

Hemipteroids

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Biology 316 - General Entomology

A. Phylogenetic relationships

- 1. The hemipteroids are a monophyletic group united by numerous characteristics.**
 - a. Hemimetabolous development
 - b. A trend towards haustellate mouthparts
 - c. No large anal lobe in the hind wing
 - d. Venation somewhat reduced
 - e. No cerci
 - f. Relatively few Malpighian tubules
- 2. Sucking mouthparts correspond to being either sap-suckers, ectoparasites, or predators.**

B. Psocoptera (psocids)

- 1. Morphological notes**
 - a. Of all the hemipteroids aside from one group of lice, these animals are the only ones with mandibulate mouthparts.
 - b. The wings are held roof-like over the abdomen and they have threadlike antennae.
 - c. Many species are wingless.
- 2. Diet**
 - a. As the mouthparts suggest, these animals are not suckers by trade.
 - b. They are mostly scavengers.
 - c. Psocids are frequently gregarious with immatures and adults forming huge congregations.
 - d. Some species are found in vegetation and are commonly called barklice.
- 3. Reproduction**
 - a. Parthenogenesis is fairly common with males being extremely rare or unknown in some species.
- 4. Social and economic aspects**
 - a. The common booklouse is found in homes where it eats dry, starchy foodstuffs. Psocids, however, are not lice.
 - b. They largely go unnoticed.

C. Phthiraptera (lice)

- 1. Morphological notes**
 - a. The lice are sometimes divided into two orders, the Mallophaga (chewing lice) and the Anoplura (sucking lice). Many current texts reflect this grouping elevating both to the rank of order. However, the previous edition of our text recognized the Mallophaga and the Anoplura as separate orders and now combines them.

- b. The sister taxon of the Phthiraptera is the Psocoptera.
- c. For those authorities that recognize two orders of lice, the chewing lice are considered to be the sister group of the Psocoptera due to their mandibulate mouthparts.
- d. Sucking lice have stylate haustellate mouthparts (piercing-sucking).
- e. Both types of lice exhibit specific adaptations for an ectoparasitic lifestyle.
 - i □ Sensory structures are often reduced or absent.
 - ii Antennae are short and can be tucked against the head.
 - iii The body is usually flat and streamlined.
 - iv The tarsi are hook-like for grasping the hair of the host.
 - v All are wingless; many species are phoretic, catching a ride attached to another flying insect. This allows the louse to find a new host, an especially important task if the current host is dying.

2. Diet

- a. Sucking lice feed on the blood of their host.
- b. Chewing lice feed on hair, feathers, or bits of skin of the host.
- c. Most lice are extremely host specific. They can feed on only ONE species of host. More on this idea later.

3. Reproduction

- a. Most lice are bisexual; however, parthenogenesis has been noted.
- b. Eggs are glued onto hair shafts or tucked into the follicles of feathers or in nests.

4. Social and economic aspects

- a. The sucking lice are parasites of domesticated animals and two species are associated with humans (crab louse and the head louse).
 - i □ The eggs of lice are called nits, hence the expression nitpicking.
 - ii Some have the ability to transmit epidemic typhus and other diseases to humans.
- b. The chewing lice are composed of several species that are serious parasites of poultry.
 - i □ There are no known chewing lice that feed on humans.
- c. All orders of birds and most orders of mammals serve as hosts.

5. Team Project - D takes notes, C speaks

- a. Lice are secondarily wingless. Outline a potential evolutionary pathway to their loss of wings. Recall that discussions of evolutionary pathways must focus on individual fitness.

D. Thysanoptera (thrips)

1. Morphological notes

- a. Thrips are very small, usually black.
- b. The wings are fringed with fine hair-like structures.

2. Diet

- a. Most thrips feed by piercing plant tissues then imbibing the juices. This usually leaves a characteristic mottling of the leaf.

- b. Many phytophagous species specialize on the reproductive tissues like flowers, buds, and young fruits.
- c. Some species are predaceous on aphids and on the eggs of mites and Lepidopterans.

