

Comparative Morphology of the Mouthparts of the Curculionoidea (Coleoptera), their Feeding Mechanism and Relationship to Classification. Part II. Family Apionidae

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Abstract - The mouthparts of the Apionidae are almost of the same structures as in the Curculionidae feeding soft plant tissues, and two subfamilies in the current system are well supported by their structures. The subfamilies Apioninae and Nanophyinae are clearly characterized as follows. In Apioninae, clypeal margin sinuate; mandibles meet anteroposteriorly when retracted and more or less curved internally; maxillary palpi two-segmented, with large palpiger; labial palpi one-segmented; prementum parallel-sided, longer than wide. In Nanophyinae, clypeal margin with two to three notches in the middle; mandibles meet anteroposteriorly when retracted and more or less curved internally; maxillary palpi three-segmented, palpiger about as great as stipes; labial palpi two-segmented, separated to each other by the apical protrusion of prementum; prementum about as long as wide. [Insecta, Coleoptera, Comparative morphology, Mouthparts, Apionidae].

INTRODUCTION

This study is second series for comparative morphology of the mouthparts about the families in Curculionoidea. The families Apionidae are characterized by the mouth parts as follows. The clypeus is defined as an apical margin of rostrum between the paraclypeal sulci, which are usually associated with the paraclypeal setae. The mandibles move obliquely upwards and they meet anteroposteriorly when they are retracted, and they are typically two-notched and three-toothed on the mesal margin. The teeth are sharp and arranged in a weak curve. The maxillae move nearly vertically. The prementum is longer than wide, parallelsided, and longer than the postmentum. The labial palpi are one-segmented, attached to the apical surface of the prementum and contiguous to each other.

The materials observed in this work are mostly inhabitants in Korea including 4 species in 2 subfamilies as in the following list (Table 1). A

Table 1. Examined species of the Family Apionidae

Subfamily	Species
Apioninae	<i>Apion (Eutrichapion) viciae</i> (Paykull, 1798) <i>Apion (Perapion) violaceum</i> Kirby, 1803
Nanophyinae	<i>Nanophyes marmoratus</i> (Goeze, 1777) <i>Nanophyes pallipes</i> Roelofs, 1874

list of species examined by SEM arranged in Morimoto's system (1962, 1981).

RESULTS

Results obtained are summarized as follows.

Apion (Eutrichapion) viciae (Paykull, 1798) (Pl. 1)

Clypeal margin sinuate, paraclypeal setae obsolete, paraclypeal sulci indefinite.

Mandibles with apical (second) tooth larger than dorsal (first) tooth. Exterior surface with

