THE STYLETS OF THE LARGE MILKWEED BUG, *ONCOPELTUS FASCIATUS* (HEMIPTERA: LYGAEIDAE , AND THEIR INNERVATION[1]

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ABSTRACT

Sections of the stylets of the large milkweed bug were examined in the electron microscope. They differ from those of 29 spp. of Homoptera studied earlier, in having: flanges on the maxillary stylets that engage grooves in the mandibular stylets; three large and three small dendrites in the central duct within the mandibular stylets; and a large salivary canal.

INTRODUCTION

The large milkweed bug, *Oncopeltus fasciatus* (Dallas), is a widely used research animal since it is reasonably large and can be reared easily in the laboratory throughout the year. Its widespread usage prompted a review of published information on its morphology, physiology and behavior (Feir 1974). No information on the structure of its stylets is included in this review, nor are there other reports on their fine structure. The present paper describes the stylets of this bug and compares them with the stylets of some Hemiptera (Suborder Homoptera) studied previously.

MATERIALS AND METHODS

The large milkweed bugs were from colonies maintained in the laboratory at the University of British Columbia.

The stylets were dissected from the bugs and immediately fixed simultaneously for 1 hr. on ice in 2% osmium tetroxide and 4% glutaraldehyde, both in 0.1 M cacodylate buffer, washed in 0.1 M cacodylate buffer (pH 7), post-fixed in 2% osmium tetroxide in the same buffer for ½ hr, dehydrated in ethanol, and embedded in Epon 812 by the method of Luft (1961). The sections were cut with glass knives on a Reichert Om U2 ultramicrotome, mounted on grids with carbon-collodion supporting films and stained with uranyl acetate and lead citrate. They were examined with Philips 200 or 300 electron microscopes.

RESULTS AND DISCUSSION

The piercing-sucking organs of the large milkweed bug consist of a pair each of mandibular and maxillary stylets. Each stylet has an enlarged base within the head capsule and an elongated shaft mostly outside the head. Except at the bases, the mandibular stylets envelop the maxillary stylets closely, so that in a cross section of the stylet bundle (Fig. 1), the mandibular stylets are on the outside and the maxillary stylets are on the inside. Except at their bases, the maxillary stylets are interlocked by a system of ridges and grooves. On the inner surface of each maxillary stylet there are two wide concavities which together form the food and the salivary canals. The food canal is anterior to and only slightly larger than the salivary canal. The bug injects saliva into the milkweed seed by way of the salivary canal and sucks the food material into the gut by way of the food canal.

More specific morphological details are as follows:

The maxillary stylets are only slightly longer (5%) than the mandibular stylets. The length of the stylets, including the base is about 6 mm. The tip of each mandibular stylet has a series of transverse, barb-like teeth across its outer face. A cross section of the whole stylet bundle, about midway in the shafts (Fig. 1) shows the interlocked maxillary stylets with the food and salivary canals between their apposed inner surfaces. The stylet bundle is approximately 26 micrometers in diameter, the food canal 9 micrometers in diameter and the salivary canal 8 micrometers in diameter. The salivary canal is thus only slightly smaller than the food canal. The mechanism that interlocks the maxillary stylets consists of three grooves in the right maxillary stylet and two grooves and three flanged ridges in the left. The maxillary stylets are not bilaterally symmetrical. There is a ridge with two flanges at the anterior margin of the outer surface of each maxillary stylet which fits into a groove on the inner surface of each mandibular stylet. This produces a compactly interlocked stylet bundle but the interlocking mechanism is such that independent movement upon one another is possible for each of the four stylets. The body of each maxillary stylet also contains a narrow central cavity which often appears in sections as two cavities because of the apposition of parts of its walls.

Each mandibular stylet contains a central duct running from the base to near the tip. The