3. Reproduction

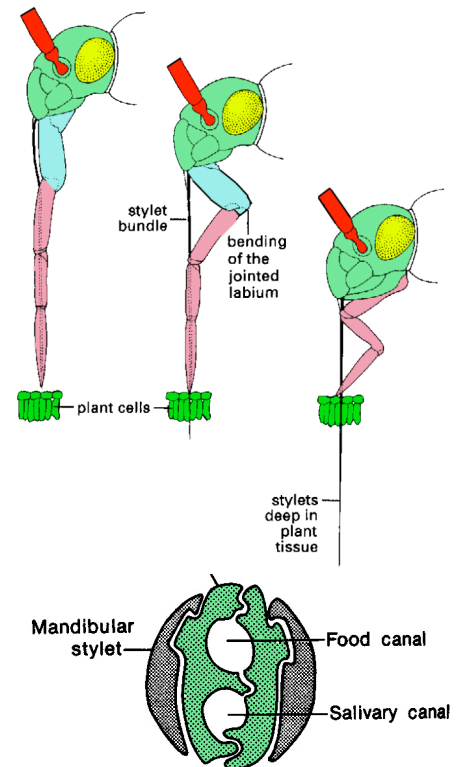
- a. Most thrips are bisexual, but parthenogenesis is common, and males are rare or unknown in some species.
- b. Female thrips are diploid while males are haploid.
- c. Some galling forms show social structure with rudimentary castes including soldiers.

4. Social and economic aspects

- a. Several plant viruses are transmitted by thrips.

5. Team Project - C takes notes, B speaks

- a. Without looking ahead in the outlines, come up with three possible adaptations for feeding on fluids.



E. Characters of the Hemiptera

1. Mouthparts

- a. They have styletate haustellate mouthparts.
- b. The stylets are composed of appressed mandibles and maxillae.
- c. The stylets form two canals, the salivary canal and the food canal.
 - i ☐ The salivary canal directs saliva into the plant.
 - ii ☐ The food canal takes plant juices into the bug.
- d. The labium forms a rostrum or guide through which the stylets are directed into the plant.

2. Adaptations related to feeding on plant fluids

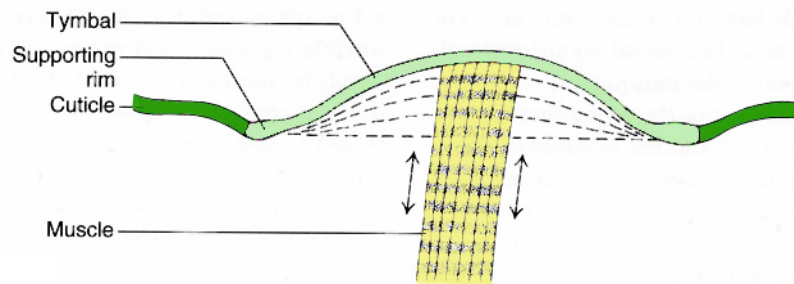
- a. Plant fluids do not provide a nutritionally complete diet.
 - i ☐ Most hemipterans that feed on plant fluids support symbiotic bacteria or yeast in their guts.
 - ii In some, these may be housed in special gut diverticula or float freely within the alimentary canal or they are inside special cells called mycetocytes.
 - iii The symbiosis is obligatory (both species require the other) and the microorganisms are transmitted transovarially from one generation to another.
- b. Salivary glands are common as the alimentary canal is modified for the uptake of fluids (either plant or animal).
- c. Extraoral digestion is common and relatively large quantities of saliva are injected into the host's tissue, causing local necrosis in plants or paralysis in animal prey.

3. Sound production

- a. Sound production is very common.

b. Sound is produced by a variety of structures suggesting multiple evolutionary events. However, the behavior that leads to sound production may be the ancestral state.

- i □ Cicadas use a parchment-like tymbal at the base of the abdomen.



- ii Reduviids stridulate by rubbing the rostrum over the striate walls of the prosternal furrow.
- iii Corixidae stridulate by drawing the anterior femora over the clypeal margin.
- iv Some Pentatomidae rub a comb on the inner surface of each wing over a striate area at the base of the abdomen.
- v There are other examples.

