pairs of black spots laterally

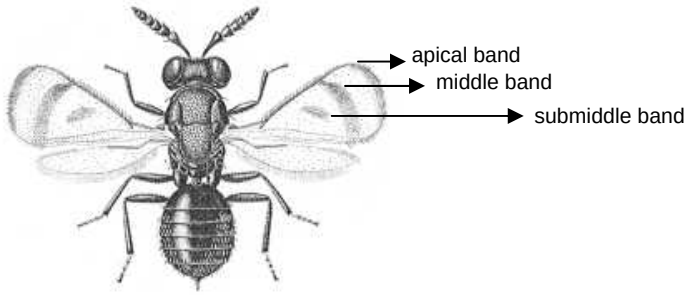
Stenomesius (parasitoids of rice leafhoppers)

- Long marginal and stigmal veins
- Abdomen subsesille
- Hindi tibia with small spurs
- Head broader than mesoscutum
- Yellow with blackish antennae, grey eyes
- Scutellum and abdominal tergites with brown patches
- Midtergites of IV and V usually with broad brown spots

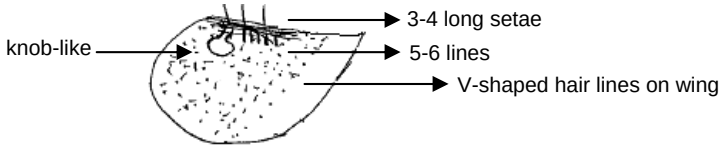
Euderus



Closterocerus

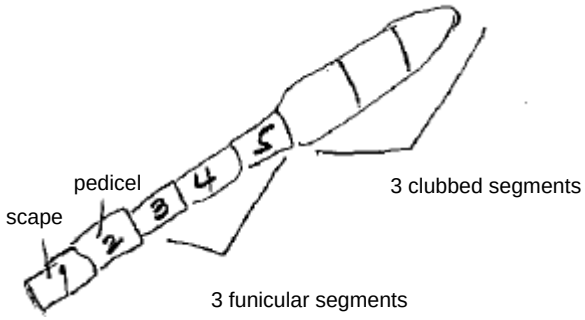


Chrysonotomyia – parasitoid of agromyzid flies



Family Aphelinidae – wasps

- Small wasp
- Antenna 8 segments including the clubbed ends (scape, pedicel, F1, F2, F3 and 3 segments clubbed ends)



- Tarsi 5 segmented

  Aphelinus (parasitoid)

  Encarsia (parasitoid) – (in many GH set-ups, this parasitoid is introduced to control whiteflies)

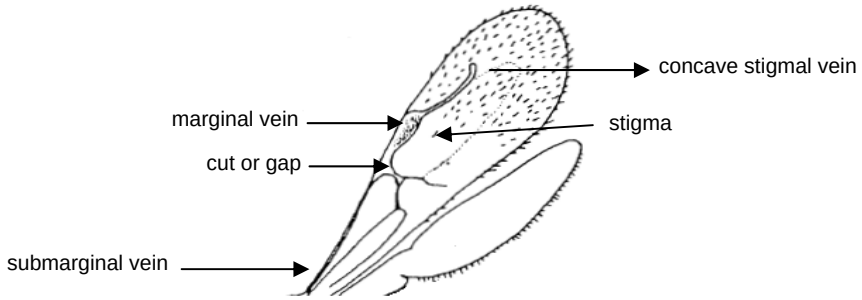
  - Stigmal vein absent

Family Bethylidae – bethylids (ant-like insect) (flat body to get inside the leaves or tubes)

- Flat body and ant-like
- Bead-like antennal segments (scape, pedicel + 11 funicular segments including clubbed ends)

Cont…Order Hymenoptera

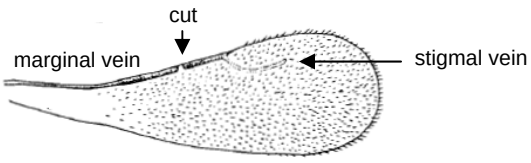
- Ridge between antennal segments on the face (raised or elevated)
- Quadrate and smooth mesothorax
- FW with closed cells and distinct stigma
- Tip of abdomen basically pointed like a bee because it has a distinct sting, abdomen curves inward
- Femur large
- Abdomen longer than thoracic region



Goniozus (parasitoid)

Family Ceraphronidae – ceraphronids (hyperparasitoids)

- Marginal vein with cut
- Well sclerotized long marginal vein extended to wing base
- Stigmal vein concave (not distinct)



- Antennal 9-11 segments, geniculate with long scape and 3 segmented clubs, which is longer than wide

Cont…Order Hymenoptera

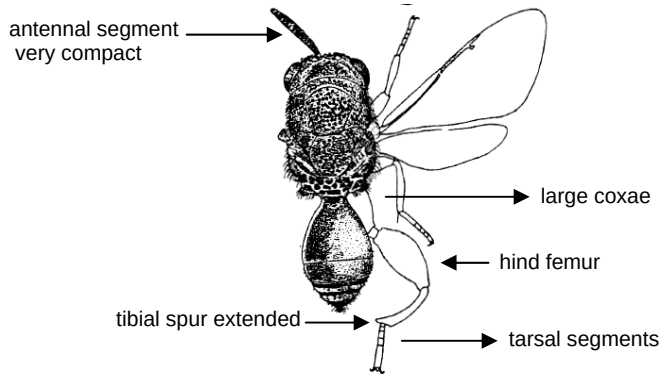
Ceraphron (parasitoid)

- yellow body
- 3-4 mm long

Aphanogmus (parasitoid) – hyperparasitoid of natural enemy of RLF parasitized by *Cotesia* sp.

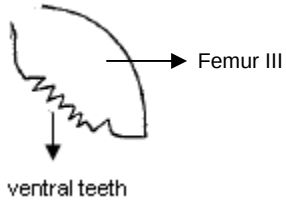
- blackish body

Family Chalcididae – chalcids

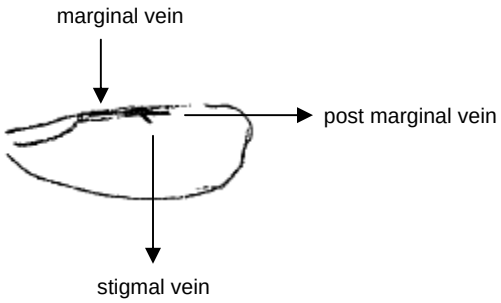


Cont…Order Hymenoptera

- Enlarged femora III with ventral teeth



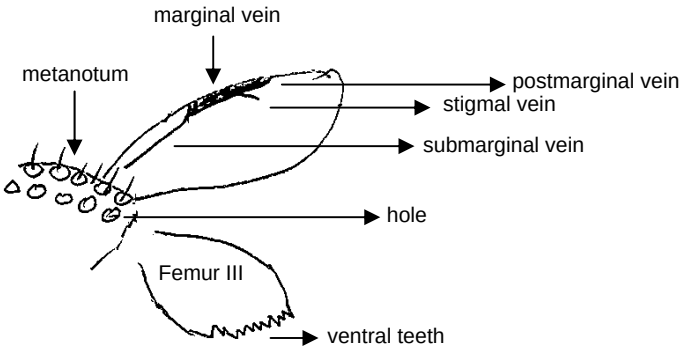
- FW has long MV, long post MV, and short SV



- Thorax and head with many punctuations (holes in the body with hairs)

Cont…Order Hymenoptera

- Body roughly punctuated and setose or hairy

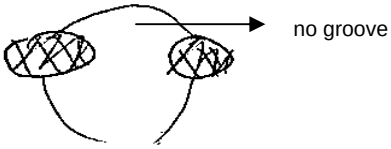


Cont…Order Hymenoptera

- Scutellum bulge posteriorly or rounded behind

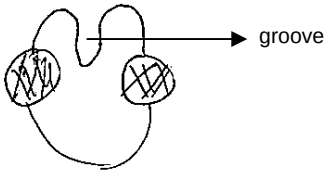
Brachymeria (parasitoid)

- no groove on the face



Anthrocephalus

- *Brachymeria*-like except for the groove on the face

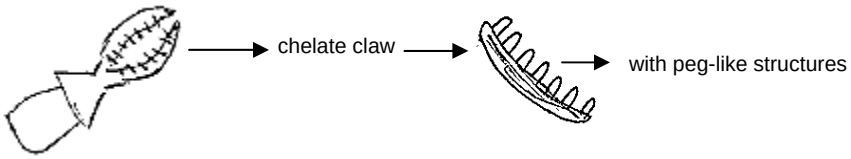


Family Dryinidae – dryinids

- Generally ant-like with or without wings

Cont…Order Hymenoptera

- No node
- Fore tarsus of female usually chelate or claw-like



- Antennae 10 segmented in both sexes
- Thorax with pronotum separated from meso and metanotum

Dicondylus (parasitoid)

- Body uniformly black except brown head

Pseudogonatopus (parasitoid)

- Red brown body
- Female without wings, male winged

Haplogonatopus (parasitoid)

- Brown or black body
- Females without wings, males with wings

Echthrodelphax (parasitoid)

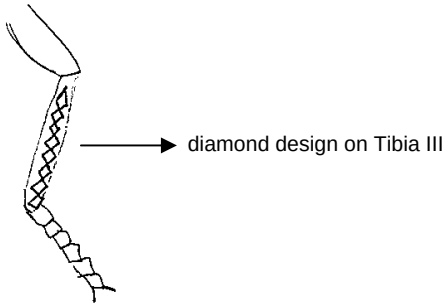
- Both sexes have wings

Other examples: *Gonatopus*, *Tetrodontochelys* (females without wings, males winged)

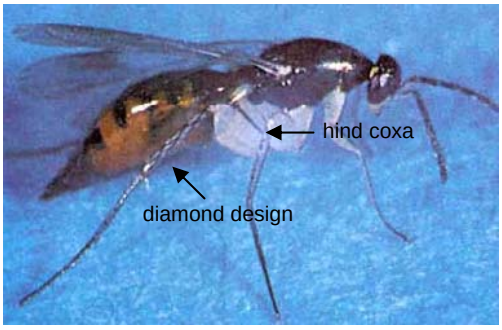
Cont…Order Hymenoptera

Family Elasmidae – elasmids (the richest among the insects because of its diamond on Tibia III)

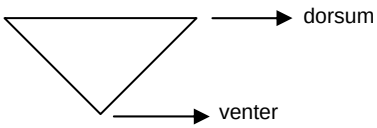
- Tibia III has diamond design because of the long bristles



- Cross section of abdomen broad (dorsally) and narrow (ventrally)
- Flattened femur III
- Hind coxa flat and disc-like



- Body spindle-shaped or triangular, compressed laterally
- Broad dorsum and narrow venter

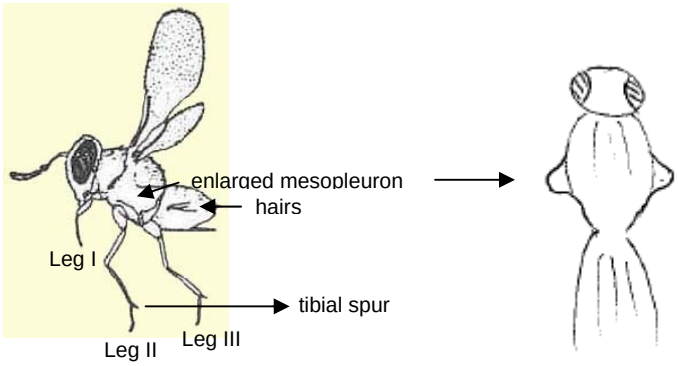


- Venation of FW absent

Elasmus (parasitoid)

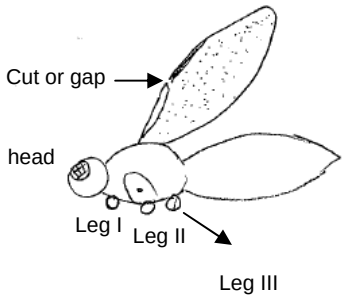
Family Encyrtidae – encrytids

- Solid and large mesopleuron

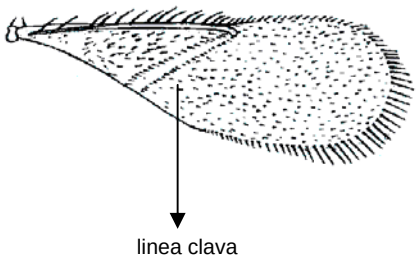


- Leg II with long spur on tibia
- Tibial spur and leg II are much longer and broader than leg I
- Antennae 8 segmented

- Small gap before stigma of FW



- Clava enlarged on FW



Differences between *Copidosomopsis* and *Homalotylus*

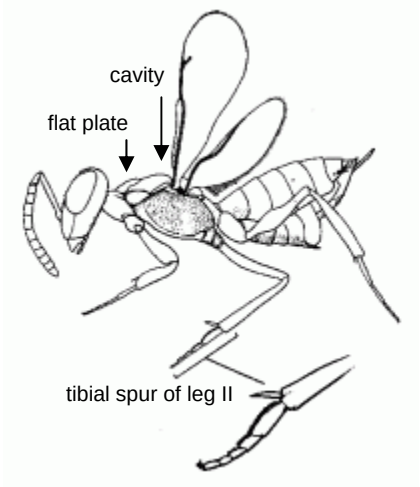
Charcteristics	*Copidosomopsis*	*Homalotylus*
FW	Not banded	Banded
Size	Small (1-2 mm long)	Moderately large (2-4 mm long)
Tip of antennae	Truncate and oblique, black with sensoriae	Elongate, rounded and white
Marginal area	With cut	Without cut

Copidosomopsis (parasitoid)

Homalotylus

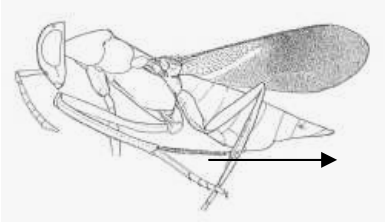
Family Eupelmidae – eupelmids (parasitoids of rice gall midge)

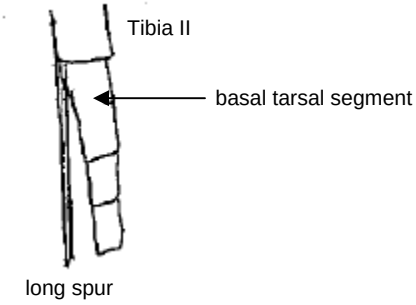
- Tibial spur of leg II very long
- Back or dorsum part with wide cavity



- Mid leg occupies a more normal position close to hind leg
- Fore and mid legs well separated
- Midcoxa closer to hind coxa
- Mesoscutum impressed posteriorly, longer than broad without distinct shoulder

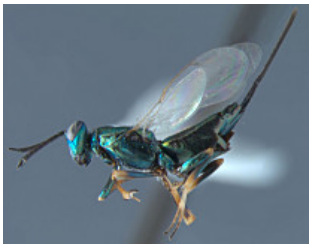
Neanastatus (= *Anastatus)* (parasitoid)



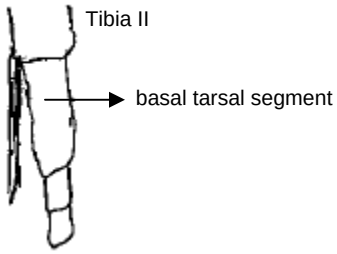


- Spur on tibia II very long as long as 1st tarsal segment of leg II
- No spines on thorax
- FW with brown infuscation

Eupelmus (parasitoid)



- No spines on thorax
- Spur on tibia II not very long, reaching only the 2nd tarsal segment of leg 2

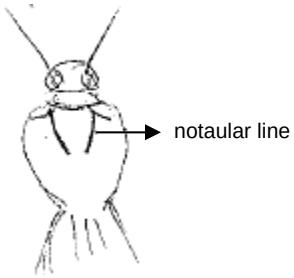


Anastatus – with prothoracic spine

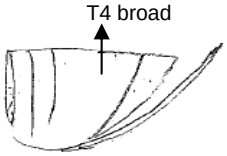
Family Eurytomidae – eurytomids

- Pronotum large, long, nearly quadrate as broad as mesonotum

- Notaular lines complete



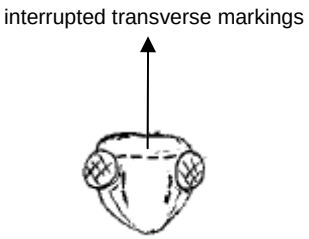
- Antennae 10 segmented (1-1-5-3)
- Tergite IV largest/broadest



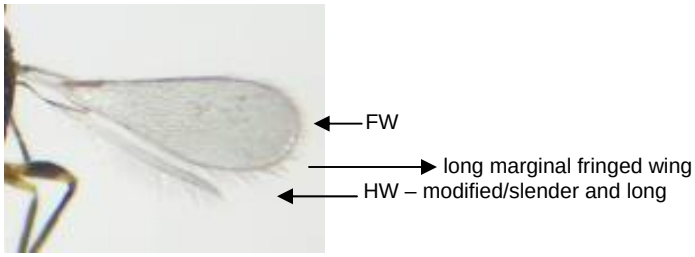
Eurytoma braconidis (parasitoid)

Family Mymaridae –mymarids

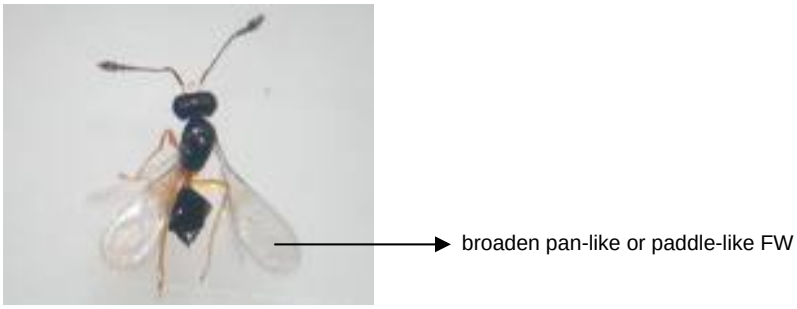
- Tarsi 4-5 segmented
- Long marginal fringe on the FW
- Head with interrupted transverse markings



- Basal part of hindwing reduced to thread-like stalk composed of the sub-marginal vein



Gonatocerus (parasitoid)



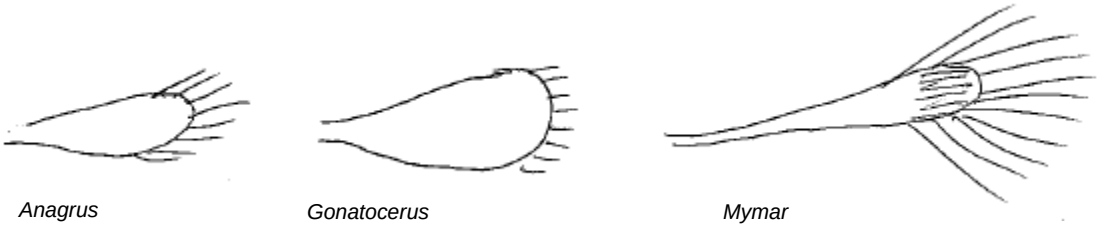
- 5 tarsal segments
- Petiole short, wider than long
- Antennal club – 1 segmented
- Antennae of male 13-segmented and female 11-segmented with 8 funicular segments
- Marginal vein not elongated, venation not reaching basal one-third of wing
- Gaster subsesille

Mymar taprobanicum (parasitoid)

- Antennal club – 1 segmented
- Marginal vein present, post marginal vein and stigmal vein absent
- FW strongly petiolated and oar-shaped, distal half of broad part dark brown with one clear row of setae
- HW with few marginal cilia, abbreviated, filiform and highly reduced

Anagrus (parasitoid) – hybrid of *Gonatocerus* and *Mymar*

- Gaster broadly connected to the propodeum
- Antennae 9 –segmented in the females (6 funicular segments and solid club) and 13-segmented in the males
- Tarsi 4-segmented

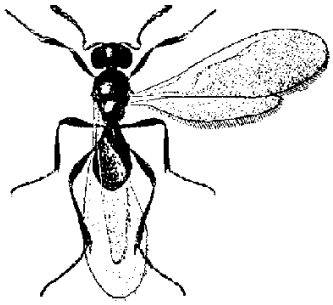


Anagrus *Gonatocerus* *Mymar*

Family Platygasteridae – platygasterids (polyembryonic) (parasitoid of dipterans and midges)

- FW no marginal, post marginal and stigmal veins or veinless
- Antennae composed of long scape, pedicel, 3 funicular segments and 5 segmented club
- Very similar to Scelionidae in appearance in terms of pleats or grooves on the back

Platygaster (parasitoid)



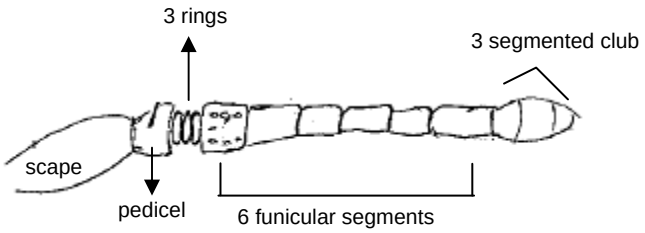
- 5 segmented tarsi
- Generally brown
- 9 antennal segments with the scape narrow
- Anterior abdominal segments 1 and 2 small and plate-like or constricted

Heptascelio

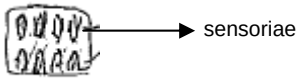
- Reduction of radial vein in HW
- Tibial spur 1-1-1
- Scutellum with a pair of spine

Family Pteromalidae – pteromalids (parasitoid)

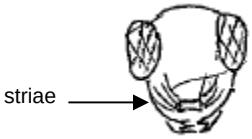
- Bluish metallic color, bluish green
- Antennae: scape, pedicel, 3 rings and 6 funicular segments, 3 segmented club



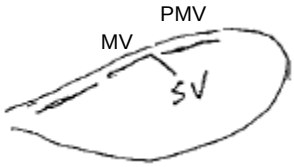
- Antennal funicle with sensoriae



- Head with striae



- Postmarginal vein (PMV) as long or longer than marginal vein (MV)



- Thorax punctuate
- Tarsi 5 segmented

Trichomalopsis (parasitoid)

- With fine striations in the area above labrum or mandible
- Metallic bluish green
- Tarsi 5 segmented
- Legs yellowish
- 9 antennal segments

Family Scelionidae – scelionids (are grouped based on the division of the ventral and dorsal plates)

- FW distinct with marginal and long stigmal veins
- Abdomen small and narrow and broaden part below
- Tarsal 5 segmented

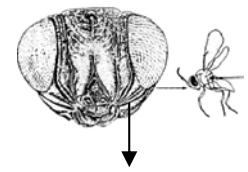
- Mid and hind tibia with 1 spur
- Antennae 11-12 segmented, elbowed or bent arising on the face
- Gaster with lateral margins rounded or carinate

Differences between genera of Scelionidae:

Characters	*Psix*	*Telenomus*	*Gryon*	*Idris*	*Baeus*	*Macroteleia*
Abdomen	rounded	rounded	rounded	rounded	rounded	narrow/elongate
Antennal club	5 segments	5 segments	5 segments	4 segments/ compact	4 segments/ compact	

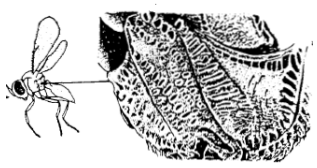
Psix (parasitoid)

- Fan-like carina prominent in the head emanating near mandibular base, extended dorsad to the frons and cheeks, and branches ventrad on either sides of insertions



lines from base of mouth going to the eyes

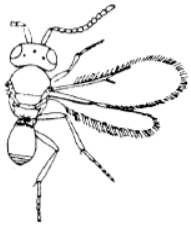
- Central keel, submedian and orbital carinae developed
- Lateral side of thorax strongly pitted



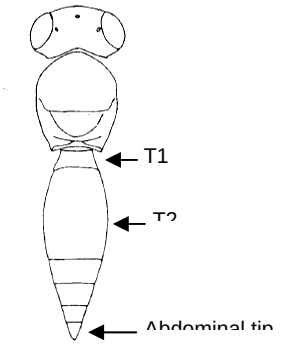
- Antennae with yellow scape

Telenomus (egg parasitoid) – very common
Hosts: stem borers (*T. dignus* and *T. rowani*)
Rice black bug (*T. triptus*)
Armyworm
Tabanid flies (*T. tabanini*)
Nisia

- Slender especially the female with pointed ends

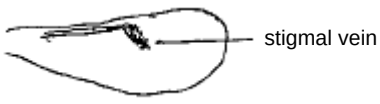


- 11 antennal segments in female and 10 in male
  - Female: 1 scape
    1 pedicel
    4 funicular segments
    5 clubs
  - Male: 1 scape
    1 pedicel
    3 funicular segments
    5 clubs
- Mandible with 3 teeth with apical tooth the sharpest
- Leg I with stout tibia, tip with a spur having bifurcate branch at tip
- Abdominal tip pointed



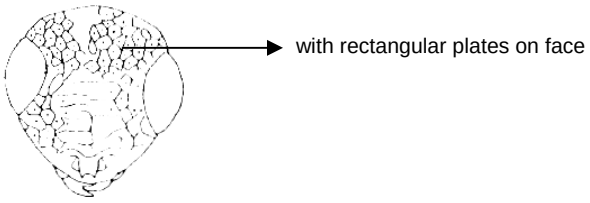
- Tergite 2 distinctly wider and longer than T1

Scelio sp. – stigmal vein is thick



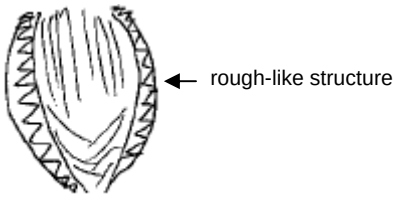
Gryon (parasitoid of rice bug)

- Small scelioninae
- Transverse head and wrinkle



- Mesothorax and scutellum with rough peg-like structures

- Stouter and globose
- Ventral part of abdomen with rough structures



Idris (parasitoid of spiders)

- With rounded abdomen

Baeus (parasitoid of spiders)

- Small and beetle-like, 0.4-0.6 mm long
- Wingless

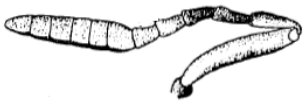


- Body strongly convex
- Rounded abdomen covered by a hard convex plate
- Last antennal segment big and semi-rounded

Macroteleia (parasitoid of grasshoppers)

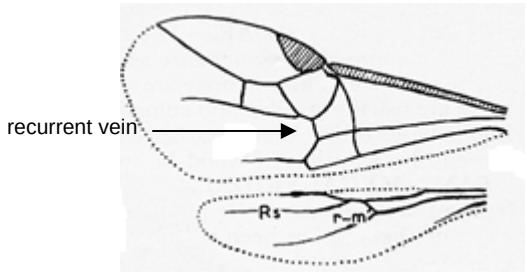
- Abdomen narrow and elongate and strongly pointed

- Antennal scape slender but not dilated



Family Braconidae – braconids

- FW with 1 or without recurrent vein



- HW with median cell not extending to the base of the marginal vein
- Gastral tergites 2 and 3 immovably fused except in Aphidiinae

Cardiochiles (parasitoid)

- Black braconid with apical 1/3 of FW dark or light brown
- Abdomen strongly recurved
- Uniformly black bodies

Cotesia (parasitoid)

- Black braconid
- Fewer closed cells towards the base
- FW venation reduced toward the apex (wing margin)
- No areolet (first closed cell/small towards apex) on the FW
- Tergite elongated/ abdomen soft

Opius (parasitoid)

- Orange-bodied

- Smaller than *Tropobracon,* 5 mm long
- Long antennae
- Tergite I black and slightly triangular
- 2nd cubital 4 sided or rectangular and long
- Lateral sides of pronotum, metanotum and tarsal 1 brown

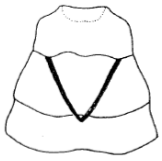
Aulacocentrum (parasitoid)

- Orange

- Slender body
- Long ovipositor in female
- Dark yellow abdomen with its dorsum uniformly blackish brown

Tropobracon schoenobii (parasitoid)

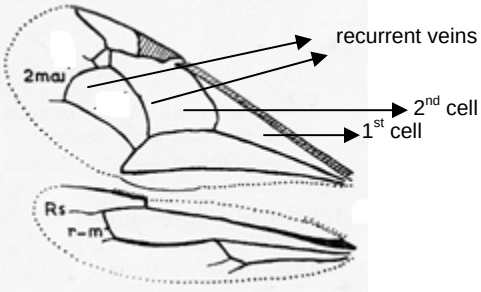
- Abdomen elongate
- Orange body
- V-shaped band on tergite 1 and 2



- 1 recurrent vein
- 6 mm long

Family Ichneumonidae – ichneumonids

- FW with 2 recurrent veins (closed vertical cell on the wing)



- More antennal segments than braconids
- HW with median cell elongated beyond the base of marginal vein

Amauromorpha (parasitoid)

- Abdominal segment 1 black and reddish apico-laterally
- Abdominal segments II and III entirely black
- Abdominal segment VII with white-apico-median transverse band

- Hind femur black to blackish brown

Xanthopimpla (parasitoid)

- Yellow body with or without black paired spots in abdominal dorsum

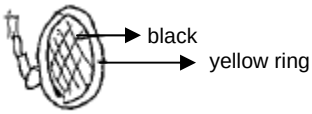
- Ovipositor very distinct

Xanthopimpla modesta – yellow with spots

X. flavolineata – yellow without spots

Trichomma cnaphalocrocis (parasitoid)

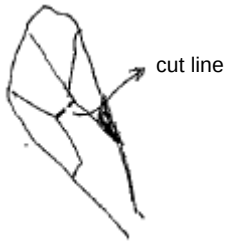
- Eyes with yellow ring or yellow ring around eyes



- Abdomen black
- Slender and black insect
- Head black
- Ovipositor about 2-3.8 as long as apical length of abdomen

Temelucha (parasitoid)

- Thin and slender abdomen with apex of tergum 1 and 2 slightly swollen
- Orange yellow color
- FW without areole but with a cut line

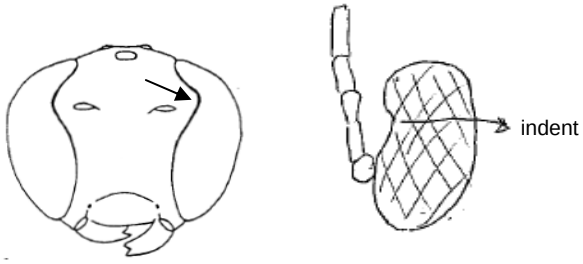


- Propodeum with at least 4 closed cells

- No yellow margin on eyes
- Ocellar area triangle black
- Inner margin of eye straight
- 1st cubital is large

Itoplectis narangae (parasitoid)

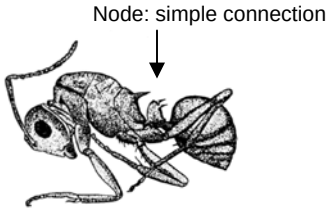
- Black head, thorax and tip of abdomen
- Eyes with strong emargination opposite antennae



- Frons black
- Tergites I-IV or I-V orange-red
- FW with 4-sided areole

Family Formicidae

- With 1 to 2 petioles or nodes, which are part of the abdomen



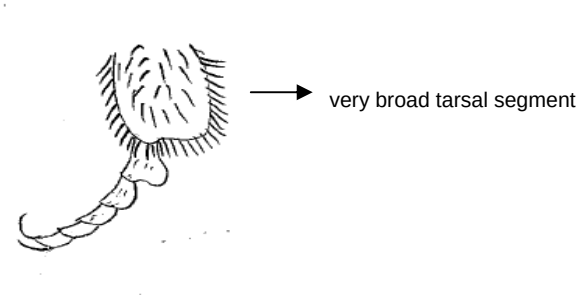
- Elbowed antennae

Polyrachis (predator)

Solenopsis (red ant) (predator)

Family Apidae (honeybees)

- Tibia III with very broad tarsal segment



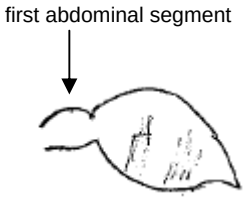
Apis (pollinator)

Differences between Families Vespidae, Anthoporidae and Sphecidae

Characters	Vespidae	Anthoporidae	Sphecidae
Forewing pleats	absent	present	absent
Tergite I	short and compact	short and compact	long and elongated
Tarsal claw	simple	simple	simple
Guild	predator	pollinator	predator

Family Vespidae

- First abdominal segment short and compact (unique characteristic of the family)



- Antennal segments bamboo-like
- Venation with shorter radial cell on wings
- Posterior lateral lobes reach above tegula, usually angulated
- FW longitudinally folded at resting position, 3 marginal cells present
- Tegula with or without raised margin
- Tarsal claws bifid to simple

