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## The Genus *Eosentomon* of Taiwan (Protura: Eosentomidae) 【Research report】

### 臺灣的古蛭屬(昆蟲綱：原尾目)【研究報告】

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#### Abstract

A total of 8 species, including 6 new species, 1 new record species, and 1 previous record species of the genus *Eosentomon* Berlese are reported from Taiwan. Detailed description, diagnosis, differentiation, and distribution of each species are included in the present paper.

#### 摘要

報導8種臺灣產古蛭屬(*Eosentomon*)(原尾目)昆蟲，其中包含6種新種，1種新記錄種和1種舊記錄種。文中包括每個種類的描述、識別特徵及分佈。

**Key words:** *Eosentomon*, Protura, Taiwan

**關鍵詞:** 古蛭屬、原尾目、臺灣。

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# The Genus *Eosentomon* of Taiwan (Protura: Eosentomidae)

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## ABSTRACT

A total of 8 species, including 6 new species, 1 new record species, and 1 previous record species of the genus *Eosentomon* Berlese are reported from Taiwan. Detailed description, diagnosis, differentiation, and distribution of each species are included in the present paper.

**Key words:** *Eosentomon*, Protura, Taiwan.

## Introduction

The proturans, first described by Silvestri (1907), are minute, slender, wingless insects. There have been about 500 species hitherto recorded in the world (Romoser and Stoffolana, 1994). The proturan fauna of Taiwan is poorly known. Only 5 species of Protura, belonging to 4 genera in 2 families, have been recorded. In the genus *Eosentomon* Berlese, only 1 species, *Eosentomon sakura* Imadate et Yosii was recorded in Taiwan before. In the present paper, we describe 6 new species, 1 new record species, and 1 redescribed previously recorded species of Eosentomidae of Taiwan.

## Materials and Methods

All specimens were collected from forest litter and humus, in tree cavities, under bark on dead trees, under stones, in pasture, cultivated field, or grassland soils, on bryophytes and lichens, and in caves. Proturans are usually separated by use of a Berlese's funnel utilizing heat and light to drive out the microfauna. The materials are preserved in 75% ethanol. Because of their small size, the

specimens must be mounted on microscope slides for examination under an oil-immersion lens. We mounted specimens directly from 75% ethanol into lactic acid, then sealed the slides with Hoyer's solution. The taxonomic treatments are based on Imadate (1974). Explanations for some terms used for measurements are as follows: L1 is the length of head/width of head, PR is the length of head/diameter of pseudoculus, TR is the length of foretarsus/length of claw, EU is the length of empodium/length of claw, and BS is ratio of the distance between the proximal end and sensilla t-1 to the distance between t-1 and the praetarsus. All specimens (including types) are deposited in the Department of Biology, Tunghai University, Taiwan.

## Descriptions

### *Eosentomon bilapilli* sp. nov. (Fig. 1; Tab. 1)

**Female:** body length 1,080-1,440  $\mu\text{m}$  (n=6). **Head:** elliptical, length 146-160  $\mu\text{m}$ , width 92-104  $\mu\text{m}$ , L1=1.4-1.6. Pseudoculus nearly circular, with 2 globules in center, 9  $\mu\text{m}$  in diameter, PR=16.6-17.4.

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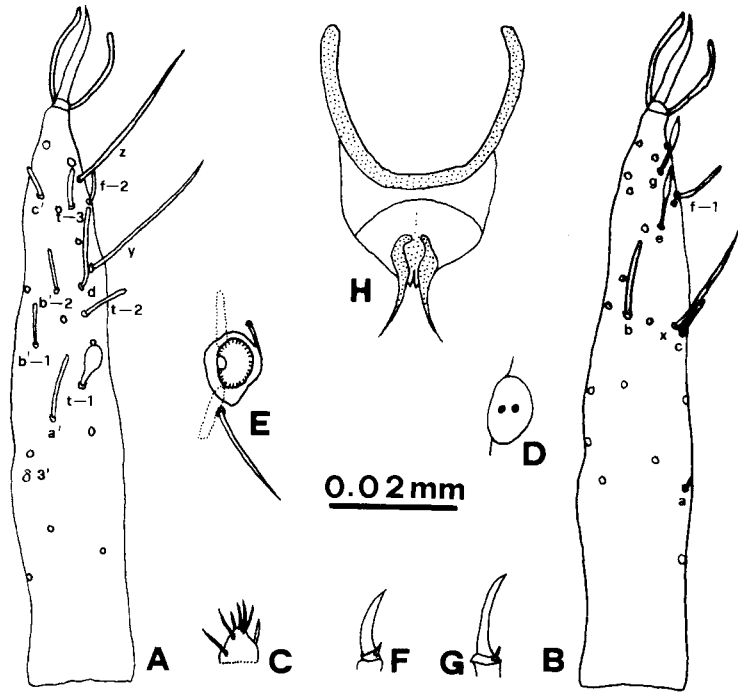


Fig. 1. *Eosentomon bilapilli* sp. nov. A: Interior side of foretarsus, B: Exterior side of foretarsus, C: Labial palpus, D: Pseudoculus, E: Spiracle, F: Distal end of middle tarsus, G: Distal end of hind tarsus, H: Female squama genitalis.

