

EXTERNAL MORPHOLOGY OF AK GRASSHOPPER (*POEKILO CERUS PICTUS*)

The hard outer covering or body wall having muscles on its inner side is called exoskeleton. It bends or grows into the body cavity at different points to form rigid processes, the apodemes. They collectively make an endoskeleton. There are many outgrowths of the body wall (such as antennae, legs, wings, etc.) which are called appendages. The body wall consists of a number of hardened areas or plates, the sclerites. These are separated by the grooves called sulci (sing. sulcus). The grooves representing the line of fusion of two sclerites are still known as sutures (e.g. epicranial suture). The body consists of a series of joints or segments which are grouped into three regions, viz., head, thorax and abdomen.

HEAD

This is the first region of the body. If you press the head from top, it clearly becomes demarcated from the thorax. The hard outer covering of the head is the head capsule. This type of head having the mouthparts (see their types under INSECT APPENDAGES) on its lower side and projecting downward is called hypognathous. Compare this type of head with that of a beetle and a bug. In a beetle the head is of prognathous type in which the mouthparts are on the front side and project forward. In a bug it is of opisthognathous or opisthorhynchous type with the mouthparts on its lower side in the form of a proboscis projecting backward. The head is made up of 6 segments, fused together to form a box-like structure, the cranium.

First of all examine the front side of head (Fig. 14A). Its upper half is the frons. It has a median longitudinal furrow, the frontal furrow which bears a tiny median ocellus (simple eye) in it. Note an ocellus has a single lens. On upper one-third of the frons, there is a grooved high ridge, the frontal costa. The groove of the frontal costa merges below into that of the frontal furrow. On the sides of the frontal costa are depressions, the antennal sockets. From each socket arises a thread-like antenna (see its parts and types under INSECT APPENDAGES): On the margin of an antennal socket, just inner to the anterior end of a compound eye, lies a lateral ocellus (pl. ocelli): Below the frons is an other somewhat raised sclerite, the clypeus. It is separated from the frons by a transverse frontoclypeal or epistomal sulcus. The clypeus is partially divided by a trans sulcus (only clear from sides) into two parts. The anterior narrow part is the anteclypeus while the posterior broader part is the postclypeus. Below the clypeus is an other sclerite, the labrum. It is separated from the clypeus by a transverse clypeolabral sulcus. On each side of clypeus and labrum the grooved outer surface of the mandible is visible. See the mandible by lifting up the labrum with your dissecting needle. Also note the segmented maxillary and labial palpi (sing. palpus) on the sides of the mouth.

Now examine the head from the lateral side (Fig. 14B). On its upper part is a large compound eye which consists of innumerable hexagonal areas, the facets. Each facet is a transparent biconvex lens through which the light passes for making an image. The large sclerite forming the whole side below and behind the compound eye is the gena (pl. genae). It is separated from

the frons by a longitudinal frontogenal or subocular sulcus. It descends from the posterior margin of the antennal socket just anterior to the compound eye. Below the gena is a small sclerite, the subgena. It is separated from the gena by a subgenal sulcus.

Now examine the head from the dorsal side (Fig. 14C). The entire upper surface of the head capsule from the frons to the thorax is the epicranium. It is divided into two epicranial plates by a median longitudinal ecdysial cleavage line or epicranial suture. The anterior constricted part of the epicranium between the frons and an imaginary line between the compound eyes is the vertex. The anterior part of the vertex is the fastigium which is divided by a fastigial furrow. It is continuous anteriorly with the furrow of the frontal costa.

Finally remove the head carefully so that the head or thorax is not damaged. On the end of the epicranium is a narrow semicircular sclerite which also extends on sides. The upper part of this sclerite just behind the epicranium is the occiput (Fig. 14B). The sides of this sclerite behind the genae (cheeks) are called postgenae. The occiput is separated from the epicranium by a semicircular occipital sulcus. It also separates the gena and postgena. On the back side of the head is a large opening, the foramen magnum or occipital foramen. Also note the cervical membrane (neck) which connects the head with prothorax.