Eumenes (predator)

Ropalidia (predator)

Family Anthoporidae - bumble bees

- Pleats on wing venation
- Hind tibiae with apical spurs
- HW with jugal lobe
- Wings bluish/black
- Genae very narrow
- Maxillary palps well developed

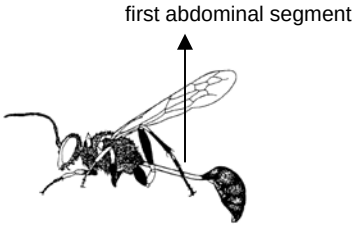
Xylocopa (pollinator)

bluish dark FW

Family Sphecidae

- Posterior lateral lobes of pronotum not reaching back to and terminate below tegula
- Hairs on body unbranched
- Notaulices wanting or feebly developed
- HW with jugal lobe
- FW with elongate radial vein

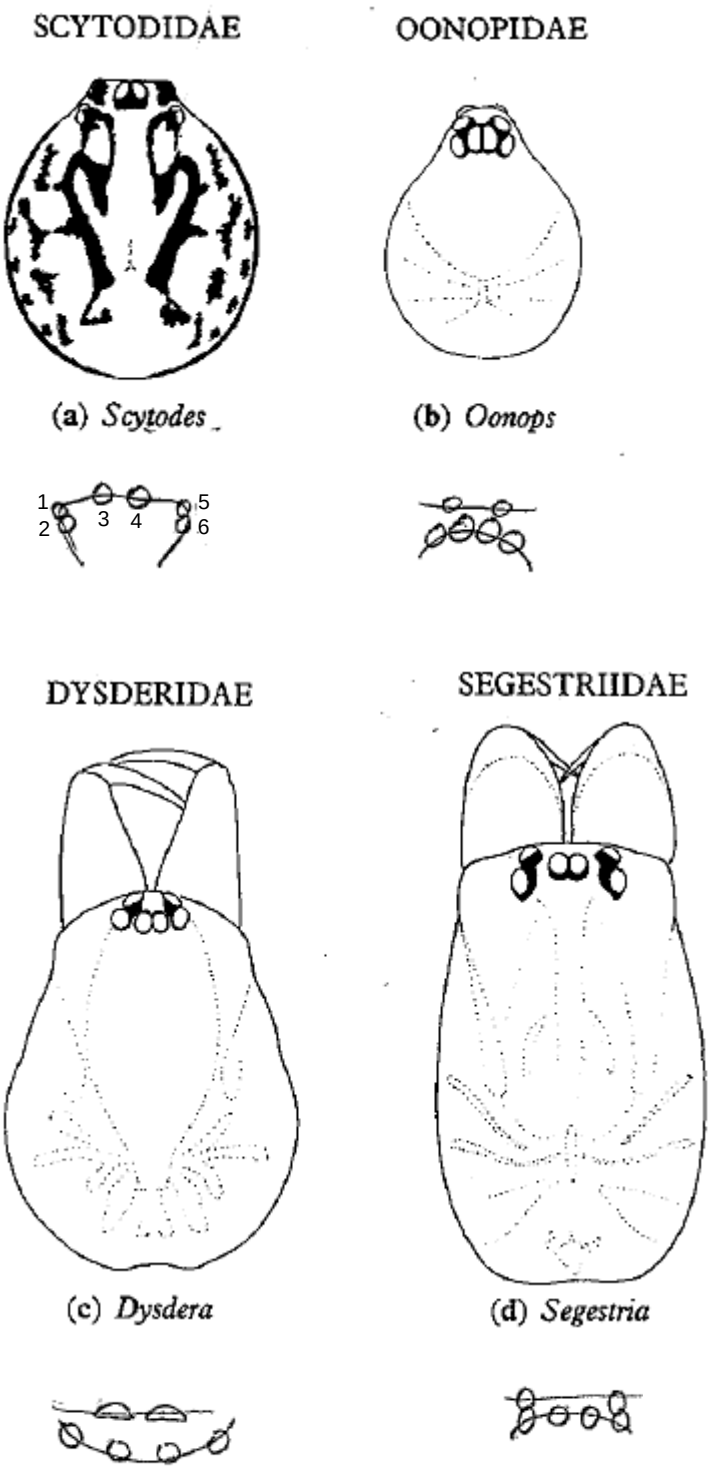
Sceliphron madraspatanum conspicillatum (Fabricius) (predator)



- First abdominal segment slender
- More longer/elongate radial cell

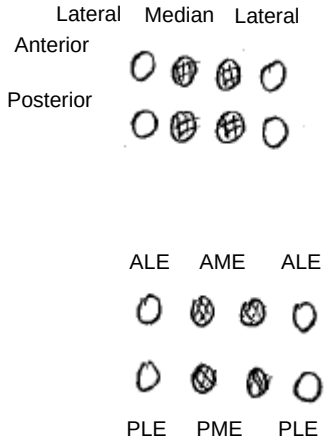
Spiders (Order Araneae) (predator)

Families with 6 eyes:

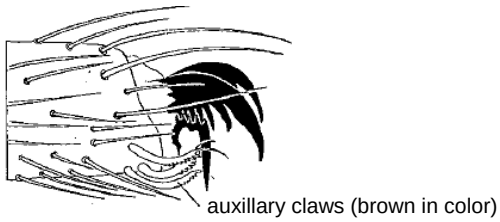


Family Araneidae – orb weavers

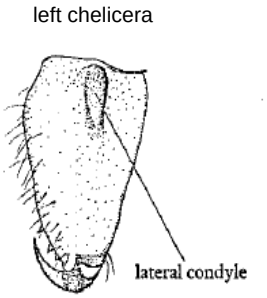
- 8 eyes arranged in 2 rows



- With auxillary claws (for manipulating or establishing the web) and 3 regular claws on the tarsus

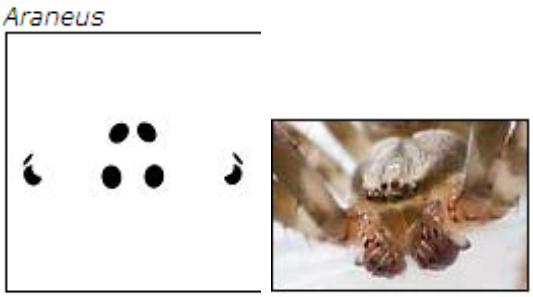


- With swollen mandible (with a condyle - a hardened tissue/plate/scar/ridge)



- 4-6 spinnerets
- Brightly colored adults that stay in the middle of the web

- Legs hairy or spiny



Araneus

- Legs uniformly yellow
- Abdomen blackish with chalk white median band constricted along lateral margins producing subtriangular marks

Argiope

- Abdomen with silvery whitish yellow band anteriorly and brown patches of irregular shapes from median towards the posterior

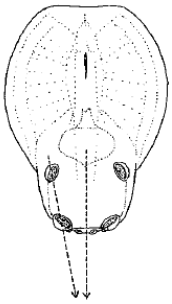
Family Lycosidae – wolf spider (a good predator because it can see the front and back)

- Eight dark eyes of unequal size arranged in three rows, the first having four eyes



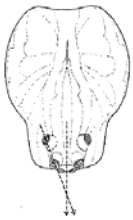
- Legs long with three microscopic claws at each tip
- Center row of eyes large and forward facing
- Two eyes in the upper row vary in size but face the sides of the head
- Brown, gray, black, pale orange, or cream, often with stripes or speckles
- First two pairs of legs may be spiny
- Abdomen and cephalothorax usually as long as wide

Pardosa – divide the eyes into 2 halves, if the 2 arrows do not overlap/meet

- Median light band of carapace prominently forked or Y-shaped anteriorly, sublateral margins with a longitudinal white band
- Abdomen with 4-5 transverse light bands dorsally in the male and 3 elongate-ovate light bands and a pair of globular light spots dorsally in the female

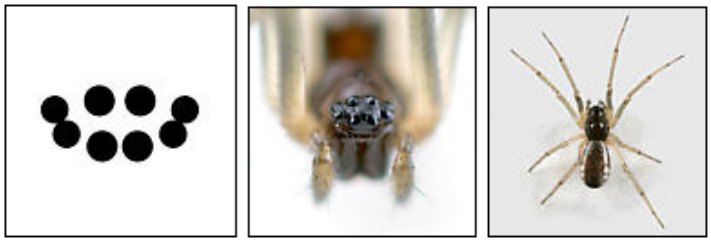
Pirata – divide the eyes into 2 halves, if the 2 arrows overlap



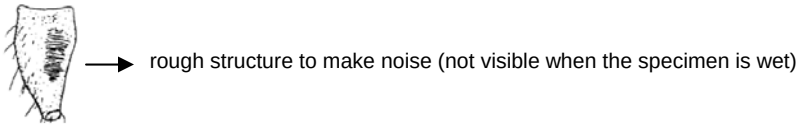
Hippasa – can make web with small needle underneath the claw. Their white webs are usually found on patchy growing area.

Family Linyphiidae – dwarf spiders (money spider)

- 8 eyes in 2 rows



- AE row strongly procurved and PE row straight or slight to moderately concave
- Chelicera with stridulating ridges or file on its dorsal side



- Spherical body shape
- Tarsus 3 claws

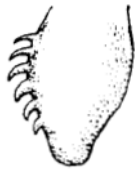
Atypena

- Abdomen globular with 3 paired of grey spots
- PME bright and shining

Erigone

- Lateral margins of carapace serrated

- Chelicerae armed with a large pointed boss anteriorly and with a row of 6-7 warty teeth anterolaterally



Family Oxyopidae – lynx spider

- 8 eyes in 3 rows (hexagonal pattern)

- Legs with long spines
- Chelicerae with longitudinal band
- 3 clawed tarsus
- Hunters

Oxyopes

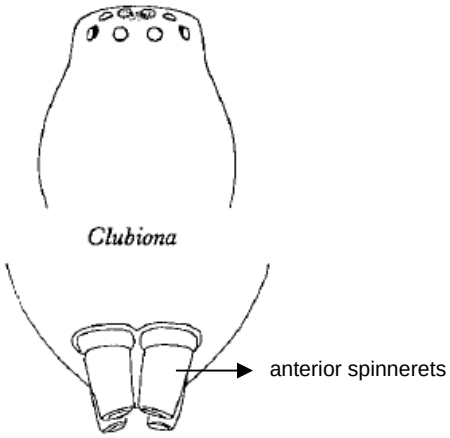
- Longitudinal band running from face to chelicerae
- Orange markings on abdomen
- Female organ with slit called epigynum

Family Clubionidae – sac spiders

- Anterior spinnerets conical. cylindrical and contiguous or close to each other
- Posterior spinnerets longer
  Spigots with hairs circling the spinnerets
- Eyes homogeneous with PME usually rounded
- Legs prograde
- General color is yellow

Clubiona – common in rice plants with minimum fertilizer because they can form the leaves into triangular form for shelter

- With short anterior spinnerets



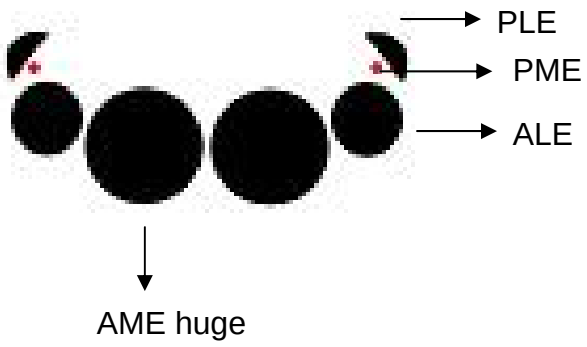
- Anterior eyes dark, straight to convex
- Posterior eyes shining and concave

Cheiracanthium

- Posterior spinnerets very long
- Cephalothorax either marked or unmarked

Family Salticidae – jumping spiders (good predator)

- 8 eyes in 3 rows, AME huge, PME very small



- 2 clawed tarsus with hairs below
- Broadly oval or partly oval body
- Hunter

Bianor

- 3 pairs of white spots in abdomen

Harmochirus

- Black
- Similar to *Bianor* but without white spots
- PLE slightly outside margin

Myrmarachne

- Ant-like with long porrect chelicera and fang
- Reddish abdomen and blackish red cephalothorax

Family Tetragnathidae – long jawed (chelicerae) orb weavers

- 8 eyes in 2 rows

- Abdomen long and elongate (except in *Dyschiriognatha* which is globular, reddish with silvery spots)
- Long legs
- Long jaw or chelicera, usually projected forward and with various teeth arrangements
- Short genitalia
- 3 clawed tarsus
- Build webs to catch prey

Tetragnatha

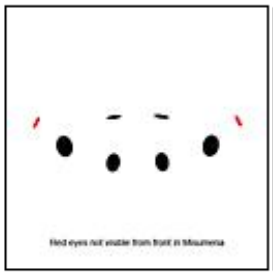
Dyschiriognatha

- Rounded abdomen
- Usually reddish with silvery spots in abdomen

Family Thomisidae – crab spider

head

- Crab-like appearance
- Prolateral leg
- Eyes on the ridge



- Leg II very long
- Long spines in the inner sides of tibia
- Flattened body and often triangular
- 2 clawed tarsus with serrated spines
- Anterior tarsi with scopulae or thick mat of hairs

Thomisus

- Eyes on the sides of the transverse ridge or eyes on ribs
- Tibiae I and II with ventrally strong spines (4-5 pairs)
- With rounded posterior surface of abdomen

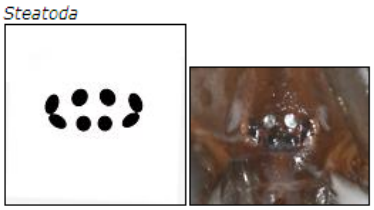
Runcinia

- Long and pointed abdomen

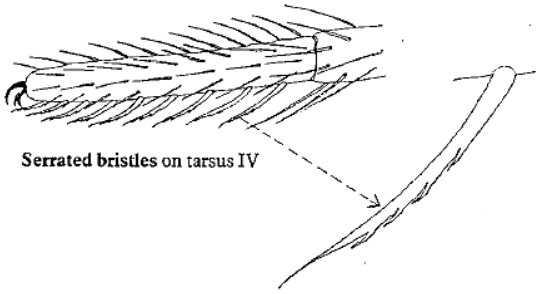
- With 2 brown longitudinal bands on cephalothorax

Family Theridiidae – comb-footed spider (most neat family because of the tarsal comb)

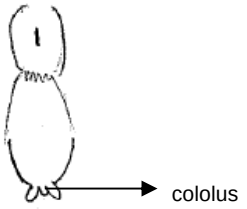
- 8 eyes in 2 rows



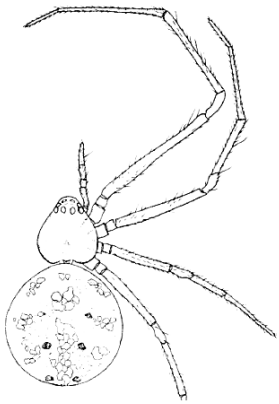
- Leg IV with tarsal comb which is serrated



- Colulus in some species



Coleosoma octomaculatum



- Yellow all throughout, 1-1.5 mm long
- Abdomen with 4 spots

Coleosoma blandum

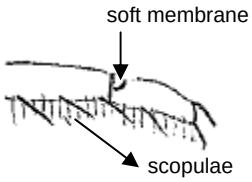
- Elongated, dark brown
- Abdomen without spots

Chrysso

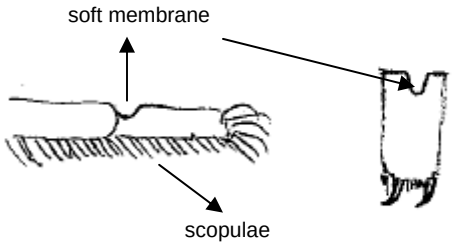
- Yellow without spots
- Triangular in lateral view
- Abdomen ends with leaf-like spots

Family Heteropodidae (=Sparassidae) – giant crab spiders, banana spider

- Dense mat of hairs called scopulae on the leg



- With soft trilobite membrane on the dorsal part of the leg (for movement of the leg)



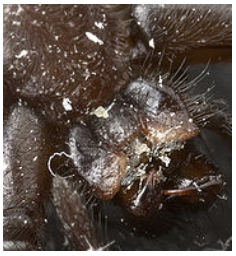
- Venter of metatarsus and tarsus with thick set of hairs or scopulae
- Flattened body
- First two pairs of legs distinctly longer than hind two pairs
- 2 tarsal claws
- AE row recurved, PE row straight
- Eyes never on a ridge

Family Gnaphosidae – cross-eyed spider, ground spider

- 8 heterogenous eyes in 2 rows - cross-eyed

- Chelicerae with boss and scopula
- Anterior spinnerets barrel-shaped that are one spinneret diameter apart

- Indentation in the endites (paired mouthparts anterior and lateral to the labium, or lip)



Gnaphosa

Zelotes

Oriental species of Gnaphosidae

- With 2 white bands on abdomen
- With constriction of band on abdomen

Other insect orders

Order Collembola – springtails (detritivores/tourist)

- Wingless group of Class Insecta
- With forked springing organ or furcula on the 4th abdominal segment
- Small to minute insects often clothed in colored scales
- Antennae less than 6 segments
- Eyes either simple ocelli or absent

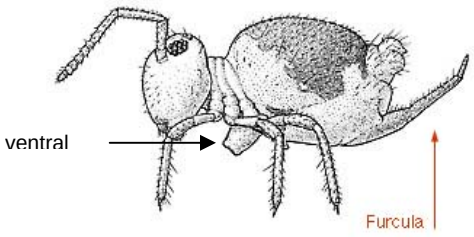
Family Sminthuridae

- Body (thorax/abdominal) segments not clear
- Thorax and first 4 abdominal segments fused
- Body globose

- 4 antennal segments

  Sminthurus (detritivores/tourist)

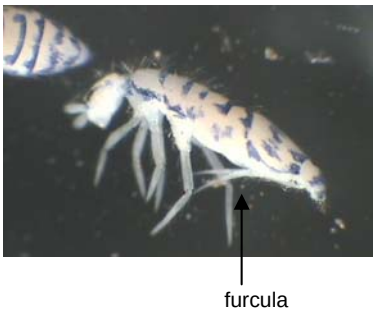
  - Ventral tube



  - Dorsum of abdomen with a median longitudinal band

Family Entomobryidae

- Abdominal/thoracic segmentation clear
- Body scaled or at least with dense, ciliated, club-shaped setae
- Segment 4 of abdomen usually much longer than 3
- Furcula always well developed



Entomobrya (detritivores/tourist)

- Elongate body

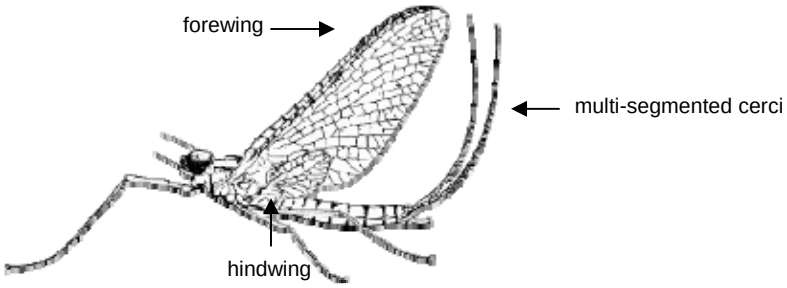
Family Isotomidae

- Body without scales or with sparsely distributed, simple, weakly ciliated but not club-shaped setae
- Segments 3 and 4 of abdomen not very different in length
- Furcula often reduced

Isotoma (detritivores/tourist)

Order Ephemeroptera – mayfly (detritivore/tourist)

- Compound eyes large, usually covering most of the head
- Antennae short and bristle-like
- Front legs long and often held out in front of body
- Four membranous wings with many veins and crossveins
- FW large, triangular
- HW smaller, fan-shaped
- Abdomen slender, bearing two (or sometimes three) long terminal filaments



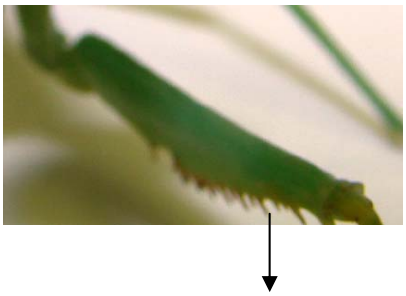
Order Mantodea – praying mantis (predator)

- Head transverse
- Pronotum long and slender
- Strong mandibles
- Leg I strong with numerous spines
- Antennae short and filiform
- FW leathery in the costal area and HW with a small terminal ends

Family Mantidae

- Ventroexternal margin of foretibia with a row of spurs
- Coxa very long

- Femur with 2 rows (outer and inner) of spines

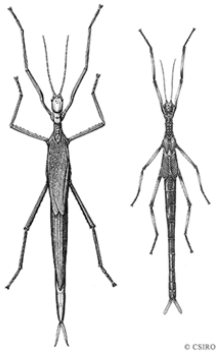


spines on enlarged femur

- Tibia with an apical hook
- Long basal tarsal segment

Mantis (predator)

Order Phasmatodea – walking sticks (formerly under Order Orthoptera)



- Winged or wingless
- Wings when present consist of short, hardened forewings which form a protective cover over part of the larger membranous hind wings
- Long neck

- Short to elongate head with long antennae
- Abdomen long and elongate
- Antennae filiform and may be either short or long
- With hole between leg III and coxa III to separate the species

Order Blattodea – cockroaches (detritivore/tourist)

- Dorsoventrally compressed bodies
- Antennae numerous and segmented
- Thorax covered by a large pronotum, which extends partly over the head
- Mandibulate or chewing mouthparts
- FW when present is modified into hardened tegmina
- HW maybe reduced in size or absent, if present membranous and with veins
- Cursorial legs adapted for running or digging
- Prominent cerci (furcula in Collembola)

Family Blatellidae (German cockroach)

- Cerci fairly long, pointed and carried at right angles to body
- Sternum 9 of male asymmetrical with 1-2 spiny style
- Sternum 7 of female wide, rounded and never bivalvular
- Tergite 10 of both sexes often triangular with long and tapering cerci
- Antennae longer than body
- Legs relatively long, slender and spiny
- Without thickened clypeal shield
- Tergite 1 never triangular may be slightly notched

Periplaneta (detritivore/tourist)

References:

Anthoporidae at http://www.google.com.ph/imgres

Braconidae at http://www.discoverlife.org/mp/20p?see=I_NAT1895&res=640

Barrion AT, Litsinger JA. 1995. Riceland spiders of South and Southeast Asia. CAB International: UK Wallingford (Oxon). 701 p.

Diptera at http://bugguide.net; http://www.pbase.com/holopain/flies&page=4; http://images.google.com.ph/imgres?imgurl=http://www.ksu.edu/parasitology/625tutorials/FIGmusca.jpg&imgrefurl=http://www.k-state.edu/parasitology/625tutorials/; http://math.uc.edu/~pelikan/OXBOW/new/D_pulchrimanus-3.JPG

Barrion AT, Litsinger JA. Taxonomy of rice insect pests and their arthropod parasites and predators. pp 13-359. *In* Biology and management of rice pests. 779 p.

Hymenoptera at http://ponent.atspace.org/fotos/ins/Hymenop/Chalcid/Trichogrammatidae/Oligosita/O_nsp1/P7401/oligosita_nsp1_01_p07401_torres_1.jpg; http://hymenoptera.tamu.edu/img/files/med.jpg

Parasitic wasps at http://www.google.com.ph/imgres?imgurl=http://www.drmcbug.com/images/Beneficials/ParasiticWasps/

Shepard BM, Barrion AT, Litsinger JA. 1995. Rice-feeding insects of tropical Asia. Manila (Philippines): International Rice Research Institute. 228 p.

Spider Eye Arrangements at http://bugguide.net/node/view

Vespidae at http://upload.wikimedia.org/wikipedia/commons/d/df/Ropalidia_marginata.jpg

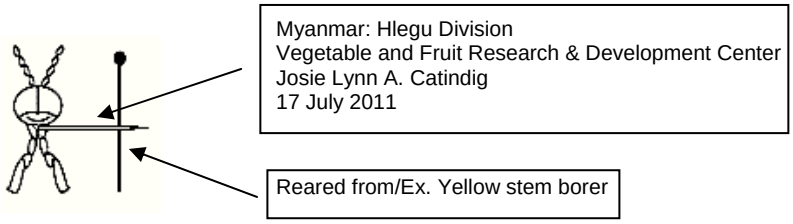
Collecting, sorting, preserving, and studying insects

Sampling methods:
1. Sweep net
2. Rice-vac or blow-vac (vacuum sampler)
3. Pitfall trap
4. Yellow pan
5. Baiting technique
   - Prey enrichment method
6. Beating tray
   - Use of umbrella
7. Light trap

Techniques and procedure:
* All samples should have proper label.

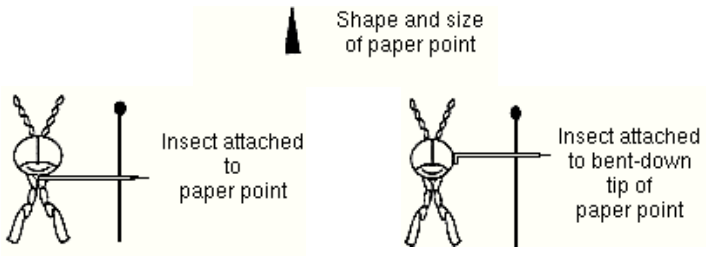
To process samples:
1. Sorting by "phenotypes"
2. Counting

Proper labeling: label includes
1. Country
2. Province/Division
3. Collector (s)
4. Date of collection



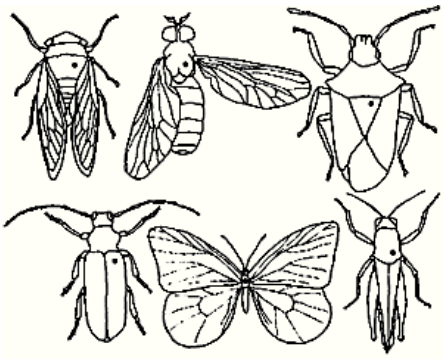
Processing specimens for identification:
(Can dry the specimens to clearly see the setae, suture and the design of the insect)

1. Alcohol preservation – 70 to 80% (and not beyond, specimens become hardened)
   Some specimens lost its marks i.e. sculpture, design when wet.
2. Card pointing – use of pinning block, card points and pins, use of gum Arabic as glue

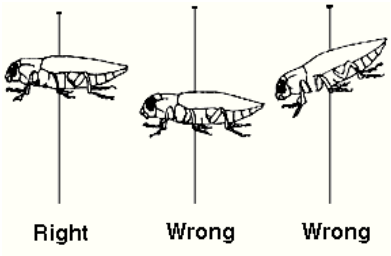


Proper insect card pointing

3. Pinning – use of pinning block and pins

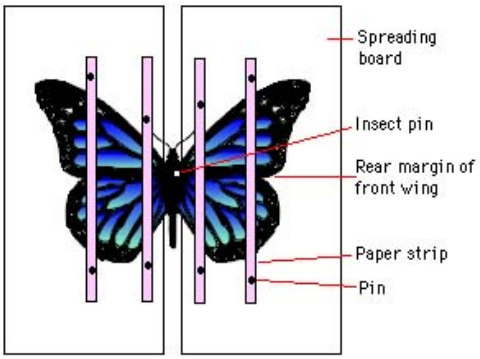


Proper insect pinning



Placement of pin

4. Spreading on boards for moths and butterflies



Properly pinned butterfly

Relaxing specimens – for Lepidoptera

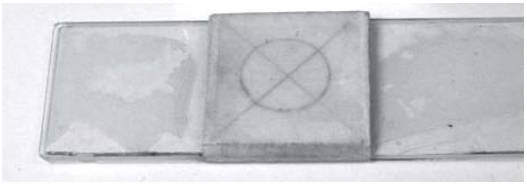
Put inside chamber with hot water for 24 hours or more.

Collection and preservation of Lepidoptera:

1. Press the abdomen until the genitalia protrudes and put inside a paper triangle.
2. Line up moths and butterflies into a tin can with killing agent (ethyl acetate).

5. Mounting on slides to preserve minute materials such as parasitic wasps and mites: use of Canada balsam, Hoyer's or Faure's medium

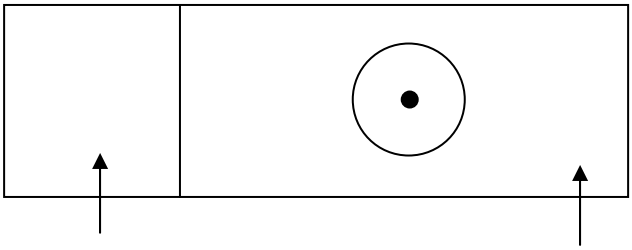
Get the center point and mount the insect



Mounting medium:
Liquid Faure medium

100 g	Chloral Hydrate
40 g	Glycerine
60 g	Gum Arabic
100 ml	Distilled water

Labeling specimens on slides



Ex. BPH eggs
Myanmar: Hlegu Division
Rice Research Institute
Josie Lynn A. Catindig
20 July 2011

or

Ex. BPH eggs
Myanmar: Hlegu Division
Rice Research Institute
Josie Lynn A. Catindig
20 July 2011

Preservation of whiteflies:

1. Put into wide mouth bottle and keep refrigerated.
2. Some whiteflies can also be kept in 70 to 80% alcohol

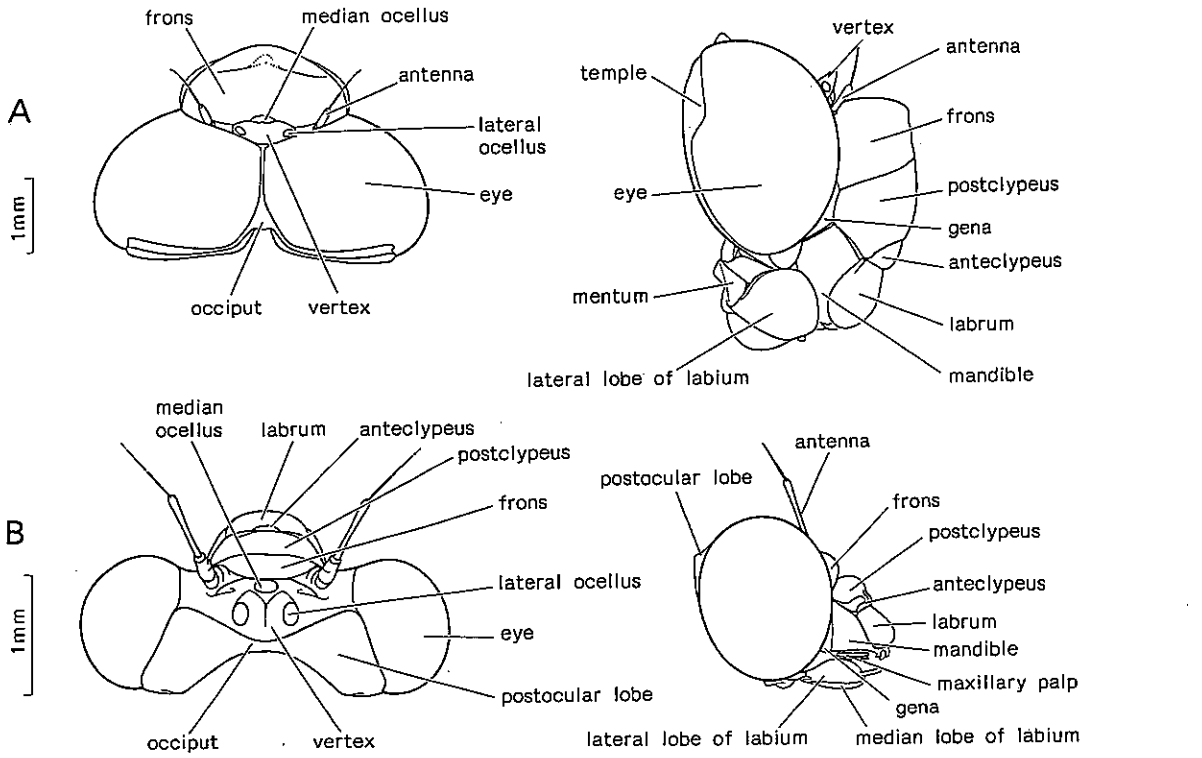
YPT and pitfall trap catches:

Decant water-soap solution and transfer to vial with 70-80% alcohol.