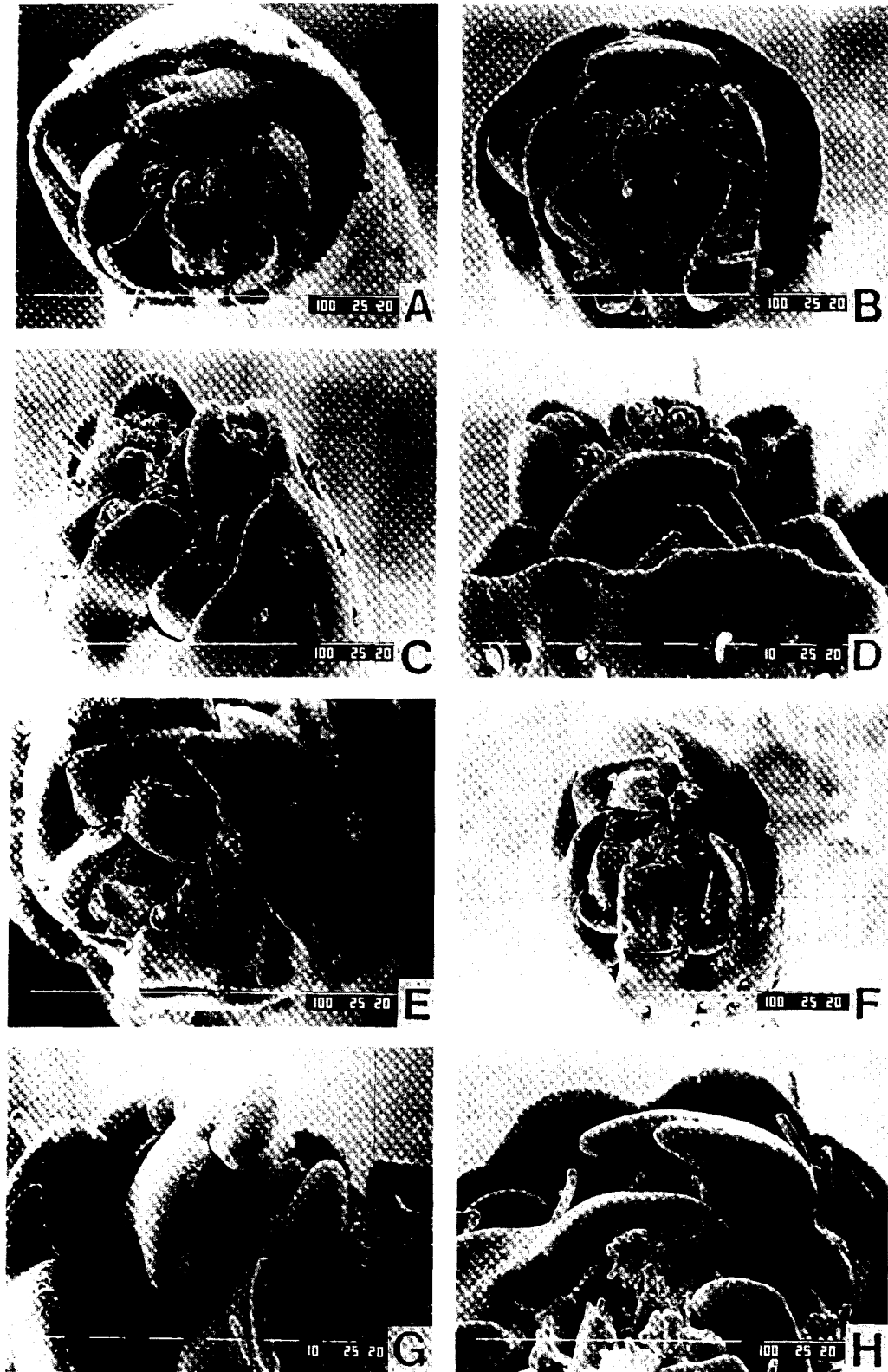


Plate 1. A-D: *Apion (Eutrichapion) viciae* (Paykull).

A: apical view. B: ventral view. C: lateral view. D: dorsal view.

E-H: *Apion (Perapion) violaceum* Kirby.

E: apical view. F, H: ventral view. G: lateral view.