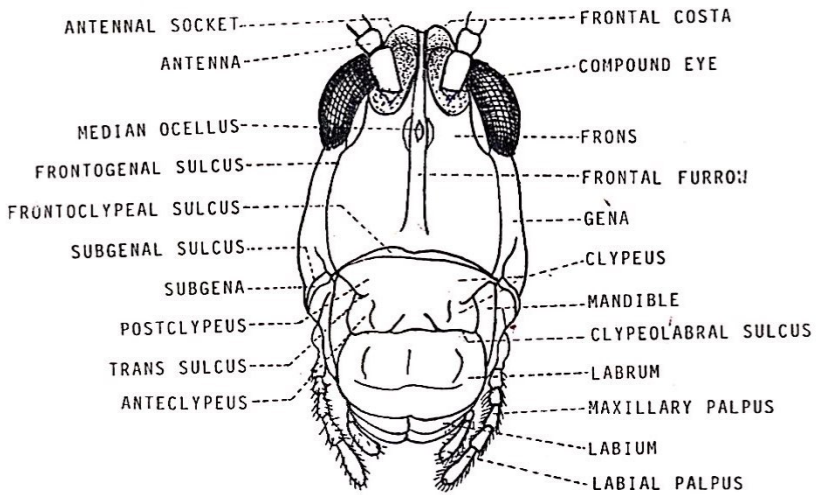
THORAX

This is the second division of the body. If you see it from below, it is very broad and thus clearly distinguished from the abdomen. The thorax consists of three segments: prothorax, mesothorax and metathorax. Each of these segments bears a pair of legs on the lower side. The mesothorax and metathorax each is provided with a pair of wings on the upper side. The mesothorax and metathorax are more or less fused together to form a single structure, the pterothorax (the part of the thorax bearing wings). Each thoracic segment has four sides: the upper or dorsal side is the notum or tergum (pl. nota or terga), the lower or ventral side is the sternum (pl. sterna) and each lateral side is the pleuron (pl. pleura). Generally the prefixes pro, meso and meta are used for indicating a sclerite or a leg on the prothorax, mesothorax and metathorax respectively.

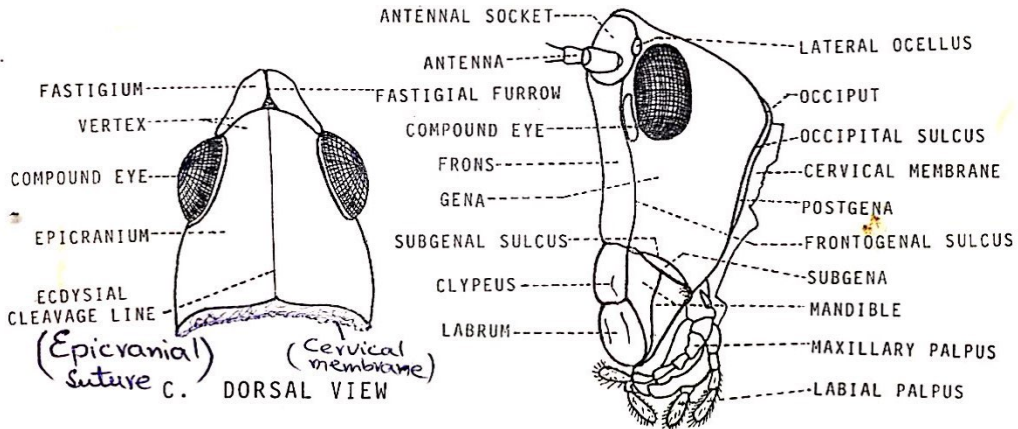
A. Prothorax: Press the prothorax and see that it is not firmly united with the rest of the thorax. Remove it alongwith the first pair of legs, the prolegs, and study the following:

1. Pronotum (Fig. 15A): It is a large saddle-like structure which is present between the head and bases of fore wings. It covers the upper and lateral sides of the prothorax. The parts covering the sides are called lateral lobes. It is produced posteriorly to form a hood-like structure, the notalia which overlaps the sides slightly and the upper side of the mesothorax entirely. The pronotum has three transverse pronotal furrows and a very fine rather an ill-defined longitudinal ridge, the median carina. The last furrow is more prominent and bent forward from its mid-dorsal line to form the tergal notch.

