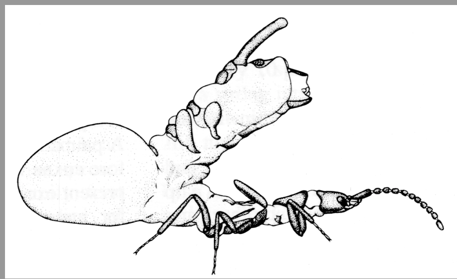

ENTOMOLOGY 322
LAB 3
Abdomen of Adult Insects

The insect abdomen retains some primitive arthropod features and is therefore a good starting point for our survey of insect anatomy. As you work through this lab keep in mind the morphology of the centipede trunk segments and consider both similarities and differences to the insect abdomen. Biologically, the abdomen of insects plays an important role in respiration, reproduction, digestion, excretion and intermediate metabolism.

1.

Obtain a live cricket (Orthoptera: Gryllidae). Note how it holds its abdomen and cerci. Grasp the thorax with your fingers or forceps and observe its abdomen under the stereomicroscope. What movements is the abdomen capable of? How do the cerci move? Do the cercal setae move?

2.

Obtain a preserved cricket and trim the wings and hind legs so that you can better see the abdomen. In lateral view identify the terga (sing., tergum), sterna (sing., sternum) and the membranous pleural region (use Fig. 3.1 for help). Note that each of the first eight abdominal pleura have spiracles. Identify the first abdominal tergum (immediately behind the metanotum). Count the visible terga of your cricket. You should count ten visible terga and either ten (in males) or eight (in females) visible sterna. Females can be identified by the presence of a large ovipositor located at the apex of the abdomen. The eleventh abdominal tergum is the epiproct (Eppt), the apical segment of the abdomen. The epiproct may be indistinguishable from the tenth abdominal tergum (X), as these two terga are often fused in pterygote insects. The eleventh abdominal sternum is represented apically by the paraprocts (Papt). The cerci (Cer) arise between the upper margin of the paraprocts and the lateral margins of the epiproct. Cerci are annulated sensory appendages, which are thought to be homologous to the jointed legs of the thorax. Cerci are modified in many insects either as clasping organs or as defensive pincers (e.g., Dermaptera).

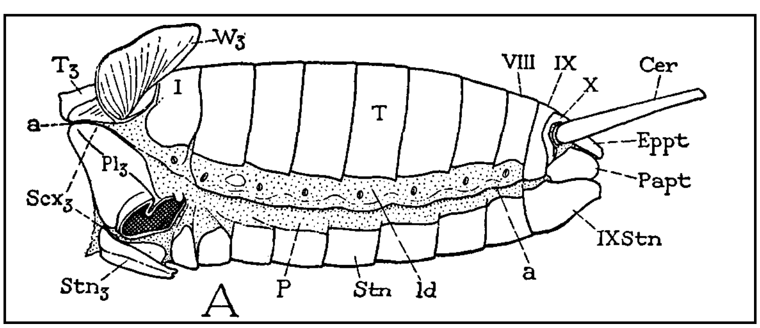

Figure 3.1 (Snodgrass 1935, p.251)

3.

Examine the demonstration of abdominal appendages in a bristletail (Archeognatha: Machilidae). Bristletails retain a seemingly very primitive abdominal morphology. Paired appendages (styli) are located on each abdominal segment, a trait found in most other arthropods (e.g., centipedes, crustacea & trilobites). Whether or not machilid abdominal appendages are homologous to entire limbs (telopodites) or limb segments (epipodites) is not clear. Remarkably, structures similar to the abdominal styli are also present on the thoracic telopodites (Fig. 4.1A, Sty?), suggesting that these are actually epipodites. It is interesting to note that the Entognatha (= Collembola, Protura & Diplura), the putative sister group to the Insecta, lacks abdominal appendages. Abdominal appendages (styli) like those of the Archaeognatha are also visible in the Thysanura, but are restricted to abdominal segments 7, 8, and 9 (Snodgrass, 1952).

Using Fig. 3.2, locate the following:

eversible vesicle (Vs)	**sternum (Stn)**
stylus (Sty)	**base (Cxpd = coxopodite)**

Now observe some living bristletails or silverfish. How do they move? How is the abdomen held when the insect walks? Can you observe how the styli are used? According to Smith (1970), the styli are used as rigid skis on which the abdomen glides. The 9th abdominal styli can be used to push the insect when it climbs or as props when trying to climb a smooth surface.

