INTERNAL MORPHOLOGY (ANATOMY) OF AK GRASSHOPPER
(POEKILOCERUS PICTUS)

It consists of the endoskeleton and various systems inside the body.

ENDOSKELETON

At various points the body wall becomes inpushed or invaginated to form rigid processes, the apodemes. These strengthen the body wall and also serve for the attachment of muscles. The framework of these apodemes is called endoskeleton. It consists of the endoskeleton of head (tentorium), the endoskeleton of thorax and the endoskeleton of abdomen. Of these, only the tentorium will be dissected and studied.

Tentorium (Fig. 26): For dissecting out the tentorium, detach the head from rest of the body. Hold the insect head from its antennae and top in the left hand. Remove away the mouthparts by giving a cut with very fine scissors at the level of the frontoclypeal sulcus. Clean out all muscles with a dissecting needle from the cavities by keeping the head with its biggest and rounded cavity upwards. Now cut away the top of head including the compound eyes and place the tentorium on a slide to see it under the binocular microscope.

The tentorium is named from its resemblance with a tent which is tightened by four ropes. It divides the foramen magnum into four openings: an upper, two lateral and a lower one. The upper is the biggest and called alaforamen, through which passes the alimentary canal. The lower is the neuraforamen, through which passes the central nervous system. The lateral have no names.

The tentorium is nearly X-shaped and consists of a central body with two anterior, two posterior and two dorsal arms. The central body is a large triangular plate which is called corpotentorium. If the tentorium is held in its natural position with the alaforamen above and the neuraforamen below, the anterior arms are the lower ones (because they are towards mouth which is on the lower side) and the posterior the upper ones. But in literature it is described with its neuraforamen above and alaforamen below (this unnatural position not followed here). The two anterior arms (pretentoria) are broadened at their anterior ends and are the ingrowths from the anterior tentorial pits located in the frontoclypeal sulcus. The two posterior arms (metatentoria) are broader at their posterior ends and are the invaginations from the posterior tentorial pits located on the ends of the postoccipital sulcus. The two dorsal arms (supratentoria) are the outgrowths from the bases of the anterior arms. They are the sclerotised threads slightly broadened at their tips and are generally broken at the time of removing muscles.

SYSTEMS

For dissecting the grasshopper, remove its wings and antennae and hold it in its natural sitting position. Give a cut with very fine scissors along the mid-dorsal line. Start this incision from the extreme posterior end and continue it to the extreme anterior end. Place it in the dissecting pan in

its natural sitting position with sufficient water to cover it. Open the two flaps gently apart with dissecting needles and pin them to the wax bottom of the pan. Also pin through the femora of the legs. Leave the dissection as such (if the specimens are not freshly killed) for 7-10 minutes so that the internal organs are well-soaked. For studying the circulatory system, dissect the insect from the ventral side. The remaining procedure is the same as already described. Now remove the masses of pale yellow or white fat bodies and other loose tissues with the help of a camel-hair brush. Place this dissection under the binocular microscope and study the following systems.

1. **Digestive system** (Fig. 27): It consists of the alimentary canal (gut) and the associated glands which help in digestion. The alimentary canal extends from the mouth to the anus. It is differentiated into the following three main regions:

(a) Foregut (stomodaeum)
(b) Midgut (mesenteron, ventriculus or stomach)
(c) Hindgut (proctodaeum or intestine)

(a) Foregut: The foregut consists of the mouth or oral cavity, pharynx, oesophagus, crop and gizzard (proventriculus). The foregut starts from the mouth cavity into which open the salivary glands. The glands are grape-like clusters of circular acini (sing. acinus) which give their secretion into two salivary ducts, one on each side of the alimentary canal in the thorax. Two salivary ducts unite to form a common salivary duct which opens below the hypopharynx. The mouth cavity leads into a short thicker anterior portion of the foregut, the pharynx (throat). The pharynx forms posteriorly a narrow and curved tube, the oesophagus. The oesophagus gradually widens behind to form the large crop which acts as a food reservoir. The crop opens into the gizzard (proventriculus) which narrows posteriorly and is not clearly differentiated externally from the former. The gizzard is surrounded by the anterior lobes of the gastric caeca (sing. caecum). The junction of foregut and midgut is provided internally with a cardiac (oesophageal) valve which regulates the passage of food.

