flagellum (except the distal ones) have thick whorls of long hair on them, e.g., male mosquitoes.

7. **Pilose** (sparsely hairy)(Fig. 18G): The segments of flagellum (except the distal ones) have very thin whorls of short hair on them, e.g., female mosquitoes.

8. **Clavate** (club-shaped)(Fig. 18H): The segments of flagellum gradually broaden towards apex, e.g., butterflies, antlions, trogossitid beetles and some darkling beetles.

9. **Capitate** (knob-like or head-like)(Fig. 18I): One or a few terminal segments of flagellum are suddenly thickened to form a head-like structure, e.g., red flour beetle, powderpost beetles, nitidulid beetles and amblyceran biting lice.

10. **Lamellate** (Leaf-like)(Fig. 18J): The terminal segments of flagellum are expanded into long, broad leaf-like plates on one side, e.g., rutelid beetles, rhinoceros beetles and dungrollers.

11. **Flabellate** (tongue-like): It has some resemblance to the lamellate antenna. But in this type one or more segments of flagellum are produced into long, thick, tongue-like processes slightly broadening towards apices, e.g., male stylopids and sandalid beetles.

12. **Geniculate** (elbow-like)(Fig. 18K): In this antenna the scape is very long and forms a sharp bend with the remaining segments like a flexed arm, e.g., weevils, honeybees, chalcid wasps and stag beetles.

13. **Aristate** (arista-like)(Fig. 18L): The scape is very small while the pedicel is large and triangular. The first segment of flagellum is greatly enlarged, where as the remaining segments are modified into a large hairy bristle, the arista, which is attached to the first segment on the dorsum of its base, e.g., house flies, fruit flies, syrphid flies, etc.

14. **Stylate** (styliform or setiform)(Fig. 18M): The flagellum forms a long, unsegmented, terminal hair, e.g., mango hoppers (leafhoppers), planthoppers, cicadas, robber flies, delphacid bugs and mayflies.

15. **Ensiform** (sword-like)(Fig. 18N): The segments of flagellum are thin, flattened and gradually taper towards apex like a leaf-blade or a sword, e.g., green grasshoppers (*Acrida sp.*).

B. **Mouthparts:** These are the organs of feeding which typically consist of the following five parts:

1. Labrum (upper lip)
2. A pair of mandibles (upper jaws)
3. A pair of maxillae (lower jaws)
4. Labium (lower lip)
5. Hypopharynx (tongue or lingua)

