which arise from the sides meet broadly beneath the heart. The anterior part that lies in the thorax and head is called the aorta. It is a delicate tube which is slightly dilated at three places. It ends near the brain. The blood (haemolymph) enters the heart through ostia from the haemocoel, carried anteriorly in the heart and aorta, and again returned to the haemocoel in the head.

5. **Nervous system**: It is divided into the following three divisions:

(a) **Central nervous system**: It is the main division and consists of the supraoesophageal ganglion (brain), suboesophageal ganglion and the ganglionated ventral nerve cord.

(b) **Peripheral nervous system**: It consists of the nerves that connect the central nervous system with the peripheral sense receptors (sense organs).

(c) **Visceral or sympathetic nervous system**: It consists of the nerves and ganglia that connect the central nervous system with the viscera (different organs in the body such as gut, heart, reproductive organs, etc.).

For this introductory course, only the central nervous system will be dissected and studied. It lies in the median line of the body below the alimentary canal except the brain which is dorsal to it. It extends from the head to the eighth abdominal segment. For clearing the central nervous system, remove the ventral diaphragm carefully with the help of fine forceps and a dissecting needle. Now trace the ventral nerve cord and proceed towards the head. The central nervous system (Fig. 31) consists of a large compound ganglion (pl. ganglia) known as supraoesophageal ganglion (brain) which lies in the head above the oesophagus. The brain (when seen under high magnification) is further differentiated into three pairs of lobes: protocerebrum (fore brain), deutocerebrum (mid brain) and tritocerebrum (hind brain). The brain is connected with the suboesophageal ganglion which lies in the head below the oesophagus. It is connected with a ventral nerve cord which has three thoracic and five abodominal ganglia. The last ganglion is the composite one and biggest of all the abdominal ganglia.

The ganglion of one segment is connected with that of an other by means of paired connectives. In each segment there are actually two ganglia which are transversely connected by means of commissures and fused into a single ganglion. All ganglia innervate (i.e. supply nerves) to the different body sclerites or organs.

6. **Respiratory system**: It consists of paired lateral spiracles, tracheae and tracheoles. The spiracles are the external openings through which the air enters and leaves the body. They can be closed because they are provided with a closing mechanism. The ak grasshopper has 10 pairs of spiracles, two thoracic (one between the prothorax and mesothorax and the other between the mesothorax and metathorax-Fig.16B) and eight abdominal (one on each of the first eight abdominal segments -- Fig. 17A). The spiracles open into elastic internal tubes, the tracheae (sing. trachea). The tracheae from the adjoining spiracles unite to form longitudinal trunks. There are six longitudinal trunks, two dorsal, two ventral and two lateral. When the grasshopper is dorsally dissected and the two flaps are brought on sides and pinned, one dorsal trunk goes on each side as shown in Fig. 32. The two ovaries are united into a single body which lies on the alimentary canal in the abdominal segments 3-5. One lateral trunk is located on each side of this body, while the two

Trachae have a wall of single layed epithelial cells cells secret cuticular thickening around the tube that have a wall of that give 58 support the tubes

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.

Spiracles are gaurded by hairs to keep the foreign parti[cles] out and valves that function as to open or close the spiracles as required.
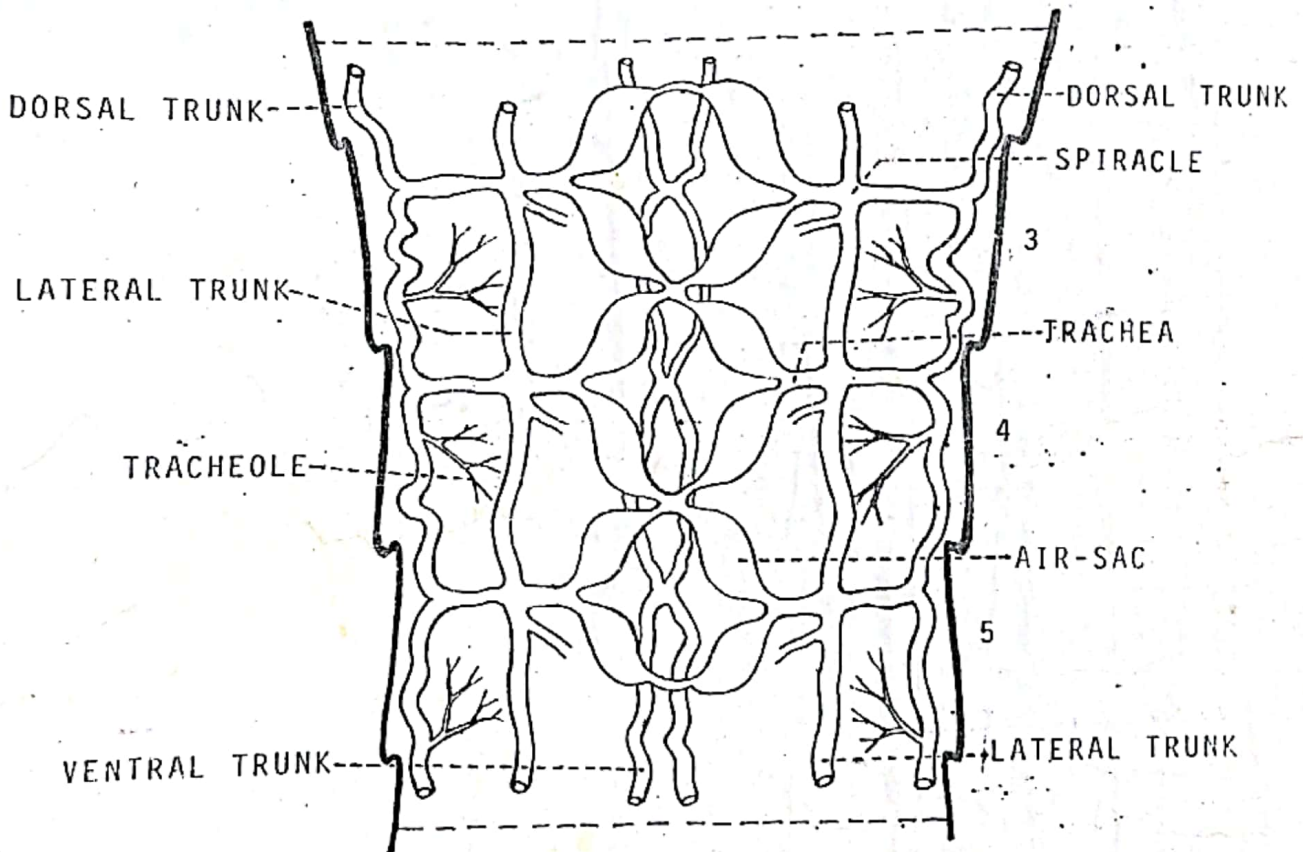

FIG.32. RESPIRATORY SYSTEM
(3-5 ABDOMINAL SEGMENTS) OF AK GRASSHOPPER