2. Propleuron (Fig. 15B): The only visible part is an anterior small triangular sclerite in front of the leg base and just below the anterior part of the lower margin of the lateral lobe. It is called proepisternum. Remove the overlapping lateral lobes of pronotum with the help of a blade and note a smaller posterior sclerite of proepimeron slightly above the leg base and just posterior to the



A. FRONTAL VIEW



B. LATERAL VIEW

FIG. 14. HEAD OF AK GRASSHOPPER

former sclerite. These sclerites are separated by a well-defined propleural sulcus.

3. Prosternum (Fig. 15C): It is between the bases of the front legs and more deeply sunk as compared with meso- and metasternum. It is roughly rectangular and divided into three sclerites. The anterior one is the narrow sclerite of presternum. It is followed by the broader basisternum which bears a stout peg-like prosternal process. These two sclerites are separated by a presternal sulcus. The last is the shield-like spinasternum which has a narrow longitudinal spinal pit in the centre. It is separated from the basisternum by a transverse profurcal sulcus which lies just posterior to the prosternal process. At the ends of this sulcus are two pits, the apophyseal or furcal pits. Each pit located on the side of the prosternal process lies in an oblique fashion. On the lateral and posterior sides of the spinasternum is an intersegmental membrane.

B. Pterothorax: The mesothorax and metathorax are more or less welded together to form pterothorax. After the removal of the prothorax, it looks like a strong box.

Note that the anterior pair of wings arises from the mesothorax and the posterior pair from the metathorax. The wings are articulated by a very complicated system of small sclerites which are beyond the scope of this introductory course. The fore wings are narrow and slightly thickened to form tegmina which function mainly for the protection of hind wings. The hind wings are thin, membranous and folded like a fan under the fore wings when the insect is at rest. They are the main organs of flight (see the structure, types, etc. of wings under INSECT APPENDAGES).

On each side of the thorax there are two small nearly oval breathing pores, the spiracles. The anterior one is situated in the membrane between the prothorax and mesothorax. It is covered by the lateral lobe of the pronotum and is called the spiracle of the mesothorax. The posterior one is situated between the mesothorax and metathorax slightly posterior to and above the base of the middle leg. It is called the spiracle of the metathorax. The insect respire through the spiracles.

The legs of the mesothorax are called mesolegs and those of the metathorax as metalegs (see the parts and types of legs under INSECT APPENDAGES).

Now carry the wings on sides and study the sclerites and sulci of the two segments separately.

(a) Mesothorax: Study the main sclerites and sulci of the following sides.

1. Mesonotum (Fig. 16A): On detaching the prothorax, a large membrane is seen at the anterior end of the mesonotum. It is followed by a broadly V-shaped intersegmental sclerite, the acrotergite (precosta). It is limited posteriorly by the antecostal sulcus. Behind the acrotergite is the largest somewhat raised sclerite of scutum which appears to be divided into two parts. On the sides of its anterior part are two depressed and nearly triangular areas which collectively form the prescutum. Each part of the prescutum is separated from the scutum by a prescutal sulcus. Posterior to scutum is an elevated, median and backwardly directed triangular sclerite, the scutellum. On its sides are two small oval areas which are considered to be the parts of scutum. At the end of mesonotum is a transverse membranous fold which by some morphologists is considered to be the part of scutellum.