(b) Midgut: The midgut is comparatively a short, cylindrical and straight tube. At its anterior end arise six large, elongated sacs, the gastric caeca which are the evaginations (outgrowths) of its anterior end. Each gastric caecum consists of a longer anterior lobe and a shorter posterior lobe. The posterior lobes are filled with food where as the anterior lobes have only the secretary function. The midgut on its inner side has a very thin peritrophic membrane for the protection of its secretary cells from the friction of the food particles. This permeable membrane also extends into the hindgut. The posterior end of the midgut is marked by the presence of malpighian tubules. At the junction of the midgut and hindgut is a pyloric valve.

(c) Hindgut: The hindgut is further differentiated into an ileum, colon and rectum. The ileum (small intestine) is a thick and straight tube which narrows posteriorly. The colon (large intestine) is a short, narrower tube (very rarely coiled) which dilates posteriorly to merge into the rectum. The rectum is a wider tube which is externally provided with six bands of longitudinal muscles alternating with six long rectal pads (papillae). The rectum ends in an anal opening.

2. **Excretory system** (Fig. 27): It consists of malpighian tubules and fat bodies. The malpighian tubules are long, very slender, blind tubes which

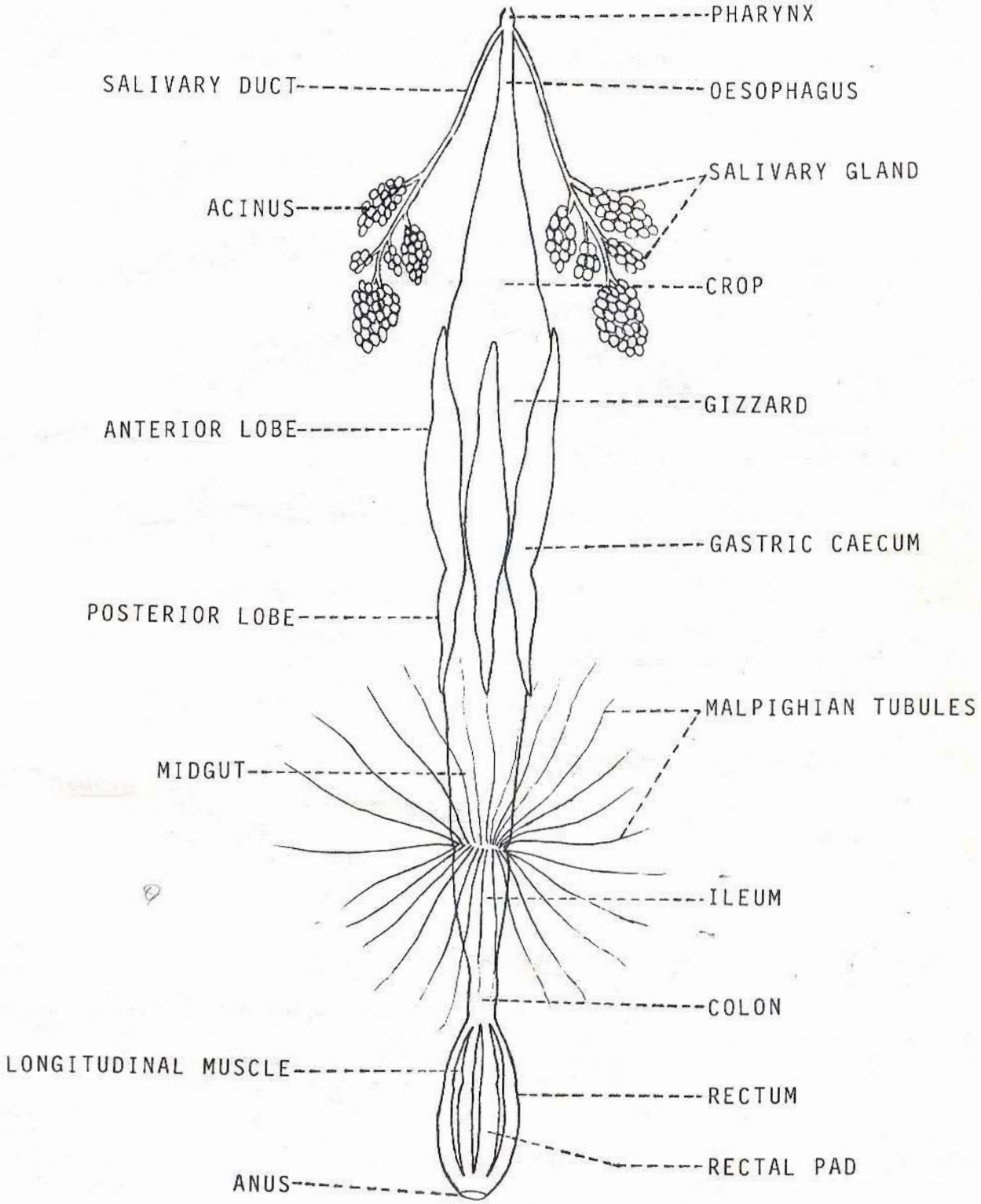


FIG.27. DIGESTIVE SYSTEM OF AK GRASSHOPPER

arise as evaginations from the anterior end of the hindgut. They extend anteriorly and posteriorly around the gut. The fat bodies are yellow or white masses of cells surrounding the gut. The principal function of the fat bodies is to store the food reserves like fat, glycogen and protein but they also carry out the excretory function.

3. Reproductive system: It should be studied separately in male and female sexes.

