ENTOMOLOGY 322 LAB24
Male Reproductive System

The elements of the male reproductive tract are similar to those of the female. In fact homologous elements are easily identified. Paired testes (=ovaries), each composed of multiple spermatic tubules (=ovarioles), are connected to a common ejaculatory duct (=common oviduct) via slender vas deferens (=lateral oviducts). In males, the distal portion of the vas deferens are swollen as seminal vessicles, which serve as storage organs for the mature spermatozoa. As in females, males have accessory glands, which typically arise from the seminal vessicles. The accessory glands in males produce materials necessary for the production of the spermatophore.

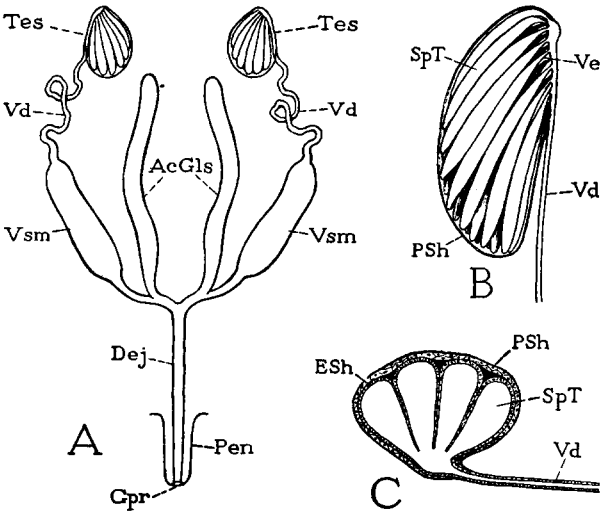

FIG. 292.—General structure of the male reproductive organs, diagrammatic. A, the male reproductive system. B, structure of a testis. C, section of a testis and duct. *AcGls*, accessory glands; *Dej*, ductus ejaculatorius; *ESh*, epithelial sheath; *Gpr*, gonopore; *Pen*, penis; *PSh*, peritoneal sheath; *SpT*, spermatic tube; *Tes*, testis; *Vd*, vas deferens; *Ve* vas efferens; *Vsm*, vesicula seminalis.

Figure 24.1 (Snodgrass. 1935. p. 568)

1.

Males in many orders of insects, including Collembola, Archaeognatha, Thysanura, Orthoptera, and Lepidoptera, transfer sperm to females in an enclosed package called a spermatophore. Often the spermatophore is quite large and packed with nutrients, which can be an important inducement to mate. The accessory glands typically produce the material incorporated into the spermatophore, and the reproductive tract may be modified for the production and transfer of the spermatophore. We shall examine one insect that produces a spermatophore, the cricket (*Acheta domestica*).

In dorsal view (Fig. 24.2), note the two testes each with a vas deferens leading to a large mass of accessory glands, called utricali. Two seminal vesicles can be seen in the midst of the accessory glands. Emerging from the base of these glands is the ejaculatory duct bearing a pair of small ductless ejaculatory vesicles. the ejaculatory duct opens into an internal chamber known as the endophallic cavity which is not readily distinguishable in the demonstration.

Spermatophores are produced by the accessory glands and can be generated surprisingly fast. Males are capable of mating once per hour and a single spermatophore is transfered with every mating. The fluid secretion, containing sperm, travels down the ejaculatory duct to the endophallic cavity. This secretion is then solidified in the expanded cavity immediately dorsad to the posterior end of the endophallic cavity; hence the name, dorsal cavity. In this chamber is a thin, whip-like sclerotized flagellum to which the gelatinous spermatophore is attached. The flagellum serves as a "handle" which allows the spermatophore to be manipulated. During copulation, much of the dorsal chamber is everted