Labial palpus with a large sensillum and tuft with 6-7 setae. **Thorax:** foretarsus length 98.0-112.8  $\mu\text{m}$ , width 19.2-20.8  $\mu\text{m}$ , claw length 21.6-24  $\mu\text{m}$ , TR=4.5-4.8; empodium length 19.2-23.2  $\mu\text{m}$ , EU=0.9-1.0. Sensilla t-1 baculiform, BS=1.0-1.3; t-2 and t-3 short, linear, t-3 broader than t-2. Exterior sensilla a rudimentary; b, c, and d linear, b longer than c, d often reaching base of f-2; e and g spatulate; f-1 and f-2 linear, f-2 shorter than f-1 in length. Interior sensilla a' surpassing base of  $\delta 3'$ ; b'-1 and b'-2 short; c' shorter than b'-1 and b'-2 in length. Middle tarsus length 52-56  $\mu\text{m}$ , claw length 15.2-16.8  $\mu\text{m}$ ; hind tarsus length 55.2-58.4  $\mu\text{m}$ , claw length 15.2-16.8  $\mu\text{m}$ . Middle and hind tarsus with short empodia, less than 1/9 of their claws in length respectively. Spiracle diameter 9.6-10.4  $\mu\text{m}$ . **Abdomen:** chaetotaxy as shown

in Table 1. Abdominal appendages I-III with terminal vesicle and 5 setae. Squama genitalis, caput processus-shaped, like a duck's head, beak thick; corpus processus narrow; filum processus thin, lateral sclerotization distinct.

**Male and larva:** unknown.

**Specimens examined:** Holotype ♀, CHIAYI: Alishan 2,200 m, 3-X-1994, R. F. Chao. Paratypes: CHIAYI: 1 ♀, same data as for holotype; Tatungshan 1,300 m, 4 ♀, 3-X-1994, R. F. Chao.

**Distribution:** Taiwan.

**Etymology:** *bi*, L., two; *lapillus*, L., jewel, meaning with 2 globules on pseudoculus.

**Remarks:** The foretarsus of this species resembles that of *Eosentomon afrostratum* Tuxen, 1977 (Tuxen, 1977a), but can be differentiated by the morp-

Table 1. Chaetotaxy of *Eosentomon bilapilli* sp. nov.

	Formula	Composition of setae
<b>Dorsal</b>		
Thorax		
I	4	A1, 2
II-III	8/14	A1, 2, 3, 4 P1, 1a, 2, 2a, 3, 3a, 4
Abdomen		
I	4/8	A1, 2 P1, 2, 3, 4
II-III	10/16	A1, 2, 3, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5
IV-V	8/16	A1, 2, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5
VI-VII	4/16	A4, 5 P1, 1a, 2, 2a, 3, 4a, 5
VIII	6/9	A1, 4, 5 Pc, 1a, 1b, 2, 2a
IX-XI	8	
XII	9	
<b>Ventral</b>		
Thorax		
I-II	6-2/6	A1, 2, 3, M P1, 2, 3
III	6-4/8	A1, 3, 4, M1, 2 P1, 1a, 2, 3
Abdomen		
I	4/4	A1, 2 P1, 2
II-III	4/6	A1, 2 P1, 2, 3
IV-VII	6/10	A1, 2, 3 P1, 2, 2A, 3, 4
VIII	0/7	Pc, 1, 2, 3
IX-X	4	
XI	8	
XII	12	

hology of sensilla t-1 and a. In fact, there are 2 diagnostic characters in this species. One is the pseudoculus with 2 globules in the center. Although there are 2 inner globules on the pseudoculus of *E. bannaense* Yin, Xie et Imadate, 1995 (Yin et al., 1995), the pseudoculus of *E. bannaense* with a median stria is different from *E. bilapilli*. The other character is the rudimentary sensillum a. Rudimen-

tary sensillum a was also found in *E. boneti* Tuxen, 1956 (Tuxen, 1956), but the morphology of the tarsus and chaetotaxy are different in these 2 species.

***Eosentomon brevisensorium* sp. nov.**  
(Fig. 2; Tab. 2)

**Female:** body length 1,020-1,220  $\mu\text{m}$ .

**Head:** elliptical, length 128-134  $\mu\text{m}$ , width 82-92  $\mu\text{m}$ , L1=1.47-1.56. Pseudoculus nearly circular, 12  $\mu\text{m}$  in diameter, PR=11.2-11.4. Labial palpus with a large sensillum and tuft of 6-7 setae. **Thorax:** foretarsus length 94.4-96.8  $\mu\text{m}$ , width 19.2-23.2  $\mu\text{m}$ , claw length 16-17.6  $\mu\text{m}$ , TR=5.5-5.9; empodium length 15.2-16  $\mu\text{m}$ , EU=0.9-1.0. Sensilla t-1 baculiform, BS=1.0-1.2; t-2 shorter than 1/2 of t-1 in length; t-3 short, between t-1 and t-2 in length. Exterior sensilla a and b linear, apex of b reaching base of e; c and d short; e and g spatulate; f-1 and f-2 short, f-1 longer than f-2 in length. Interior sensilla a' linear; b'-1 and b'-2 short, b'-2 subequal to b'-1 in length; c' short. Middle tarsus length 42.4-43.2  $\mu\text{m}$ . Middle and hind tarsi with short empodia, less than 1/9 of their claws in length, respectively. Spiracle diameter 8-8.8  $\mu\text{m}$ . **Abdomen:** chaetotaxy as shown in Table 2. Abdominal appendages I-III with terminal vesicles and 5 setae. Squama genitalis, caput processus-shaped, like a duck's head, beak thick; corpus processus slightly sclerotized; filum processus thick, lateral sclerotization distinct.