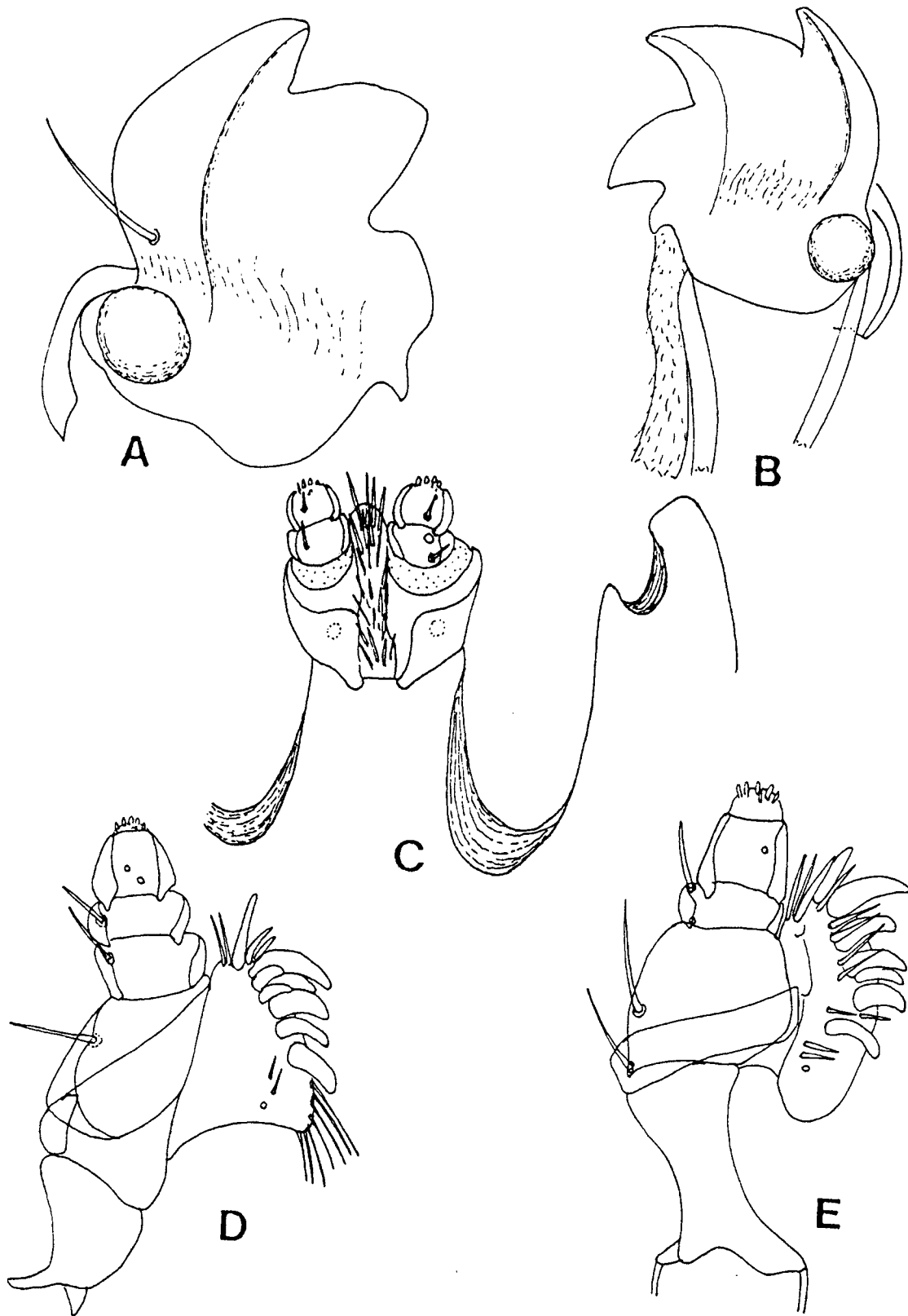


Fig. 1. A, B: Mandibles, ventral. C: Labium. D, E: Maxilla.
 A, E: *Apion (Perapion) violaceum*. B, C, D: *Nanophyes marmoratus*.

one long and one short setae in front of prebasal flexion.

Prementum about twice as long as wide, with a pair of setae at one-third from apex.

Hypostomal arms vertical lamellar, parenthesis-shaped.

***Apion (Perapion) violaceum* Kirby, 1803**
(Fig. 1A, E; Pl. 1)

Almost of the same structure as the preceding except for the following points.

Epistomal margin arcuate on each side, and prementum about 1.4 times as long as wide.

***Nanophyes marmoratus* (Goeze, 1777)**
(Fig. 1B, C, D; Pl. 2)

Clypeal margin with two distinct notches in the median part, paraclypeal setae two in each paraclypeal groove.

Mandibles as in *Apion*, but ventral tooth sharper.

Maxillary palpi short and rigid, first and second segments each with a seta, apical segment with nipple-like papillae and a few oblong sensory slits. Palpiger with a seta on ventral face. Maxillary cleft as wide as postmentum.

Prementum about as long as wide, almost parallel-sided from the base to 3/5, then rapidly narrowing apically. Labial palpi attached to apicolateral surfaces and distant to each other. Postmentum a little longer than prementum, almost parallel-sided, without setae. Hypostomal arms sharp triangular, more obtusely ridged than in *Apion*.

***Nanophyes pallipes* Roelofs, 1874**
(Pl. 2)

Almost of the same structures as in the preceding except for the clypeal margin, which has three notches in the middle.

**General morphology of the family
Apionidae**

The septum of the preoral cavity. The septum is absent.

The labrum. The labrum is completely absent.

The clypeus. The clypeus is defined as an apical margin of rostrum between the paraclypeal sulci, which are usually associated with the paraclypeal setae. But these characters are indefinite in *Apion*. The clypeal margin is sinuate in *Apion*, and two or three notched in *Nanophyes*.

The mandibles. The mandibles of the Apionidae move obliquely upwards and they meet anteroposteriorly when they are retracted. The dorsal articulation of the mandibles is nearly of the same structure, and the ventral articulation is well developed. The exterior surface has a distinct flexion between the dorsal and ventral condyles, the surface basal to the flexion forms a smooth and evenly curved articular surface and produced as a lobe of lamella. The mandibles are typically two-notched and three-toothed on the mesal margin. The teeth are sharp and arranged in a weak curve.