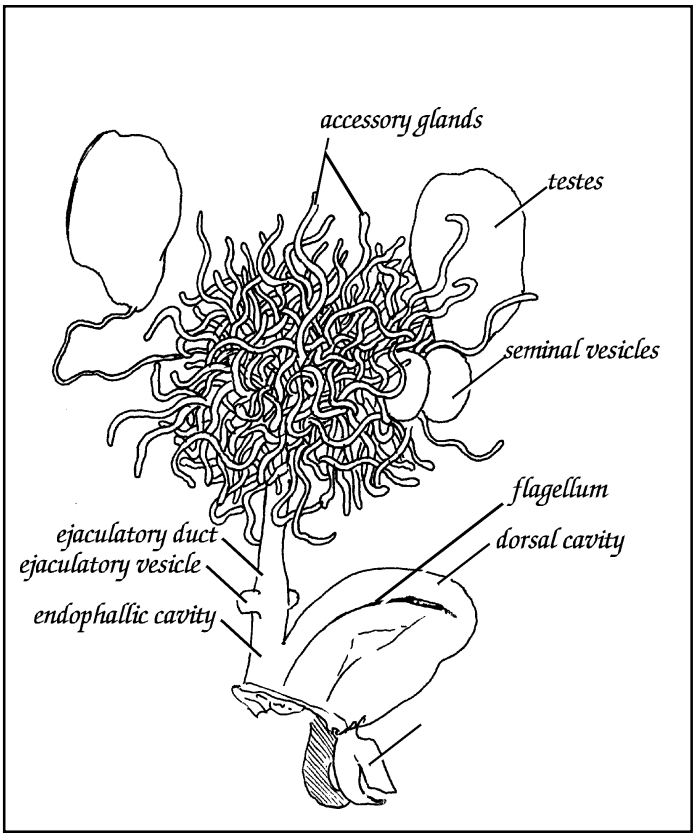

Figure 24.2 *Acheta domestica*. Male reproductive tract, dorsal view.

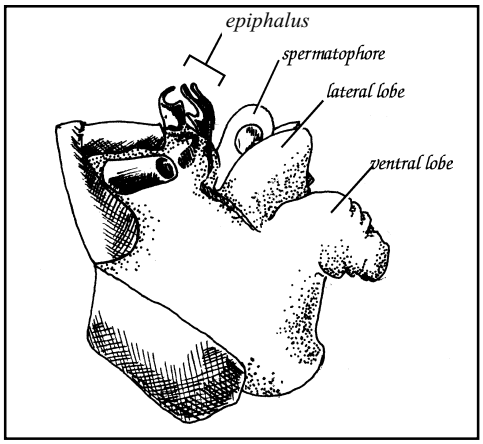

Figure 24.3 *Acheta domestica*. Everted male genitalia with spermatophore, lateral view.

and males expose the spermatophore for some time prior to actually inseminating the female. Above the dorsal lobe is a set of clasper-like sclerites known as the epiphallus (Fig. 24.3) These sclerites are often important taxonomic characters and also contain mechanosensilla which must be triggered to initiate spermatophore secretion in the male.

2.

Examine the demonstrations of the reproductive system of a male roach (Blattodea: *Nauphoeta*) (Fig. 24.4).

Locate the following structures of the reproductive system:

ejaculatory duct
accessory glands (utricli)
vasa deferentia
testes

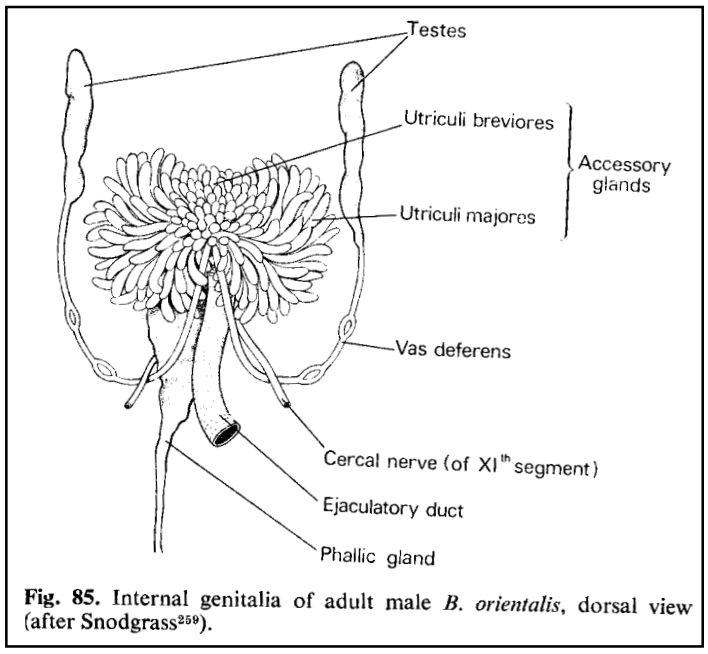

Fig. 85. Internal genitalia of adult male *B. orientalis*, dorsal view (after Snodgrass[259]).

Figure 24.4 (Cornwell, 1968. p.193)

As in the cricket, the accessory glands secrete substances that form the spermatophore. In cockroaches, these substances include uric acid, which imparts the opaque white color to the spermatophore. Remember from lab 15 that in roaches the malpighian tubules do not secrete uric acid. Instead uric acid is stored in the fat body for long periods of time. The uric acid in the spermatheca is ingested by the female and deposited in the ootheca. Symbiotic bacteria in the ootheca metabolize the uric acid, which is used as an important nitrogen source for the developing embryos. Thus males are providing directly to the well-being of their offspring (assuming they are actually the father). Seminal vesicles arise from the anterior end of the ejaculatory duct among the gland tubules and can be seen from ventral view. The testes are small because sperm production occurred during the last nymphal instar; the mature spermatozoa are stored in the seminal vesicles.