**Male and larva:** unknown.

**Specimens examined:** Holotype ♀, NANTOU: Chitou 1,150 m, 29-V-1994, R. F. Chao. Paratypes: 3 ♀, same data as for holotype.

**Distribution:** Taiwan.

**Etymology:** *brevis*, L., short; *sensorium*, L., a small sense organ, meaning sensillum t-2 of foretarsus short.

**Remarks:** This new species resembles *Eosentomon belli* Yin, 1982 (Yin, 1982), but can be differentiated in the morphology and length of sensilla t-1, t-2 and t-

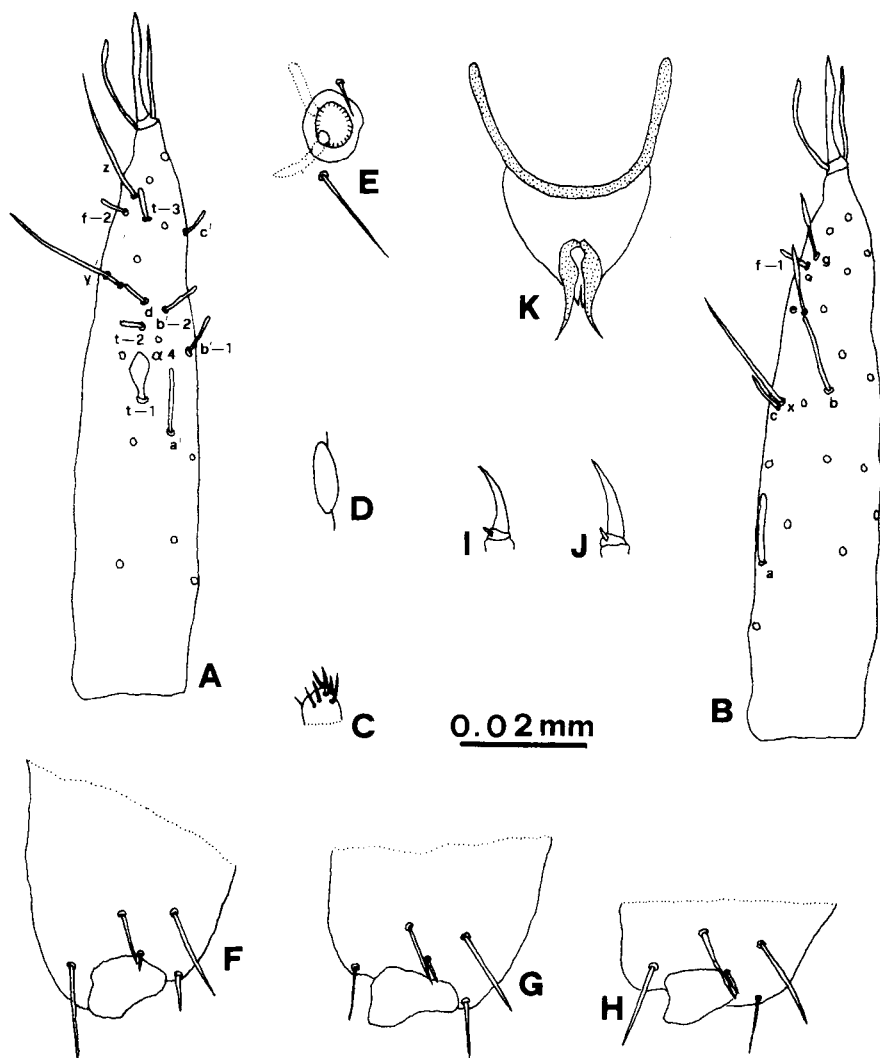


Fig. 2. *Eosentomon brevisensorium* sp. nov. A: Interior side of foretarsus, B: Exterior side of foretarsus, C: Labial palpus, D: Pseudoculus, E: Spiracle, F: Abdominal leg I, G: Abdominal leg II, H: Abdominal leg III, I: Distal end of middle tarsus, J: Distal end of hind tarsus, K: Female squama genitalis.

3. The major diagnostic character of this species is that most of the foretarsal sensilla are short, especially t-2 which is shorter than 1/2 the length of t-1.