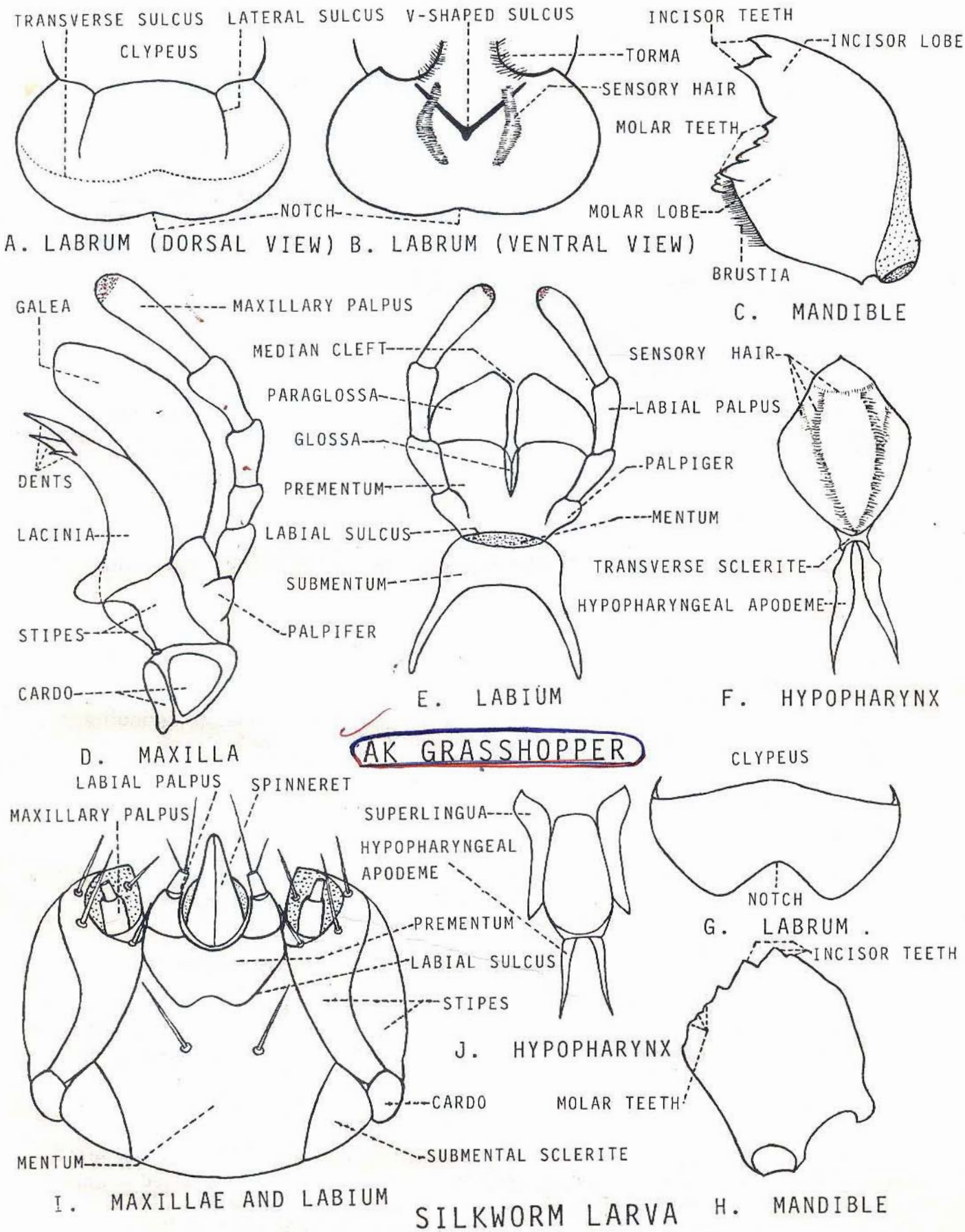

FIG.19. CHEWING TYPE OF MOUTHPARTS

These parts are greatly modified in different insects due to their different methods of feeding. Hence, there are many types or modifications of mouthparts. They are generally classified into chewing (mandibulate) and sucking (haustellate) types. Insects with chewing mouthparts cut and chew or masticate the food with hard mandibles. But those with sucking mouthparts have a somewhat elongated beak or proboscis to suck the liquid food. They have further many types. The mouthparts are often classified as ectognathous and entognathous. In the former case, the mouthparts are not hidden within the head, e.g., bristletails, grasshoppers, bugs, butterflies, etc. In the latter case, the mouthparts are hidden within the head such as doubletails, telsontails and springtails.

I. Chewing or biting type: Under this type, you will dissect out the mouthparts of the following two insects and compare them.

1. **Ak grasshopper** (*Poekilocerus pictus*): Dissect out the mouthparts in the following order and place them on a slide.

Labrum (Fig. 19A, B): It is a broad flap-like sclerite attached to the clypeus and capable of up and down movement. It forms the roof of the mouth cavity. Its anterior border has a slight notch. Its upper surface has two short lateral sulci dividing its basal half into three parts. It has also an ill-defined transverse sulcus which divides it into an anterior and a posterior part. Its lower surface is lined with a membrane, the epipharynx. There is a V-shaped sulcus in its posterior part. It has also two median curved bands of sensory hair. The posterior angles of labrum have two sickle-shaped sclerotised bars, the tormae.

Mandibles (Fig. 19C): These are paired, triangular, asymmetrical, strongly sclerotised but hollow jaws lying below the labrum. They move sideways. The biting surface of each mandible has two lobes, namely, the molar lobe and the incisor lobe. The former is near the base of the mandible and has a group of short and blunt molar teeth(dents) which form the mola or grinding area. The latter has a group of longer and acute incisor teeth (dents) which cut the food. The inner edge between the molar teeth and the base of the mandible has a row of short hair called brustia.

Maxillae (Fig. 19D): These are paired structures lying below the mandibles. They move sideways just like mandibles. Each maxilla consists of a basal sclerite, the cardo (pl. cardines) which on its apex has an other sclerite, the stipes (pl. stipites). The cardo has further two parts, an outer broad and triangular and an inner long and narrow one. Similarly the stipes has also two parts, an outer broad and rectangular and an inner long and narrow one. The stipes contains three structures on it. On its outer side is a small process called palpifer which bears on it an antenna-like 5-segmented structure, the maxillary palpus (pl. palpi). The stipes on its apex bears two lobe-like structures. The outer one is broad, elongate and called the galea while the inner one is basally broad but tapering anteriorly and known as the lacinia. The latter is strongly sclerotised and has three black pointed dents at its apex.

Note: When the two lobes on the stipes fuse and form a single structure, it is called mala.

Labium (Fig. 19E): It is a single structure lying below the maxillae. It closes the mouth from the lower side. It is divided by an ill-defined transverse labial sulcus into two main parts: the posterior one, the postmentum and the anterior one, the prementum. The postmentum is further divided into two parts: the lower very large is the submentum while the upper very small (in the