3.

Examine the demonstration of the male reproductive system of a solitary bee, *Colletes* (Hymenoptera: Colletidae) (Fig. 24.5). Note the heavily sclerotized external genitalia that you investigated in detail in the last exercise. The reproductive system is much simpler in gross structure than that of the roach. The paired testes and seminal vessicles are enclosed in a common testicular capsule located medially, above the alimentary canal. The testes are distinct during larval and pupal development, when spermatogenesis takes place, but, as in the roach, spermatogenesis is completed by the adult stage and the testes become reduced in size. The male's lifetime allocation of sperm is stored within the seminal vessicles within the testicular capsule. Two vasa deferentia lead ventrally from the testicular capsule and are ultimately united with ducts leading from the paired, transparent mesodermal accessory glands.

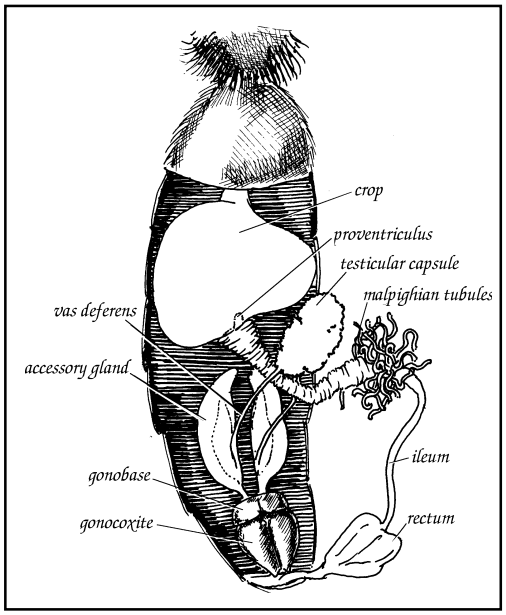

Figure 24.5 Male reproductive system in a colletid bee.

4.

Examine the demonstration of the reproductive system of the male milkweed bug, *Oncopeltus*. Locate the following structures (use Fig. 24.6):

testes	**mesodermal accessory glands (mesadenes)**
testicular follicles	**erection fluid reservoir**
vasa efferentia	**ejaculatory duct**
vasa deferentia	**genital capsule**
seminal vesicles	**subgenital glands**

In addition to the mesodermal accessory glands, ectodermal accessory glands are present within the lumen of the erection fluid reservoir. The reservoir and the ejaculatory duct are of complicated structure inside, and the erection fluid is prevented from mixing with the semen when it passes through the