***Eosentomon convexoculi* sp. nov.**  
(Fig. 3; Tab. 3)

**Female:** body length 1,340-1,860  $\mu\text{m}$ .  
**Head:** elliptical, length 160-176  $\mu\text{m}$ ,

L1=1.6-1.7. Pseudoculus nearly circular, with two J-shaped convexes, closed at base, 11.2  $\mu\text{m}$ , PR=14.3-14.9. Labial palpus with a large sensillum and tuft of 6-7 setae. **Thorax:** foretarsus length 108-114.4  $\mu\text{m}$ , width 20.8-22.4  $\mu\text{m}$ , claw length 22.4-24  $\mu\text{m}$ , TR=4.6-5.1; empodium length 21.6-24  $\mu\text{m}$ , EU=0.9-1.0. Sensilla t-1 baculiform, BS=1.0-1.3; t-2 filiform; t-3 short,

Table 2. Chaetotaxy of *Eosentomon brevisensorium* sp. nov.

	Formula	Composition of setae
Dorsal		
Thorax		
I	4	A1, 2,
II - III	8 / 16	A1, 2, 3, 4 P1, 1a, 2, 2a, 3, 3a, 4, 5
Abdomen		
I - III	8 / 12	A1, 2, 3, 4 P1, 1a, 2, 3, 4, 5
IV - VI	10 / 16	A1, 2, 3, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5
VII	6 / 16	A2, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5
VIII	6 / 9	A2, 4, 5 Pc, 1a, 1b, 2, 2a
IX - XI	8	
XII	9	
Ventral		
Thorax		
I	6-2 / 6	A1, 2, 3, M P1, 2, 3
II - III	6-4 / 8	A1, 2, 3, M1, 2 P1, 2, 2a, 3
Abdomen		
I	4 / 4	A1, 2 P1, 2, 3
II - III	4 / 6	A1, 2, 3 P1, 2, 2a, 2b, 3
IV - VII	6 / 10	Pc, 1, 1a, 2
VIII	0 / 7	
IX - X	6	
XI	8	
XII	12	

club-shaped. Exterior sensilla a, b, and c shortly linear; d linear, longer than a, b, and c in length; e and g spatulate; f-1 linear, f-2 setiform, f-2 shorter than 1/4 of f-1. Interior sensilla a' linear, lower than  $\delta 3$  in position; b'-1 and b'-2 linear, b'-2 longer than b'-1 in length, apex of b'-2 reaching base of  $\delta 6$ ; c' linear and slightly broad, subequal to b'-1 in length. Middle tarsus length 55.2-58.4  $\mu\text{m}$ , claw length 15.2-16.8  $\mu\text{m}$ ; hind tarsus length 67.2-72.8

$\mu\text{m}$ , claw length 18.4-19.2  $\mu\text{m}$ . Middle and hind tarsi with short empodia, less than 1/9 of their claws in length, respectively. Spiracle diameter 10.4-12  $\mu\text{m}$ . **Abdomen:** chaetotaxy as shown in Table 3. Abdominal appendages I-III with terminal vesicles and 5 setae. Squama genitalis, caput processus-shaped, like duck's head, beak blunt; corpus and filum processus broad, heavily sclerotized, lateral sclerotization distinct.

**Male and larva:** unknown.

**Specimens examined:** Holotype ♀, TAICHUNG: Anmashan 2,100 m, 9-IX-1994, R. F. Chao. Paratypes: 7 ♀, same data as for holotype. CHIAYI: Alishan 2,200 m, 2 ♀, 3-X-1994, R. F. Chao; Chushan 2,400 m, 2 ♀, 3-X-1994, R. F. Chao.

**Distribution:** Taiwan.

**Etymology:** *convexus*, L., convex; *oculus*, L., the eye, meaning with 2 J-shaped convexes in the pseudoculus.

**Remarks:** The foretarsus of this species resembles that of *Eosentomon pacificum* Imadate et Yosii, 1959 (Imadate, 1974), but can be differentiated in the morphology of sensilla a and f-2. Otherwise, the major characters of this new species are: foretarsus of sensilla f-2 shorter than 1/4 of f-1; and with 2 J-shaped convexes in the pseudoculus.

***Eosentomon coruscoculi* sp. nov. (Fig. 4; Tab. 4)**

**Female:** body length 1,100-1,320  $\mu\text{m}$ . **Head:** elliptical, length 124-136  $\mu\text{m}$ , width 92-104  $\mu\text{m}$ , L1=1.1-1.3. pseudoculus nearly circular, with 3 globules in center, 11.2  $\mu\text{m}$  in diameter, PR=10.3-11.3. Labial palpus with a large sensillum and tuft of 6-7 setae. **Thorax:** foretarsus length 95.2-107.2  $\mu\text{m}$ , width 17.6-20.8  $\mu\text{m}$ , claw length 18.4-21.6  $\mu\text{m}$ , TR=4.9-5.2; empodium length 23.8-21.6  $\mu\text{m}$ , EU=0.9-1.0. Sensilla t-1 baculiform, BS=1.0-1.3; t-2 and t-3 short, t-3 shorter than 2/3 of t-2 in length. Exterior sensilla a and b filiform, a shorter than b in length; c short; d

