LABORATORY EXERCISE 27:
Courtship and Reproduction, Part II: Sound

D. Acoustical Cues:

Representatives of many orders produce (and receive) acoustical signals to attract other conspecifics, advertize their own presence, compete with other individuals of the same sex, or exchange information with their heterosexual partner during courtship and mating. In some insects, these signals take the form of substrate-borne vibrations, produced by either drumming or shaking. In insects large enough to provide a sufficiently large radiating surface, the acoustical signals may enter the air as airborne sound. Substrate-borne signals may be of any frequency (= pitch or tone), from very low (a few cycles per second or ***hertz***) to relatively high (especially when the substrate is actually struck, via drumming), ranging up into the low ***kilohertz*** range. Airborne sounds are typically much higher in frequency, ranging from a few kilohertz up into the ultrasound range (above 20 kilohertz). Whether substrate-borne or airborne, mating signals are typically divided up into phrases or syllables with highly specific temporal (timing) properties, such as phrase duration, interval, repetition rate, etc.

Substrate-borne sounds are produced by the insect moving its whole body or, more usually, some body part. Some of the best-studied insect drummers are the stoneflies or Plecoptera; males of many stonefly species use their moving abdomens to produce species-specific mating signals. Examine the abdomen of a male of a stonefly, noting the sternal region of the abdomen. Are there any particular modifications that you can see? Insect groups within which substrate shaking or ***tremulation*** have been described include many Tettigoniidae (order Orthoptera) and most members of the green lacewing family Chrysopidae (order Neuroptera). Several living lacewings are on demonstration; we may get to see them tremulating.

Airborne sounds are produced by two mechanisms, stridulation and tymbal vibration: During **stridulation**, two parts of the body are scraped against each other. For example, in many short-horned grasshoppers (Orthoptera, suborder Caelifera), the rough or pegged inner surface of the metathoracic femur is rubbed against a specially reinforced wing vein on the folded fore wing. Alternatively, in long-horned grasshoppers like katydids and crickets (Orthoptera, suborder Ensifera), specially modified front wings are moved rapidly back and forth against one another. Spread the front wings of a male of either a katydid (Tettigoniidae) or a cricket (Gryllidae) to reveal the sound-producing structures. Make a drawing (**Drawing #51**) of the left and right wings in open position, labeling the file, scraper (plectrum), mirror, and main veins.

Tymbal vibration uses a special, complex structure powered by internal musculature to produce airborne sounds. The best examples of paired tymbals are found in the auchenorrhynchan Hemiptera, typified by Cicadidae (cicadas). In cicadas and related families, the tymbal is located on the dorso-lateral surface of the 1st abdominal segment and consists of a ridged area of cuticle backed by an air space derived from an abdominal tracheal sac. Make a drawing (**Drawing #52**) of one tymbal of a cicada from the dorsolateral view, labeling the surrounding body segments, tymbal, and cuticular ridges. Smaller auchenorrhynchan "hoppers" use their tymbals to produce substrate vibrations, by pressing the abdomen against the substrate.