The maxillae. The maxillae move nearly vertically. The maxillae of *Apion* are unique in having two-segmented palpi which are somewhat retracted into the large palpiger, but those of *Nanophyes* are three-segmented. The apical segment of the maxillary palpi bears several nipple-like papillae at its apex and several oblong sensory pores on the dorsal or lateral walls. The maxillary clefts are rather wide and ventral parts of the maxillae are broadly visible between the prementum and hypostoma. In *Apion*, the palpiger is large and it has two longitudinal setae, but the stipes is narrow and almost fused with palpiger. In *Nanophynae*, the palpiger, the stipes and the cardo are defined. The galea has become fused with the lacinia into the mala, which is demarcated from the stipes.

The labium. In the Apioninae, the prementum is longer than wide, parallel-sided, and longer than the postmentum. The labial palpi are one-segmented, attached to the apical surface of the prementum and contiguous to each other. In the *Nanophyinae*, the prementum is about as long as wide and shorter than or about as long as the postmentum. The labial palpi are two-segmented, attached to the apicolateral edges of the prementum, and narrowly separated by the apical protrusion of the prementum. The terminal segment of the labial palpus bears the same nipple-like papillae at its apex as those of the maxillary palpus, but the oblong sensory pores are absent. The postmentum is devoid of setae. The hypostomal arms produce to the level of apical margin of the prementum, ridged vertical. The postcoila is deeply cleft from the inner apical margin of the hypostomal arm.