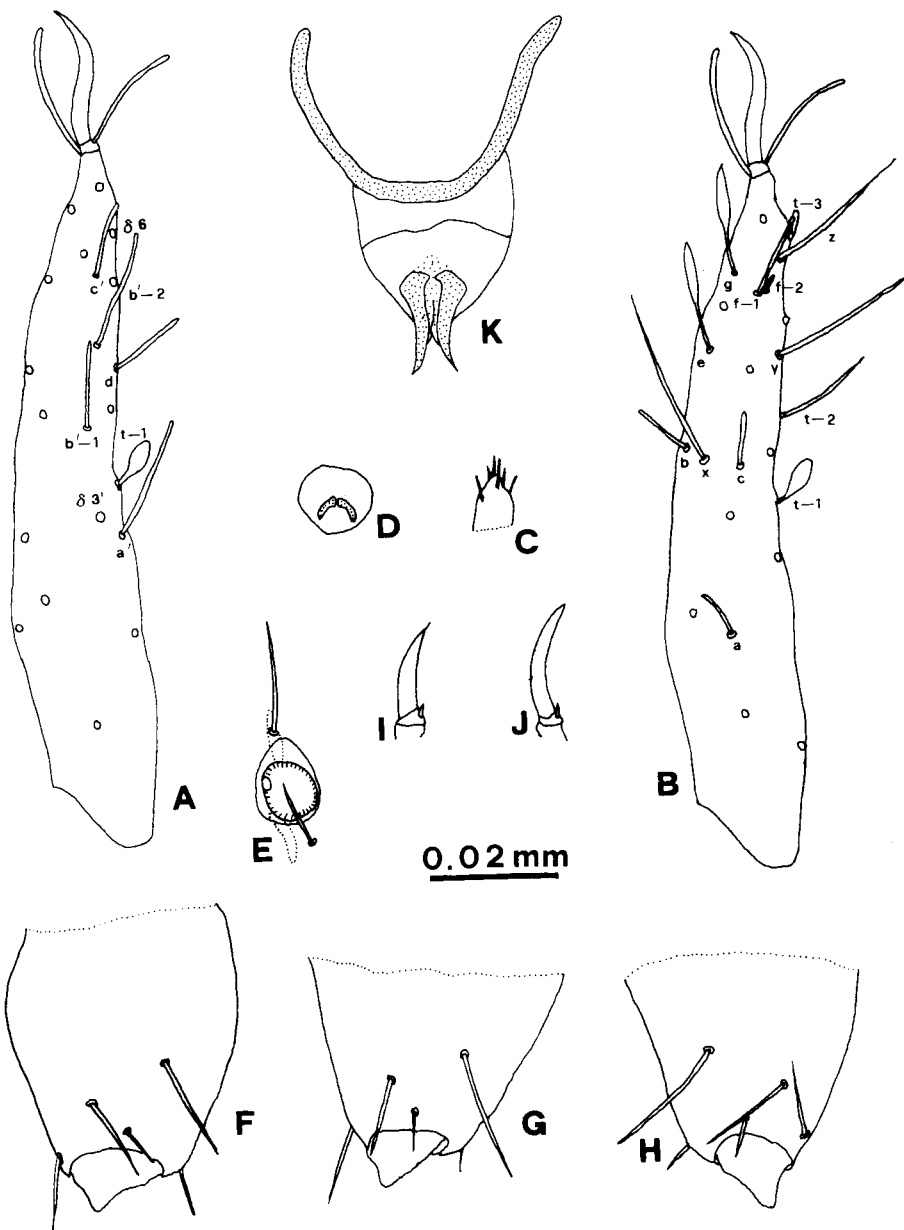


Fig. 3. *Eosentomon convexoculi* sp. nov. A: Interior side of foretarsus, B: Exterior side of foretarsus, C: Labial palpus, D: Pseudoculus, E: Spiracle, F: Abdominal leg I, G: Abdominal leg II, H: Abdominal leg III, I: Distal end of middle tarsus, J: Distal end of hind tarsus, K: Female squama genitalis.

setiform; e and g spatulate; f-1 linear, f-2 short, club-shaped, f-2 shorter than 1/2 of f-1 in length. Interior sensilla a' linear and broad, apex of a' surpassing base of  $\delta$  3'; b'-1 linear, b'-2 filiform, b'-2 and y

placed in same row; c' linear, c' subequal to b'-1 in length and broader than b'-1, apex of c' reaching base of  $\delta$  6. Middle tarsus length 43.2-45.6  $\mu$ m, claw length 11.2-12.8; hind tarsus length 53.6-56.8  $\mu$ m,

Table 3. Chaetotaxy of *Eosentomon convexoculi* sp. nov.