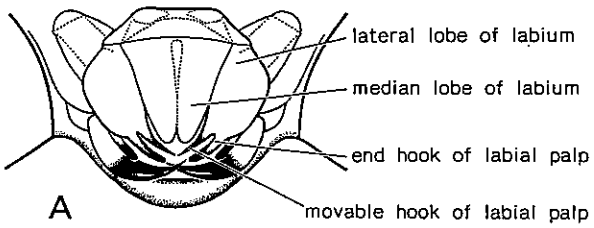
Drying of insects

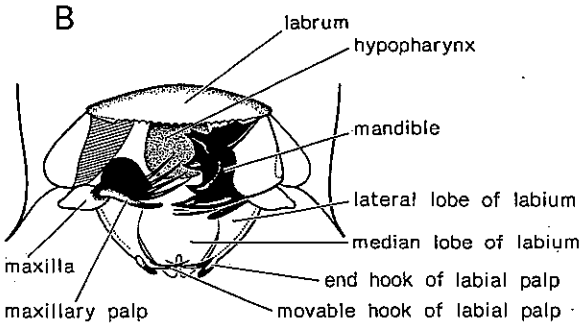
Small insects – 60^{o}C for 3 days
Big insects – 60^{o}C for 5-6 days

ODONATA

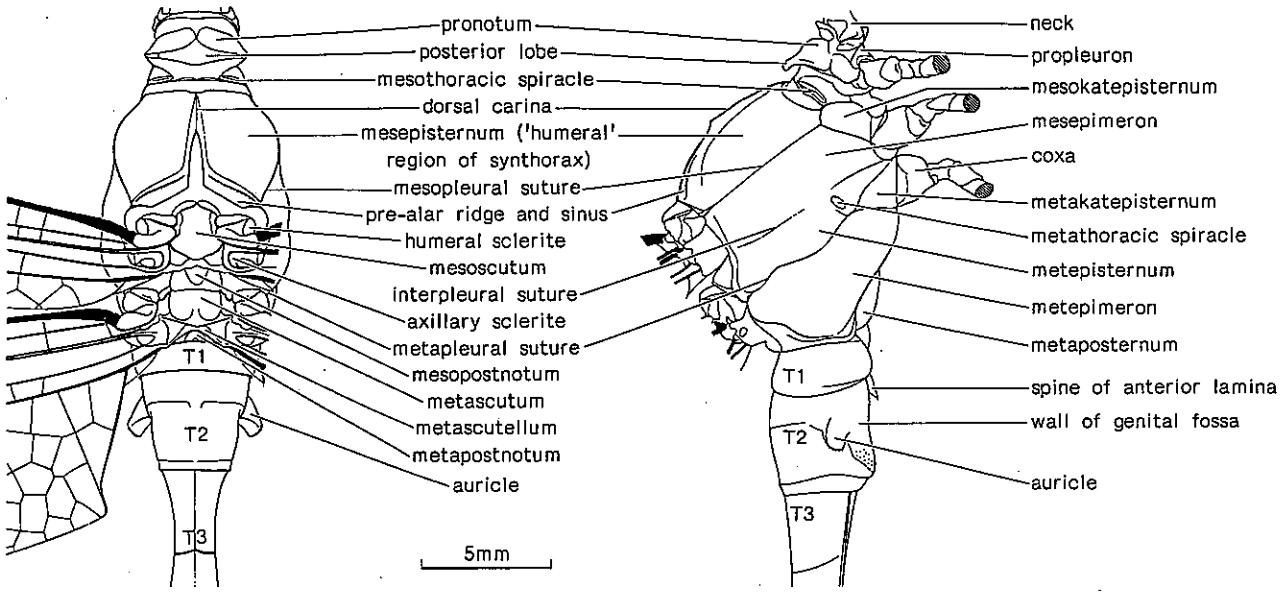


Dorsal and lateral views of heads of ♂♂: A, *Austroaeschna parvistigma*, Anisoptera-Aeshnidae; B, *Synlestes weyersii*, Zygoptera-Synlestidae.
[F. Nanninga]

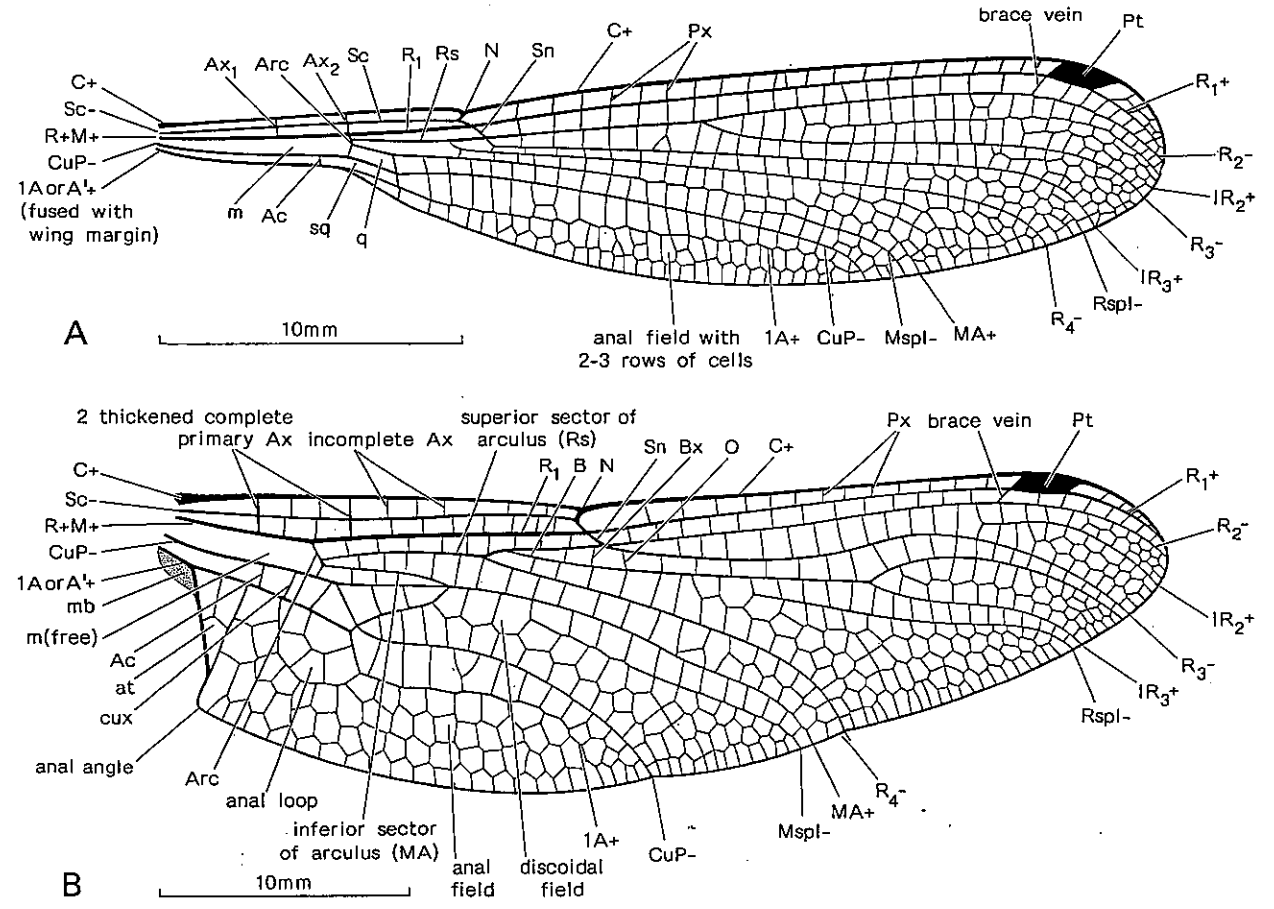




Mouth-parts of ♂ *Synlestes weyersii*, Zygoptera-Synlestidae: A, ventral view; B, anterior view, labrum and right mandible removed.
[F. Nanninga]



Dorsal and lateral views of thorax and anterior abdominal segments of ♂ *Austroaeschna parvistigma*, Anisoptera-Aeshnidae. [F. Nanninga]



Hind wings of ♂♂: A, *Austroargiolestes icteromelas*, Zygoptera-Megapodagrionidae; B, *Austroaeschna parvistigma*, Anisoptera-Aeshnidae. [F. Nanninga]

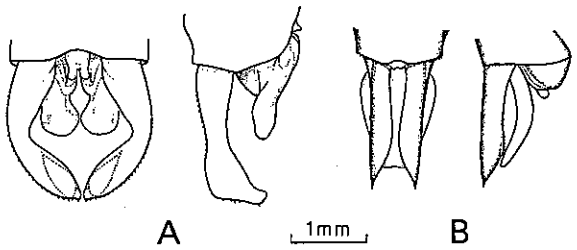
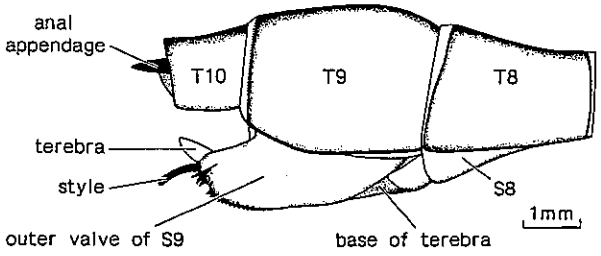
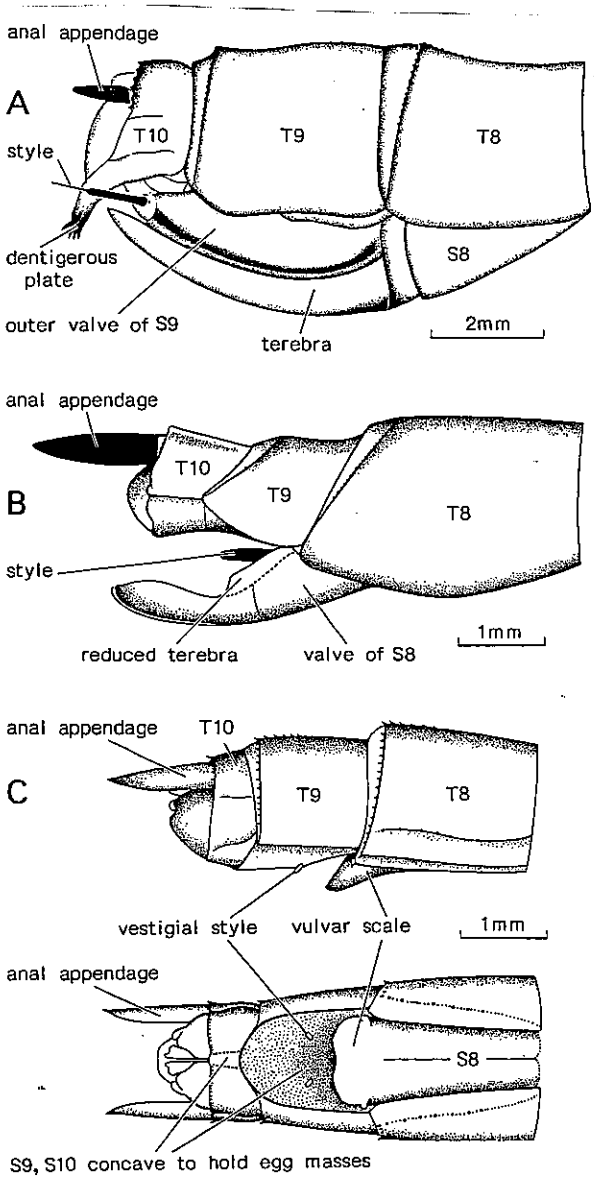


Fig. 17.5 Dorsal and lateral views of anal appendages of ♂♂: A, *Diphlebia nymphoides*, Zygoptera-Amphipterygidae; B, *Diplacodes bipunctata*, Anisoptera-Libellulidae. [F. Nanninga]



Terminalia of ♀ *Synlestes weyersii*, Zygoptera-Synlestidae, lateral. [F. Nanninga]



Terminalia of ♀ Anisoptera: A, *Austroaeschna pulchra*, Aeshnidae, lateral; B, *Synthemis eustalacta*, Corduliidae, lateral; C, *Diplacodes bipunctata*, Libellulidae, lateral and ventral. [F. Nanninga]

ORTHOPTERA

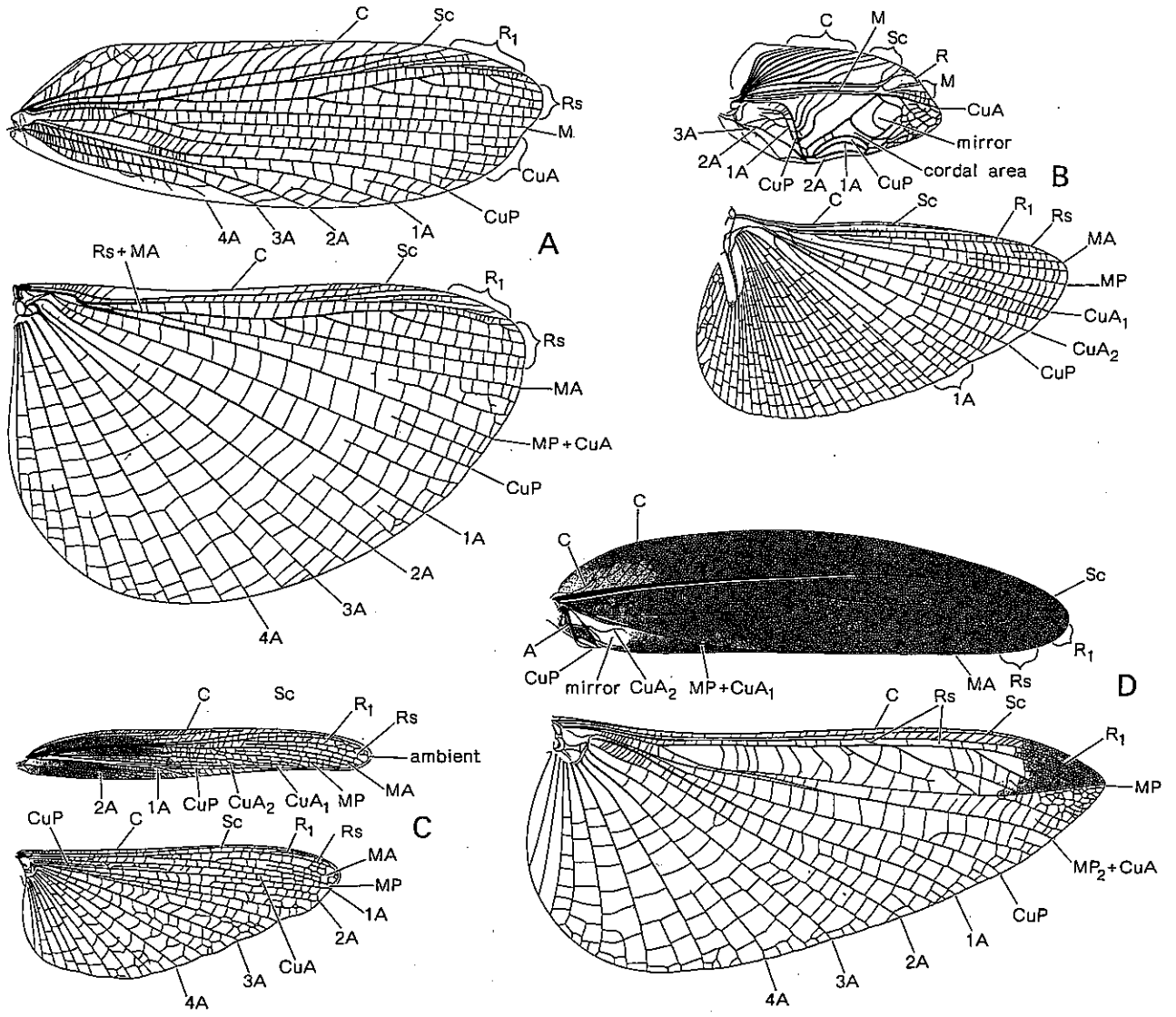
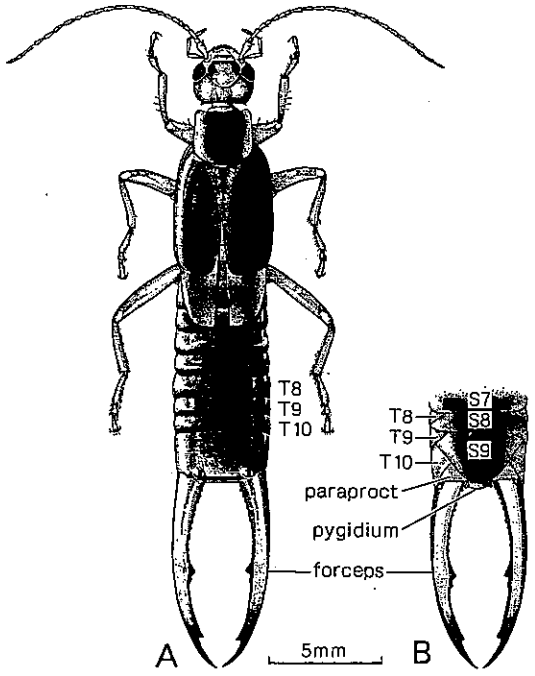
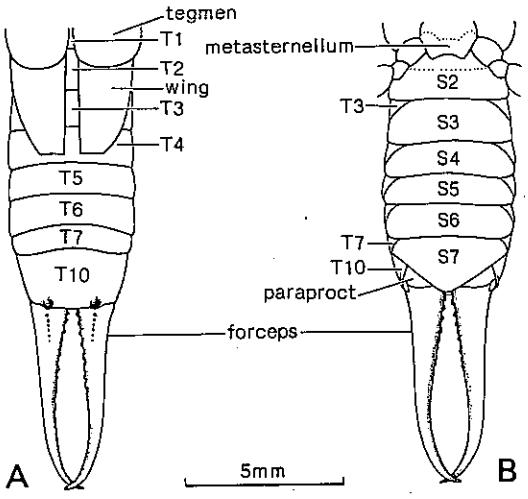


Fig. 24.1 Male wings: A, *Hadrogryllacris* sp., Gryllacrididae; B, *Teleogryllus commodus*, Gryllidae; C, *Bermius brachycerus*, Acrididae; D, *Torbia viridissima*, Tettigoniidae. [F. Nanninga]

DERMAPTERA

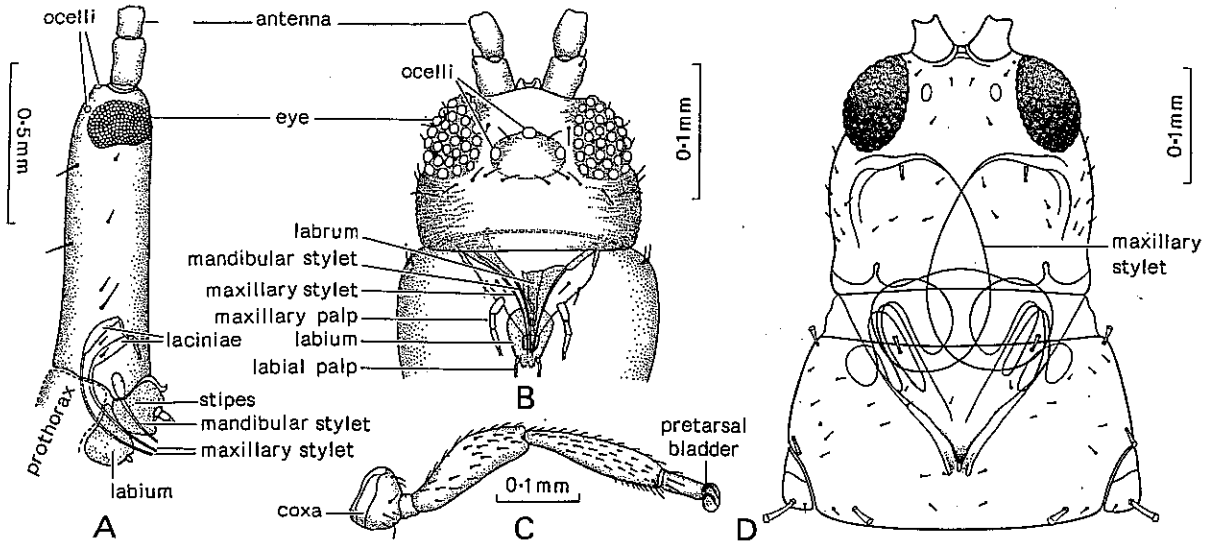


Labidura truncata, Labiduridae, ♂: A, dorsal; B, terminal segments, ventral. [T. Nolan]

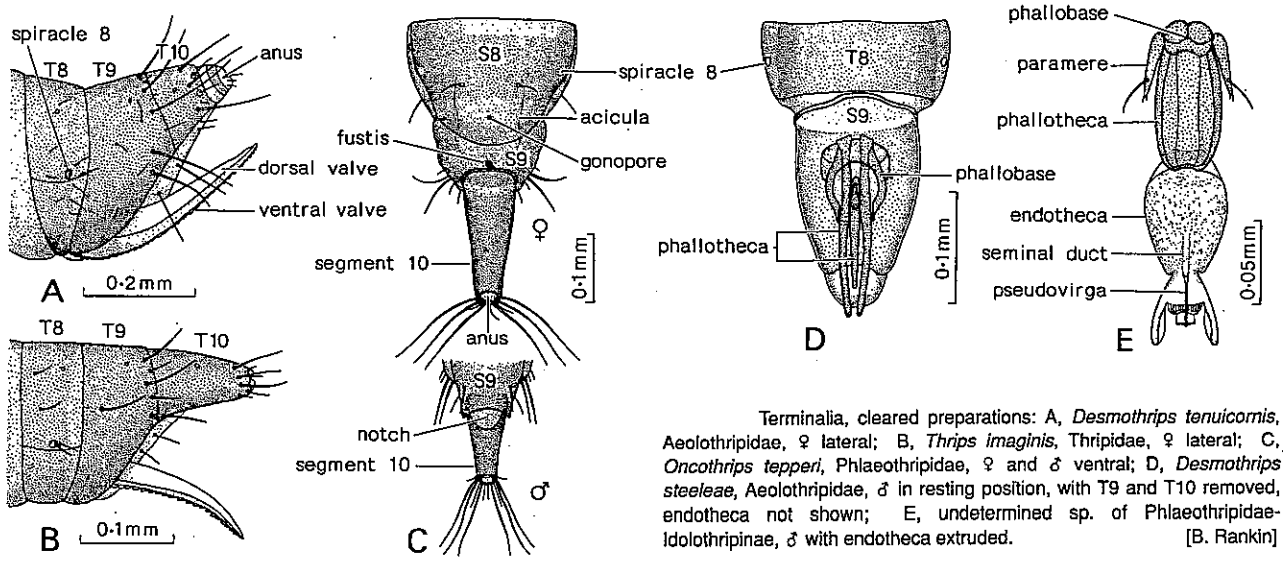


Abdomen of *Labidura truncata*, ♀: A, dorsal; B, ventral. [T. Nolan]

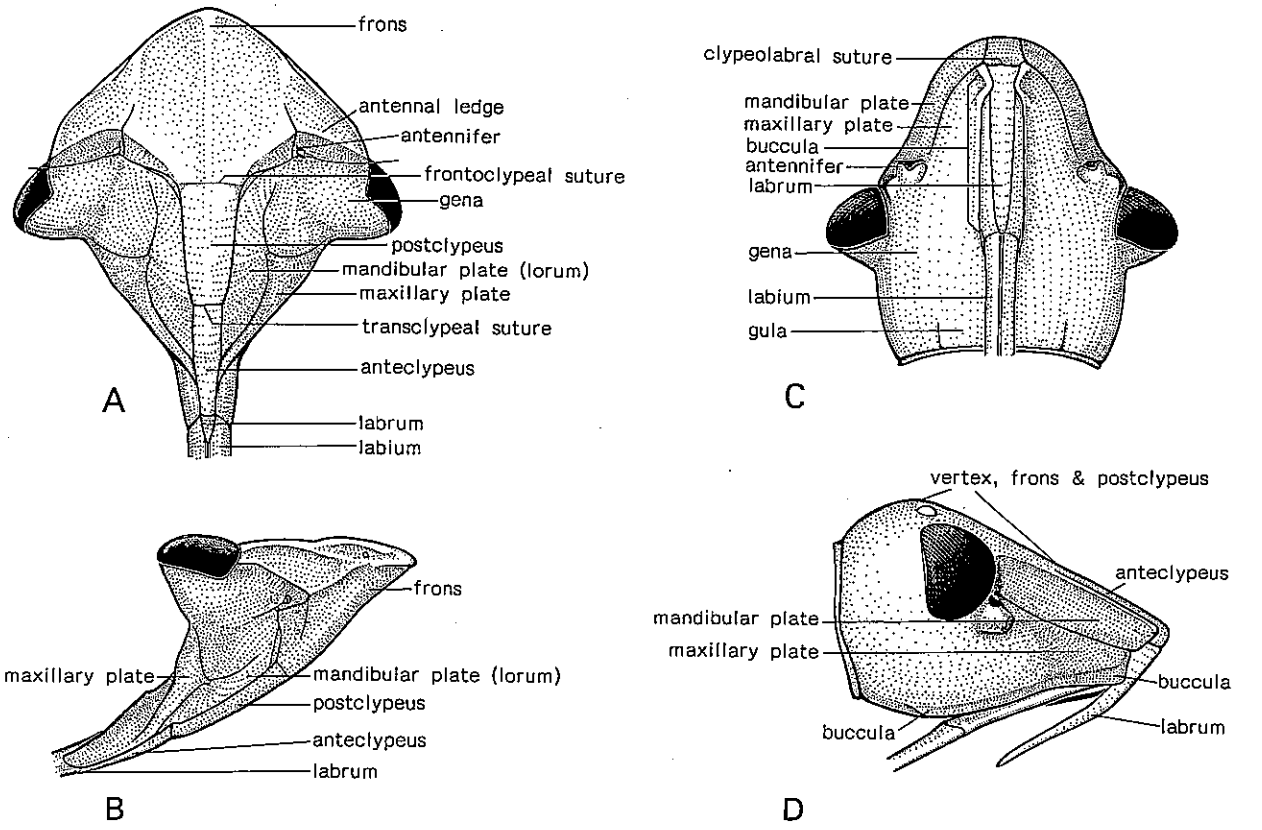
THYSANOPTERA



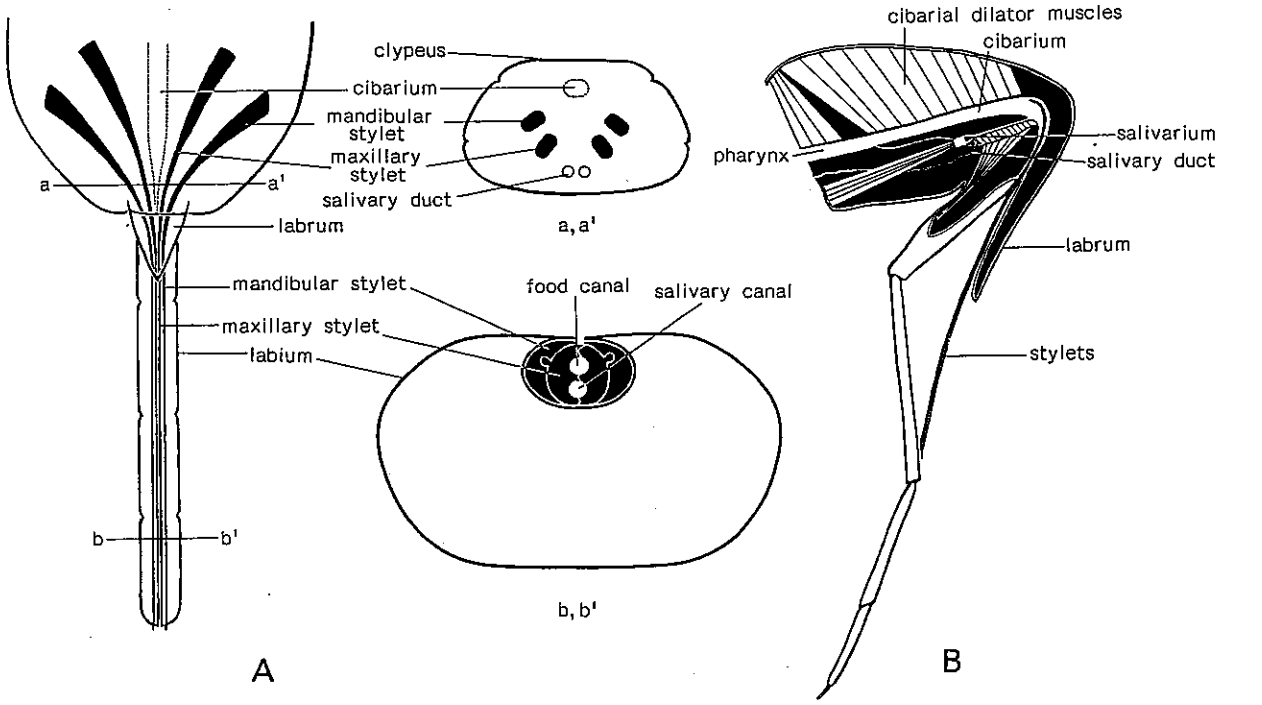
A, head and mouth-parts of *Idolothrips spectrum*, Phlaeothripidae, lateral; B, head of *Thrips australis*, Thripidae, dorsal, with mouth-parts seen through prothorax; C, hind leg of *T. australis*; D, head of *Adrothrips intermedius*, Phlaeothripidae, showing convoluted maxillary stylets. [B. Rankin]



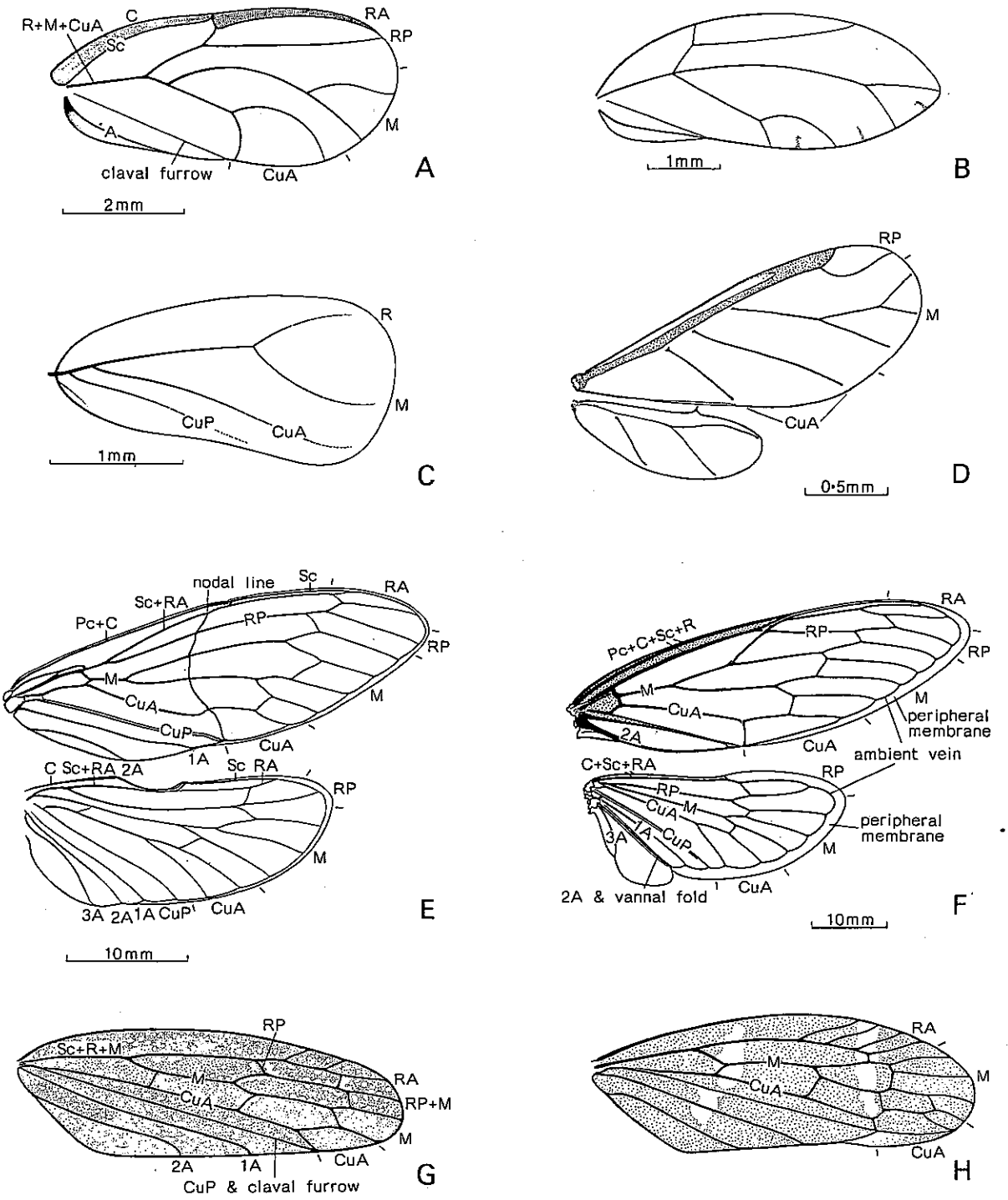
Terminalia, cleared preparations: A, *Desmothrips tenuicornis*, Aeolothripidae, ♀ lateral; B, *Thrips imaginis*, Thripidae, ♀ lateral; C, *Oncothrips tepperi*, Phlaeothripidae, ♀ and ♂ ventral; D, *Desmothrips steeleae*, Aeolothripidae, ♂ in resting position, with T9 and T10 removed, endotheca not shown; E, undetermined sp. of Phlaeothripidae-Idolothripinae, ♂ with endotheca extruded. [B. Rankin]