The eversible vesicles are membranous sacs that can be everted by hemostatic pressure and retracted by muscles. According to Smith and others, they are used to absorb water from damp bark, since these insects do not drink standing water.

Persuade the bristletails to jump. How is the abdomen used? According to Evans (1975), high-jumps are performed with the bristletail first arching its abdomen upwards, then rapidly (in 2-8 msec) beating its abdomen and tail downwards. As the animal rises off the ground, it curls its thorax ventrally, then swings its abdomen upwards so it somersaults once or twice. It may land in any orientation but will right itself very quickly (often less than 0.05 sec), so it always appears to land on its feet. The abdominal musculature, among the most complex in the Arthropoda, includes twisted rope-like muscles that are also found in jumping Crustacea.

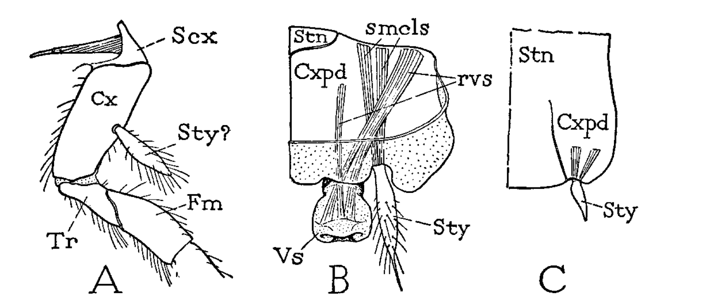

FIG. 148.—Appendages of Apterygota. A, metathoracic leg of *Nesomachilis* with coxal stylus. B, abdominal appendage of *Nesomachilis* bearing a stylus (*Sty*) and retractile vesicle (*Vs*). C, abdominal appendage of *Heterojapyx* with base (*Cxpd*) united with sternum.

Figure 3.2 (Snodgrass 1935, p271)

4.

Obtain a live honey bee or bumble bee and observe its abdominal movements. It exhibits much flexibility in its ventilatory and stinging movements. These movements are controlled by a large number of abdominal muscles. We will examine a few of these in detail below in *Apis mellifera*.

Obtain a preserved honey bee. Each tergum overlaps the tergum posterior to it and successive terga are connected by flexible, arthrodial membrane, which is hidden from view by this overlapping pattern. Note that the sterna show a similar overlapping arrangement, so that each abdominal segment may be telescoped within the segment anterior to it. Thus, overlapping sclerites serve to protect the flexible intersegmental membranes while simultaneously increasing the flexibility of the abdomen. Flexibility is essential for activities such as ventilation, oviposition, and stinging. Finally, note that most of the external surface of abdomen is formed by the terga, which overlap on the sides of the abdomen far more than the terga of the cricket do.

Next, cut the honey bee abdomen in sagittal section and pin the abdomen down with minutin pins so that you can see the interior of the abdomen. Carefully remove the gut and loose connective tissue to reveal the internal musculature. If you have been careful to remove only the gut, you will see a thin, meshlike muscle running horizontally just beneath the terga. These muscles are the transverse dorsal