F. Suborder Heteroptera (true bugs)

1. Morphological notes

- a. All heteropterans have their first pair of wings modified with the basal portion thickened and leathery and the distal portion membranous.
- b. The beak arises from the front part of the head.
- c. Many have scent glands located near the metathoracic coxae.

2. Diet

- a. Species are phytophagous, predators, or parasites.
- b. Many are aquatic, but most are terrestrial.
- c. Herbivores feed on the parenchyma of plants, in contrast to the other suborders of the Hemiptera that feed on either phloem or xylem fluids.
- d. Some species are specialists on seeds.
- e. The largest number of marine species occurs within the Heteroptera. Gerridae contain several marine species.

3. Reproduction

- a. Most species are oviparous, ovipositing their eggs on or in plant tissue, on soil, or on other surfaces.
- b. None are parthenogenetic, in sharp contrast to the other suborders of the Hemiptera.

4. Social and economic aspects

- a. Many are important pests in agriculture and stored crops.
- b. One family, the bed bugs (Cimicidae), is ectoparasitic on humans. However, they are not known as vectors for diseases.
- c. One large family, the assassin bugs (Reduviidae), is mostly predaceous and one subfamily is entirely ectoparasitic on vertebrates. A reduviid known as the cone-nosed

kissing bug transmits the causative agent of Chagas disease, *Trypanosoma cruzi*. It is estimated that 16-18 million people are infected with Chagas disease; of those infected, 50,000 will die each year.

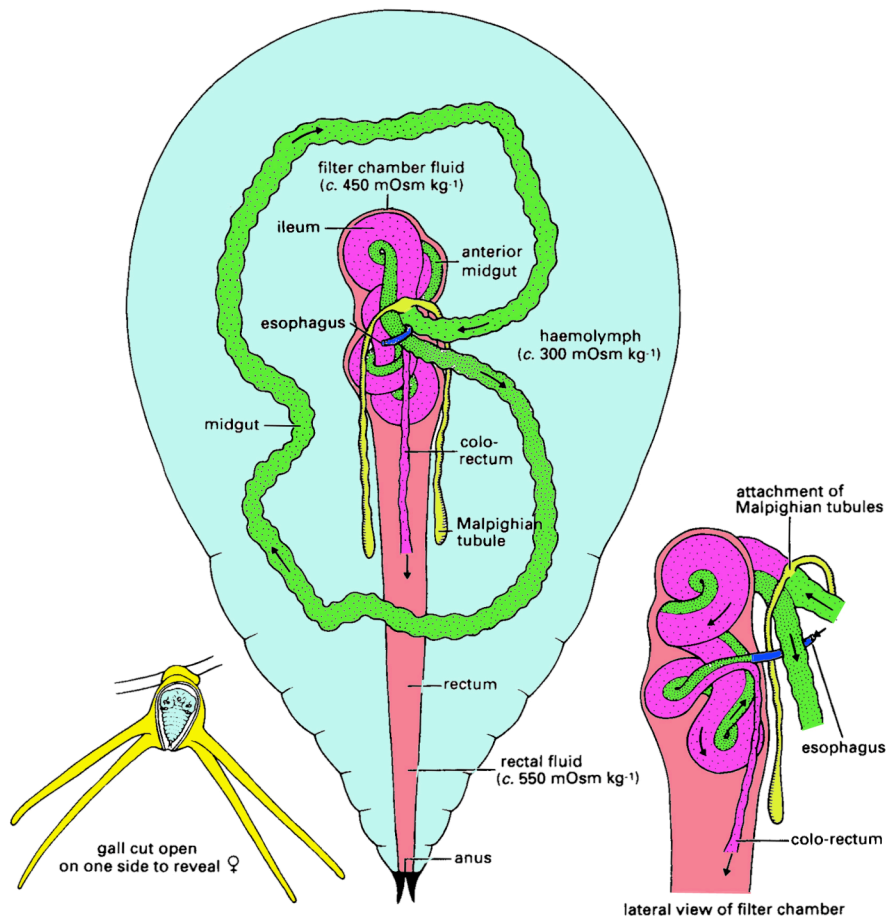
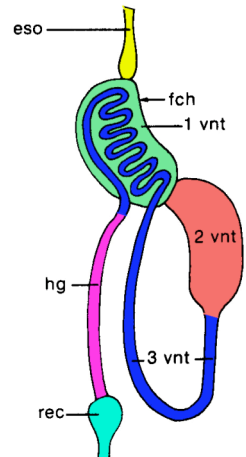
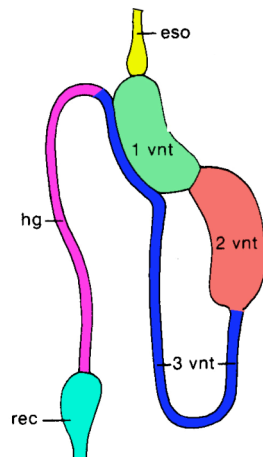
5. Team Project - B takes notes, A speaks