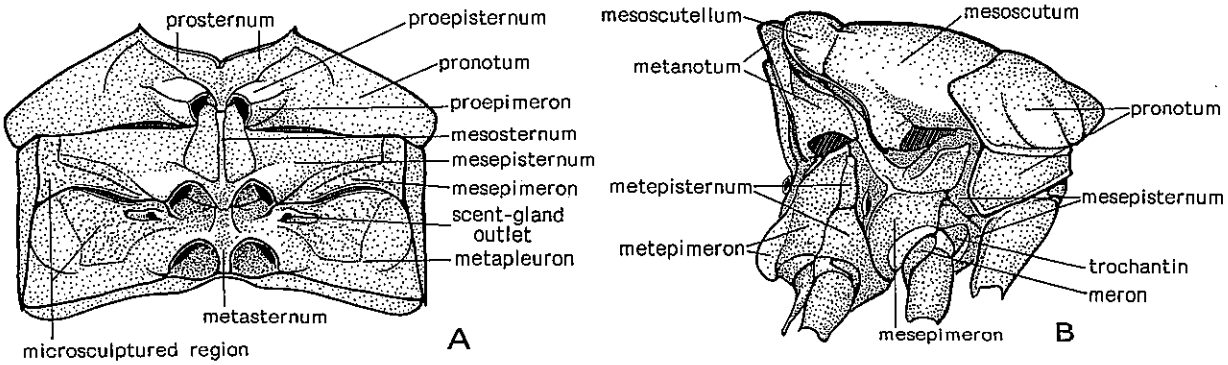
Heads: A, *Stenocotis depressa*, Cicadellidae, frontal; B, same, lateral; C, *Nezara viridula*, Pentatomidae, ventral: D, same, lateral. [S. Monteith]



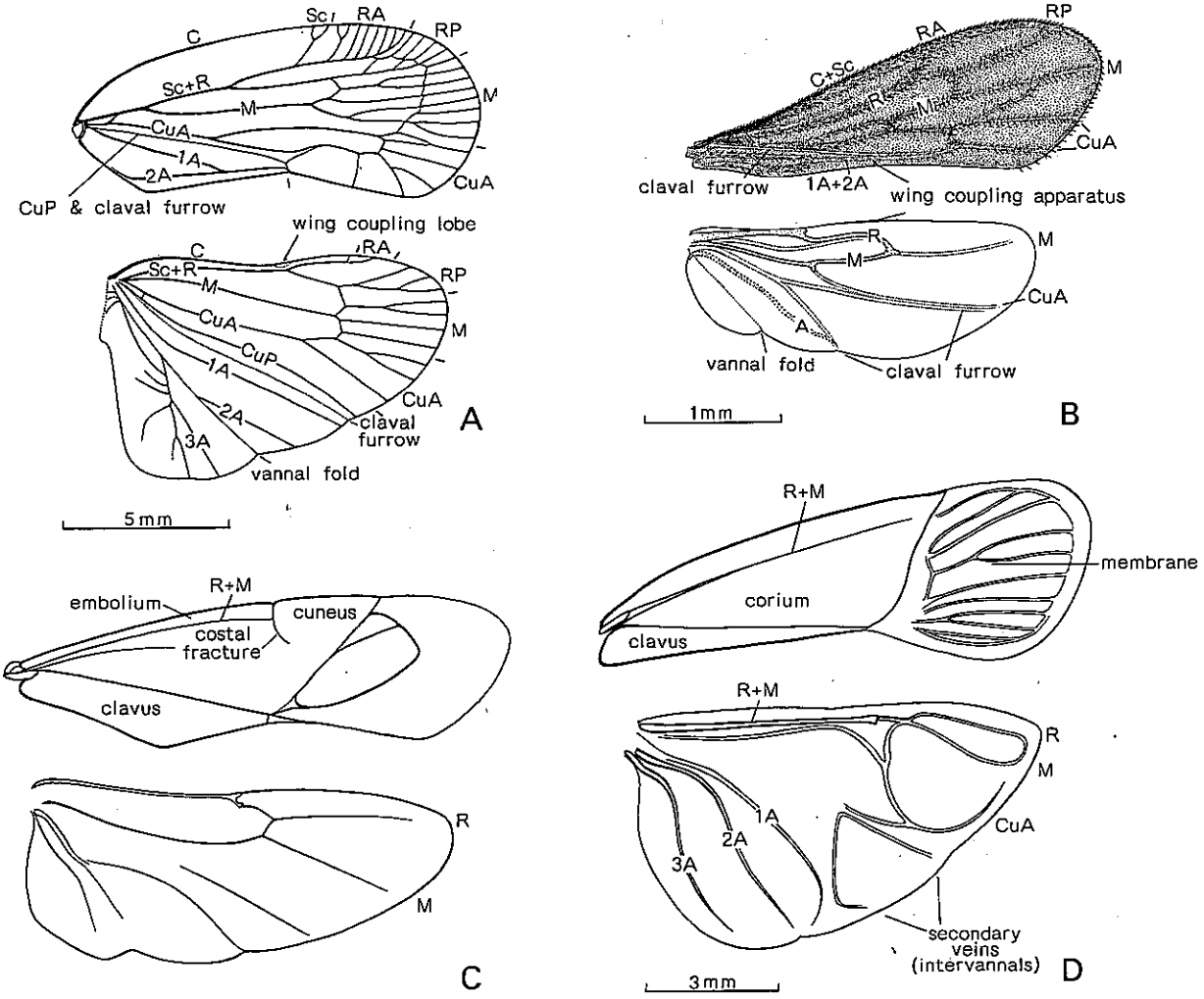
Mouth-parts: A, diagram of principal parts and transverse sections through a–a' clypeal region, b–b' labial region; B, diagrammatic longitudinal section showing relationships of cibarium, pharynx, and salivarium. [S. Monteith]



A, fore wing of *Acizzia acaciaedecurrentis*, Psyllidae; B, same of *Trioza eugeniae*, Triozidae; C, same of *Synaleurodicus* sp., Aleyrodidae; D, fore and hind wings of *Aphis acaenovinae*, Aphididae; E, same of *Tettigarcta tomentosa*, Tettigarctidae; F, same of *Cyclochila australasiae*, Cicadidae; G, fore wing of *Putoniessa nigra*, Cicadellidae; H, same of *Australoscopus* sp., Eurymelidae. [A–C by T. Nolan; D, E, G, H by S. Monteith; F by S. P. Kim]

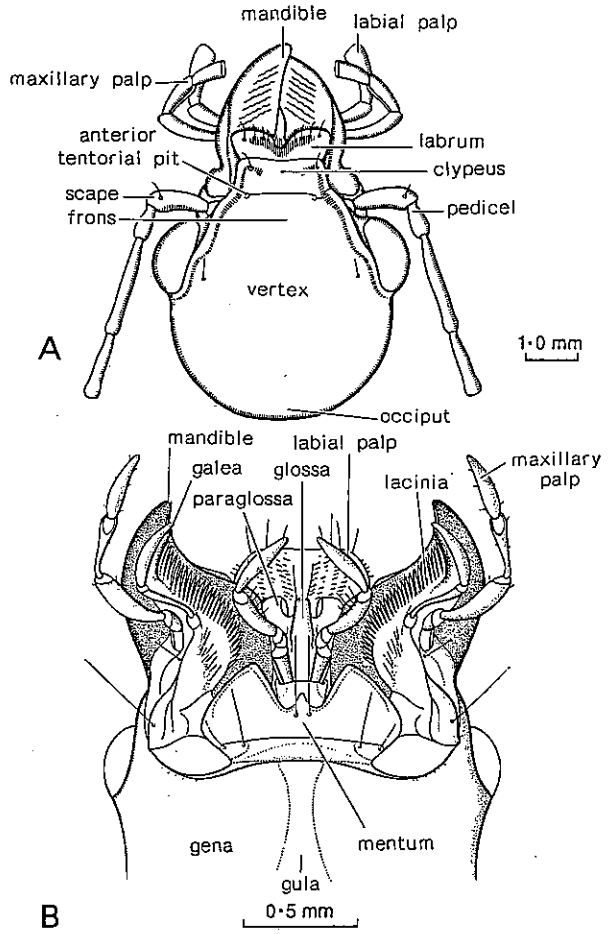


Thorax: A, ventral aspect of *Nezara viridula*, Pentatomidae; B, lateral aspect of *Cystosoma saundersii*, Cicadidae. [S. Monteith]

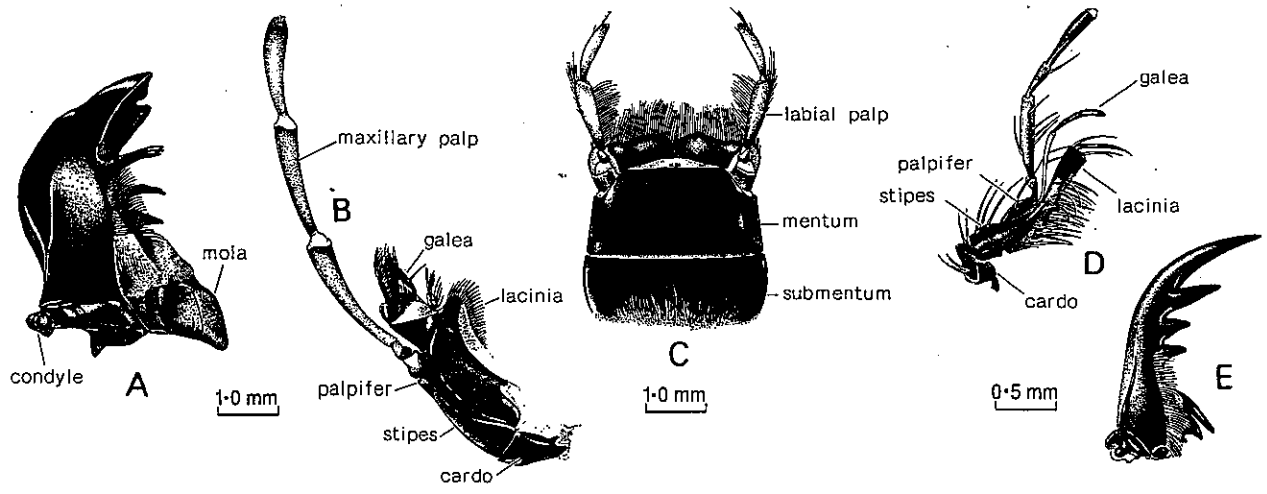


A, fore and hind wings of *Achilus flammeus*, Achilidae; B, same of *Oncylocotis* sp., Enicocephalidae; C, same of *Creontiades* sp., Miridae; D, same of *Nezara viridula*, Pentatomidae. [A, B by S. P. Kim; C, D by S. Monteith]

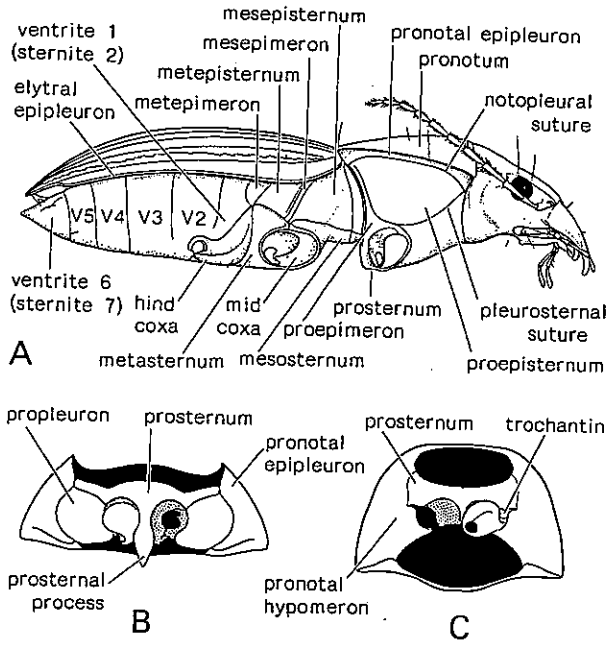
COLEOPTERA



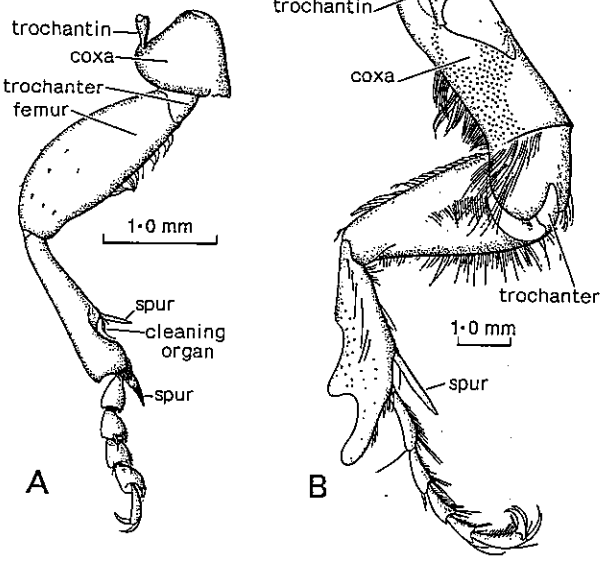
Head: A, *Calosoma schayeri*, Carabidae, dorsal; B, *Hypharpax* sp., Carabidae, ventral. [F. Nanninga]



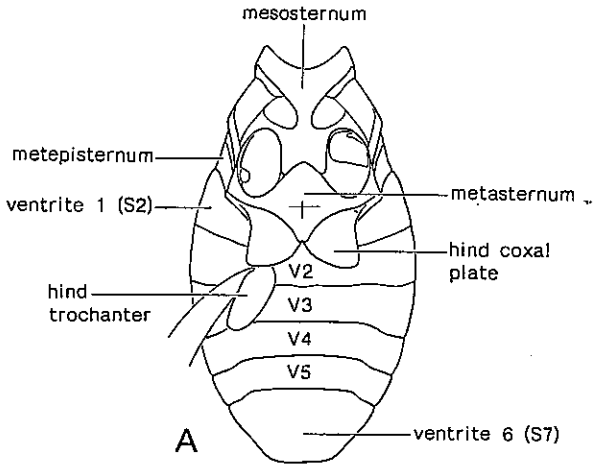
Mouth-parts. *Hydrophilus latipalpus*, Hydrophilidae: A, mandible, ventral; B, maxilla, ventral; C, labium, ventral. *Cicindela semicincta*, Carabidae: D, maxilla, ventral; E, mandible, ventral. [F. Nanninga]

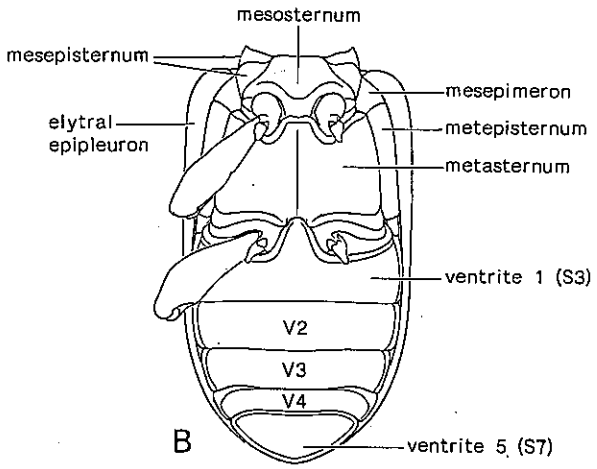


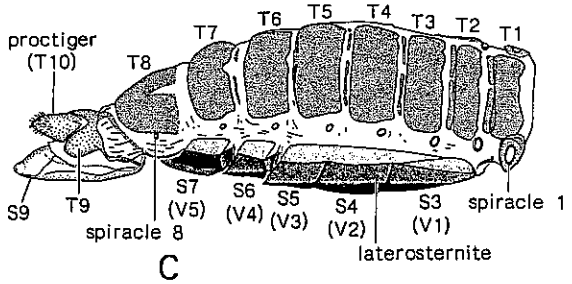
A, *Notonomus violaceus*, Carabidae, lateral. Prothorax, ventral: B, *Hyderodes schuckardi*, Dytiscidae; C, *Dermestes maculatus*, Dermestidae. [A by F. Nanninga; B–C by S. Smith]



Fore leg: A, *Hypharpax* sp., Carabidae; B, *Colpochila* sp., Scarabaeidae. [F. Nanninga]

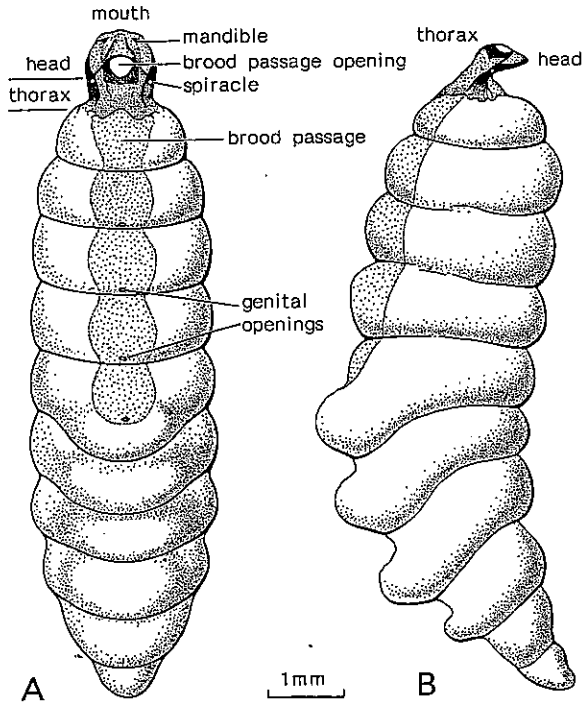




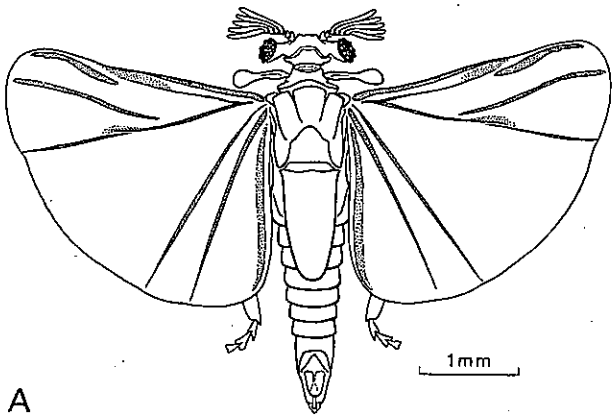


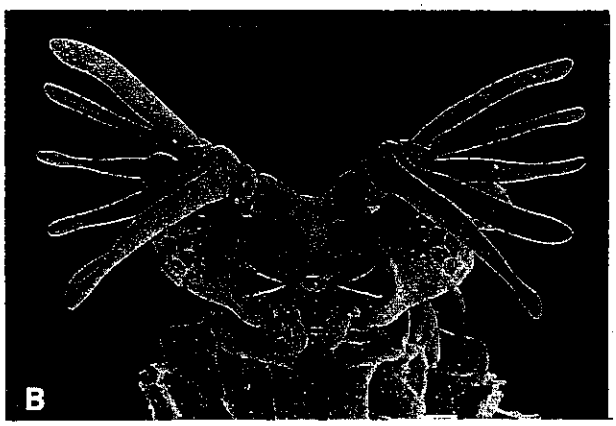
Pterothorax and abdomen, ventral: A, *Pamborus guerinii*, Carabidae; B, *Meneristes intermedius*, Tenebrionidae. C, *Rhinorhipus tamborinensis*, Rhinorhipidae, male abdomen (with aedeagus removed), dorsolateral. [A, B by S. Smith; C by S. P. Kim]

STREPSIPTERA

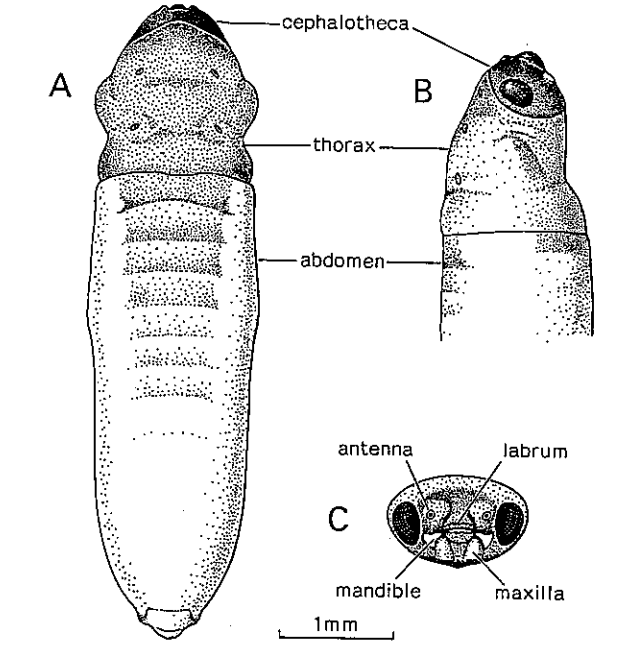


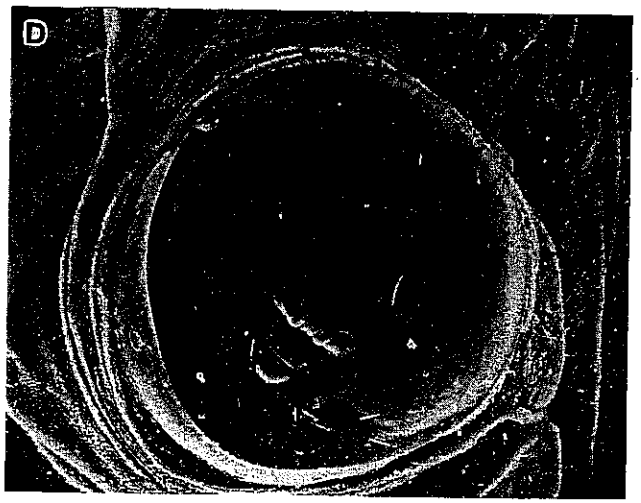
Coriophagus rieki, Halictophagidae, adult ♀: A, ventral; B, lateral, dorsal surface to right. [R. Ewins]





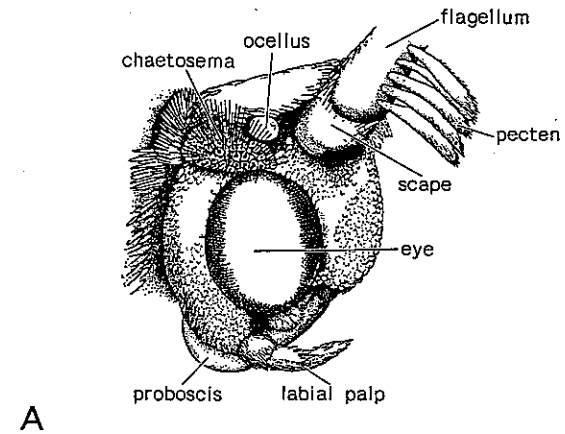
Coriophagus rieki, Halictophagidae, adult ♂: A, dorsal; B, head, ventral. [A by R. Ewins; B by K. Pickerd]



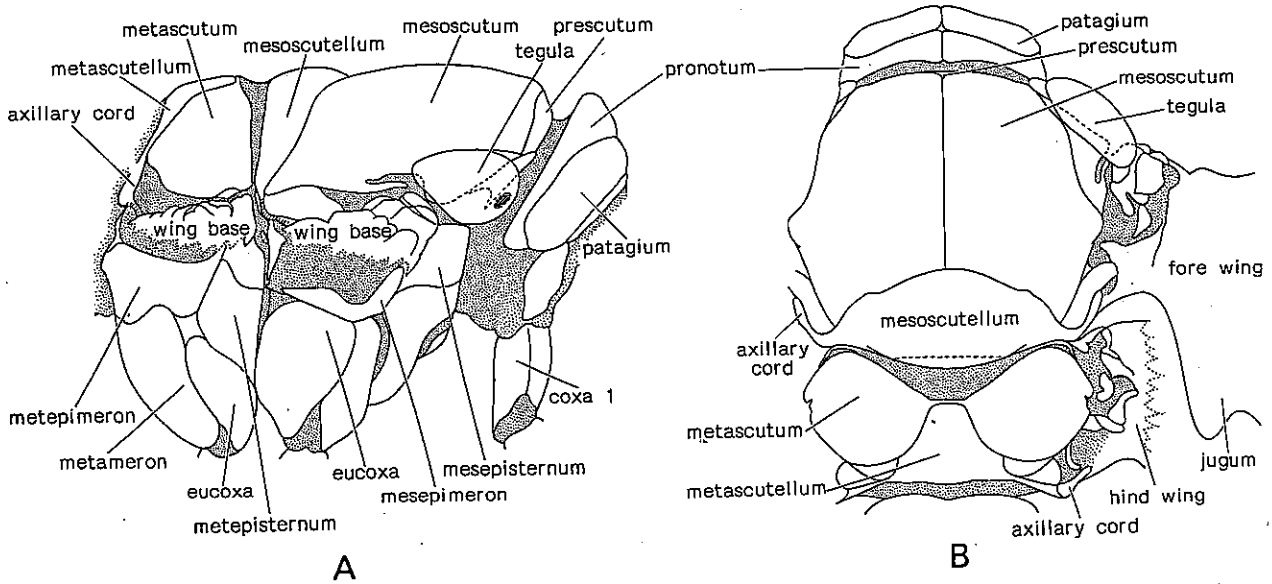


Male puparium: A–C, Stylopidae: A, dorsal; B, lateral; C, cephalotheca, frontal; D, *Elenchus varleyi*, Elenchidae, cephalotheca, frontal. [A–C by R. Ewins; D by B. M. Luke]

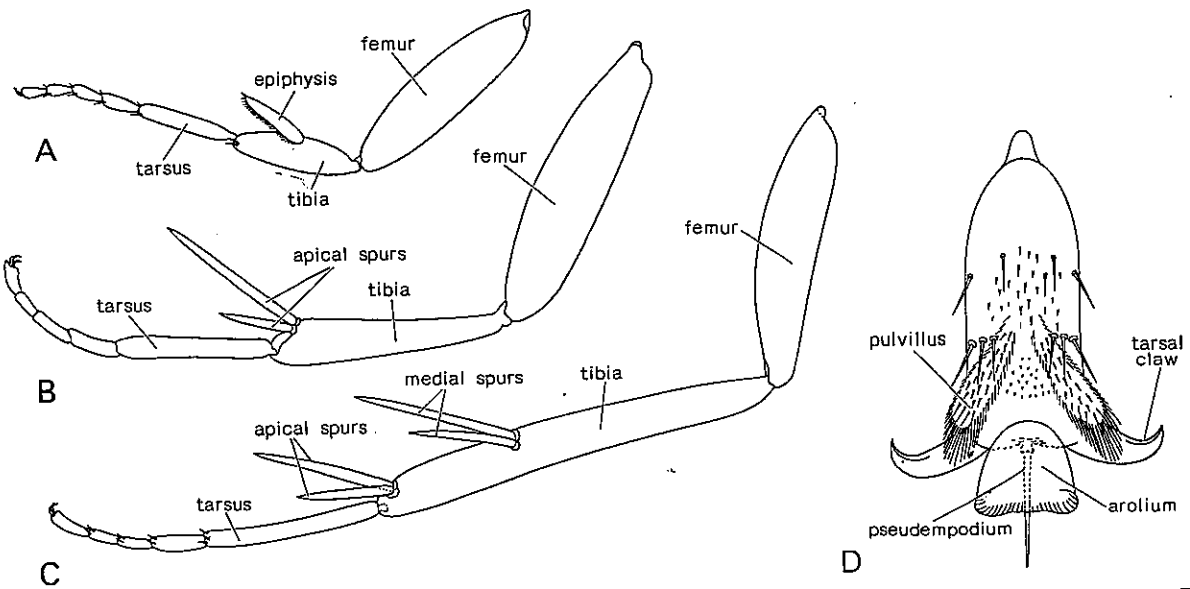
LEPIDOPTERA



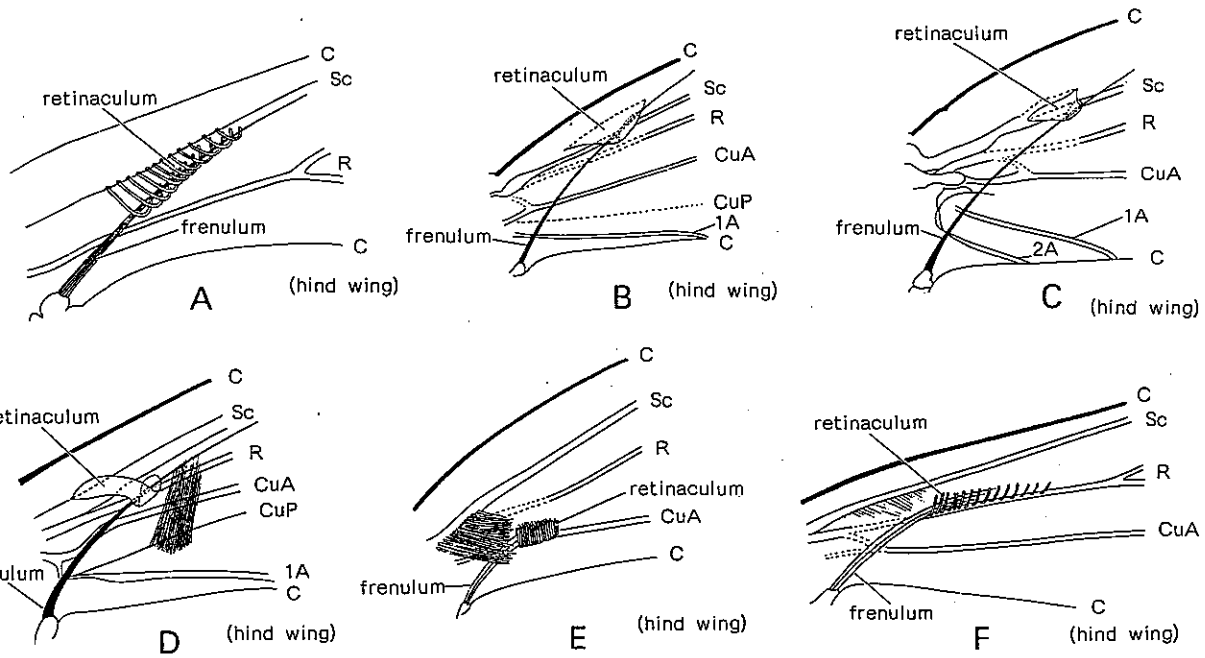
Head and mouth-parts: A, *Pollanisus*, Zygaenidae, lateral; B, *Monopis*, Tineidae, ventral. [B. Rankin]



Thorax of *Oncopera*, Hepialidae: A, lateral; B, dorsal. [B. Rankin]