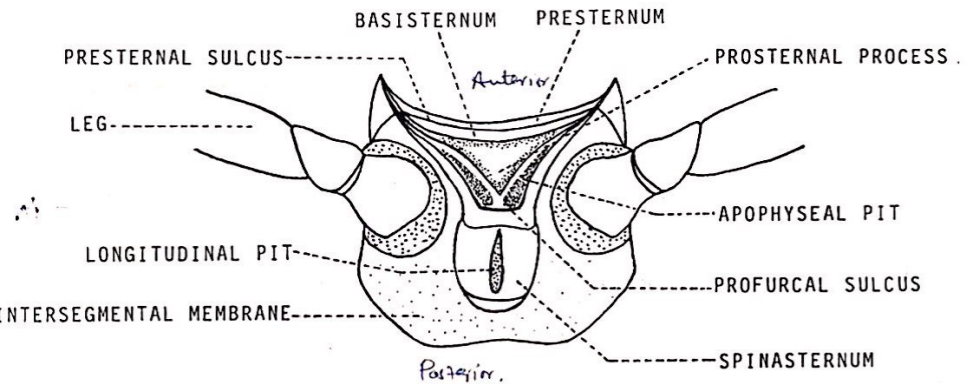
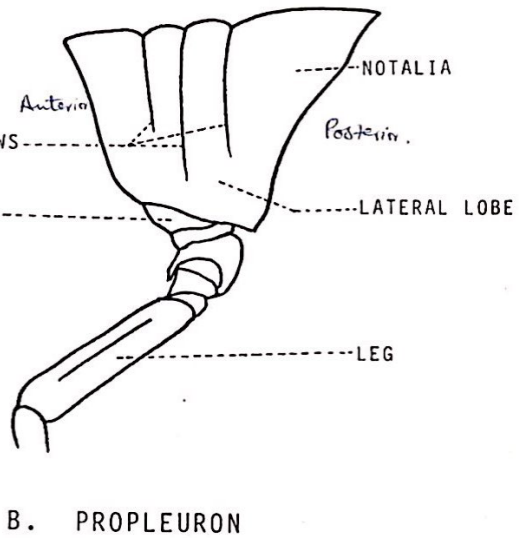
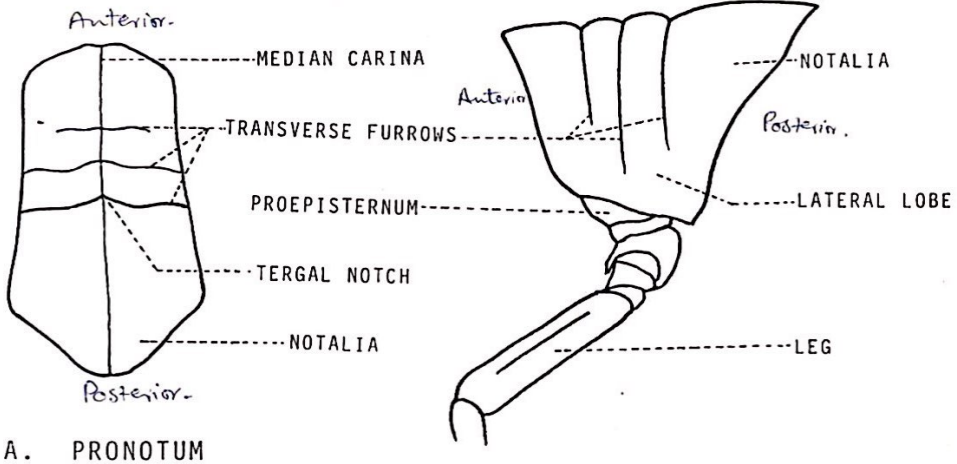


FIG. 15. PROTHORAX OF AK GRASSHOPPER

2. **Mesopleuron (Fig. 16B):** It consists of two large sclerites between the bases of mesoleg and fore wing. The anterior sclerite is called the mesoepisternum while the posterior is the mesoepimeron. They are separated by the mesopleural sulcus which is located at the level of middle of coxa. The mesopleuron is separated anteriorly from the propleuron by a very clear interpleural sulcus which contains a spiracle on its lower end. The mesopleuron is also separated posteriorly from the metapleuron by a well-defined interpleural sulcus which also contains a spiracle on its lower end.

3. **Mesosternum (Fig. 16C):** At its anterior end is a narrow transverse sclerite, the presternum. It is followed by the large basisternum. These two sclerites are separated by the presternal sulcus. The basisternum is limited posteriorly by a rather broader groove, the mesofurcal sulcus which has three pits in it. The lateral ones are oblique, elongated and called apophyseal pits. The middle one is the spinal pit and represents the rudimentary spinasternum. The basisternum is extended back from the sides to form large mesosternal lobes which represent the sternellum. These lobes are widely separated by the mesosternal interspace. This space accommodates the anterior median prolongation of the metasternum.

(b) **Metathorax:** Study the main sclerites and sulci of the following sides.