The male reproductive system (Fig. 28) consists of a pair of testes (sing. testis). These testes are closely associated into a single yellow structure which generally lies on the midgut of the alimentary canal. (Give a longitudinal cut with a blade along its mid-dorsal line to separate it into two parts.) Each testis is composed of a large number of tubular testicular follicles. Each follicle opens by means of a short, slender duct, the vas efferens (pl. vasa efferentia) into the long genital duct or vas deferens (pl. vasa deferentia). The follicles are attached to the body wall by a suspensory ligament. The vasa deferentia run posteriorly to open into a wider tube, the ejaculatory duct, below the ventral nerve cord. Just anterior to the points of opening of vasa deferentia, two groups of long tubular accessory glands also open into the ejaculatory duct. A medial pair of these glands becomes fairly dilated to serve as seminal vesicles (vesiculae seminales) for storing the sperms. The ejaculatory duct opens posteriorly into a large pouch-like structure, the ejaculatory sac which opens into the aedeagus (part of external genitalia).

The female reproductive system (Fig. 29) consists of a pair of ovaries. These ovaries are closely associated into a single body which lies on the midgut and a part of the hindgut. (Also separate it into two component parts by giving a longitudinal cut along its mid-dorsal line.) Each ovary is composed of a large number of tubular ovarioles which arise from the side of the oviduct. The ovarioles end in thread-like filaments which unite to form a suspensory ligament by which they are attached to the body wall. The oviducts also extend anteriorly to form two accessory glands. Then the oviducts run posteriorly and after making a short bend unite into a fairly dilated common oviduct (vagina) below the ventral nerve cord. The vagina terminates in the genital chamber. The spermatheca is a sac-like oval body which receives and stores the sperms. It opens by means of a coiled spermathecal duct into the genital chamber. The latter ends into an egg-guide which is situated between the ventral valves of the ovipositor (part of external genitalia).