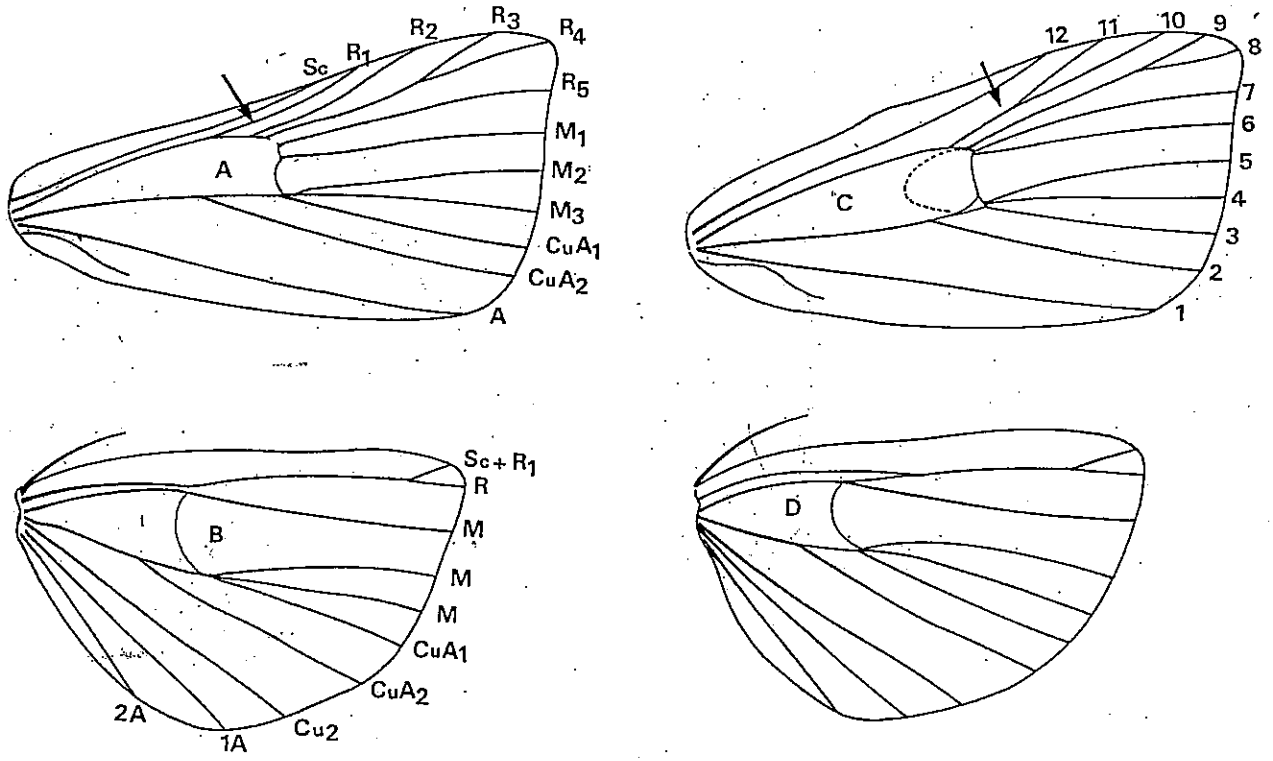


Legs of *Epiphyas*, Tortricidae: A, fore; B, mid; C, hind; D, apical fore tarsal segment, ventral. [B. Rankin]



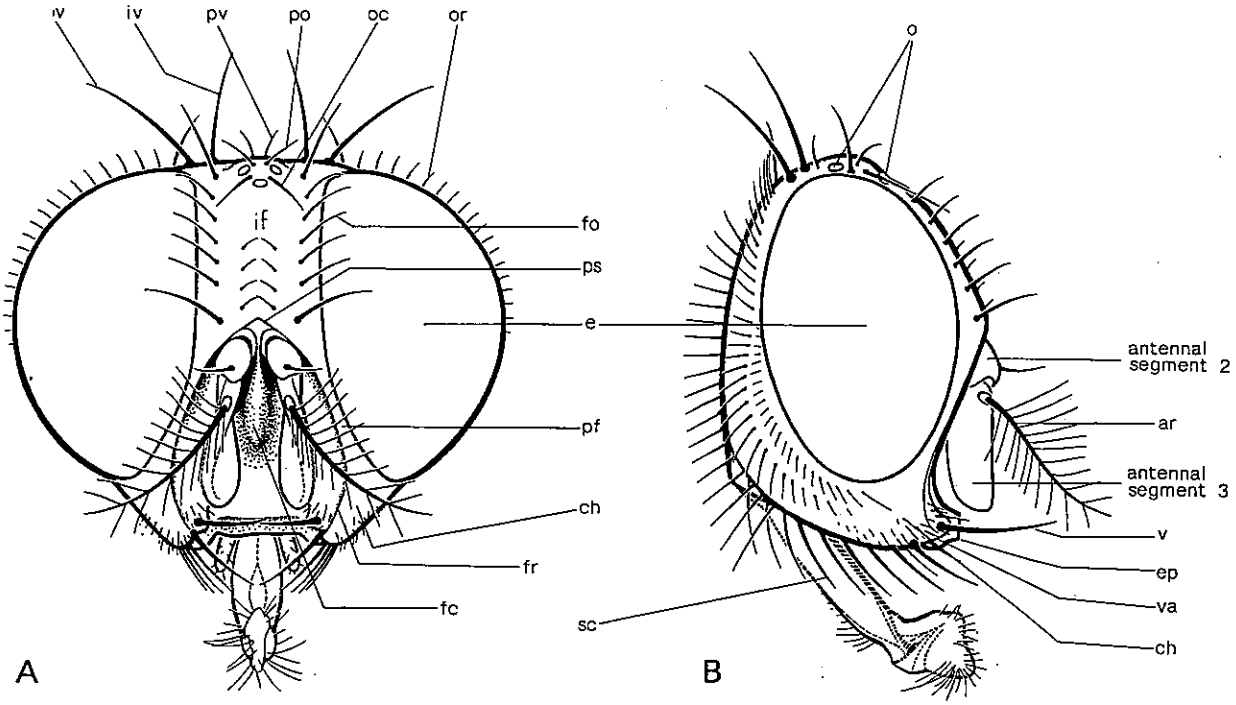
Wing bases, ventral, showing retinaculum and frenulum: A, *Pectinivalva,* ♂, Nepticulidae; B, *Lepidoscia,* ♂, Psychidae; C, *Barea,* ♂, Oecophoridae; D, *Uresiphita,* ♂, Pyralidae; E, *Barea,* ♀, Oecophoridae; F, *Phthorimaea,* ♀, Gelechiidae. [B. Rankin]

ORDER LEPIDOPTERA
FAMILY PYRALIDAE

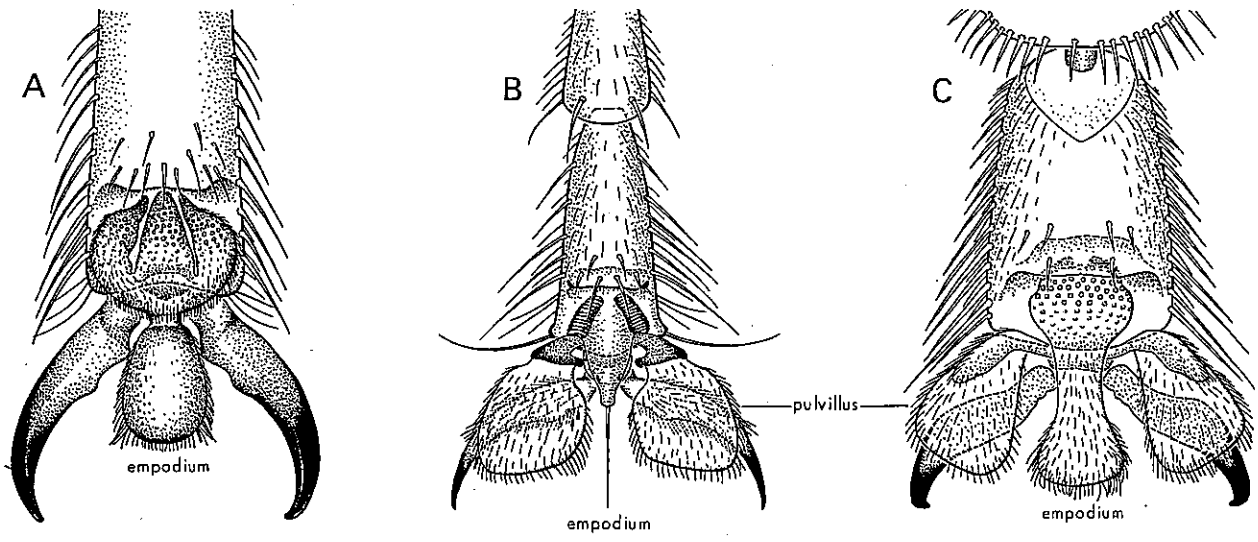


Wing venation in *Marasmia* (A,B) and *Cnaphalocrocis* (C,D).

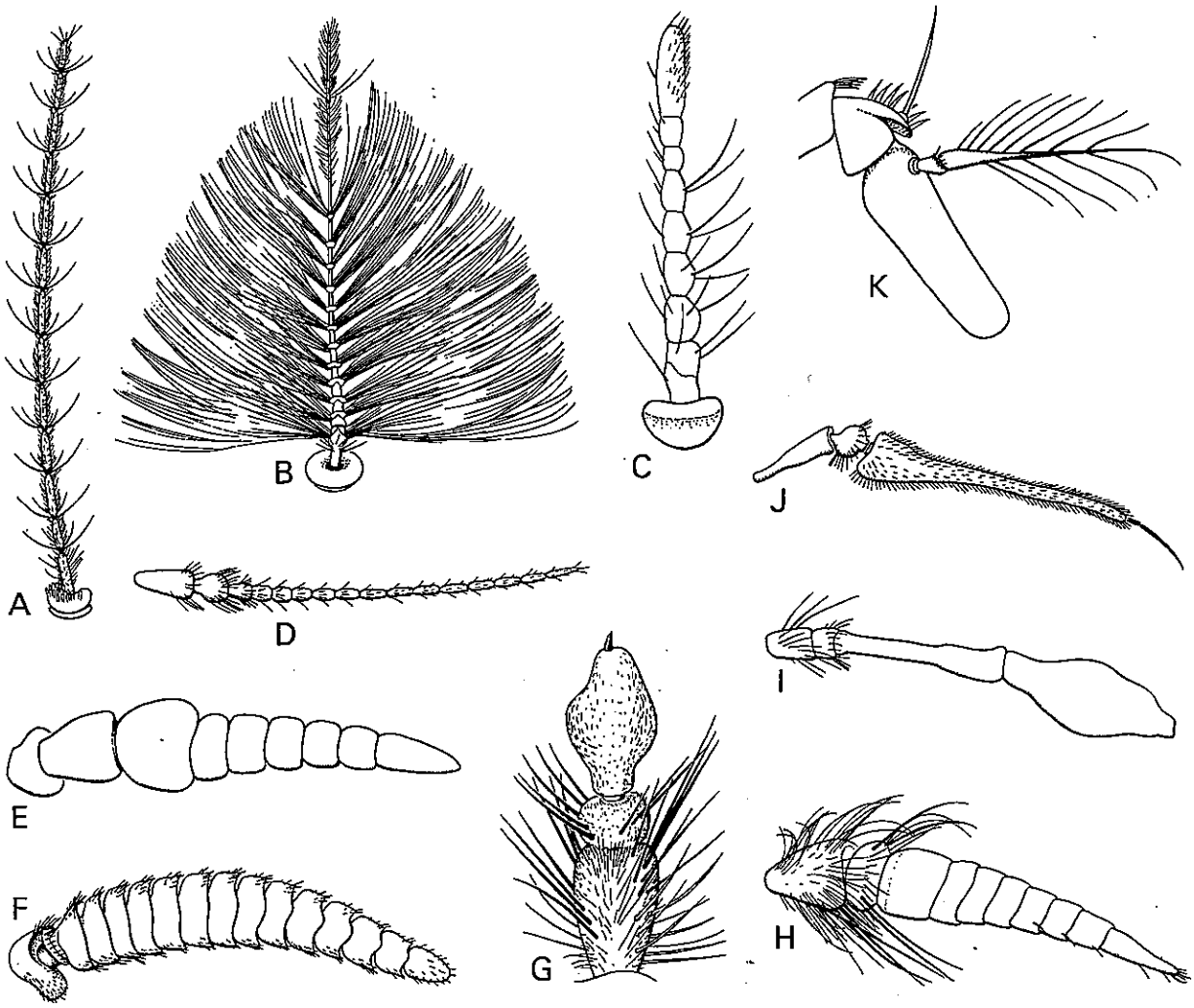
DIPTERA



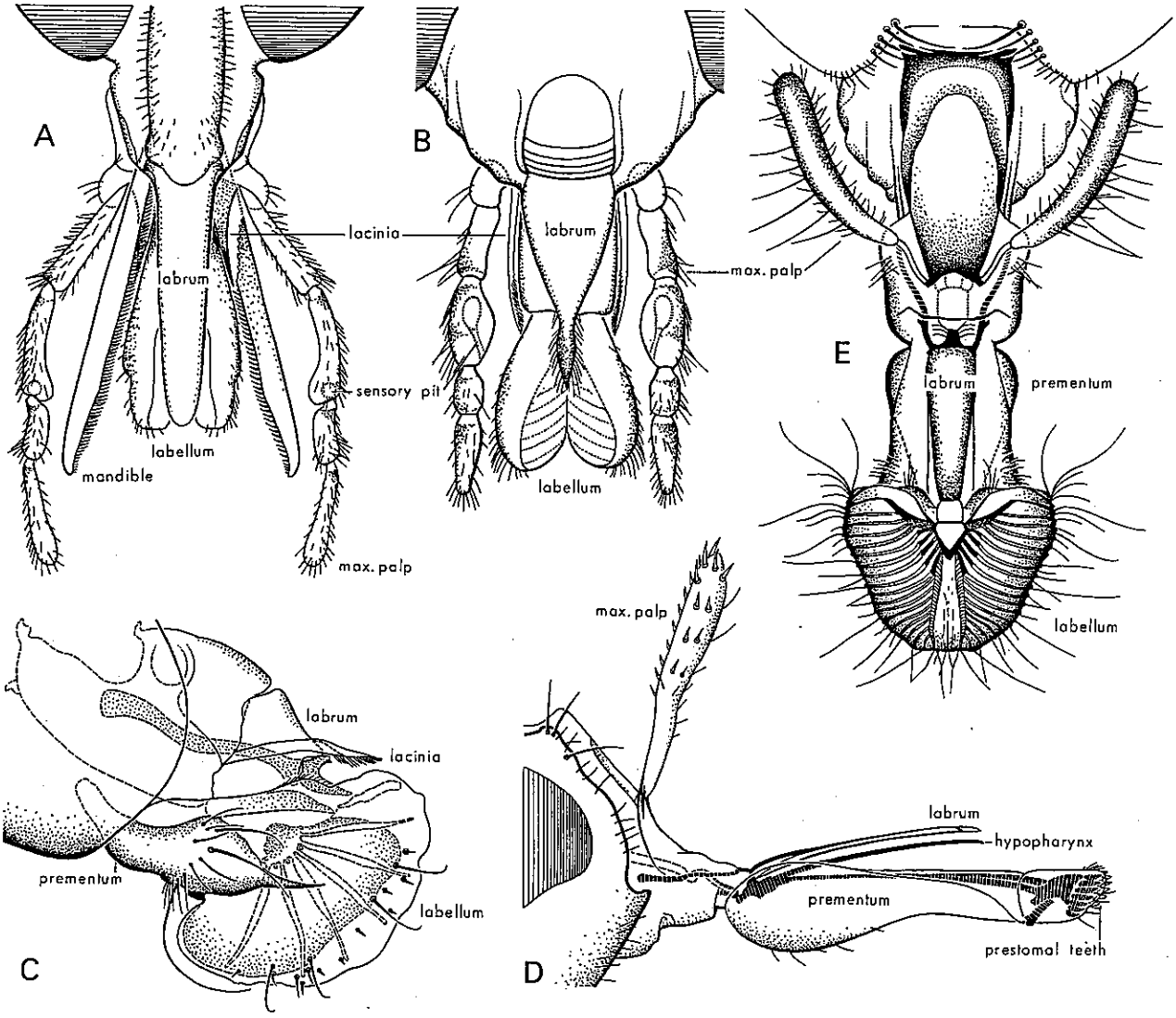
Head of muscoid fly: A, anterior; B, lateral. [T. Binder]
ar, arista; ch, cheek; e, eye; ep, epistoma; fc, facial carina; fr, facial ridge; o, ocellus; pf, parafacial; ps, ptilinal suture; va, vibrissal angle. Bristles: fo, fronto-orbital; if, interfrontal; iv, inner vertical; oc, ocellar; or, orbital; ov, outer vertical; po, postocellar; pv, postvertical; sc, subcranial; v, vibrissa.



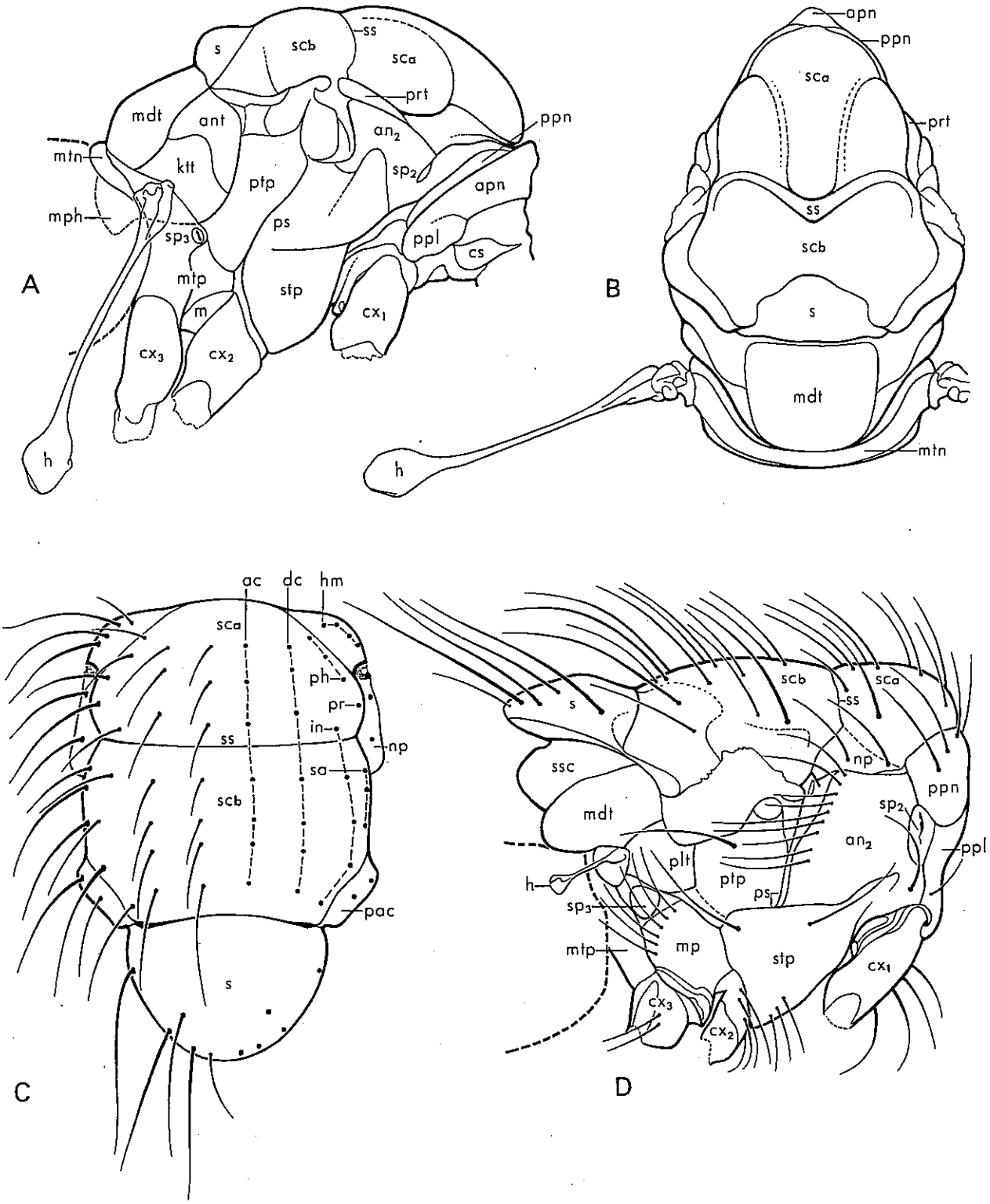
Tarsal and associated structures: A, *Clytocosmus helmsi*, Tipulidae; B, *Musca domestica*, Muscidae; C, *Inopus rubriceps*, Stratiomyidae.
[T. Binder]



Antennae of various Diptera: A, *Aedes alternans*, Culicidae, ♀; B, *A. alternans*, ♂; C, *Heptagyia tasmaniae*, Chironomidae, ♀; D, *Sylvicola dubius*, Anisopodidae, ♀; E, *Austrosimulium bancrofti*, Simuliidae, ♀; F, *Keroplatus mastersi*, Mycetophilidae, ♂; G, *Apiocera asilica*, Apioceridae, ♀; H, *Scaptia maculiventris*, Tabanidae, ♀; I, *Miltinus viduatus*, Mydidae, ♂; J, *Rhaphium pudicum*, Dolichopodidae, ♂; K, *Musca vetustissima*, Muscidae, ♂.
[T. Binder]

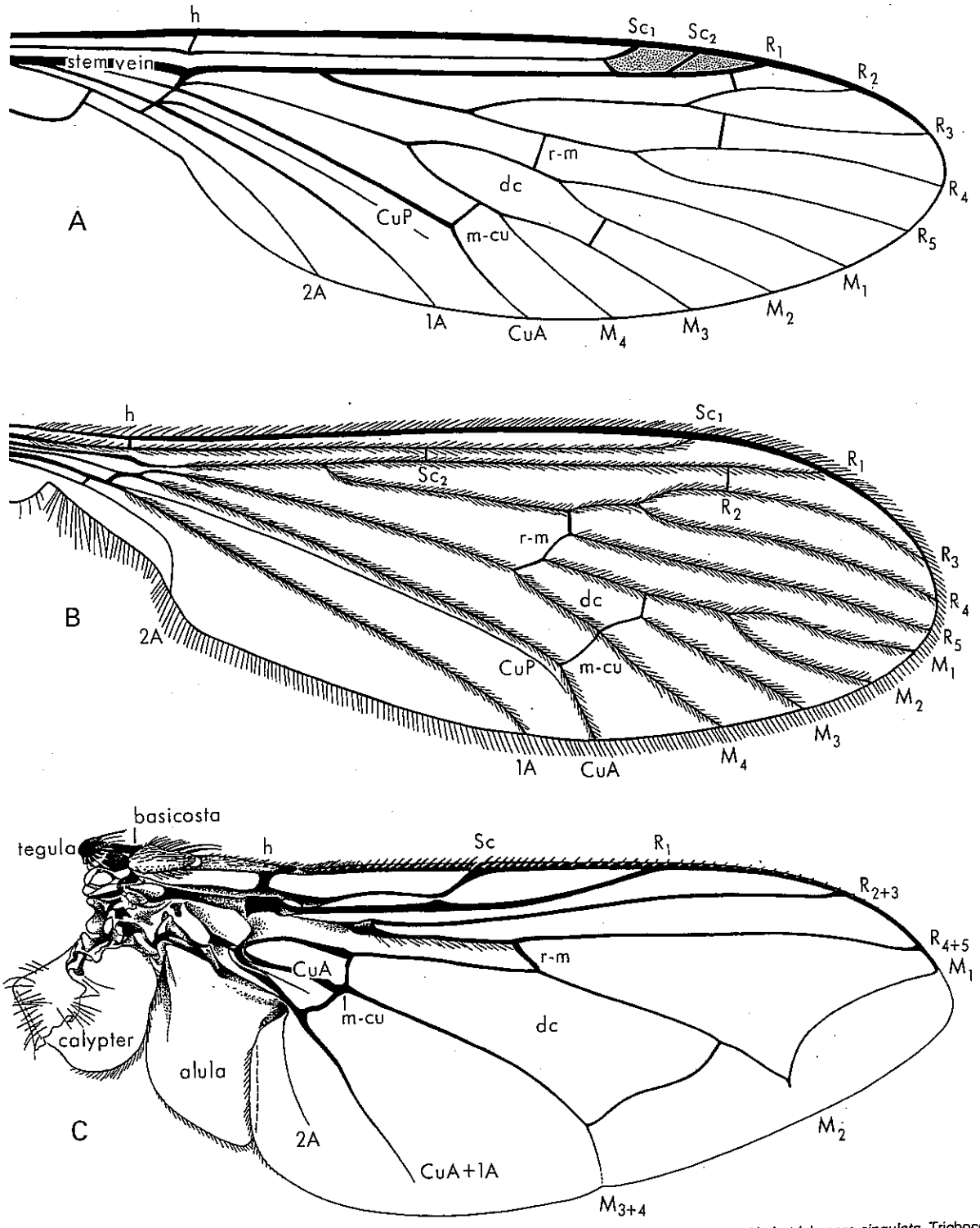


Mouth-parts of various Diptera (all ♀♀): A, *Edwardsina* sp., Blephariceridae, dorsal; B, *Sylvicola dubius*, Anisopodidae, dorsal; C, *Heteropsilopus cingulipes*, Dolichopodidae, lateral, palp not shown; D, *Haematobia exigua*, Muscidae, lateral; E, *Calliphora stygia*, Calliphoridae, dorsal. [T. Binder]

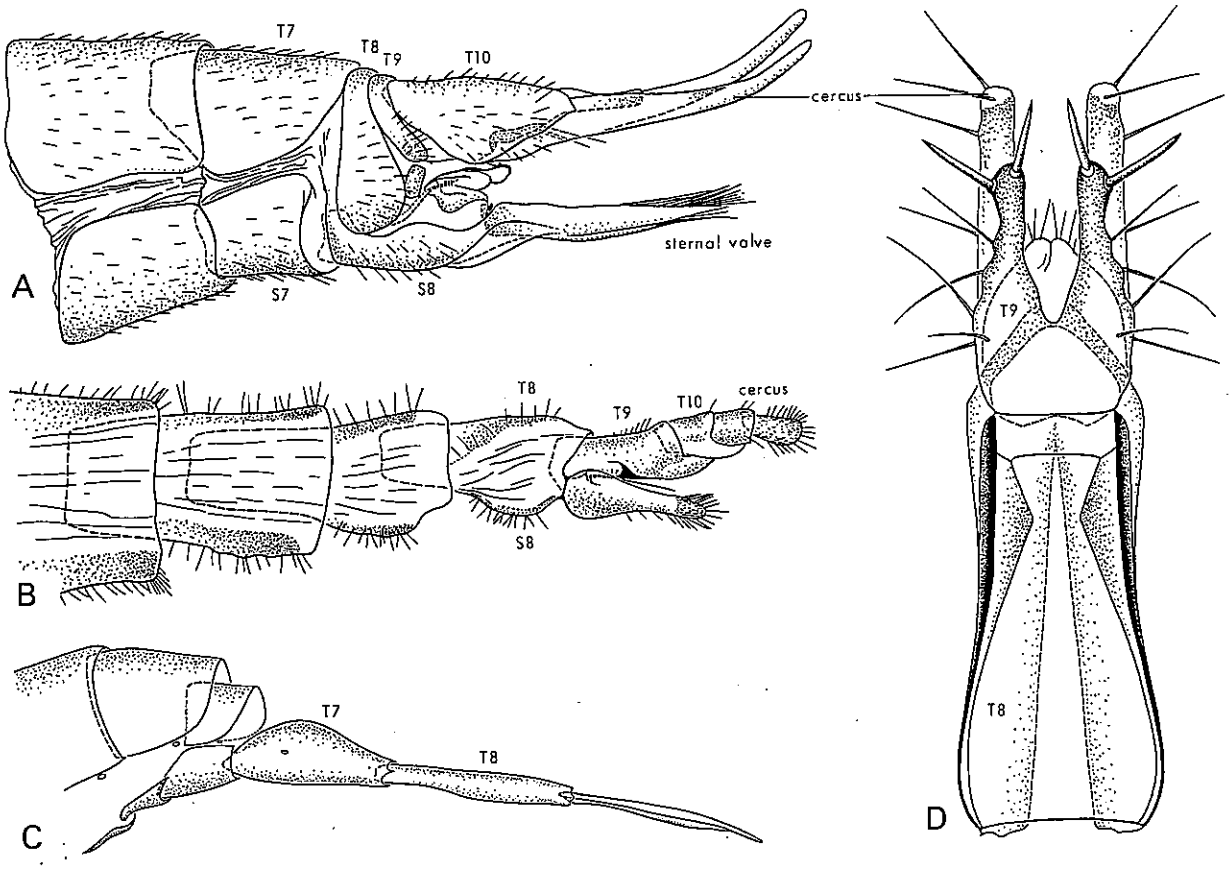


Thoracic structure and chaetotaxy: A, B, Tipulidae, lateral and dorsal; C, D, Tachinidae, dorsal and lateral. [T. Binder]

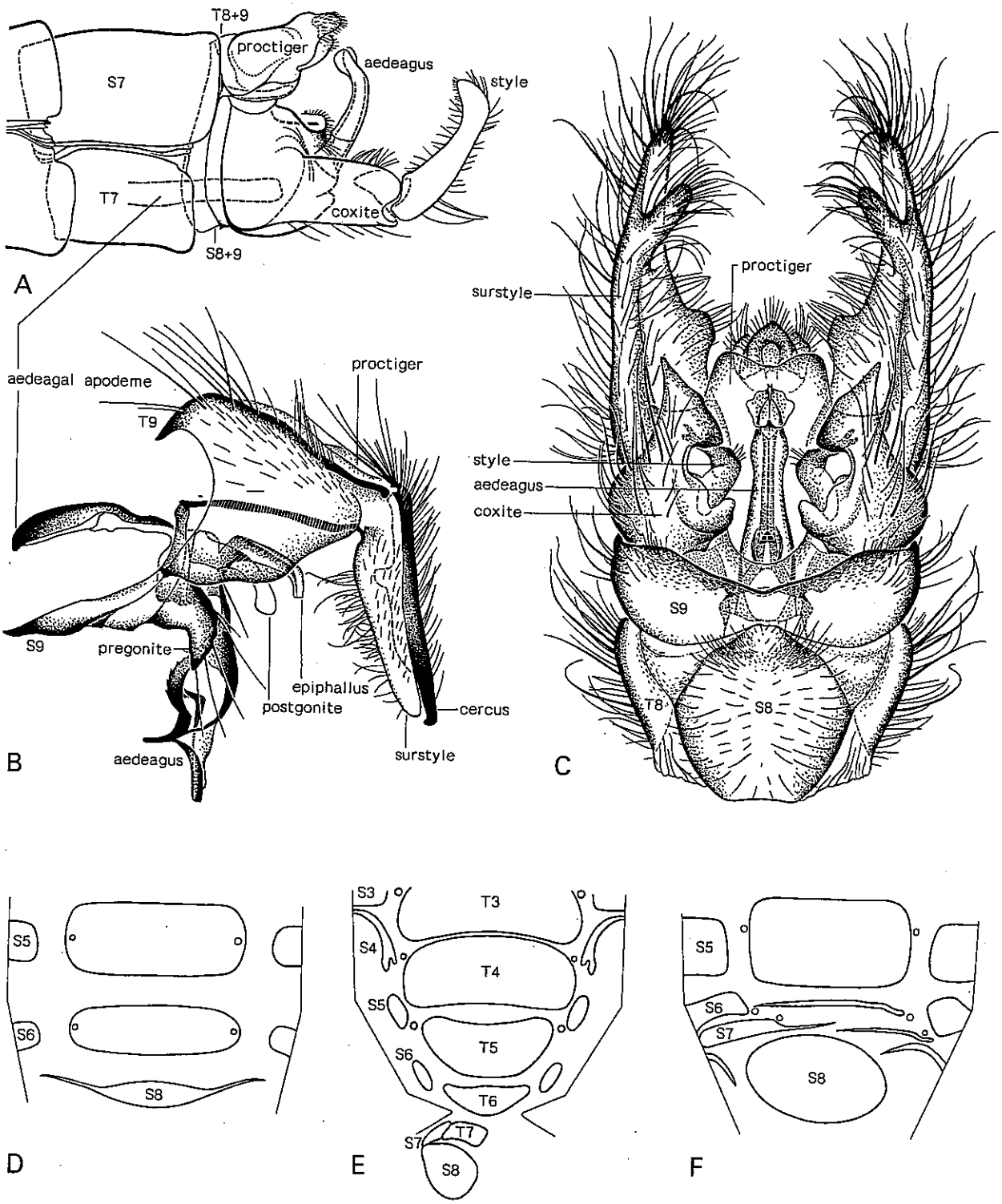
an, anepisternite (mesopleuron); ant, anatergite; apn, anterior pronotum; cs, cervical sclerite; cx, coxa; h, haltere; ktt, katatergite; m, meron; mdt, mediotergite; mp, meropleuron; mph, mesopostphragma; mtp, metapleuron; mtn, metanotum; np, notopleuron; pac, postalar callus; plt, pleurotergite; ppl, propleuron; ppn, posterior pronotum; prt, paratergite; ps, pleural suture; ptp, pteropleuron; s, scutellum; sc_a, sc_b, presutural and postsutural parts of scutum or mesonotum; sp, spiracle; ss, scutal or mesonotal suture; ssc, subscutellum; stp, sternopleuron. Subscript numbers 1–3 indicate pro-, meso- and metathorax, respectively. Bristles (in C): ac, acrostichal; dc, dorsocentral; hm, humeral; in, intraalar; ph, posthumeral; pr, presutural; sa, supraalar.