	Formula	Composition of setae
Dorsal		
Thorax		
I	4	A1, 2
II - III	6 / 16	A1, 2, 3 P1, 1a, 2, 2a, 3, 3a, 4, 5
Abdomen		
I	4 / 8	A1, 2 P1, 1a, 2, 3
II - IV	10 / 16	A1, 2, 3, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5
V - VI	4 / 16	A4,5 P1, 1a, 2, 2a, 3, 4, 4a, 5
VIII	2 / 16	A5 P1, 1a, 2, 2a, 3, 4, 4a, 5
IX	6 / 7	A2, 4, 5
X - XI		Pc, 2a, 3, 3a
XII	8	
	4	
	9	
Ventral		
Thorax		
I - II	6-2 / 6	A1, 2, 3, M P1, 2, 3
III	6-4 / 8	S1, 2, 3, M1, 2 P1, 1a, 2, 2
Abdomen		
I	4 / 4	A1, 3 P1, 2
II - III	4 / 6	A1, 2 P1, 2, 3
IV - VII	4 / 12	A1, 4 P1, 2, 2a, 3, 4, 5
VIII	0 / 7	Pc, 1, 2, 3
IX - X	4	
XI	8	
XII	12	

claw length 14.4-16.8  $\mu\text{m}$ . Middle and hind tarsi with short empodia, less than 1/9 of their claws in length, respectively. Spiracle diameter 8.8-10.4  $\mu\text{m}$ . **Abdomen:** chaetotaxy as shown in Table 4. Abdominal appendages I-III with terminal vesicles and 5 setae. Squama genitalis, caput processus-shaped, like a duck's head, beak

Table 4. Chaetotaxy of *Eosetnomon coruscoculi* sp. nov.

	Formula	Composition of setae
Dorsal		
Thorax		
I	4	A1, 2
II - III	6 / 16	A1, 2, 3 P1, 1a, 2, 2a, 3, 3a, 4, 5
Abdomen		
I	4 / 10	A1, 2 P1, 1a, 2, 3, 4
II - III	10 / 16	A1, 2, 3, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5
IV - V	8 / 16	A1, 2, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5
VI - VII	4 / 16	A4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5
VIII	4 / 9	A4, 5 Pc, 1a, 1b, 2, 2a
IX - XI	8	
XII	9	
Ventral		
Thorax		
I	2-1 / 4	A1, Mc P1, 2
II	6-2 / 6	A1, 2, 3, M P1, 2, 3
III	6-4 / 8	A1, 2, 3, M1, 2 P1, 1a, 2, 3
Abdomen		
I	4 / 4	A1, 2 P1, 2
II - III	4 / 6	A1, 2 P1, 2, 3
IV - V	4 / 12	A1, 2 P1, 2, 2a, 3, 4, 5
VI - VII	4 / 12	A1, 3 P1, 2, 2a, 3, 4, 5
VIII	0 / 7	Pc, 1, 2, 3
IX - X	4	
XI	8	
XII	12	

broad; corpus processus narrow; filum processus filiform, lateral sclerotization distinct.

**Male and larva:** unknown.

**Specimens examined:** Holotype ♀:



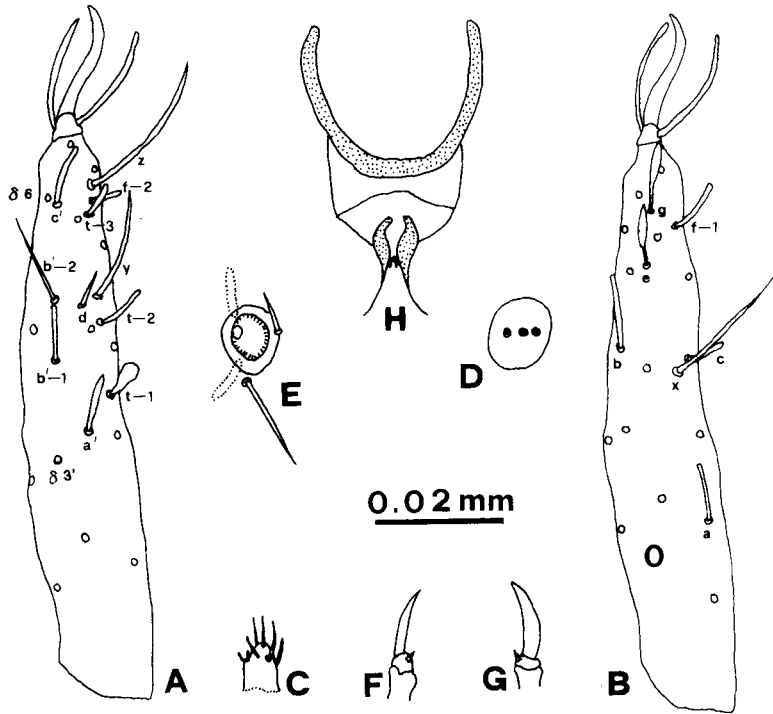


Fig. 4. *Eosentomon coruscoculi* sp. nov. A: Interior side of foretarsus, B: Exterior side of foretarsus, C: Labial palpus, D: Pseudoculus, E: Spiracle, F: Distal end of middle tarsus, G: Distal end of hind tarsus, H: Female squama genitalis.

NANTOU: Fenghuangshan 1,300 m, 14-XI-1994, R. F. Chao. Paratypes: 2 ♀, same data as for holotype. CHIAYI: Tatumngshan 1,300 m, 2 ♀, 3-X-1994, R. F. Chao.