1. **Metanotum (Fig. 16A):** It has the same sclerites and sulci as mesonotum plus an additional sclerite, the postnotum at the end. The acrotergite is much narrower than that of the mesonotum and almost entirely overlapped by the transverse membranous fold of the mesonotum. The two triangular areas of the prescutum are also much smaller than those of the mesonotum. Two large triangular areas on the sides of the scutellum are also considered as parts of the scutum. Behind the membranous fold is a broad transverse intersegmental sclerite, the postnotum (postscutellum).

2. **Metapleuron (Fig. 16B):** It is similar in structure to the mesopleuron. It has two large sclerites, the anterior one is the metaepisternum while the posterior one is the metaepimeron. These are separated by the metapleural sulcus lying at the level of middle of coxa.

3. **Metasternum (Fig. 16C):** It is broader than mesosternum. It largely consists of basisternum whose anterior broad prolongation is fitted into the mesosternal interspace. The basisternum is followed by a small rectangular sclerite, the spinasternum from which the spinal pit and its corresponding internal process have disappeared. The basisternum and spinasternum are separated by the metafurcal sulcus which has two widely separated apophyseal pits on its lateral ends. The spinasternum is separated from the first abdominal sternum by the antecostal sulcus. The basisternum is extended back from the sides to form smaller metasternal lobes which together form the sternellum. These lobes are separated by a large gap which is called metasternal interspace. This space accommodates the anterior median prolongation of the first abdominal sternum.

ABDOMEN

This is the third and last division of the insect body. It is long, narrow and consists of eleven segments (Fig. 17A). Some of its posterior segments are so modified for mating and oviposition that they do not look like segments. Each segment is divided into two parts: the large dorsal part which also covers the sides is the tergum and the smaller ventral part is the sternum. These

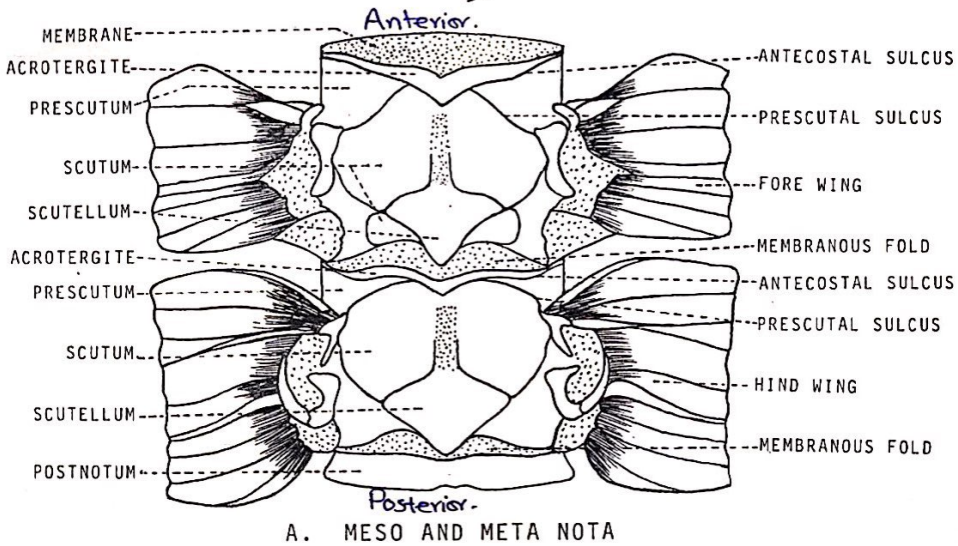
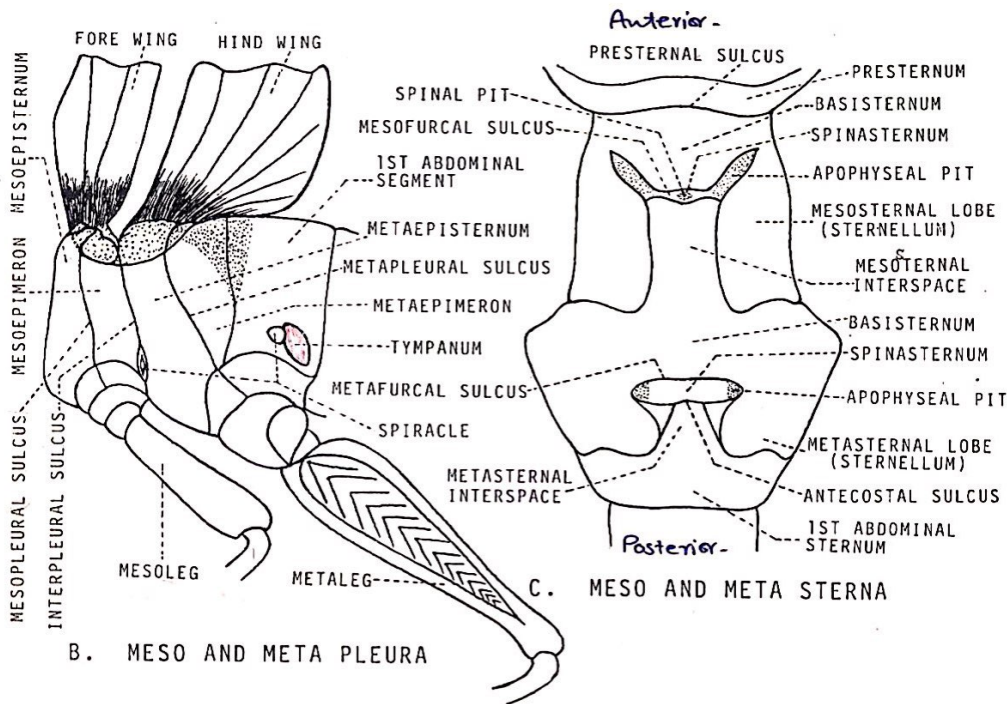