Wing venation: A, reconstruction of hypothetical ancestor of Diptera (cf. Fig. 1.18A); B, tipuloid pattern, *Nothotrichocera cingulata*, Trichoceridae; C, muscoid pattern, *Chrysomya saffranea*, Calliphoridae. Standard notation for veins; dc, discal cell. [T. Binder]



Female terminalia: A, *Gynoplistia* sp., Tipulidae, lateral; B, *Sciara* sp., Sciaridae, lateral; C, *Dacus tryoni*, Tephritidae, lateral; D, *Heteropsilopus cingulipes*, Dolichopodidae, dorsal. [T. Binder]



Male terminalia: A, *Eutanyderus wilsoni*, Tanyderidae, lateral, ventral surface uppermost; B, *Calliphora stygia*, Calliphoridae, lateral; C, *Neoaratus hercules*, Asilidae, ventral. Protandrograms: D, Teratomyzidae, undescribed; E, *Paraclius* sp., Dolichopodidae; F, *Dasycoelopa australis*, Coelopidae.
[A–C by T. Binder; D–F by A. Hastings]

ILLUSTRATIONS

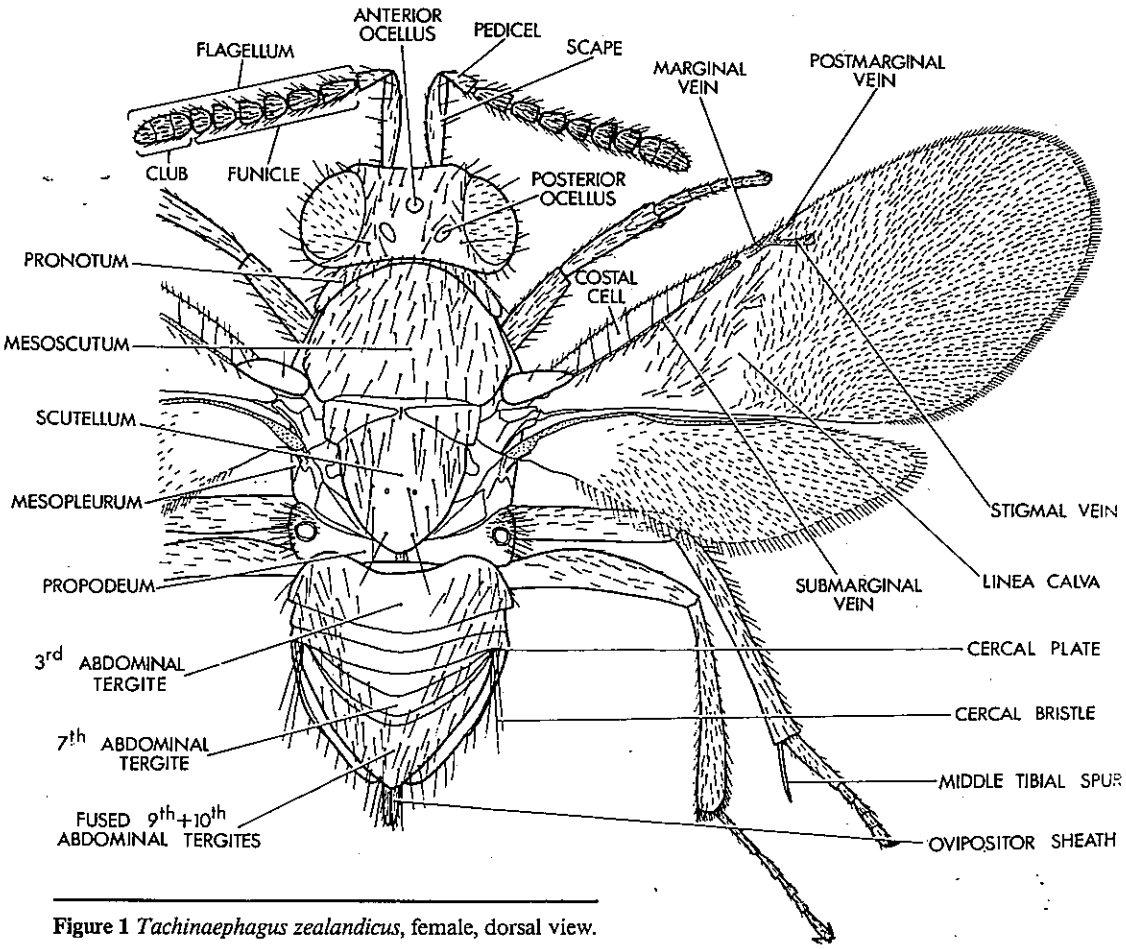


Figure 1 *Tachinaephagus zealandicus*, female, dorsal view.

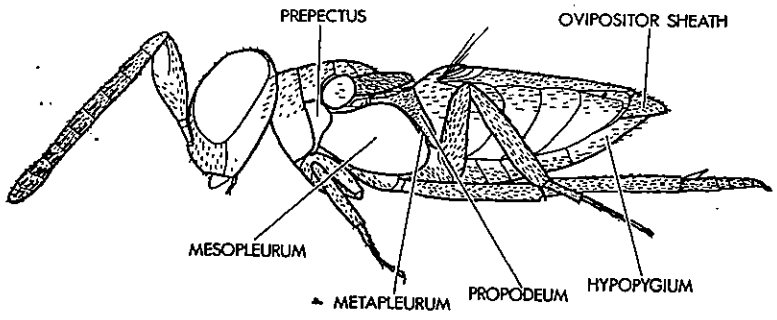
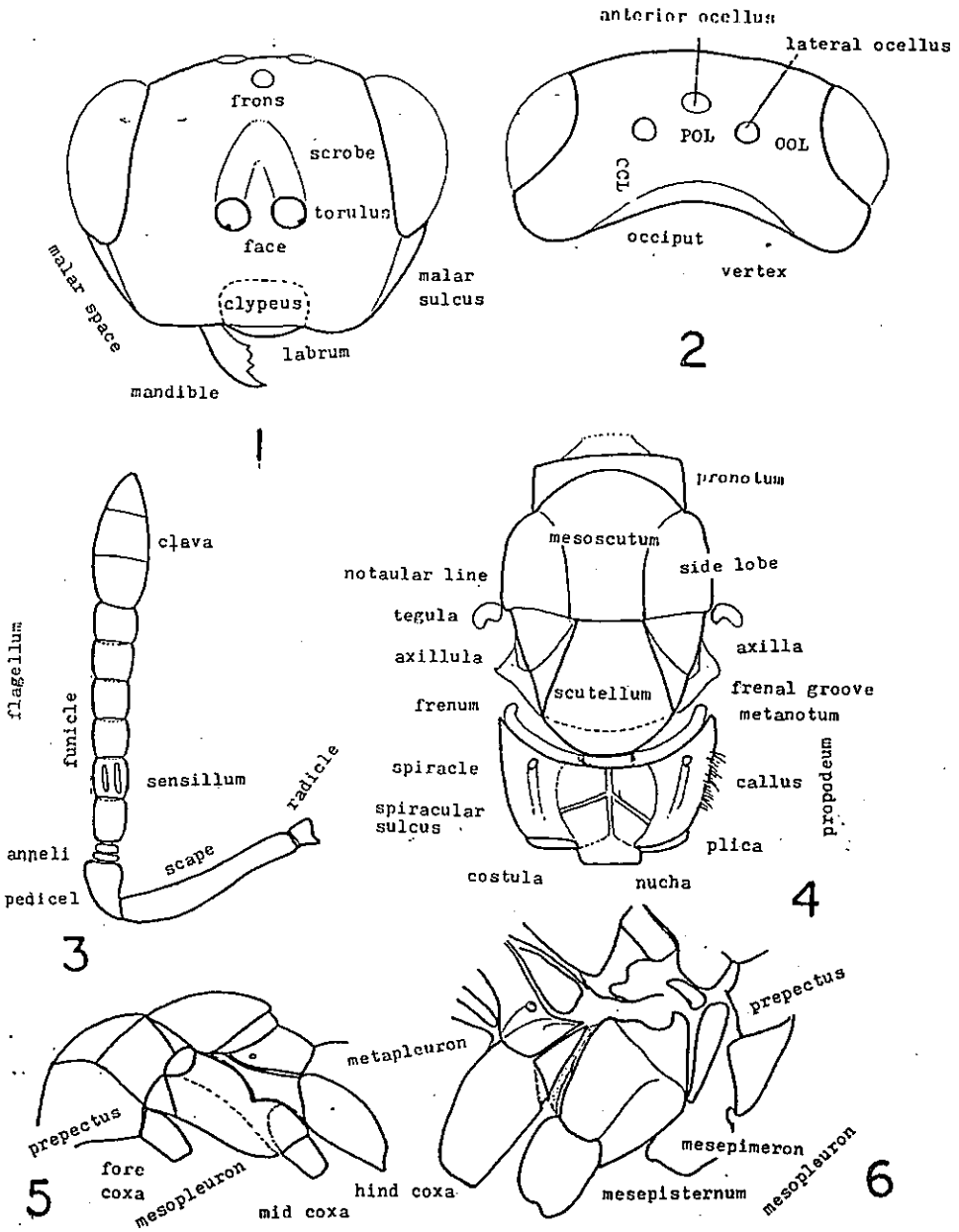
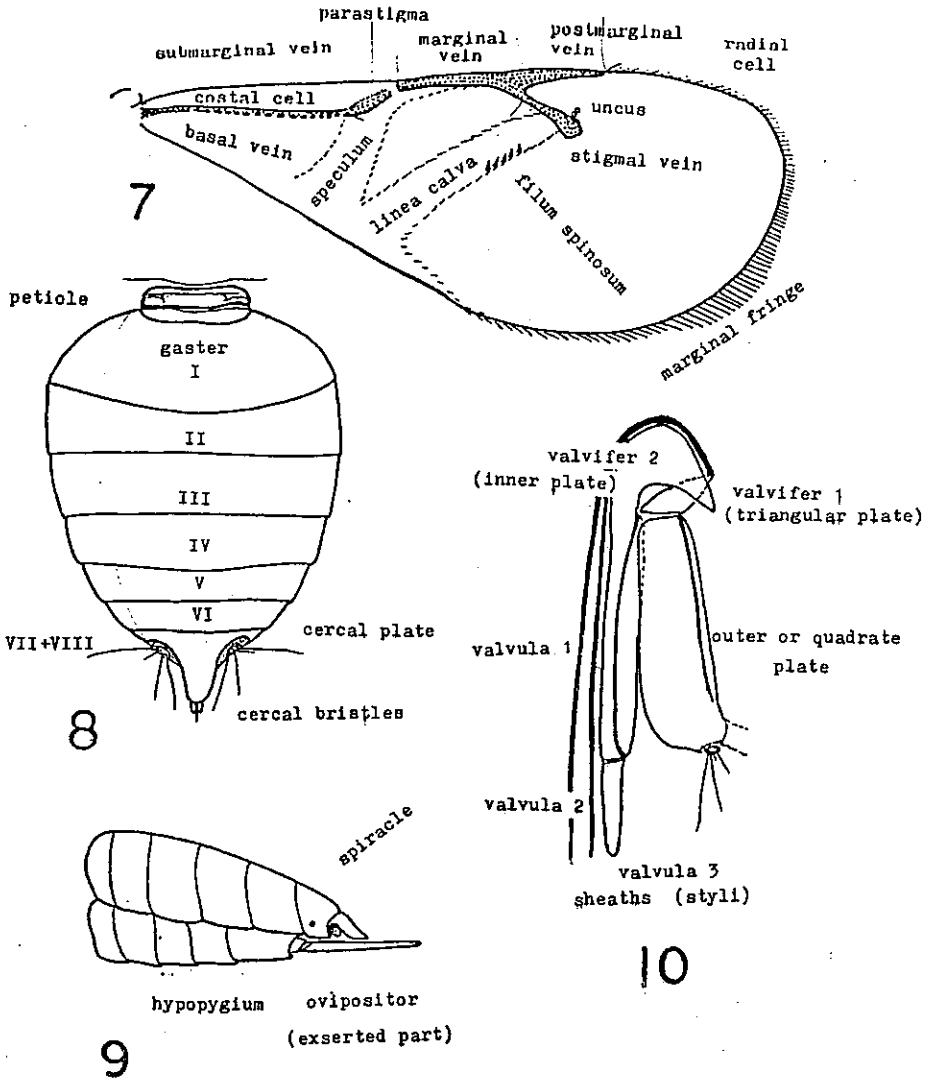


Figure 2 *Odiaglyptus biformis*, female, lateral view (drawn from card-mounted specimen).



Figs. 1-6. Explanation of terminology

1, head in front view, generalized chalcid; 2, head sorsum, generalized chalcid; 3, antenna, F Pteromalid; 4, thoracic dorsum, generalized chalcid; 5, thorax in profile; 6, thorax in profile of Aphelinus.



Figs. 7–10. Explanation of terminology (contd.)

7, fore wing, generalized chalcid; 8, gaster dorsal, Promuscidea F; 9, gaster profile, generalized chalcid; 10, female genitalia, right half.

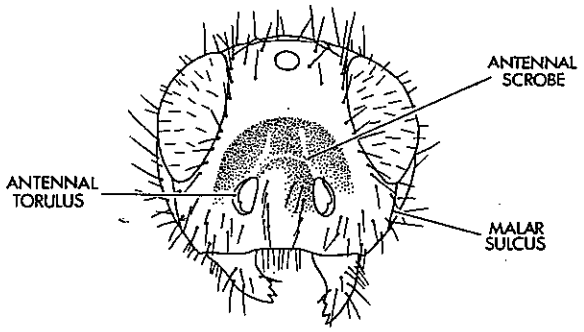


Figure 3 *Tachinaephagus zealandicus*, female, head, facial view.

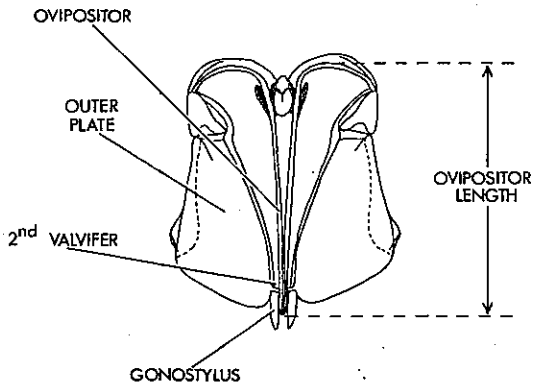


Figure 4 *Protyndarichoides cinctiventris*, female genitalia, ventral view.

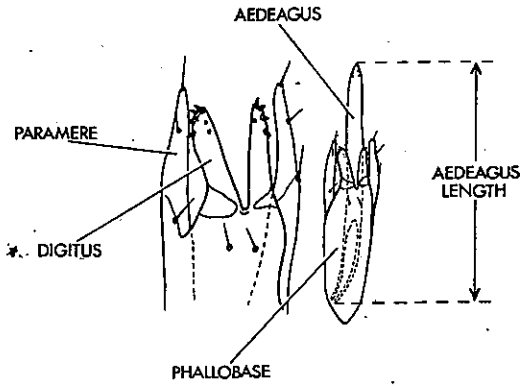
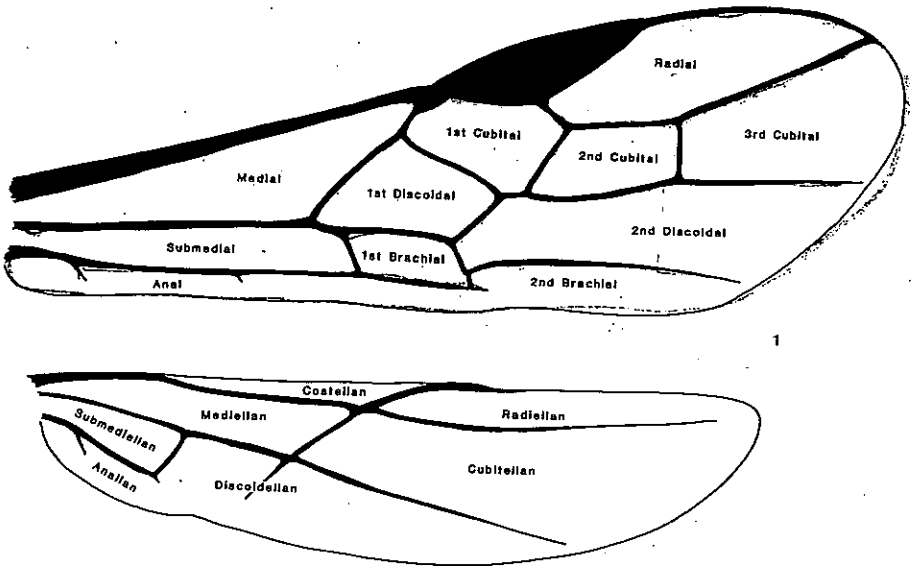
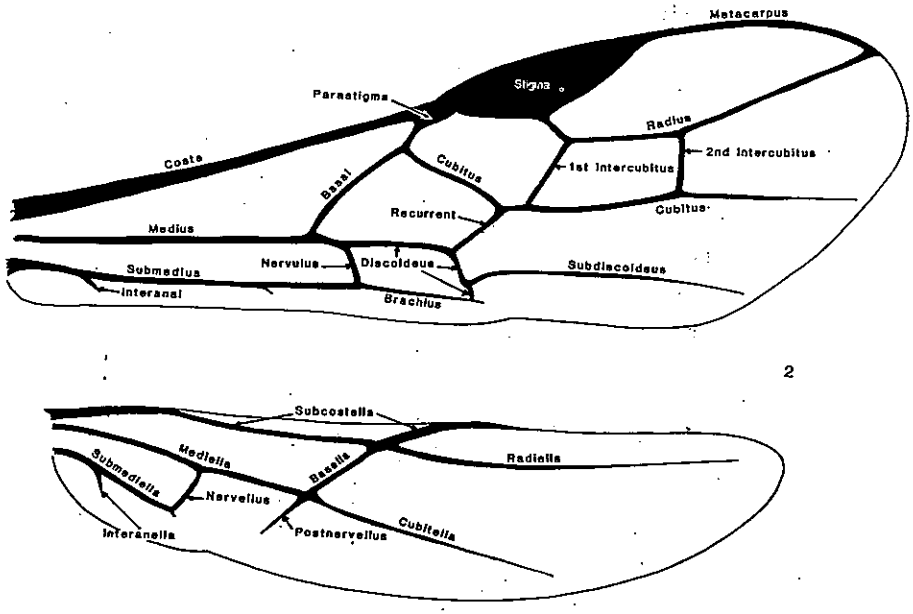


Figure 5 *Zelencyrtus latifrons*, male genitalia, ventral view.



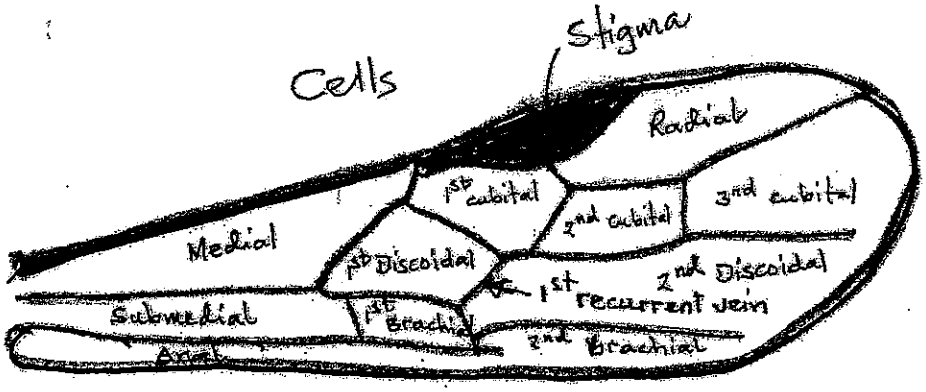
Cells

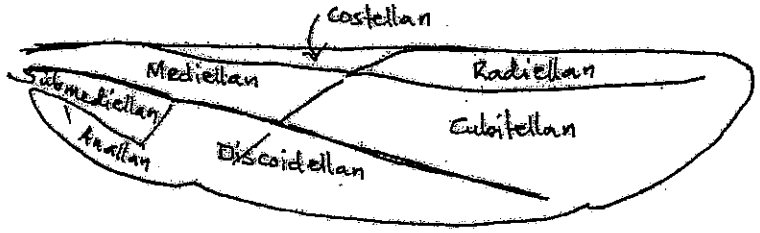


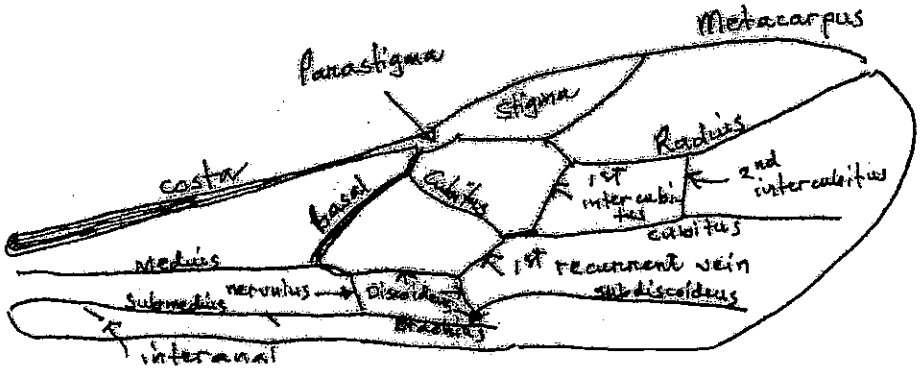
Veins

Figs. 1–2. Generalized illustrations of typical braconid wings with veins and cells indicated.

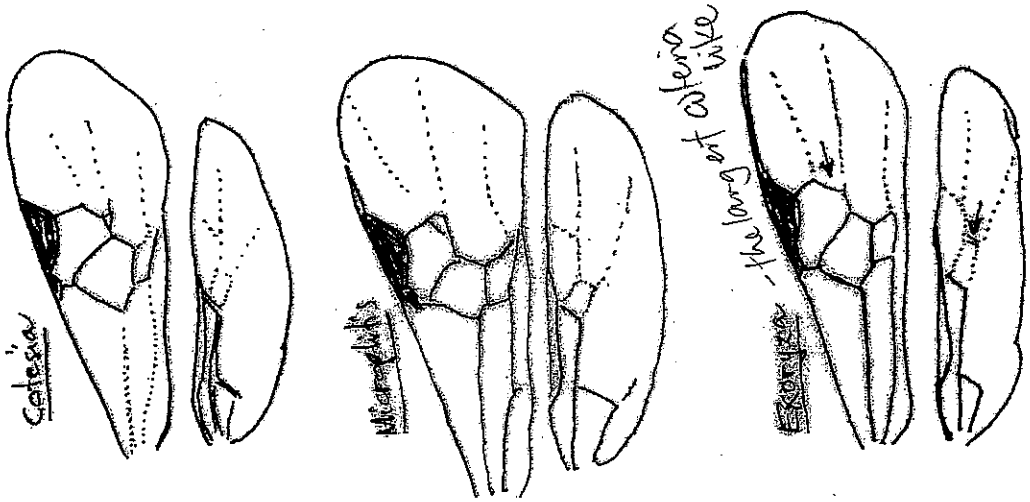
Family Braconidae
Wing cells & veins



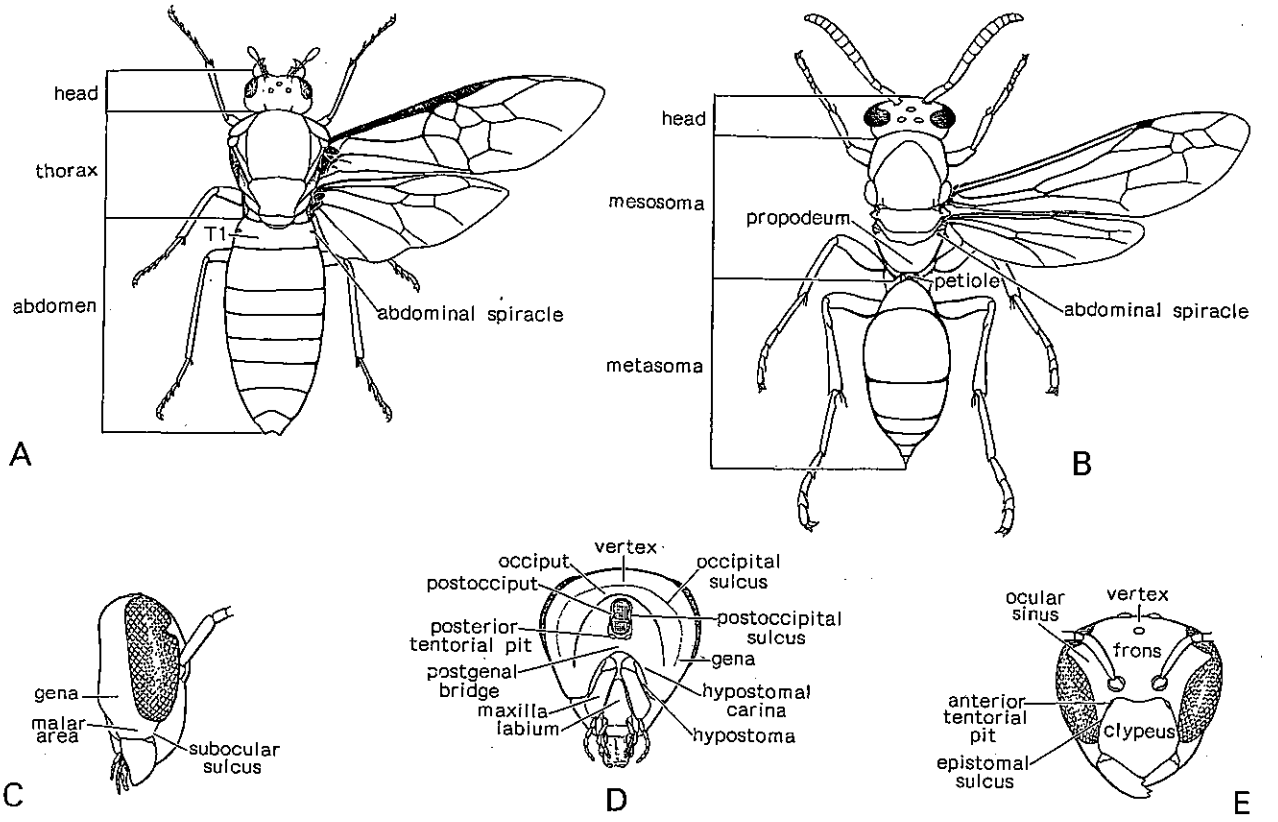




Veins



HYMENOPTERA



Adults: A, Symphyta (*Perga* sp., Pergidae); B, Apocrita (*Polistes* sp., Vespidae). C–E, head of *Polistes*: C, lateral; D, posterior; E, frontal.
[S. Monteith]

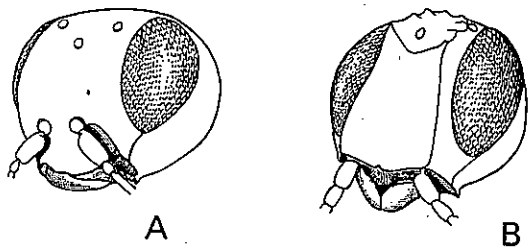
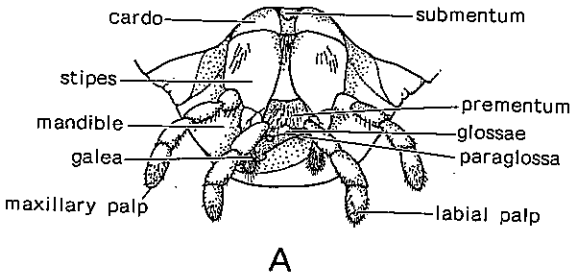
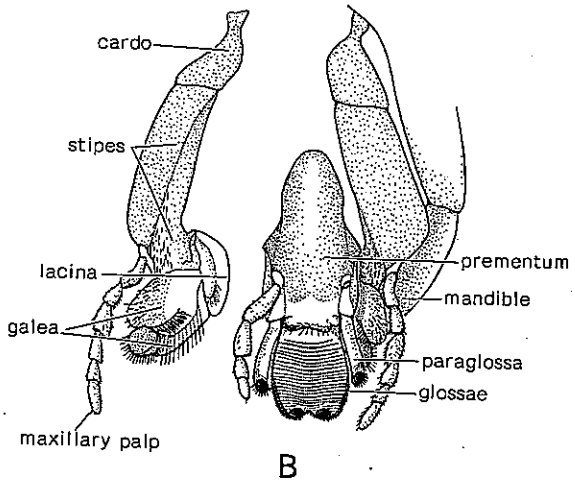
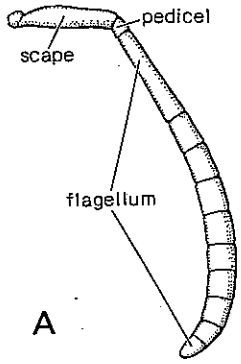


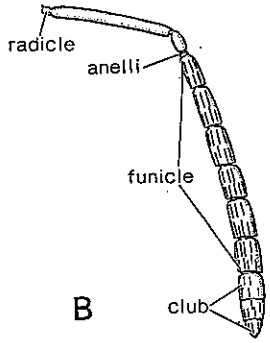
Fig. 42.3 Subantennal groove in: A, *Megalyra* sp., Megalyridae; B, *Guiglia* sp., Orussidae. [S. Monteith]

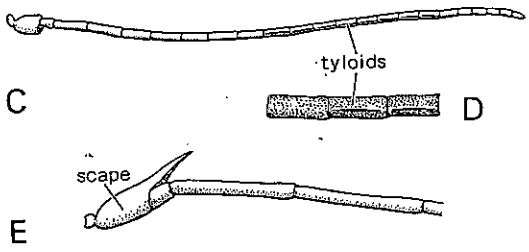




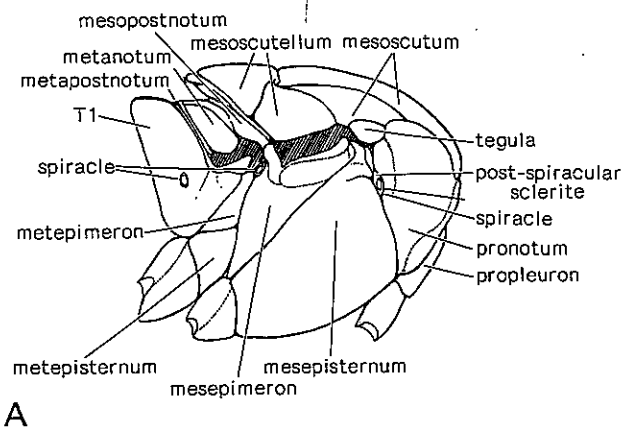
Mouth-parts: A, *Perga* sp., Pergidae; B, *Polistes* sp., Vespidae. [S. Monteith]

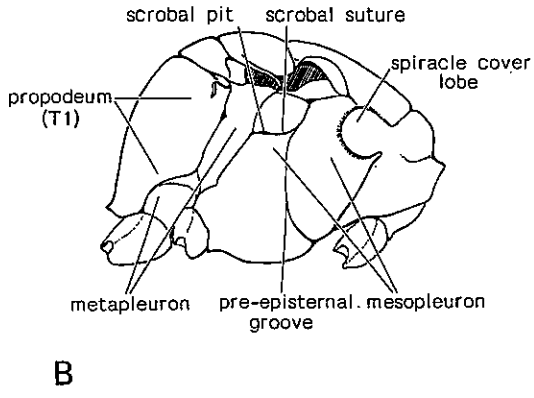


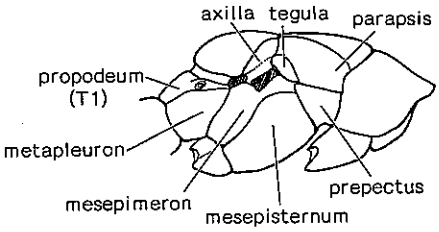


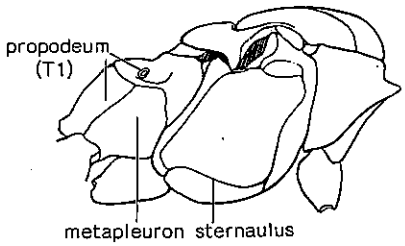


Antennae: A, Vespidae; B, Chalcidoidea; C, D, Trigonalyidae; E, *Austroserphus* sp., Proctotrupidae. [S. Monteith]