4. Circulatory system: It consists of the dorsal blood vessel and the accessory pulsating organs present at the bases of appendages. The circulatory system in insects is an open one, i.e., there are no arteries and veins (except the single dorsal blood vessel) and the blood circulates freely in the body cavity, the haemocoel. The latter has two longitudinal diaphragms (partitions) of membranous connective tissue: the dorsal and the ventral diaphragms. These diaphragms divide the body cavity into three sinuses: the dorsal (pericardial) sinus, the large central (perivisceral) sinus and the ventral (perineural) sinus.

The dorsal blood vessel (Fig. 30) lies along the midline in the pericardial sinus just below the body wall. It is a long, straight, white tube extending from the head to the 10th abdominal segment. It consists of two parts. The posterior part that lies in the abdomen is called the heart. It becomes segmentally dilated to form chambers (ampullae) which are provided with paired dorsolateral openings, the ostia (sing. ostium) having valves in them. The heart tapers posteriorly and ends blindly in the 10th segment. Eight pairs of alary muscles

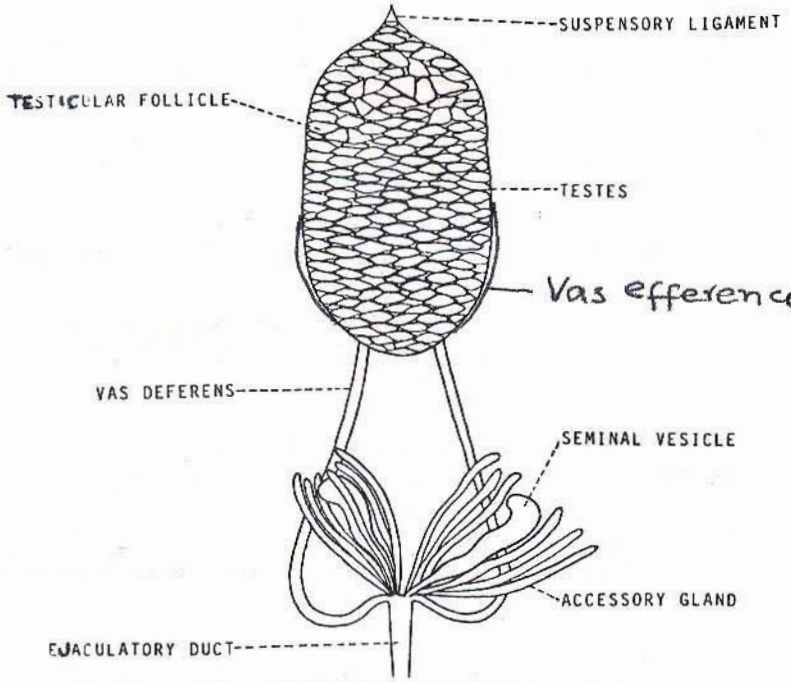


FIG. 28. REPRODUCTIVE SYSTEM OF MALE AK GRASSHOPPER

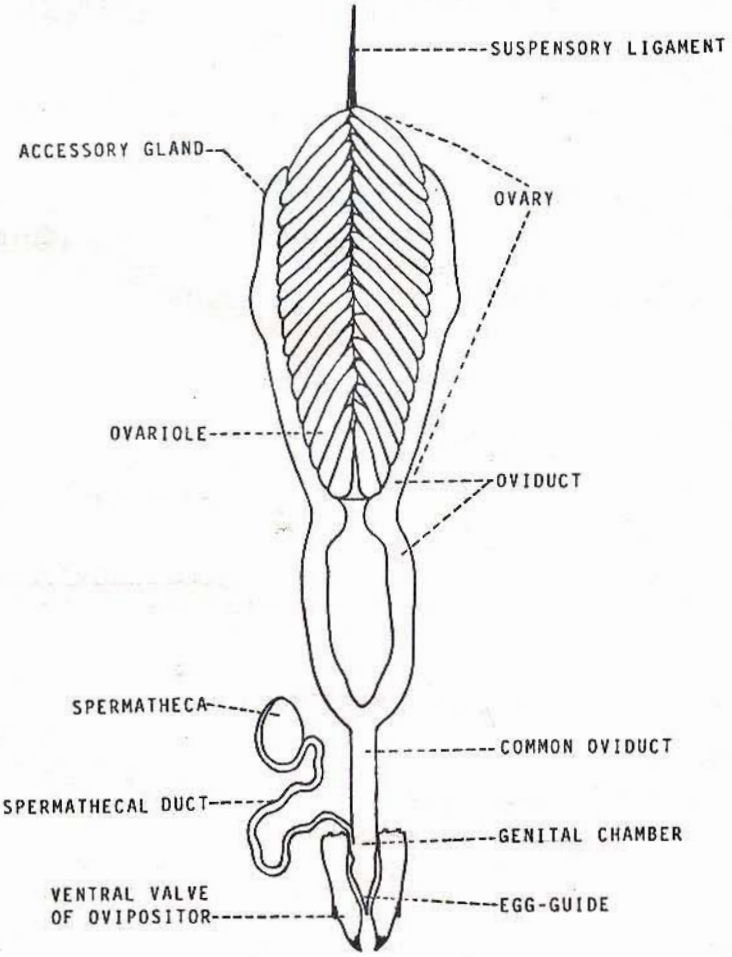


FIG. 29. REPRODUCTIVE SYSTEM OF FEMALE AK GRASSHOPPER

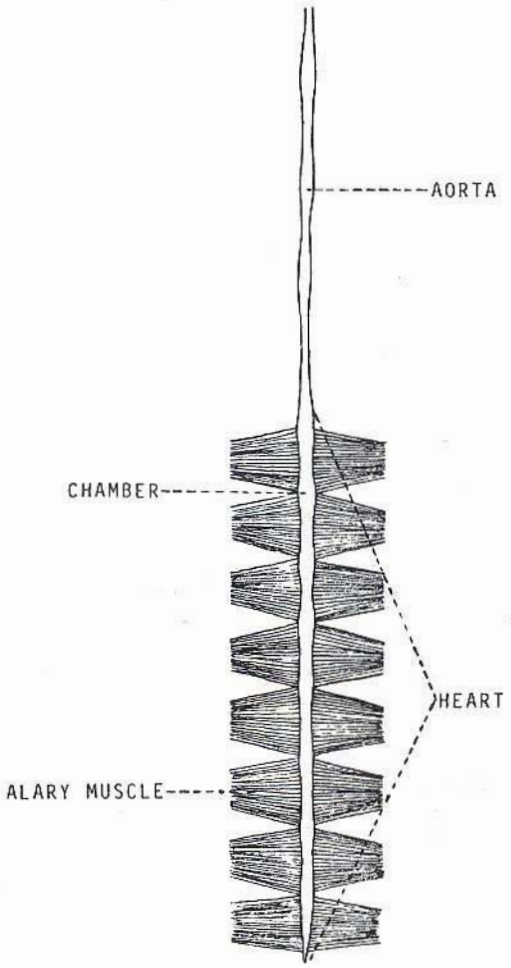
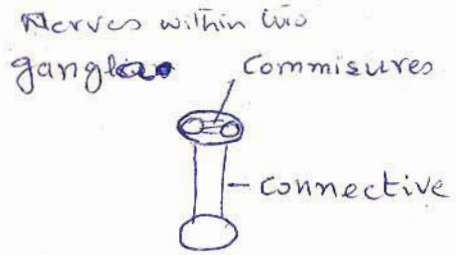