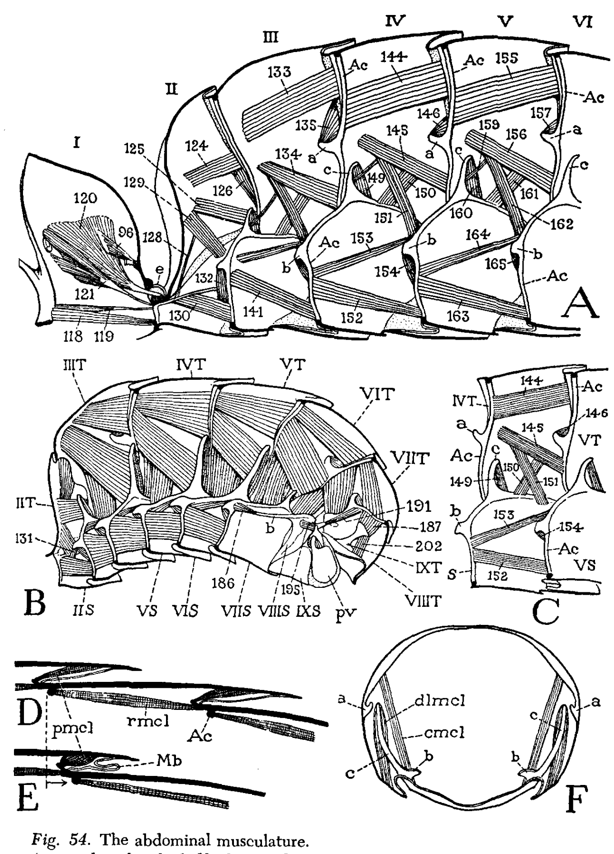

Fig. 54. The abdominal musculature.
A, muscles of right half of propodeum and first four abdominal segments of a worker, mesal. B, muscles of right half of abdomen of a drone, mesal. C, muscles of right half of segment IV of a worker, mesal. D, diagram of retracted abdominal terga. E, mechanism of protraction of segments. F, diagram of mechanism of dorsoventral compression and dilatation of a segment.
a, anterior tergal apodeme; *b*, anterior sternal apodeme; *c*, lateral sternal apodeme; *e*, membranous dorsal wall of petiole. For explanation of abbreviations see pages 166–167.

Figure 3.3 (Snodgrass 1956, p. 141)

muscles and they form the dorsal diaphragm, which separates the heart from the gut.

Note that each tergum bears internally two anterior apodemes (a; Fig. 3.3 A) which extend from the anterolateral margin of each tergum forward beneath the tergum laying anterior. Likewise, note that each sternum bears two median anterior apodemes (b), and two slender, lateral apodemes (c). Locate these apodemes in any of the abominal segments 2-4 — they are important sites of muscle attachment.

Using Fig. 3.3 A identify the following muscles:

1.) internal dorsal longitudinal muscles (144, 145) — these muscles connect successive tergal antecostae, causing abdominal shortening.

2.) external dorsal longitudinal muscles (146) — these muscles connect the apodemes of one tergum to the posterior margin of the tergum anterior. Contraction of these muscles causes the terga to separate, thus extending the abdomen.

Homologous ventral longitudinal muscles are also present — do you see them?

3.) lateral (tergo-sternal) internal muscles (150, 151) — these muscles connect the tergum and sternum and cause lateral compression of the abdomen.

4.) lateral (tergo-sternal) external muscles (149) — these muscles connect the lateral sternal apodeme (c) to the lateral margins of the tergum. Because the tergum overlaps the sternum contraction of these muscles causes the abdomen to dilate. Do you think these muscles could be present in the cricket abdomen?

5.

Obtain a preserved june beetle (Coleoptera: Scarabaeidae) and examine its abdomen under the stereomicroscope. Note how the elytra (=hardened forewings) overlap the abdominal segments. Remove or bend up the right elytron and hing wing. Now locate the eight visible abdominal segments, noting how the thorax joins the abdomen so as to greatly reduce segments 1 and 2. Where are the spiracles located? Which parts of the abdomen are flexible and which are sclerotized? Do you think that the sterna are capable of anterior-posterior ventilatory pumping movements? Note that the sclerotization of the sterna extends dorsally to include the pleural region. The terga, which are protected by the elytra, are completely flexible. How does the sclerotization of abdominal segment 7 compare with that of the more anterior segments? Why is it different? Note that the genitalia can be completely retracted into the abdomen, and that the eighth tergum forms a lid over this genital chamber.

6.

Observe the demonstration of a live beetle, in which the elytra have been pinned back to expose the terga. Note that expansion and contraction of the abdomen are mostly limited to dorso-ventral movements of the terga, which are normally protected by the hard elytra. These movements are important in ventilation of the tracheal system. Thus beetles, which we normally think of as rigid, heavily sclerotized insects, still retain abdominal flexibility associated with respiration.

7.

Obtain a specimen of your insect species. Remove or fold back the wings if they overlap the abdomen. Observe the external anatomy of the abdomen. Are the genital segments modified? Is the ovipositor or external male genitalia visible? Do the terga and sterna overlap? How many spiracles are visible?

Locate the following structures in your insect (if present):

terga	**epiproct and paraproct**
sterna	**anus**
pleural membranes	**external male genitalia**
intersegmental membranes	**ovipositor**
spiracles	**cercus**