FIG. 16. PTEROTHORAX OF AK GRASSHOPPER

two are separated by a longitudinal sulcus which represents the greatly reduced lateral area (pleuron). The first abdominal segment is the largest one. It looks like a part of the thorax than of the abdomen and is intimately fused with the thorax. Its sternum (Fig. 16C) is very broad with its anterior median prolongation fitted into the metasternal interspace. On its each side just above the hind coxa is a white membrane, stretched across an oval cavity, which is called tympanum or outer membrane of the ear. Note a nearly circular spiracle in front of the tympanum. Segments two to eight are similar, each having a tiny spiracle at the lower anterior angle of its tergum on each side. The 9th and 10th terga, especially the former in the male (Fig. 17B), are narrow in both sexes. They are partially fused because the sulcus between them is obsolete on the lower side. The 11th tergum is represented by a triangular plate above the anal opening which is called epiproct or supra-anal plate. On the sides and slightly concealed under the epiproct are two lateral plates, the paraprocts or podical plates. They represent the 11th sternum. On each paraproct is a conical process, the cercus (pl. cerci). It comes out from a membrane on the posterior margin of the 10th tergum. It is very small in the female as compared with that of the male. The last visible sternum is 8th in the female and 9th in the male (Fig. 17A,B). In both the sexes it is called a subgenital plate which will be discussed below as a part of the external genitalia.

External genitalia:

1. **Female:** The subgenital plate is very large and produced backwards beyond the limits of its corresponding tergum (Fig. 17A). Its posterior margin bears a median process called egg-guide and two lateral lobes (if seen from ventral side). The egg-guide is triangular or conical and wedged between the bases of the ventral valves of the ovipositor.

The ovipositor (Fig. 17C) consists of a dorsal pair and a ventral pair of valves with their tips directed in opposite directions. The dorsal and ventral pair of valves can be spread apart and brought together. These are used as digging organs in oviposition. Push apart the dorsal and ventral pair of valves with your dissecting needle and note a small inner pair of valves or the forked organ concealed between them. The inner valves and the egg-guide are used for placing the eggs in the egg-pod.

2. **Male:** The subgenital plate (Fig. 17B) is a large boat-like structure. It forms the genital chamber on its upper side which conceals the male genital organs. The copulatory or genital organs are collectively known as aedeagal or phallic complex. The posterior end of the subgenital plate which incurves into the genital chamber to cover the tip of the phallic complex is called pallium. (Expose the phallic complex by depressing the posterior end of the subgenital plate with a dissecting needle and take it out.) It consists of two parts, the aedeagus and the epiphallus.