FIG.30. DORSAL BLOOD VESSEL OF AK GRASSHOPPER



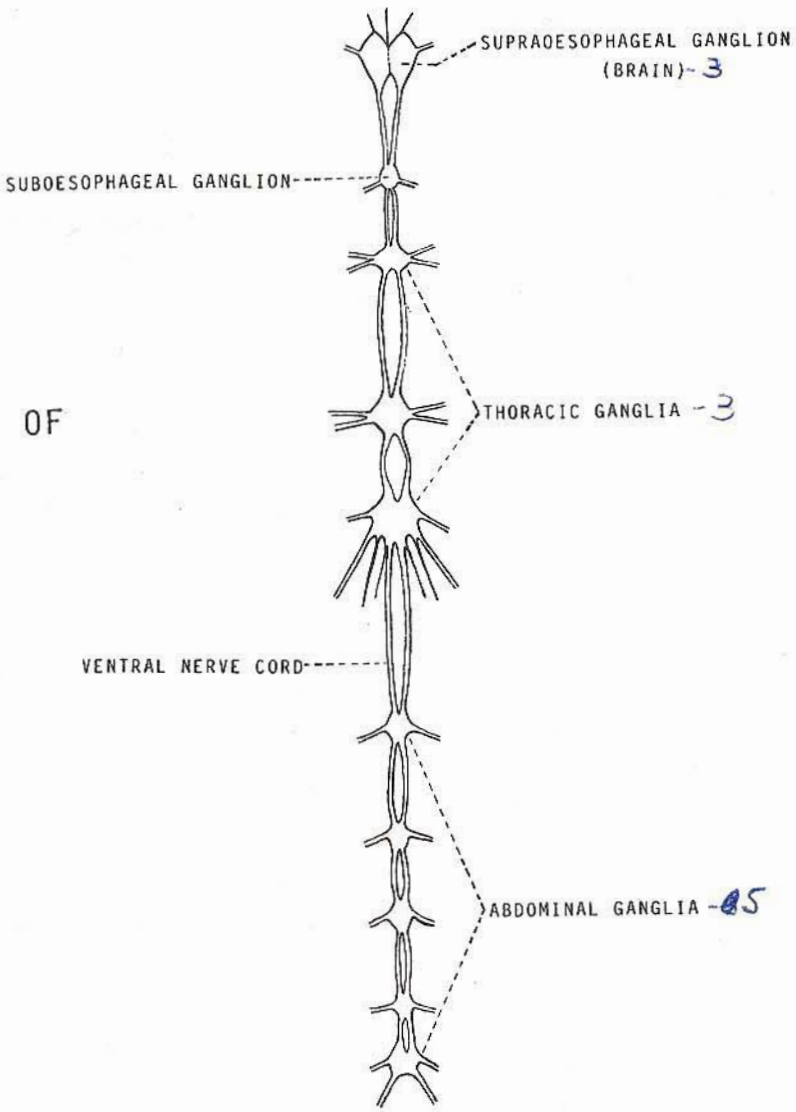


FIG.31. CENTRAL NERVOUS SYSTEM OF AK GRASSHOPPER

ventral trunks are present below it. The tracheae from the spiracles also extend on the inner side, branch and dilate to form white air-sacs which unite with those of the opposite side on the ovaries in a beautiful fashion (Fig. 32). The tracheae or longitudinal trunks give numerous branches which divide and subdivide into finer branches known as tracheoles that enter the body tissues.