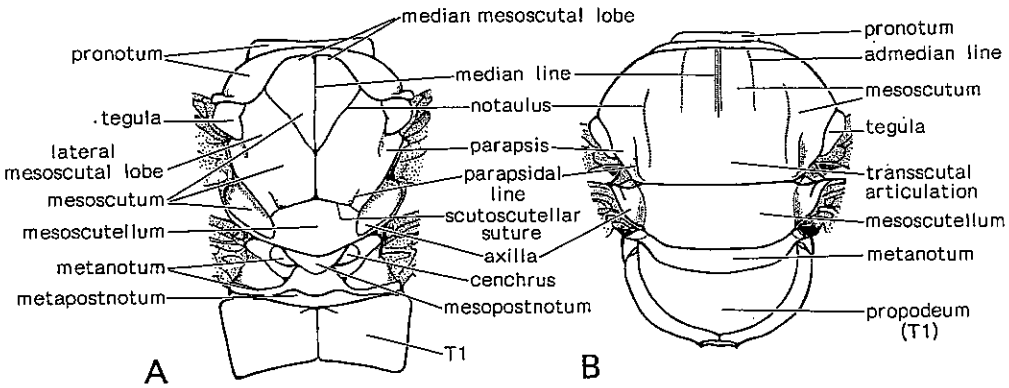


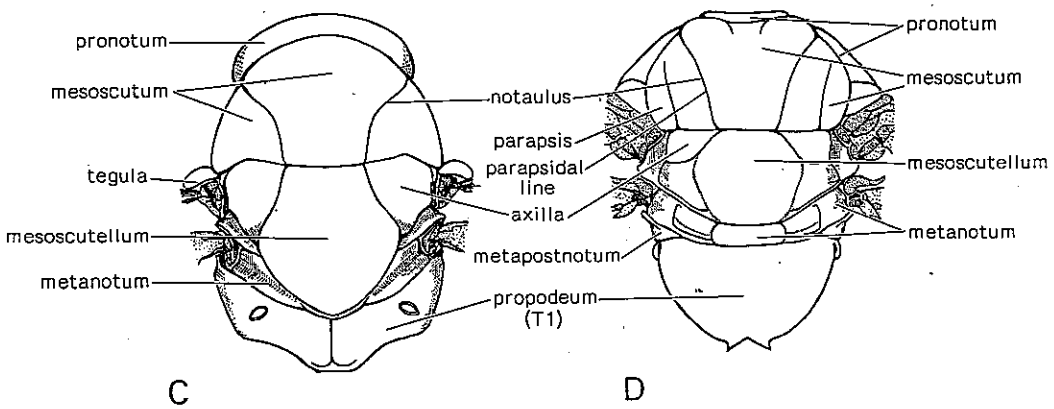




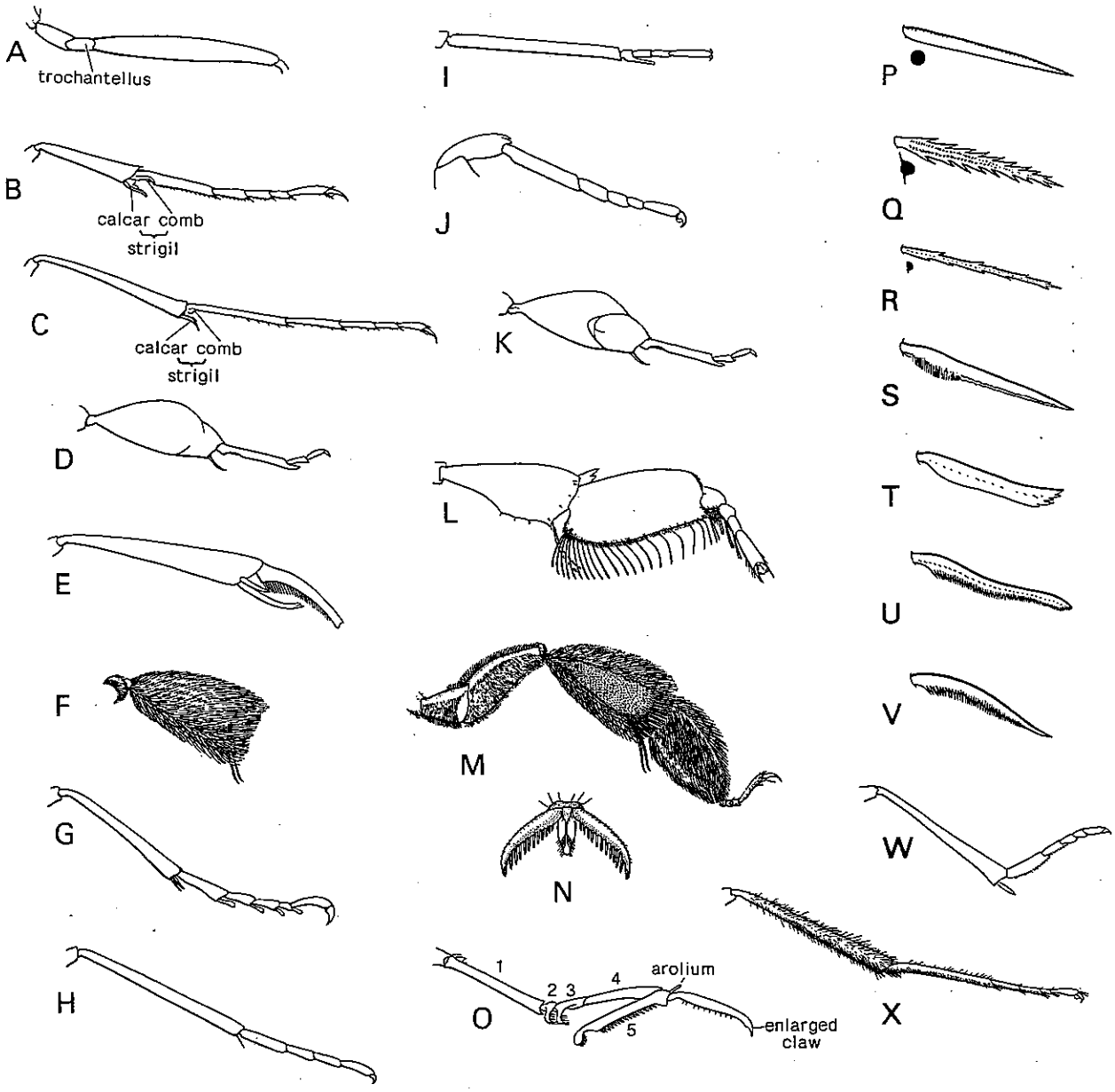


Lateral thorax: A, *Perga* sp., Symphyta-Pergidae; B, *Hyleoides* sp., Apoidea-Colletidae; C, *Thaumasura* sp., Chalcidoidea-Pteromalidae; D, *Ceratomansa* sp., Ichneumonidae. [S. Monteith]





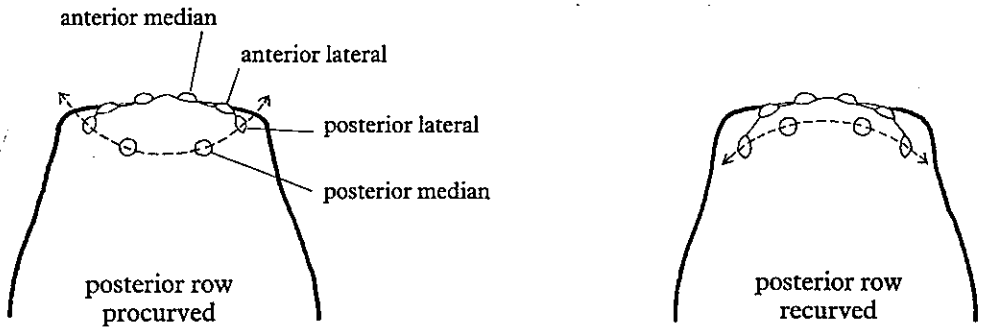
Dorsal thorax and propodeum: A, Symphyta-Tenthredinidae; B, *Sphecius* sp., Sphecidae; C, *Agamerion* sp., Pteromalidae; D, *Taeniogonalos* sp., Trigonalyidae. [S. Monteith]



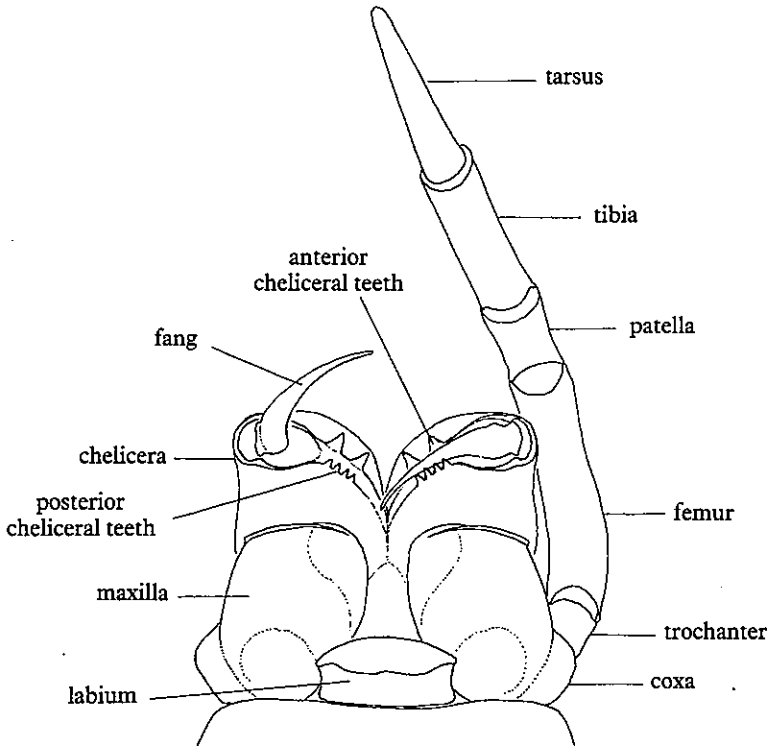
Legs: A, hind, of *Ceratomansa* sp., Ichneumonidae; B, fore, C, hind, of *Sceliphron* sp., Sphecidae; D, fore, of *Guiglia* sp., Orussidae, ♀; E, fore, of Ceraphronidae; F, hind tibia, of *Amegilla* sp., Anthophoridae; G, fore, of *Perga* sp., Pergidae; H, fore, of *Elasmus* sp., Elasmidae; I, hind, of *Iballa* sp., Iballidae; J, fore, of *Pleistodontes* sp., Agaonidae; K, fore, of *Guiglia* sp., Orussidae, ♀; L, fore, of *Bembix* sp., Sphecidae; M, hind, of *Amegilla* sp., Anthophoridae; N, claws of *Netelia* sp., Ichneumonidae; O, fore, of *Dryinus* sp., Dryinidae, ♀; P–V, mid or hind tibial spurs (P, simple; Q, R, flattened, with dentate margins; S–V, modified to form calcar); W, mid, of Eupelmidae; X, hind, of *Megalyra* sp., Megalyridae.

[A–O,W, X by S. Monteith; P–V after Brothers 1975]

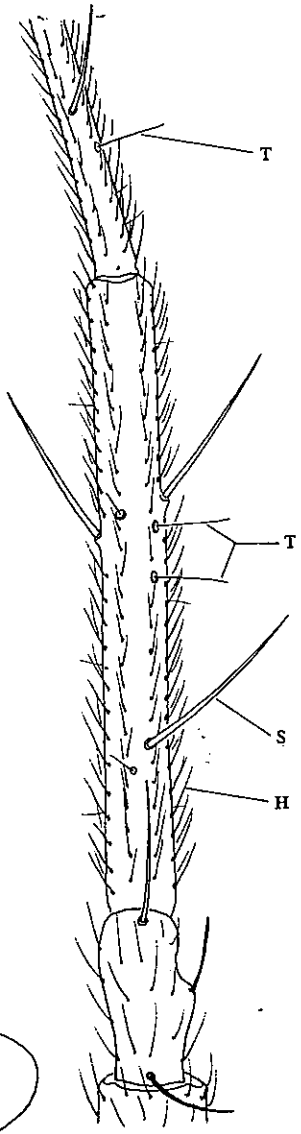
ARANEAE



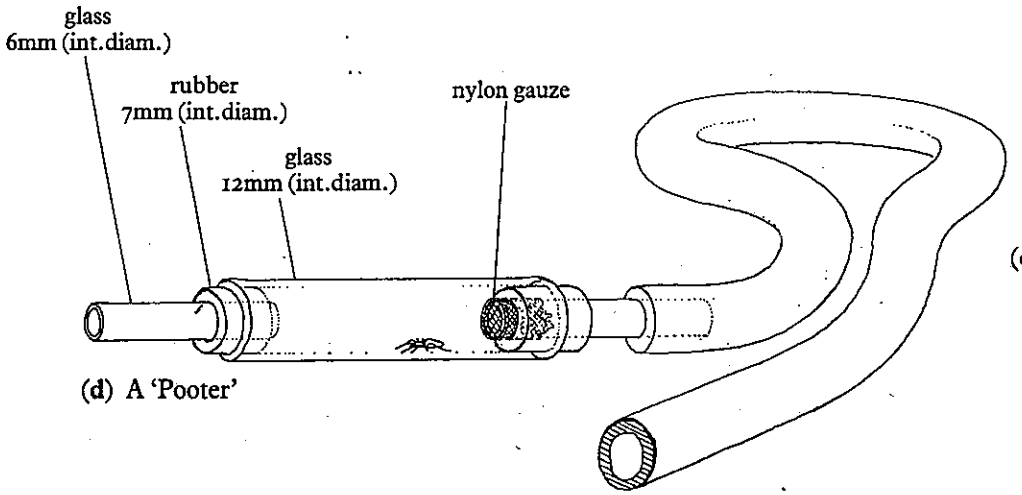
(a) **Eyes** dorsal view



(b) **Chelicerae, maxillae, labium and palp**
♀ spider, ventral view

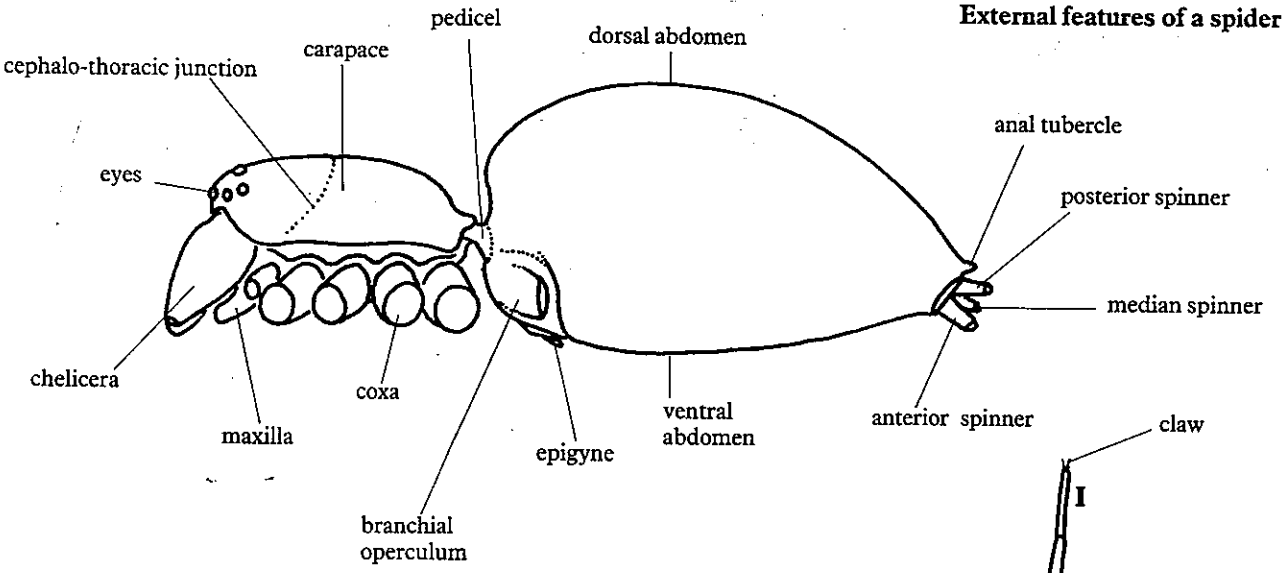


(c) Part of leg showing **trichobothria** (T), **spines** (S) and **hairs** (H)

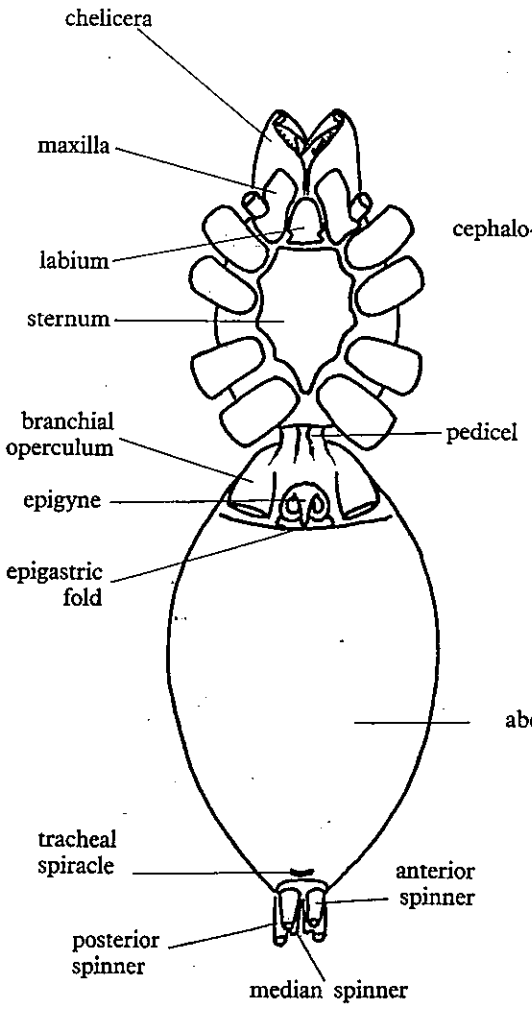


(d) A 'Pooter'

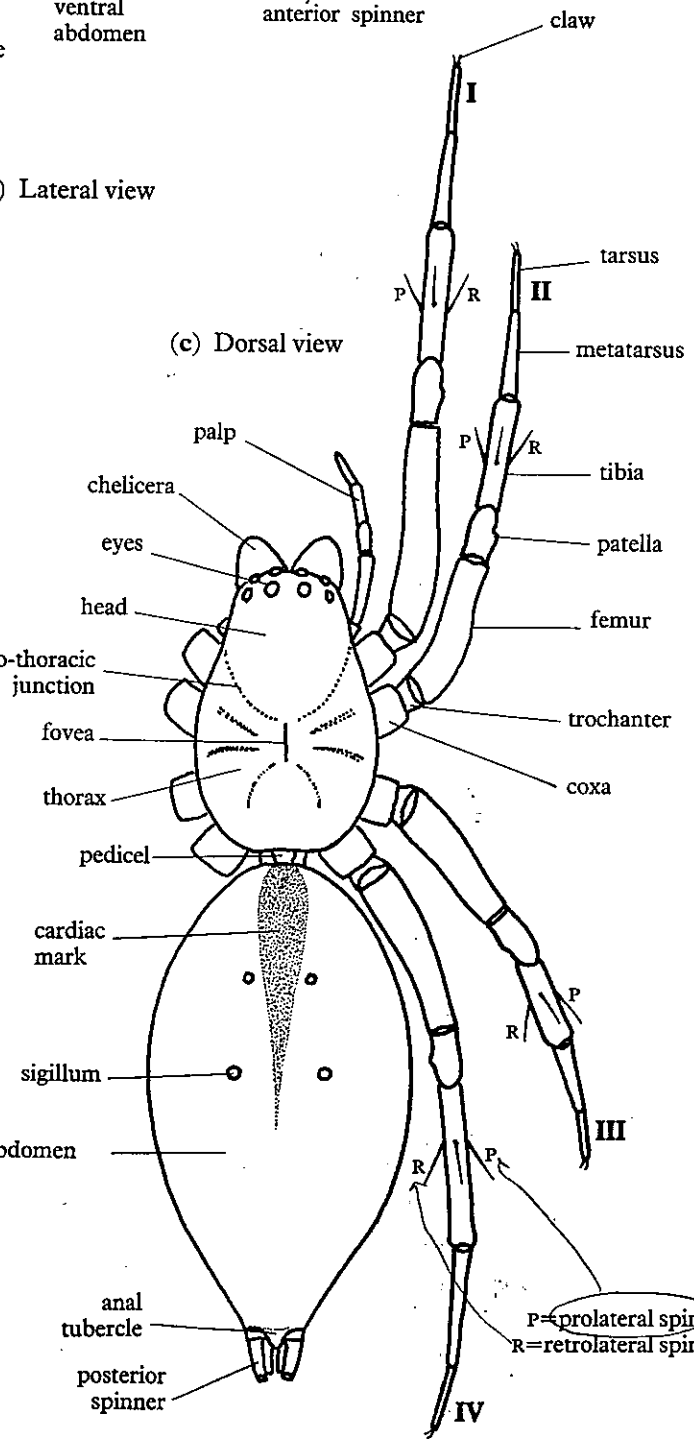
External features of a spider (♀)



(a) Lateral view



(b) Ventral view



(c) Dorsal view

* Key to families of Spiders *

1 Chelicerae massive, projecting in front of the carapace, articulated for upward and downward movement, the folded fangs lying parallel to the long axis of the body. Posterior spinners with three segments (Plate 1; Text Fig. 12, p. 47). Suborder ORTHOGNATHA (Mygalomorphae). One British representative ..... ATYPIDAE

– Chelicerae, large or small, attached under the anterior border of the carapace and, although sometimes projecting forwards, articulated for inward and outward (or oblique) movement. Posterior spinners never with more than two segments. Suborder LABIDOGNATHA (Araneomorphae) 2

2(1) Cribellum present anterior to spinners (reduced in ♂) (Text Figs 4a–j). ♀ with a calamistrum on metatarsus IV (degenerate in ♂) (Text Figs 4k–m) 3

– Cribellum and calamistrum absent 5

3(2) Three rare CRIBELLATE spider species (two families) are recognizable instantly by general appearance:

(i) Plate 2; Text Fig. 12b, p. 47 ..... ERESIDAE

(ii) Plates 11, 12; Text Figs 17a,b, p. 57 ..... ULOBORIDAE

– Not as above 4

4(3) Fairly large cribellate spiders, 5–15mm in length. Calamistrum of ♀ having a double row of bristles (Text Fig. 4k). Tarsi with several trichobothria ..... AMAUROBIIDAE

– Smaller cribellate spiders, less than 4mm in length. Calamistrum of ♀ with a single row of bristles (Text Figs 4l,m). Tarsi with a single trichobothrium, or none ..... DICTYNIDAE

5(2) Spiders with six eyes, all easily seen from above, in a fairly compact group (Text Figs 5a–d, p. 38). Adult ♀ without an epigyne. ♂ palpal organs with a simple bulb attached to the tarsus, which is little modified. (Text Figs 18–20, pp. 59, 61, 63) (HAPLOGYNE Spiders) 6

– Spiders with eight eyes, sometimes together, sometimes widely separated and not always easily seen initially. Adult ♀ with an epigyne of varying complexity. ♂ palpal organs more or less complex and partly contained within the hollowed out modified tarsus (cymbium) (ENTELEGYNE Spiders) 7

6(5) Spider marked clearly on carapace, abdomen and legs with black pattern on pale yellow background. Carapace humped up posteriorly; legs slender; chelicerae small. Single British species has a distinctive appearance (Plate 14). Eyes as in Text Fig. 5a, p. 38 ..... SCYTODIDAE

– Small spiders (adults 1.5–2mm). Uniformly pale yellow or pinkish-red in colour. Chelicerae small (Plate 13). Eyes as in Text Fig. 5b, p. 38 ..... OONOPIDAE

– Larger spiders (adults 5–22mm). Chelicerae larger and projecting anteriorly (Plates 15–17). Eyes as in Text Fig. 5c, p. 38 ..... DYSDERIDAE

– Eyes as in Text Fig. 5d, p. 38 ..... SEGESTRIIDAE

7(5) (Spiders with eight eyes but lacking cribellum and calamistrum)

A Carapace roughly circular, as wide as long, with eyes as in Text Figs 5e,g, p. 38 (Plates 18, 19; compare Plate 126). Legs extremely long (leg I four to five times body length). Tarsi with flexible false segments (Text Fig. 5f, p. 38) ..... PHOLCIDAE

B Carapace square-fronted with four large eyes on the front, the median pair being particularly large (Text Figs 5h–k, p. 38). Two smaller pairs of eyes dorsolaterally ..... SALTICIDAE

C Spinners in a transverse row and tracheal spiracles ⅓–½ way from spinners to epigastric fold (Text Figs 6a–c, p. 39). Small spiders ..... HAHNIIDAE

D Eyes arranged as in Text Fig. 6d, p. 39 (note the very small anterior medians which may not be visible from above). Legs with very long spines (Text Fig. 6e). The single British species is rare ..... OXYOPIDAE

E Tracheal spiracles just behind epigastric fold (Text Fig. 6f, p. 39). Carapace with a median line of *short*, dark hairs (Text Fig. 6g). The single British species, the water spider, almost entirely aquatic ..... ARGYRONETIDAE

F Tracheal spiracles easily visible midway between spinners and epigastric fold (Text Figs 7a,b, p. 40). Distinctive mark on dorsal side of abdomen of the single British species (Text Fig. 7c) ..... ANYPHAENIDAE

G Eyes as in Text Figs 7d–g, p. 40. An anterior row of four small, equal-sized eyes (not always seen from above) and a posterior row of larger equal-sized eyes which are strongly recurved forming a trapezium. An imaginary line through the posterior lateral and posterior median eyes crosses the midline ahead of the anterior margin of the carapace ..... LYCOSIDAE

H Eyes as in Text Figs 7h–i, p. 40. An anterior row of small, equal-sized eyes, always easily visible from above, and a posterior row of larger equal-sized eyes which are fairly strongly recurved. (NOTE. In *Textrix* (Agelenidae) the recurved posterior row has eyes *unequal* in size.) An imaginary line through the posterior lateral and posterior median eyes crosses the midline on or behind the anterior margin of the carapace ..... PISAURIDAE

I Eyes as in Text Fig. 7j, p. 40. The eyes in the posterior row are equal in size but those in the anterior row have the medians distinctly larger than the laterals. Carapace yellowish with chocolate markings ..... ZORIDAE

J Legs I and II, when viewed from above, show a series of prominent curved spines on metatarsus and tibia (Text Fig. 8a, p. 41). Small curved spines are set at regular intervals between them. When viewed laterally, the metatarsi appear markedly curved ..... MIMETIDAE

K Posterior spinners larger than anteriors *and* of two segments (Text Figs 8b–g, p. 41), median spinners easily visible. (Terminal segment of posterior spinners not always visible in *Cryphoeca* (Plates 94, 96b) where it may be obscured by long hairs.) Three tarsal claws present ..... AGELENIDAE

L Eyes black (occasionally dark blue-grey) with both rows recurved to a greater or lesser degree (Text Figs 8h–m, p. 41). Most (but not all) species have crab-like stance with legs I and II longer and stouter than III and IV ..... THOMISIDAE

– Description not covered by *A* to *L* 8

8(7) Tarsi with three claws, easily visible, the paired ones usually furnished with teeth (Text Figs 9a–d, p. 42) 10

– Tarsi with only two claws which may be partly hidden by tufts of hair (Text Figs 9e–j, p. 42) 9

9(8) Anterior spinners cylindrical, slightly longer than posteriors and separated so that median spinners are easily visible (Text Figs 9k–n, p. 42). Posterior median eyes oval in most genera. (NOTE. In *Micaria* (Text Fig. 9n) the anterior spinners are *not* separated but the posterior eyes are distinctly oval; *Scotophaeus*, and occasionally *Zelotes*, although having entirely characteristic spinners (Text Figs. 9l,m), have circular posterior median eyes) ..... GHAPHOSIDAE

– Anterior spinners cylindrical or conical, and close together so that median spinners are not visible. Posterior spinners usually a little longer and occasionally of two segments (Text Figs 10a–d, p. 43). Posterior median eyes circular ..... CLUBIONIDAE (p. 80), EUSPARASSIDAE

(NOTE. The single British species of the Eusparassidae (*Micrommata virescens* (Clerck), Plate 39) is unmistakable, ♀ being entirely green and ♂ having three longitudinal scarlet bands on abdomen.)