- The Hemiptera are important vectors for disease. Why these bugs? List three possible reasons.

G. Suborders Auchenorrhynca and Stenorrhynca (cicadas, hoppers, psyllids, whiteflies, aphids, and scale insects)

1. Morphological notes

- Some of the most bizarre looking insects are in these suborders.
- Feeding exclusively on plant fluids poses specific osmoregulatory and nutritional problems for these bugs.
- Many have a filter chamber associated with the gut that facilitates the rapid removal of excess water and the concentration of sap. See page 71 in your text.
- The filter chamber is not entirely efficient for the removal of sugars and amino acids from the excess fluids. These fluids are excreted through the anus in the form of "honey dew," a sticky sugary substance.
- Some species use the filter chamber in osmoregulation. They excrete sugars. The filter chamber is highly specialized in that it lies within the rectal wall, facilitating the maintenance of a high osmotic pressure relative to the hemolymph.



Recall the rectum is relatively impermeable.

2. Diet

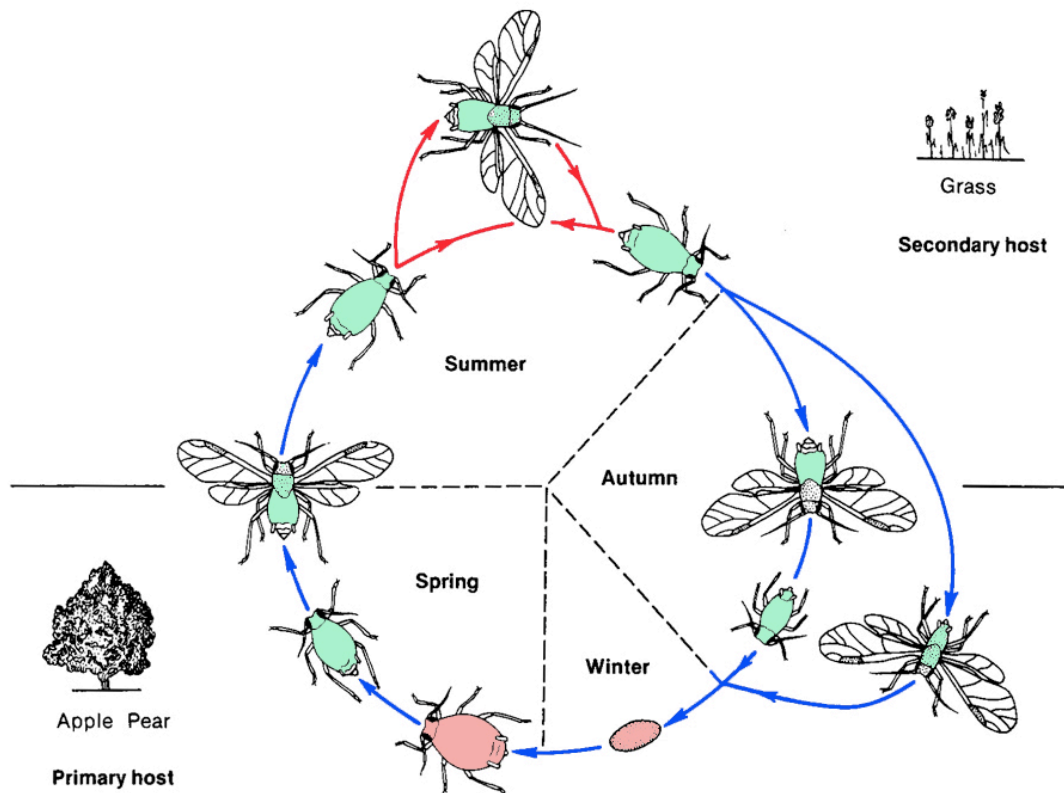
- Sternorrhyncha are phloem feeders and include aphids, whiteflies, scale insects, and psyllids.
- The Suborder Auchenorrhyncha comprise the xylem feeders, the hoppers (plant, leaf, tree) and cicadas.
- There are a few exceptions to this division based on diet.