**Distribution:** Taiwan.

**Etymology:** *Coruscus*, L., glittering; *oculus*, L., the eye, meaning with 3 globules in the pseudoculus.

**Remarks:** The foretarsus of this species resembles that of *Eosentomon penelopae* Tuxen, 1977 (Tuxen, 1977b), but can be differentiated in the lengths of f-1, f-2 and d. The other characteristic of this species is 3 globules in the pseudoculus. A similar character was found in *E. magnum* Yin et Zhang, 1982, and *E. agaeophthalmum* Yin et Zhang, 1982 (Yin and Zhang, 1982), but there are 5 longitudinal striae and 3 globules in the

pseudoculus of these 2 species. There are only 3 globules and no longitudinal striae in the pseudoculus of this new species.

***Eosentomon lapilloculi* sp. nov.** (Fig. 5; Tab. 5)

**Female:** body length 1,320-1,550  $\mu\text{m}$ . **Head:** elliptical, length 140-154  $\mu\text{m}$ , width 102-112  $\mu\text{m}$ ,  $L1=1.3-1.5$ . Pseudoculus nearly circular, with a globule in center, 11.2  $\mu\text{m}$  in diameter,  $PR=12.2-12.8$ . Labial palpus with a large sensillum and tuft of 6-7 setae. **Thorax:** foretarsus length 104-111.2  $\mu\text{m}$ , width 20-22.4  $\mu\text{m}$ , claw length 16.8-21.6  $\mu\text{m}$ ,  $TR=4.9-5.2$ ; empodium length 16.8-32.2  $\mu\text{m}$ ,  $EU=1.0-1.1$ . Sensilla t-1 baculiform,  $BS=1.1-1.3$ ; t-2 linear; t-3 short club-shaped, t-3 shorter than 1/4 of t-2. Exterior sensilla a and d short club-shaped; b linear; c linear, lower than

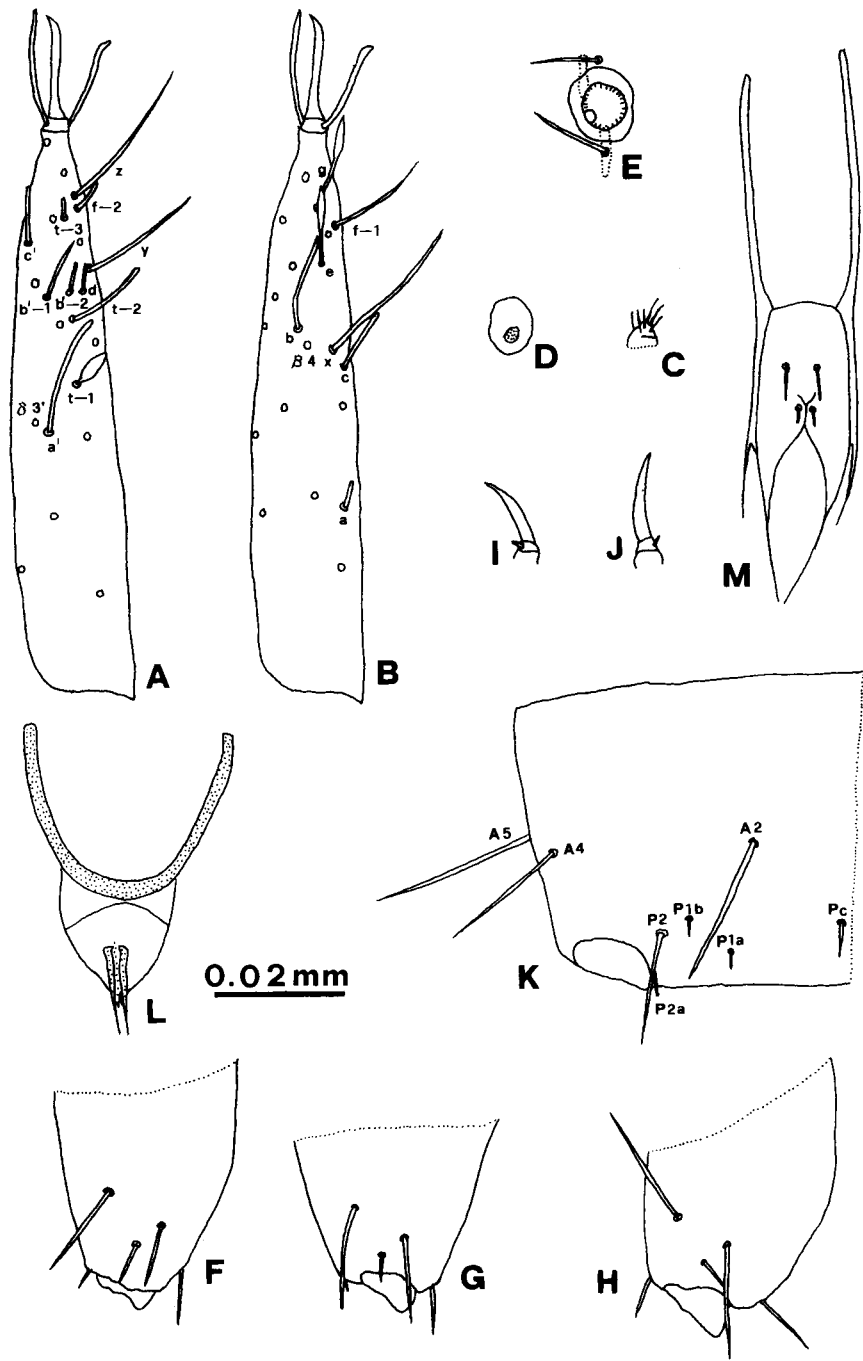


Fig. 5. *Eosentomon lapilloclui* sp. nov. A: Interior side of foretarsus, B: Exterior side of foretarsus, C: Labial palpus, D: Pseudoculus, E: Spiracle, F: Abdominal leg I, G: Abdominal leg II, H: Abdominal leg III, I: Distal end of middle tarsus, J: Distal end of hind tarsus, K: Tergite VIII, L: Female squama genitalis, M: Male squama genitalis.