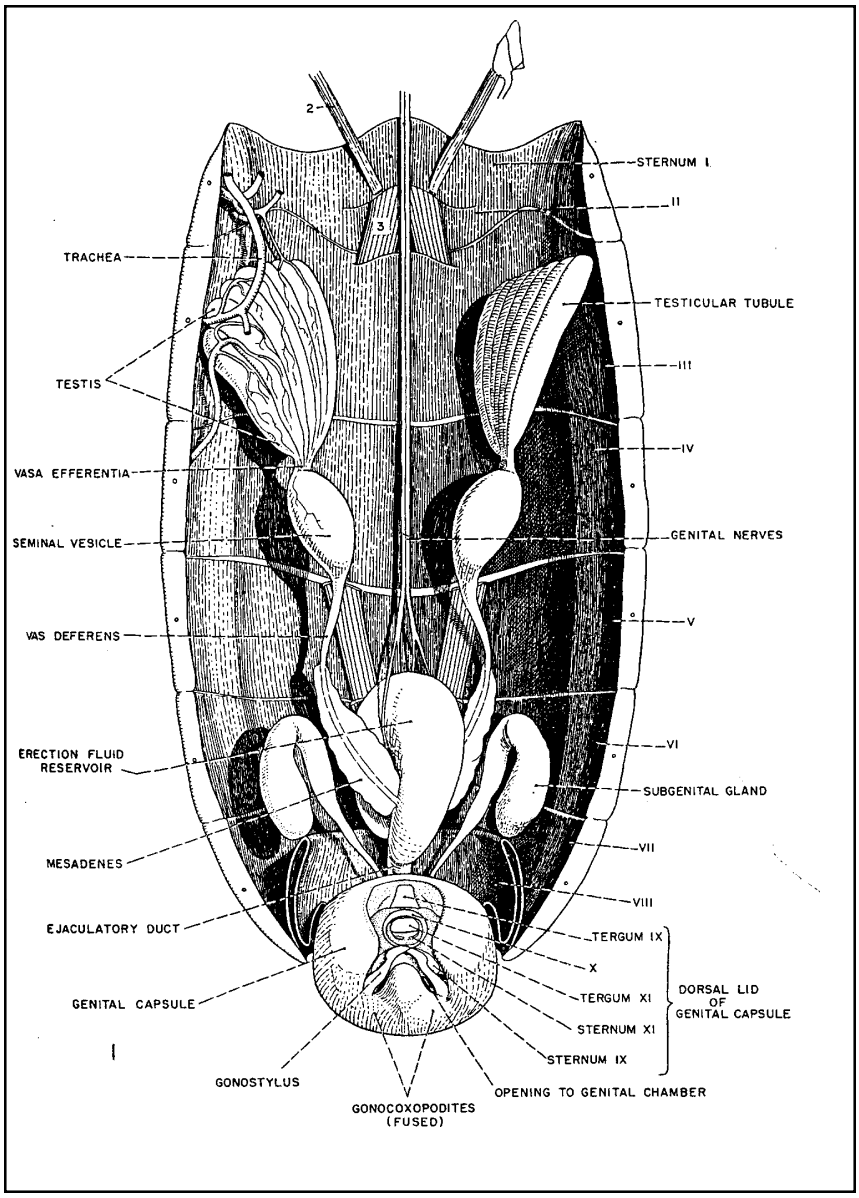

Figure 24.6 (Bonhag & Wick, 1953, p 177)

reservoir. Fluid from the reservoir is pumped into the aedeagus by means of an erection fluid pump posterior to the ejaculatory duct and probably not visible in the dissection. The subgenital glands open via a common duct ventrally between the 8th abdominal sternum and the genital capsule. They contain abundant intracellular symbionts and thus may be mycetomes.

5.

Examine the demonstration of the male reproductive tract of *Sarcophaga bullata* (Diptera: Sarcophagidae) (Fig. 24.8). Note that the elongate testes are enclosed in red-pigmented tissue. Follow the thin, vas deferens from one testis medially to the ejaculatory duct, and identify the paired accessory glands that arise from the ejaculatory duct at about the same position as the vas deferens.

Why do you think that in many male insects the testes (and no other internal organs) are encased in pigmented tissue? (Hint: this is especially true for diurnal insects such as butterflies, bees and higher flies, which are exposed to direct sunlight.)

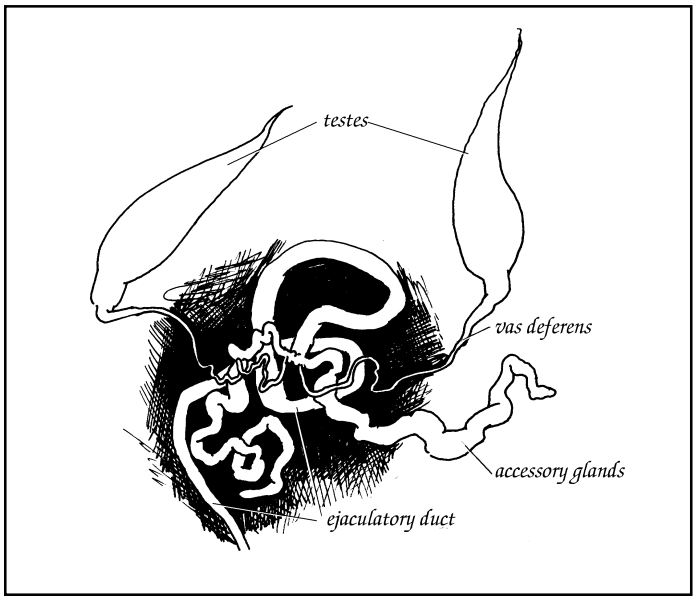

Figure 24.7 *Sarcophaga bullata*. Male reproductive tract, dorsal view.

6.

We will now examine the ultrastructure of insect testes. Each testis consists of multiple spermatic tubules (homologous to the ovarioles which make up the ovary in females; SpT in Fig. 24.1). Spermatogenesis, or the development of sperm cells, occurs sequentially in each spermatic tubule, with immature cells being located apically and mature spermatozoa located toward the base, where the spermatic tubules meet the vas deferens (Vd in Fig. 24.1).