3. Relationships with ants

- Ants are attracted to the honey dew excretions of scale insects and aphids.
- Many species of scale and aphid are tended by ants, much like how humans tend cows.
- Ants provide protection against predators and move their "cows" to different places on the plant or to different plants. The scale or aphid provide honey dew and some are "culled" for protein.

4. Reproductive oddities

- While many hemipterans have simple life cycles, many have very complex life cycles involving different host plants, bisexual and parthenogenetic reproduction, and the formation of winged and wingless forms.
- An example is the apple-grain aphid.



5. Team Project

- a. From a fitness perspective, which form of reproduction is most efficient, asexual or sexual? Why? What kinds of stimuli would trigger the production of alates?

6. Social and economic aspects

- a. Many hemipterans are vectors for plant diseases. Many insects of agricultural crops do relatively little damage via feeding, but the diseases they transmit can cause enormous economic losses.
- b. One current pest species in Southern California is the Red Gum Lerp (Psyllidae) that feeds on *Eucalyptus*. They can cause extreme damage that results in tree death.

H. Phylogenetic considerations

1. Some texts recognize the two orders, Homoptera and Hemiptera. However, there is enough evidence to warrant combining these two orders.

2. Most authors recognize one order called the Hemiptera with the true bugs comprising the suborder Heteroptera. However, the taxon “Homoptera” is still used and you will see it in various contexts.

3. The Suborder Coleorrhyncha is represented by one family containing 20 species.

- a. The adults superficially resemble tingids (lacebugs), as their wings are reticulate and held flat over the abdomen.
- b. They share a number of characters with both the true bugs and the Homoptera, placing them as the sister taxon to the true bugs.
- c. The alimentary canal lacks a filter chamber as do the Hemiptera, but the rostrum is inserted posteriorly on the head, as in Homoptera.
- d. All stages feed on mosses and liverworts.

4. Paraphyly and the “Homoptera”

- a. The “Homoptera” do not form a monophyletic taxon because the Suborder Auchenorrhyncha form the sister taxon to the Coleorrhyncha-Heteroptera clade.

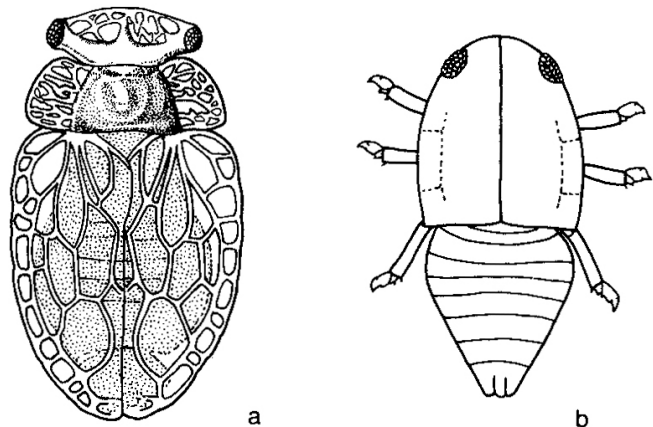


Figure 34.3 Peloridiidae; **a**, adult; **b**, nymph. (a, modified from Myers and China, 1929; b, modified from Helmsing and China, 1937.)