Feeding mechanisms

The mouth parts of the weevils in the Apioni-

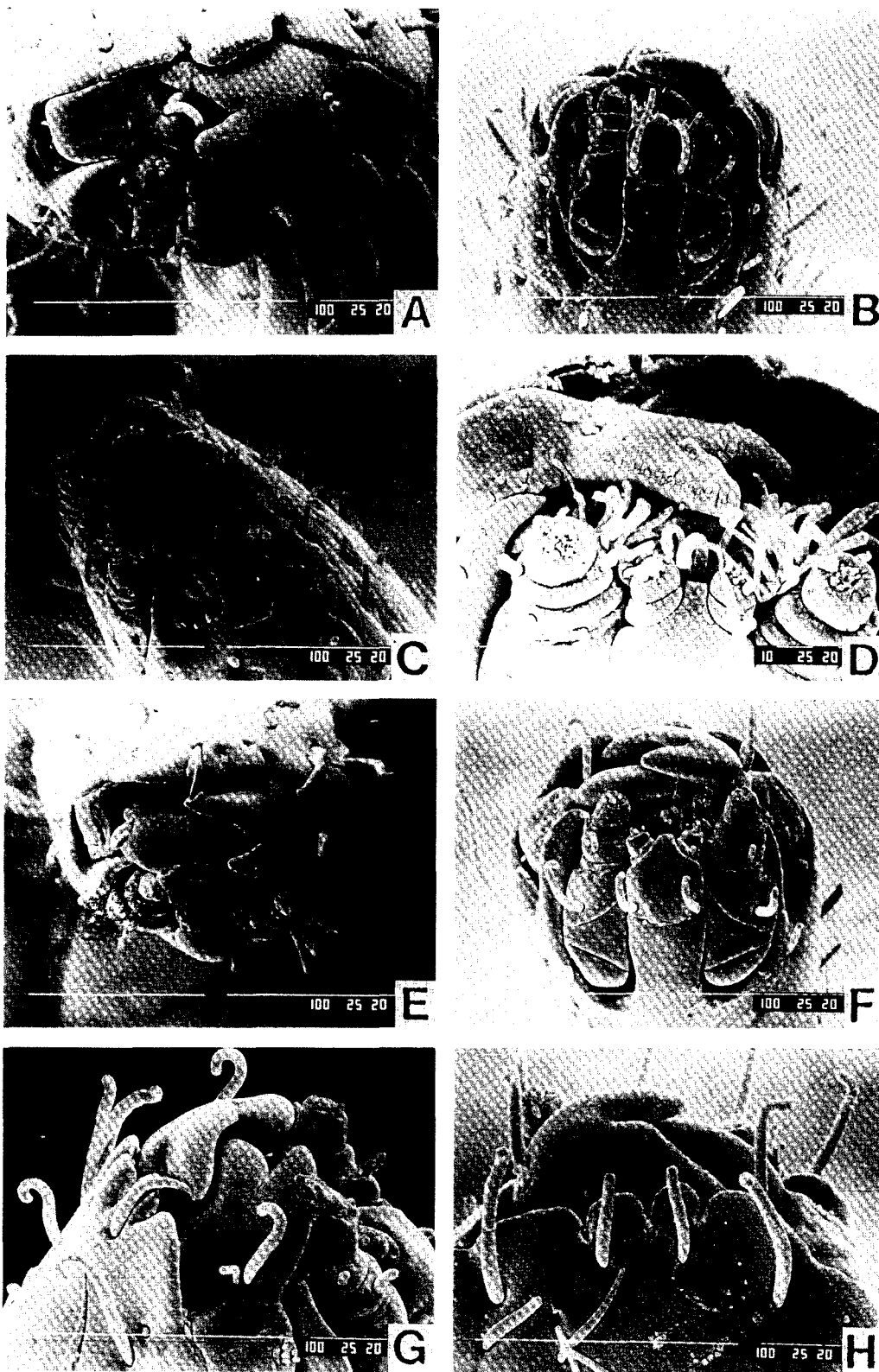


Plate 2. A-D: *Nanophyes marmoratus* (Goeze).

A: apical view. B, D: ventral view. C: lateral view. D: maxillary palpi and labial palpi.

E-H: *Nanophyes pallipes* Roelofs.

E: apical view. F: ventral view. G: lateral view. H: dorsal view.

Table 2. Mouthparts of the Family Apionidae

	clypeus	mandibles	maxillae	labium	
				prementum	labial palpi
<i>Apion</i> (<i>Eutrichapion</i>) <i>viciae</i>	sinuate	move obliquely, meet anteroposteriorly	move vertically, palpi two-segmented	twice as long as wide, with a pair of setae	one-segmented
<i>Apion</i> (<i>Perapion</i>) <i>violaceum</i>	sinuate	move obliquely, meet anteroposteriorly	move vertically, palpi two-segmented	twice as long as wide, with a pair of setae	one-segmented
<i>Nanophyes</i> <i>marmoratus</i>	with two notches	move obliquely, meet anteroposteriorly	move vertically, palpi three-segmented	about as long as wide	two-segmented
<i>Nanophyes</i> <i>pallipes</i>	with three notches	move obliquely, meet anteroposteriorly	move vertically, palpi three-segmented	about as long as wide	two-segmented

dae are nearly of the same structures to one another. Their mandibles meet anteroposteriorly when retracted and more or less curved internally. The teeth are sharp and arranged in a weak curve. The mandibles of this type are efficient for chewing the soft tissue of plants (Ting 1933; Butt 1951; Evans 1963).

Considerations on the classification of the Apionidae

Obtained data of the family Apionidae are summarized as Table 2. The subfamilies Apioninae and Nanophyinae are clearly characterized by the mouth parts as follows.

Apioninae: Clypeal margin sinuate; maxillary palpi two-segmented, with large palpiger; labial palpi one-segmented, contiguous to each other; prementum parallel-sided, longer than wide; hypo-stomal protrusions vertical lamellar, parenthesis-shaped.

Nanophyinae: Clypeal margin with two to three notches in the middle; maxillary palpi three-segmented, palpiger about as great as stipes; labial palpi two-segmented, separated to each other by the apical protrusion of prementum; prementum about as long as wide; hypostomal protrusions triangular, not lamellar.

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바구미상과(딱정벌레목) 갑충 구기의 비교형태와 그 섭식기작과 분류와의 관계에 대한 연구. Part II. 창주등이바구미과

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적 요 - 본 연구는 창주등이바구미과 갑충의 구기가 부드러운 식물조직을 섭식하는 바구미과 갑충과 거의 같은 구조를 하고 있다는 사실을 잘 나타내고 있다. 창주등이바구미과 갑충에 대하여 주사전자현 미경을 사용하여 구기를 본래의 위치에서 관찰하고, 여기에 해부에 의한 연구도 병행하여 얻은 구기구조에 대한 연구의 결과는 다음과 같다. 창주등이바구미아과의 바구미는 두순 가장자리가 꾸불꾸불한 모양이고, 큰턱은 수축시 전후로 만나며 안쪽으로 약간 굽어있는 구조를 하고 있다. 작은턱 수염은 두마디로 큰 생수절을 가지며, 아랫입술 수염은 한 개의 마디로 되어 있다. 하순전기절은 평행면을 가지며 넓이보다 길이가 더 길다. 별창주등이바구미아과의 바구미는 두순가장자리 중앙에 2~3개의 홈을 가지고, 큰턱은 수축시 전후로 만나며 안쪽으로 약간 만곡된 구조를 하고 있다. 작은턱 수염은 세마디로 생수절과 첩교절의 크기가 같으며, 아랫입술 수염은 두마디로 하순전기절 폭대기의 용기에 의해 서로 분리되어 있다. 하순전기절의 넓이와 길이는 같다.