The aedeagus (Fig. 17D) is nearly flask-shaped, strongly sclerotised and wrapped (except tip) in a thick membranous sac, the ectophallic membrane. (Now remove this membrane to see the parts clearly.) The aedeagus consists of a pair of large basal valves which are connected with two long, narrow and curved apical lobes. Tips of these lobes are separated by a narrow slit which leads into a large cavity, the phallotreme cleft. This cleft contains penis between two penial valves. There is a small depression at the junction of the basal valves and apical lobes. (Also see the lateral view of the aedeagus (Fig. 17E).)

The epiphallus (Fig. 17F) is a collar-like or bridge-shaped sclerotised structure which is present on the dorsal side of the aedeagus. It is also removed along the ectophallic membrane, with which it is attached. It consists of two long lateral sclerites which are connected sub-basally by a bridge. They also have two small triangular hook-like posterior projections which slightly project outwards. The epiphallus contains two lateral appendices which are also connected at their bases.

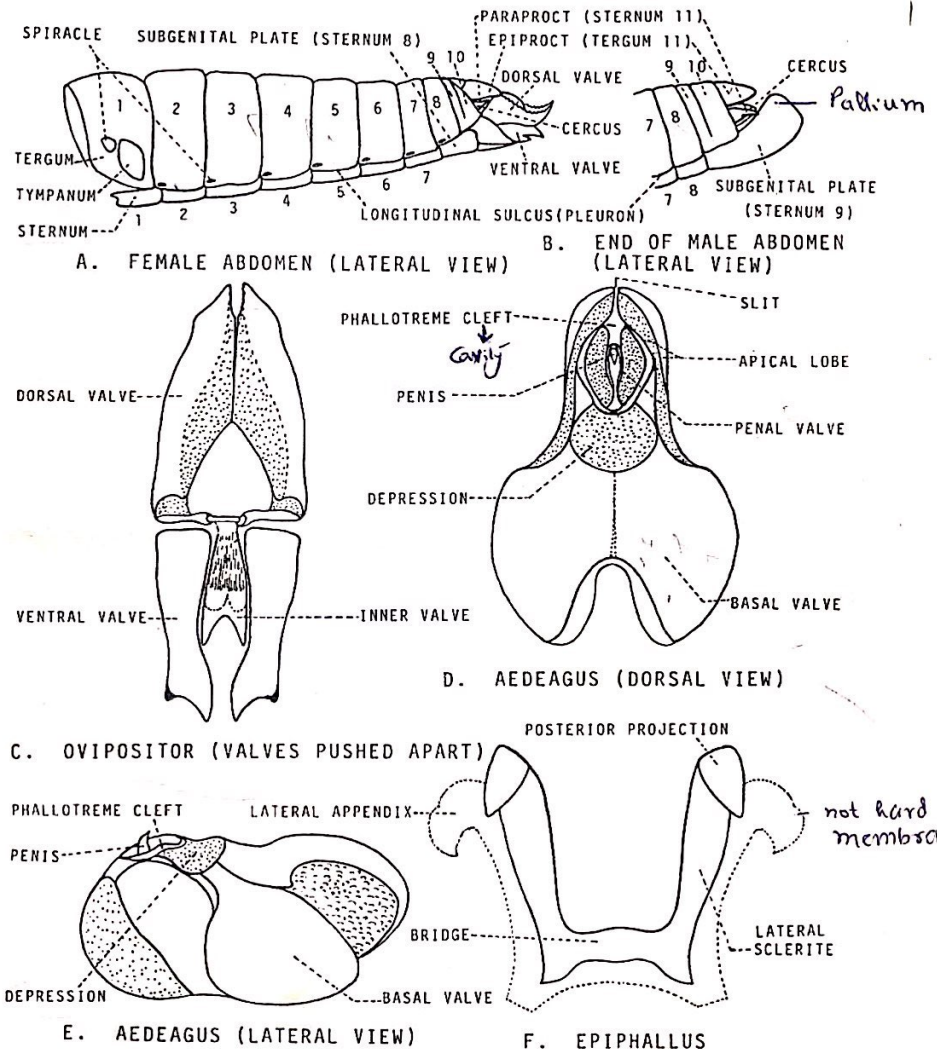


FIG. 17. ABDOMEN AND GENITALIA OF AK GRASSHOPPER