Germ cells, located in germarium (Grm in Fig. 24.8)at the apex of each spermatic tubule, divide mitotically to form spermatogonia (Spg in Fig. 24.8). Each spermatogonium is surrounded by a group of cells (cyst cells) which enclose all the descendants of the original spermatogonial cell in a cyst (Cst in Fig. 24.8) while they undergo mitosis and migrate down the spermatic tubule. Each spermatogonial cell divides 6-8 times to produce 64-256 diploid spermatocytes. Each spermatocyte then divides meiotically (in region III), forming 4 haploid spermatids (Spd in in Fig. 24.8), which elongate into mature spermatozoa (Spz in Fig. 24.8).

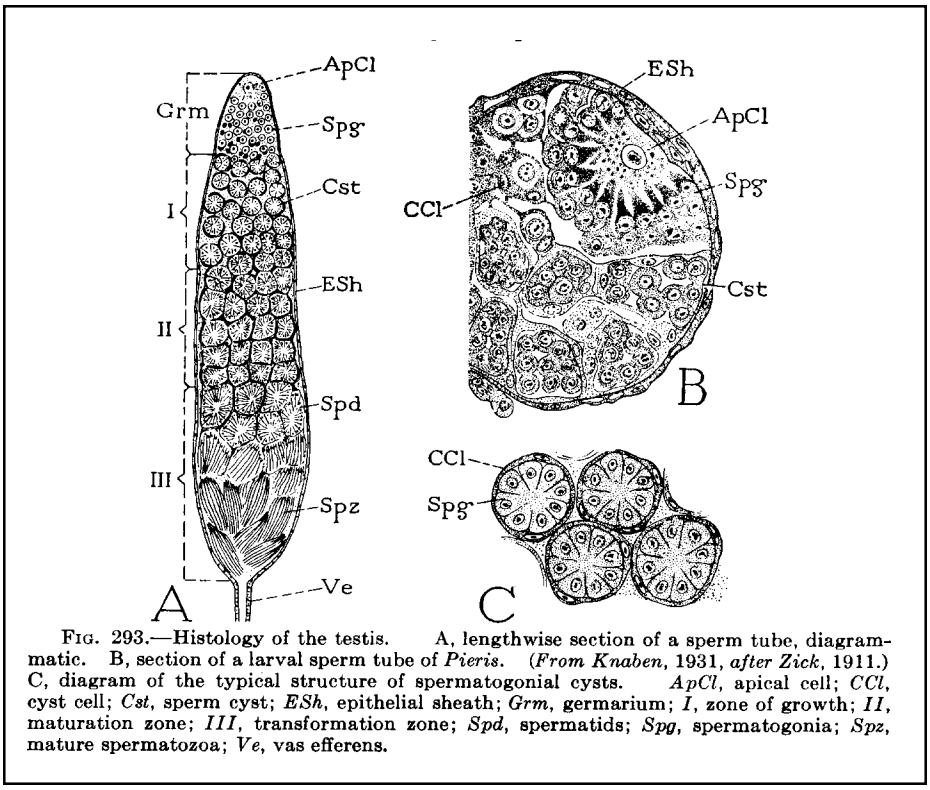

FIG. 293.—Histology of the testis. A, lengthwise section of a sperm tube, diagrammatic. B, section of a larval sperm tube of *Pieris*. (*From Knaben*, 1931, *after Zick*, 1911.) C, diagram of the typical structure of spermatogonial cysts. *ApCl*, apical cell; *CCl*, cyst cell; *Cst*, sperm cyst; *ESh*, epithelial sheath; *Grm*, germarium; *I*, zone of growth; *II*, maturation zone; *III*, transformation zone; *Spd*, spermatids; *Spg*, spermatogonia; *Spz*, mature spermatozoa; *Ve*, vas efferens.

Figure 24.8 (Snodgrass. 1935. p. 570)

Examine the slides of sections of grasshopper testes and locate the following components (use Figs.24.8):

testes (Tes)
spermatic tubules (SpT)
spermatogonia (Spg) in the germarium (Grm)
sperm cysts (Cst)
spermatids (Spd)
mature spermatozoa (Spz)
nuclei in mitotic or meiotic division

7.

Examine the demonstration of living spermatozoa in ringer's solution under a phase contrast microscope. This slide has been prepared by dissecting the spermatheca out of a female cricket and squashing it on the microscope slide. Notice the long tail and its swimming movements, and the narrow head.

8.

Examine the male reproductive system of your insect and locate the following parts:

ejaculatory duct
vas deferens
testis
spermatic tubules
seminal vesicles
accessory glands