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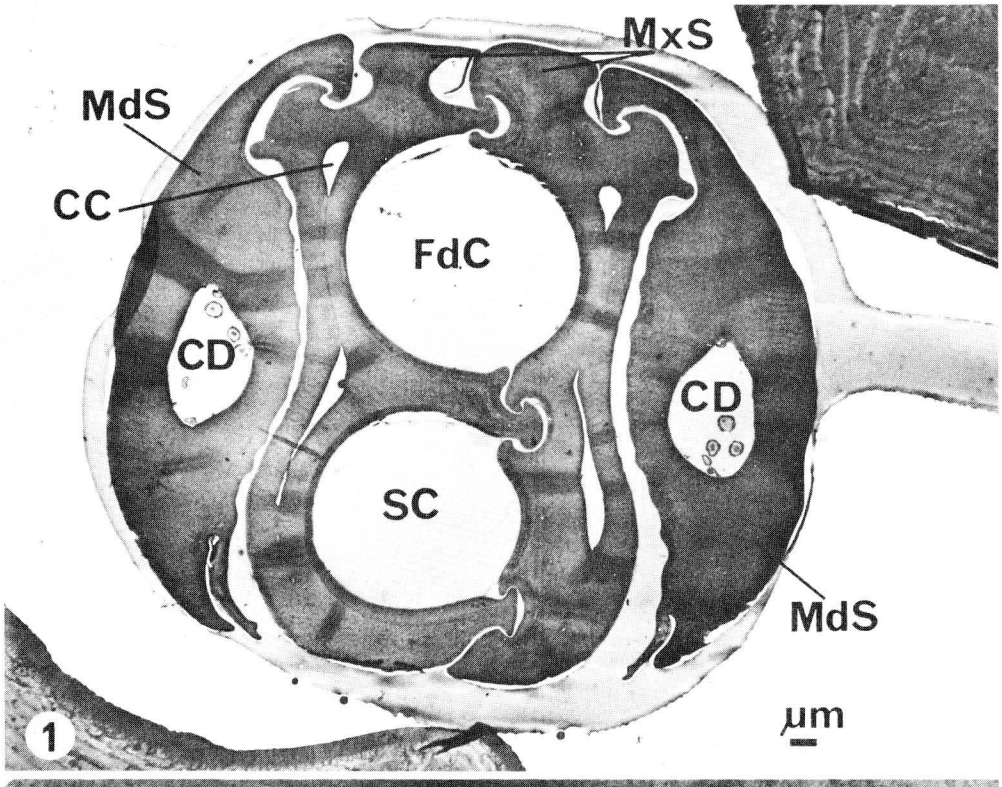

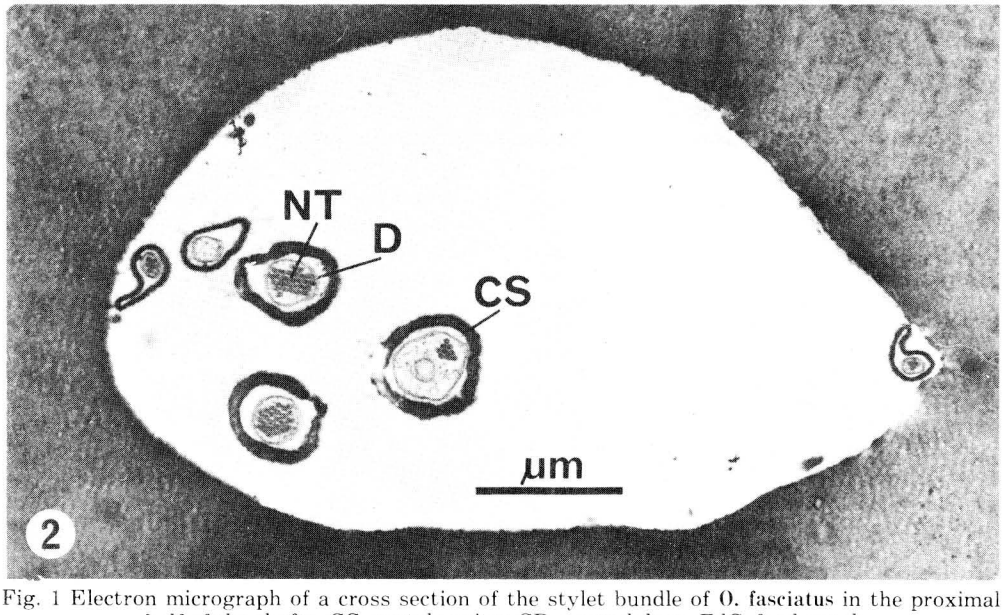

Fig. 1 Electron micrograph of a cross section of the stylet bundle of **O. fasciatus** in the proximal half of the shafts. CC, cental cavity; CD, central duct; FdC, food canal; MdS, mandibular stylet; MxS, maxillary stylet; SC, salivary canal.

Fig. 2 Electron micrograph of a section of the central duct in a mandibular stylet of **O. fasciatus**. There are six dendrites in the central duct. Each dendrite (D) contains neurotubules (NT) and is surrounded by a cuticular sheath (CS).