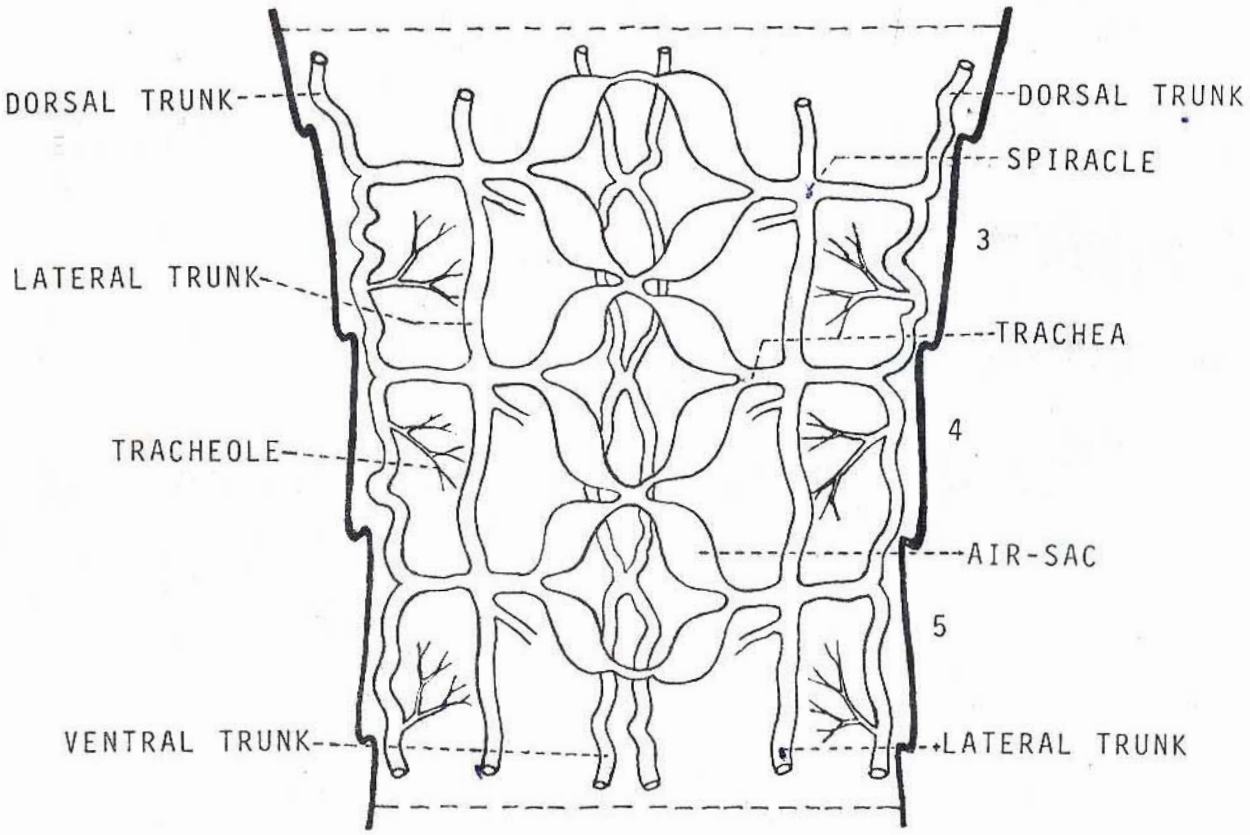


FIG.32. RESPIRATORY SYSTEM (3-5 ABDOMINAL SEGMENTS) OF AK GRASSHOPPER

Types of Reproduction:-

Oviperity:- This type includes the insects in which the female lays eggs. Egg laying insects are called oviperis insects.
e.g., Grasshopper, flies, crickets.

Viviperity:- Female gives birth to young ones. Eggs are hatched inside the body and thus the young ones come out.
e.g. aphids.

Parthenogenesis:- Unfertilized eggs are laid by the female. These eggs hatched into young ones.
It may be when males are absent or rare.
e.g. some aphids, honey bees etc.

Paedogenesis:- Young ones of insects start reproducing the new young ones. i.e., Reproductive organs of young ones (immature stages of the insects) become functional eg. beetles.

Poly-embryony:- More than one young ones come out from a single egg. e.g. parasitic wasps & parasitic stylops.

Hermaphroditism:- A single individual contains both types of male and female reproductive organs.
e.g. some scale insects.

Castration:- Reproductive organs become non-functional due to many reasons like disease, due to attack of parasites.
It may occur in any insect.