10 Tarsi IV with a comb of serrated bristles ventrally, difficult to see in very small species (Text Fig. 10e, p. 43). Labium no swollen distally (Text Fig. 10f). (Occasionally swollen in *Euryopis*, *Theonoe* and *Robertus*; but note, also *not* swollen in *Pachygnatha*, Tetragnathidae.) Posterior margin of chelicerae usually lacking teeth. ♂ palp lacking distinct paracymbium which is often only a very small hook near the distal margin of cymbium (Text Fig. 10g). Web composed of irregular criss-cross strands, only very occasionally forming a sheet .... THERIDIIDAE

– Tarsi IV with a comb of serrated bristles ventrally (easily visible). Labium swollen distally (Text Fig. 10h, p. 43). ♂ palp with large paracymbium (Text Fig. 10i). Web composed of irregular criss-cross strands ..... NESTICIDAE

– Tarsi IV without serrated bristles ventrally. Small spider (1.5–3mm). Both ♀♂ of the single British species have a globular abdomen marked with silver (Plate 157) ..... THERIDIOSOMATIDAE

– Tarsi IV without serrated bristles ventrally. Labium swollen distally (Text Figs 11a,c–e, p. 44) *except* in *Pachygnatha*, Tetragnathidae. Posterior margin of chelicerae with one to several teeth. ♂ palp with a paracymbium (Text Figs 11a–e). Spinners of sheet-like webs or orb webs (often with haphazard strands above and below) 11

11(10) Maxillae distinctly longer than broad (Text Figs 11a–c, p. 44). (As the maxillae project ventrally they may need to be viewed slightly from behind to see this.) Some species have elongate chelicerae. ♀ epigynes simple. ♂ palps with an elongate paracymbium, sometimes branched (Text Figs 11a–c). Most species spin orb webs ..... TETRAGNATHIDAE

– Maxillae not, or scarcely longer than broad (Text Figs 11d,e, p. 44) 12

12(11) Chelicerae usually with stridulating ridges laterally (Text Fig. 11e, p. 44) and without a lateral condyle. Tarsi with three claws but no auxiliary foot-claws (Text Figs 9b–d, p. 42). Spinners of sheet webs ..... LINYPHIIDAE Volume 2; Volume 3, Plates 158–237

– Chelicerae without stridulating ridges and usually with a lateral condyle (Text Fig. 11d, p. 44). Tarsi with three claws and auxiliary foot-claws (Text Fig. 9a, p. 42). Spinners of orb webs..... ARANEIDAE

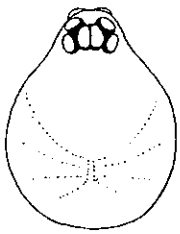
Text Figure 5

I SPIDER FAMILIES WITH SIX EYES **carapaces**

SCYTODIDAE

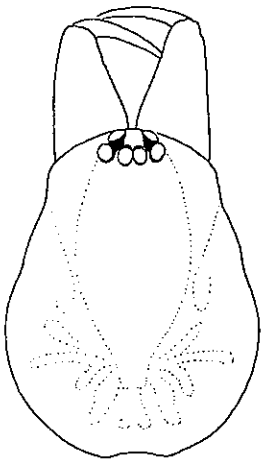
(a) *Scytodes*

OONOPIDAE



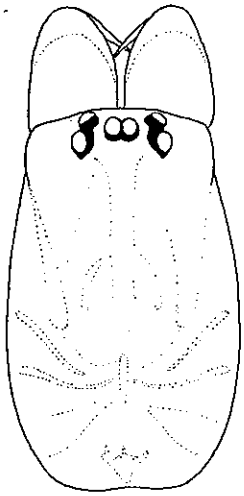
(b) *Oonops*

DYSDERIDAE



(c) *Dysdera*

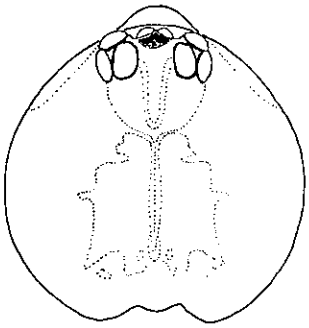
SEGESTRIIDAE



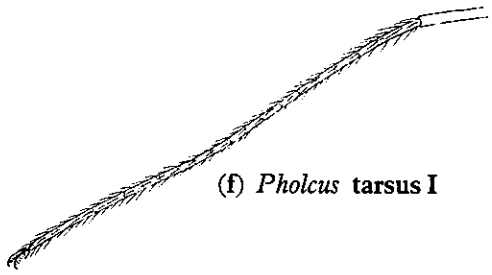
(d) *Segestria*

II SPIDER FAMILIES WITH EIGHT EYES **carapaces**

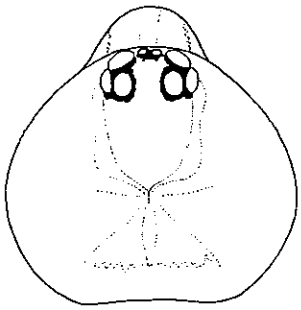
PHOLCIDAE



(e) *Pholcus*

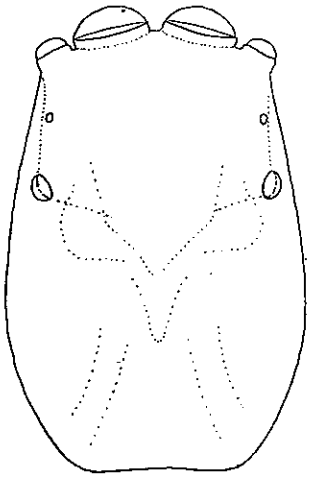


(f) *Pholcus* **tarsus I**

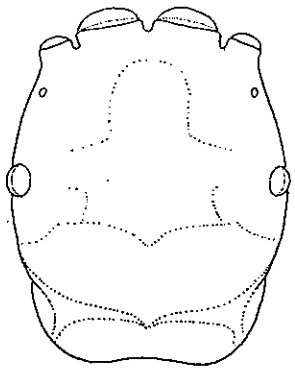


(g) *Psilochorus*

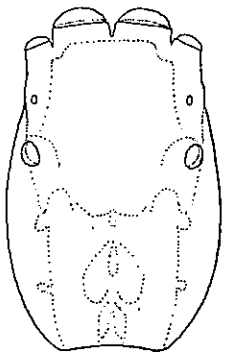
SALTICIDAE



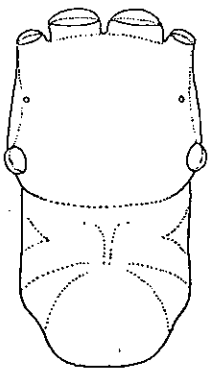
(h) *Salticus*



(i) *Ballus*

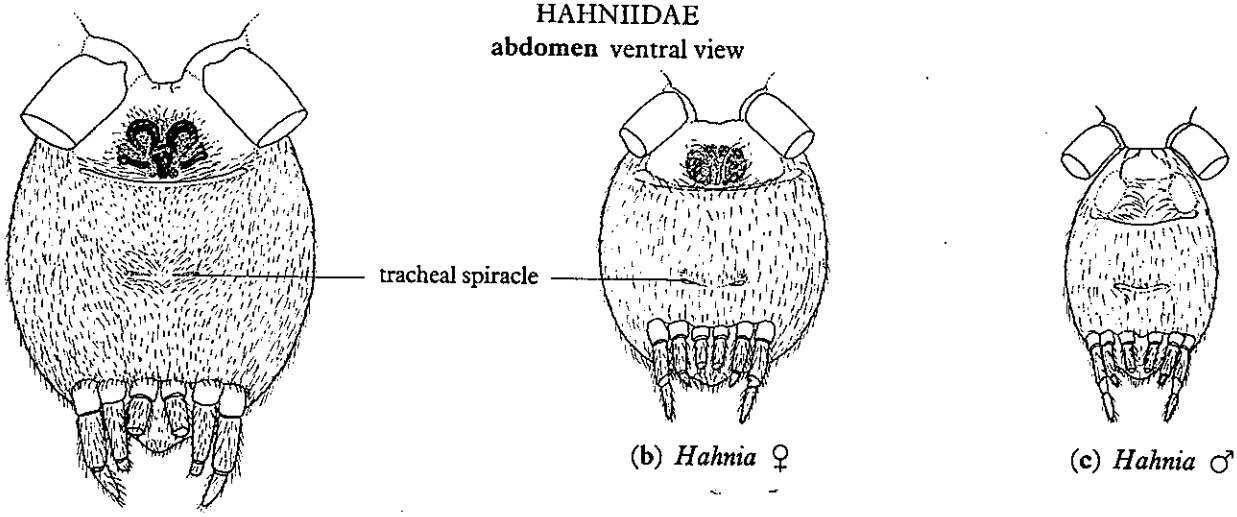


(j) *Marpissa*



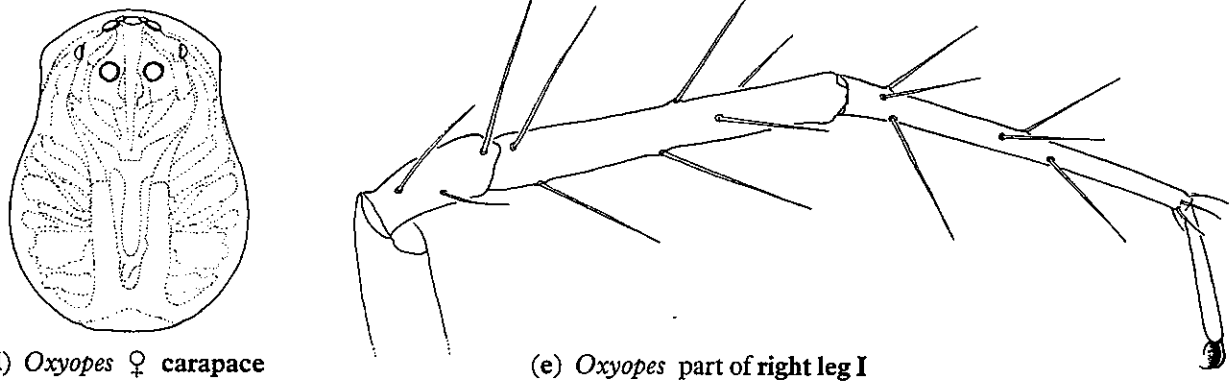
(k) *Myrmarachne*

Text Figure 6
HAHNIIDAE
abdomen ventral view



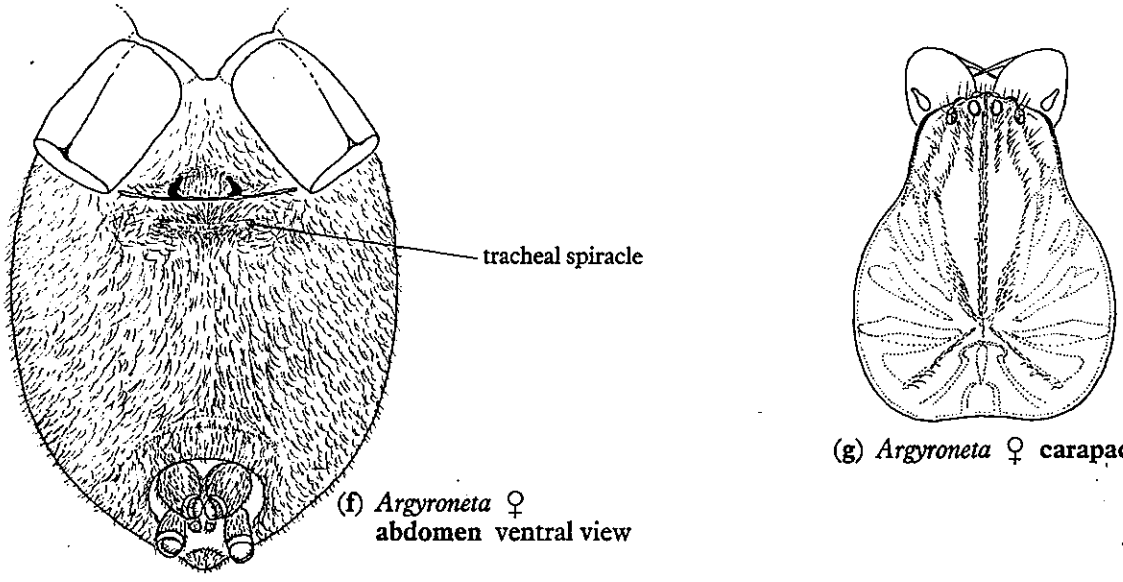
(a) *Antistea* ♀ (b) *Hahnia* ♀ (c) *Hahnia* ♂

OXYOPIDAE



(d) *Oxyopes* ♀ **carapace** (e) *Oxyopes* part of **right leg I**

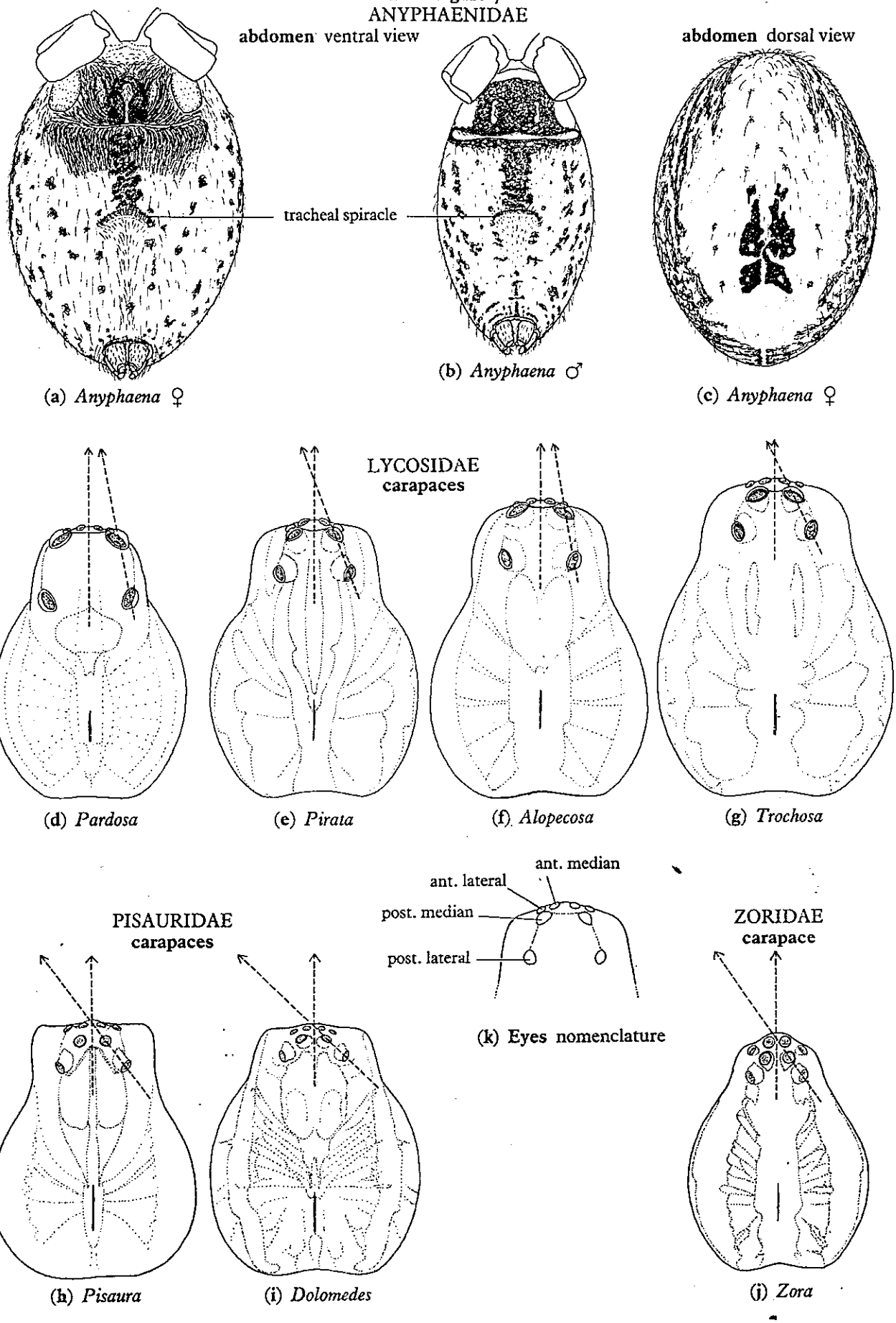
ARGYRONETIDAE



(f) *Argyroneta* ♀ **abdomen** ventral view

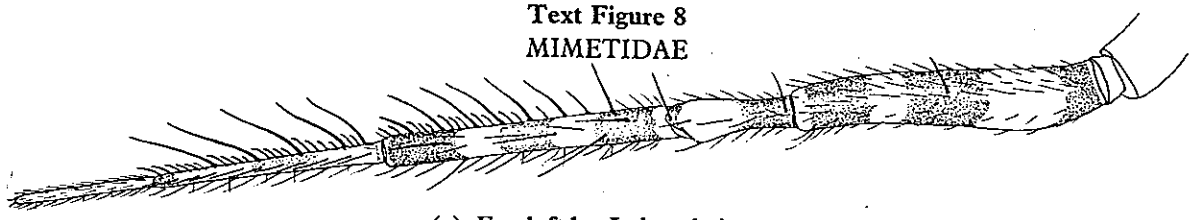
(g) *Argyroneta* ♀ **carapace**

Text Figure 7



Text Figure 8

MIMETIDAE

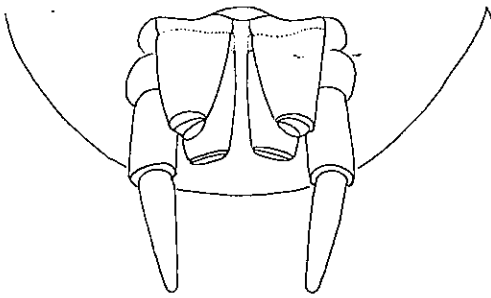


(a) *Ero* **left leg I** dorsal view

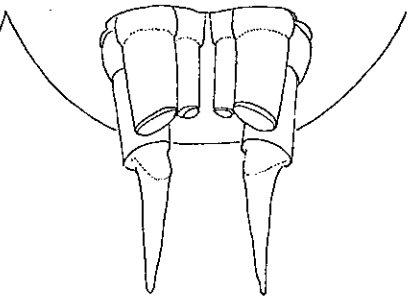
AGELENIDAE

spinners ventral view

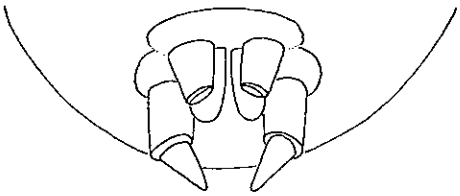
(b) *Tegenaria*



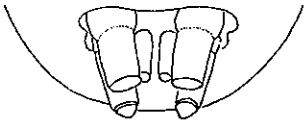
(c) *Textrix*



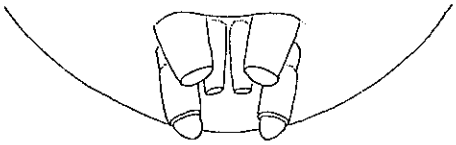
(d) *Coelotes*



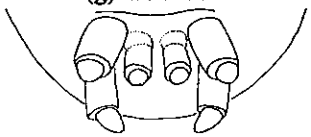
(e) *Cryphoeca*



(f) *Cicurina*

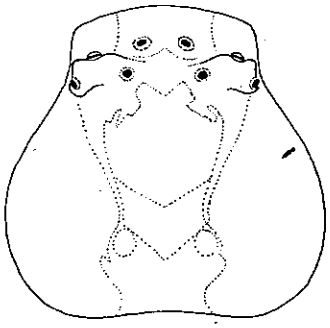


(g) *Tetrilus*

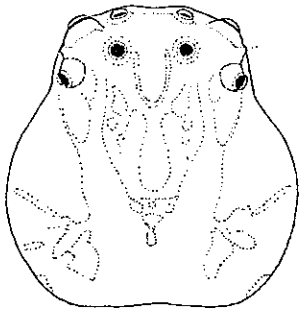


THOMISIDAE

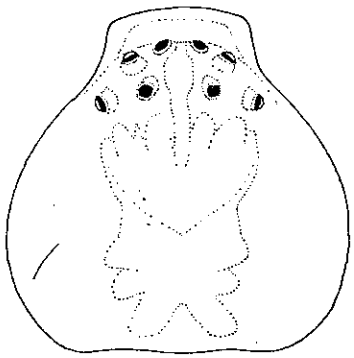
carapaces



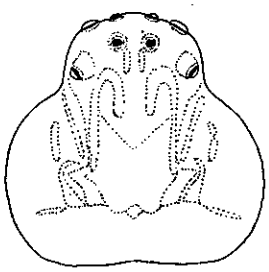
(h) *Thomisus*



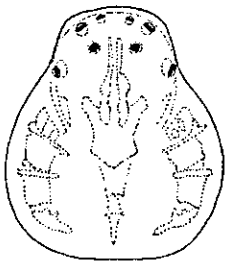
(i) *Xysticus*



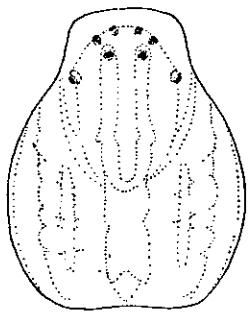
(j) *Philodromus*



(k) *Oxyptila*



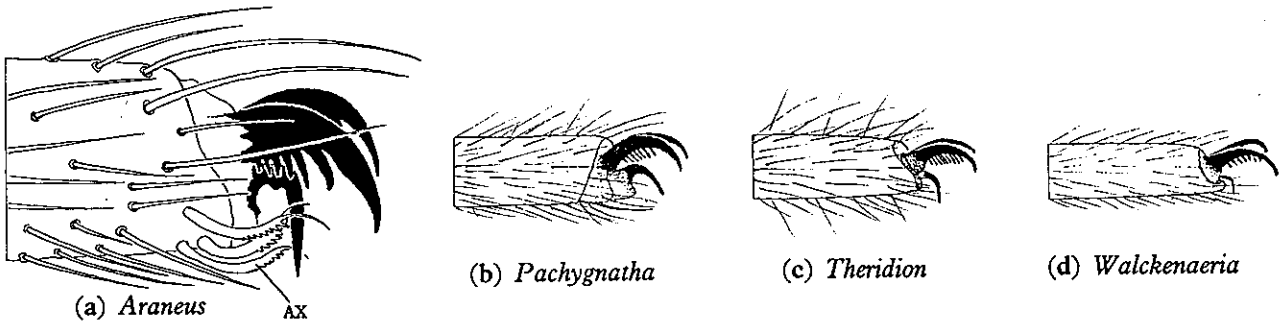
(l) *Thanatus*



(m) *Tibellus*

Text Figure 9

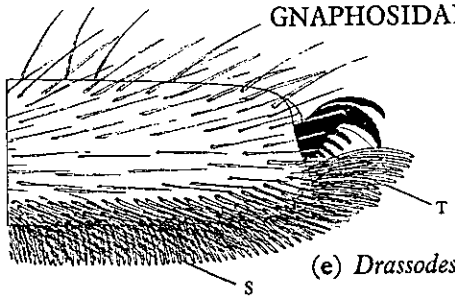
Examples of **tarsi with three claws** and sometimes **auxiliary foot claws** (AX)



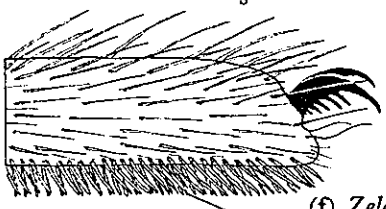
(a) *Araneus* (b) *Pachygnatha* (c) *Theridion* (d) *Walckenaeria*

Examples of **tarsi with two claws** and sometimes **claw tufts** (T) and **scopulae** (S)

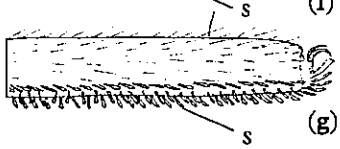
GNAPHOSIDAE



(e) *Drassodes*

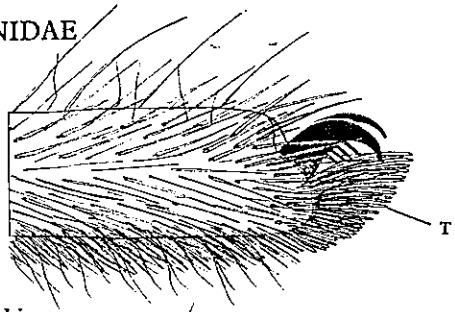


(f) *Zelotes*



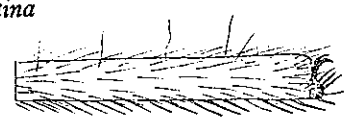
(g) *Micaria*

CLUBIONIDAE



(h) *Clubiona*

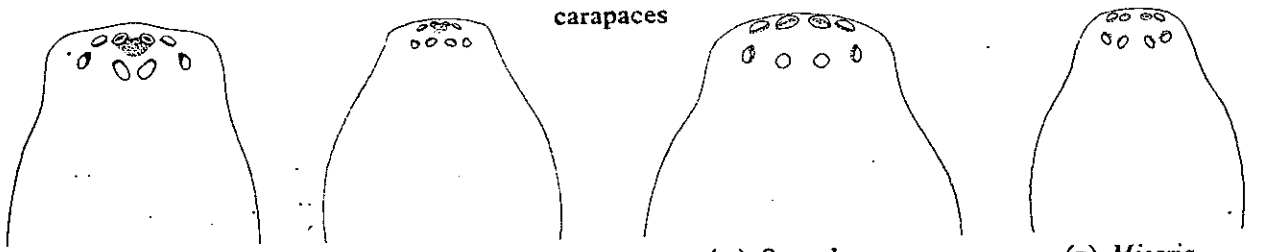
(i) *Scotina*



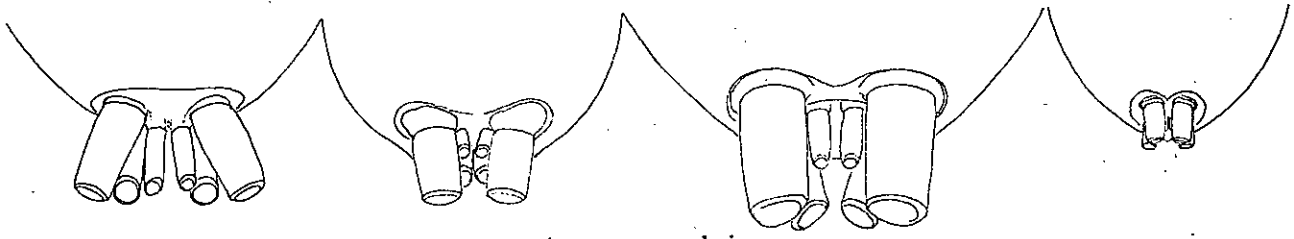
(j) *Phrurolithus*

GNAPHOSIDAE

carapaces

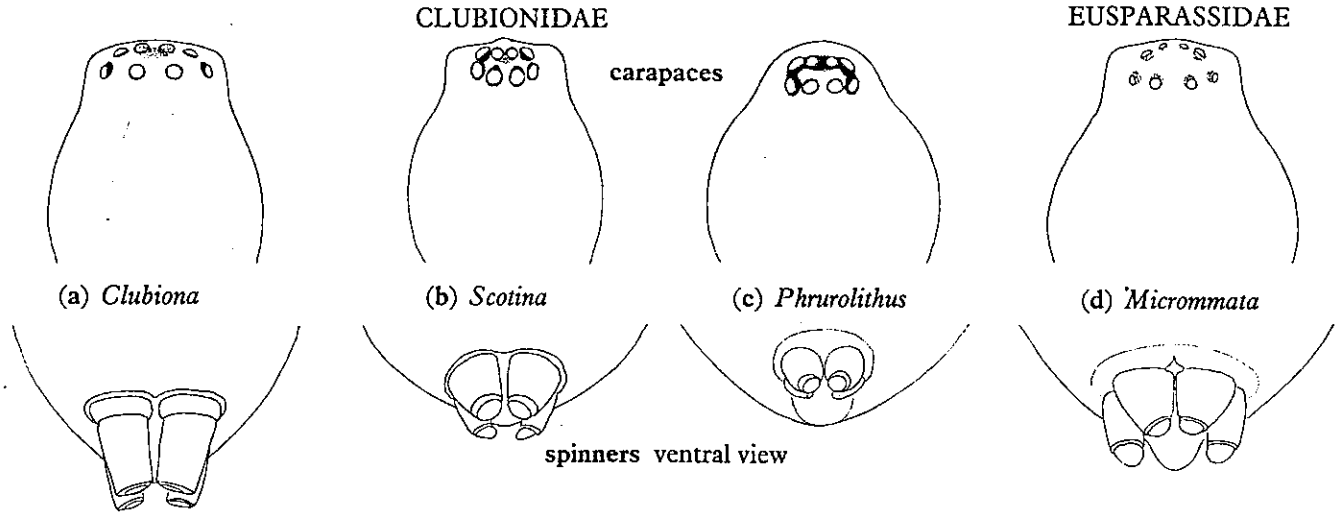


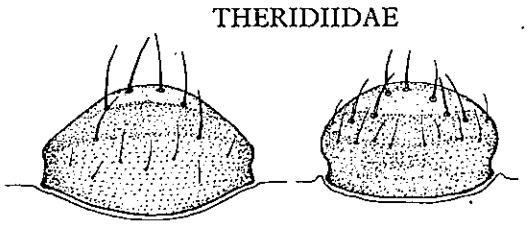
(k) *Drassodes* (l) *Zelotes* (m) *Scotophaeus* (n) *Micaria*

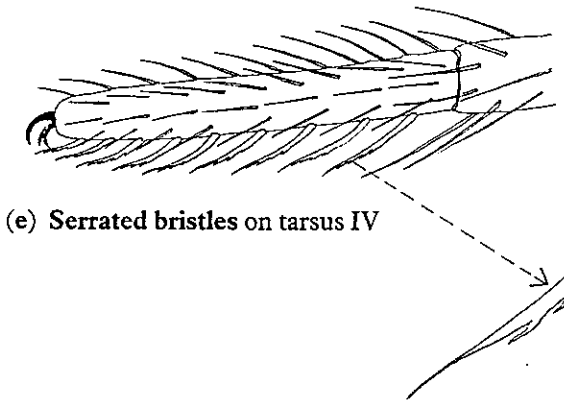


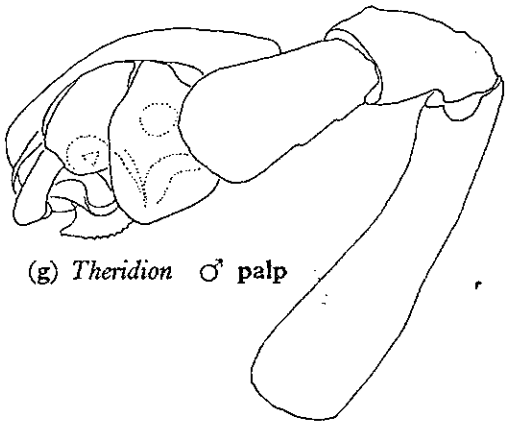
spinners ventral view

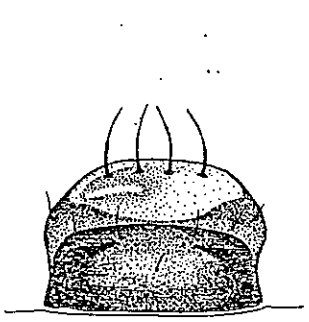
Text Figure 10

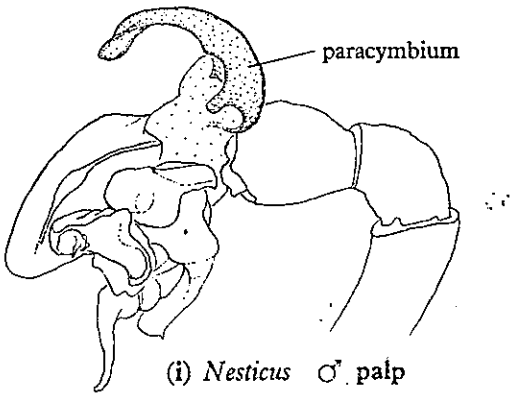










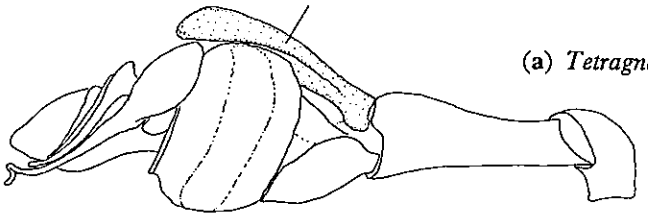


♂ palps

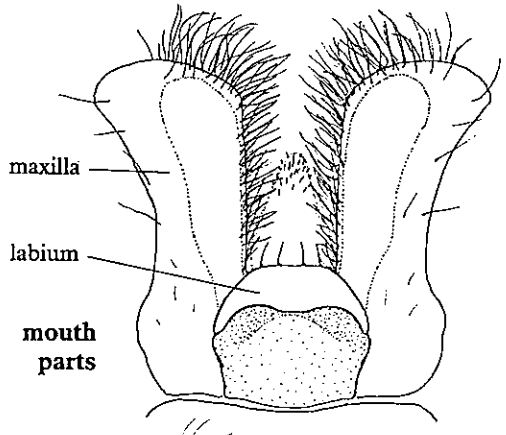
P = paracymbium

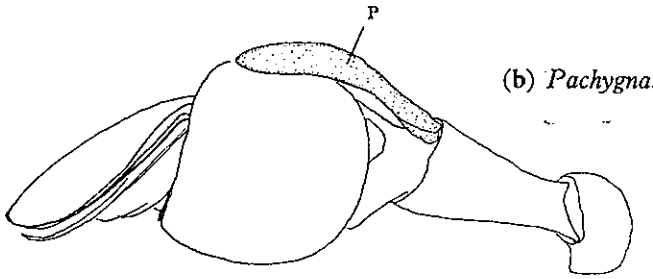
Text Figure 11

TETRAGNATHIDAE

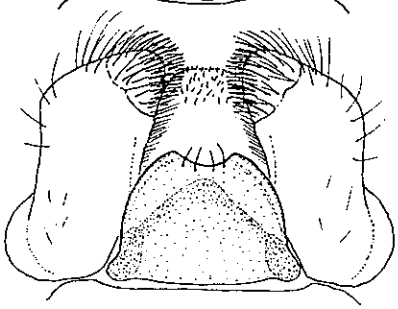


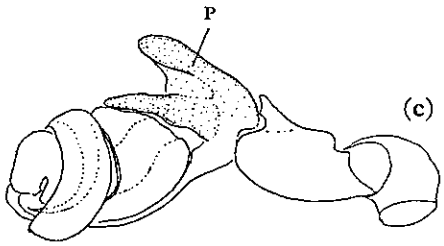
(a) *Tetragnatha*



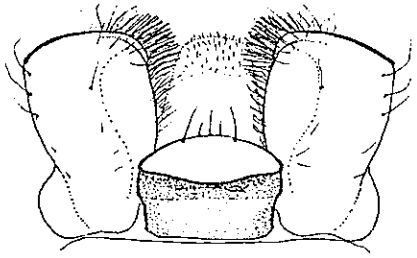


(b) *Pachygnatha*



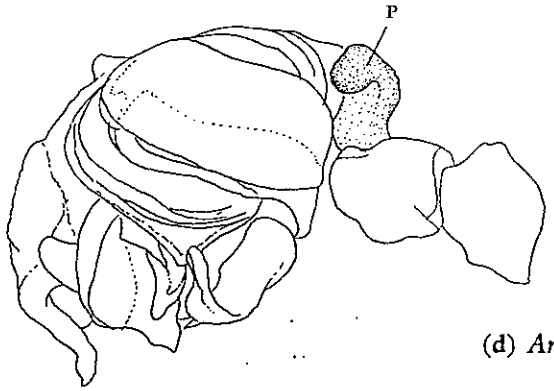


(c) *Meta*

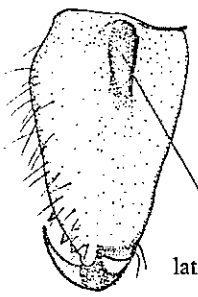


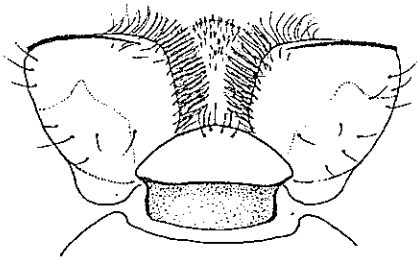
ARANEIDAE

chelicerae (left)

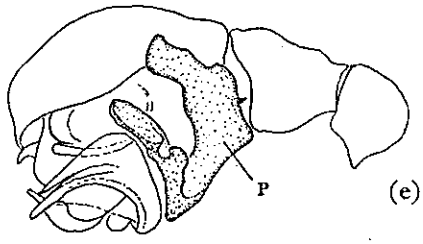


(d) *Araneus*





LINYPHIIDAE



(e) *Lepthyphantes*