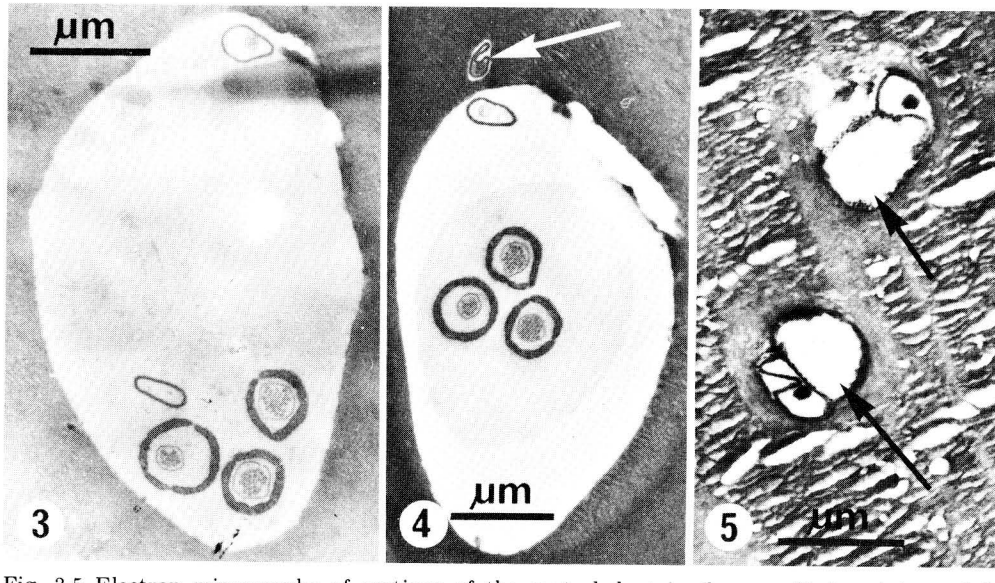

Fig. 3-5 Electron micrographs of sections of the central duct in the mandibular stylets of **O. fasciatus.** 3. midway, about three mm from the tip, showing five dendrites in the duct 4. about two mm from the tip, showing four dendrites in the duct and one (arrow) in the wall of the stylet. 5. at the stylet tip, after the central duct has bifurcated. The two branches of the central duct are indicated by arrows.

central duct is approximately 2 by 6 micrometers and contains six dendrites. All the dendrites were traced from the base of the mandibular stylet to midway along the stylet bundle. The dendrites are of two types: three large dendrites which are usually near the centre of the duct and away from the walls; and three smaller dendrites usually placed peripherally and close to the wall (Fig. 2). About midway along the stylet bundle one of the small, peripheral dendrites leaves the central duct and proceeds to the outside of the stylet and a receptor site, leaving five dendrites in the central duct (Fig. 3). About 1 mm closer to the tip, another of the small, peripheral dendrites leaves the duct (Fig. 4), leaving only 4 dendrites in the duct (Fig. 4). The last small peripheral dendrite leaves the duct, about 1 mm further distad, leaving only the three large dendrites in the duct. Close to the tip of the stylet, the central duct bifurcates (Fig. 5); one branch contains two dendrites, the other branch contains one.

The stylets of the large milkweed bug differ in some respects from those of the Hemiptera (Suborder Homoptera) previously studied by me (Forbes 1969 & 1972, Forbes & Mullick 1970, Forbes & Raine 1973, Chan & Forbes 1975). The salivary canal of the large milkweed bug is almost as large as the food canal, presumably because large amounts of saliva are needed to soften the somewhat dry food before it can be sucked up the food canal; aphids, the six-spotted leafhopper, the greenhouse whitefly, the pear psylla, and the balsam woolly aphid all have a salivary canal which is much smaller than the food canal. These all suck liquid plant sap, so that presumably less saliva is required when they feed. The body of each maxillary stylet of the large milkweed bug contains a large, narrow central cavity, which is apparently empty; the maxillary stylets of the six-spotted leafhopper also have cavities but these contain dendrites. There are ridges and grooves that interlock the maxillary with the mandibular stylets of the large milkweed bug; no such interlocking mechanism occurs in any of the homopterous insects mentioned. The central duct in the mandibular stylets of the large milkweed bug contain six dentrites, three of which are smaller and go to receptor sites proximad to the tip of the stylet and three of which are larger and reach the stylet tip; all of more than 25 species of aphids examined have mandibular stylets with two similar dendrites running to their tips (Forbes 1969 & unpublished, Chan & Forbes 1975). The greenhouse whitefly and the pear psylla also have two dentrites running to the stylet tips but the balsam woolly aphid has three. The six-spotted leafhopper's mandubular stylets have three dendrites which run to their tips or very close to them.

The structure and function of the stylets of other Hemiptera and the probable significance of the nerves in the stylets have been discussed in my earlier papers already cited.

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