Table 5. Chaetotaxy of *Eosentomon lapilloculi* sp. nov.

	Larva II		Maturus junior		Imago	
	Formula	Composition of setae	Formula	Tertiary setae	Formula	Complementary setae
<b>Dorsal</b>						
<b>Thorax</b>						
I	4	A1, 2	4		4	
II	8/12	A1, 2, 3, 4 P1, 1a, 2, 2a, 3, 4	8/14	P3a	8/14	
III	6/12	A1, 2, 3 P1, 1a, 2, 2a, 3, 4	10/14	A5 P3a	10/14	
<b>Abdomen</b>						
I	0/8	P1, 1a, 2, 3	4/8	A1, 2	4/8	
II	2/14	A5 P1, 1a, 2, 2a, 3, 4, 5	10/16	A1, 2, 3, 4 P4a	10/16	
III	4/14	A4, 5 P1, 1a, 2, 2a, 3, 4, 5	10/16	A1, 2, 3 P4a	10/16	
IV	4/16	A4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	10/16	A1, 2, 3	10/16	
V-VI	4/16	A5 P1, 1a, 2, 2a, 3, 4, 4a, 5	4/16		4/16	
VII	2/14	A5 P1, 1a, 2, 3, 4, 4a, 5	2/16	P2a	2/16	
VIII	6/7	A2, 4, 5 Pc, 1a, 2, 2a	6/9	P1b	6/9	
IX	8		8		8	
X			4		4	
XI			4		4	
XII	9		9		9	
<b>Ventral</b>						
<b>Thorax</b>						
I	2-2/6	A1, M P1, 2, 3	6-2/6	A2, 3	6-2/6	
II	6-2/6	A1, 2, 3, M P1, 2, 3	6-2/6		6-2/6	
III	6-2/6	A1, 2, 3, M1 P1, 2, 3	6-4/8	M2 P1a	6-4/8	
<b>Abdomen</b>						
I	4/4	A1, 3 P1, 2	4/4		4/4	
II-III	4/4	A1, 2 P1, 2	4/6	P2	4/6	
IV-VII	4/8	A1, 2 P1, 2, 2a, 3	6/10	A3 P4	6/10	
VIII	0/7	Pc, 1, 2, 3	0/7		0/7	
IX	4		4		4	
X			4		4	
XI			8		8	
XII	12		12		12	

base of  $\beta 4$  in position; e and g spatulate; f-1 filiform, f-2 short, club-shaped, f-2 shorter than  $1/3$  of f-1 in length. Interior sensilla a' linear, lower than base of  $\delta 3'$  in position; b'-1 filiform, b'-2 short club-shaped, b'-2 subequal to d in length; c' linear. Middle tarsus length 48-52  $\mu\text{m}$ , claw length 15.2-17.6  $\mu\text{m}$ ; hind tarsus length 65.6-68.8  $\mu\text{m}$ , claw length 17.6-22.5  $\mu\text{m}$ . Middle and hind tarsi with short empodia, less than  $1/9$  of their claws in length, respectively. Spiracle diameter 10.4-11.2  $\mu\text{m}$ . **Abdomen:** chaetotaxy as shown in Table 5. Abdominal appendages I-III with terminal vesicles and 5 setae. Squama genitalis, caput processus-shaped, like a duck's head, beak short and thin; corpus processus narrow; filum processus filiform, lateral sclerotization distinct.

**Male:** shape of sensilla in foretarsus and chaetotaxy of thorax and abdomen similar to those of female. Squama genitalis normal.

**Maturus junior:** body length 1,060-1,400  $\mu\text{m}$ . Foretarsus length 89.6-99.2  $\mu\text{m}$ , shape and position of sensilla in foretarsus similar to female. Chaetotaxy as shown in Table 5.

**Larva II:** body length 980  $\mu\text{m}$ . Clypeal apodeme not visible. Foretarsus length 88  $\mu\text{m}$ , shape and position of sensilla in foretarsus similar to those of maturus junior. Chaetotaxy as shown in Table 5.

**Larva I:** unknown.

**Specimens examined:** Holotype ♀, TAICHUNG: Kukuan 730, 7-IX-1994, R. F. Chao. Paratypes: CHIAYI: Alishan 2,200 m, 7 ♀, 3 maturus junior, 1 larva II, 3-X-1994, R. F. Chao; Tatungshan 1,300 m, 2 ♀, 3-X-1994, R. F. Chao. MIAOLI: Takehshan 450 m, 1 ♀, 31-VIII-1994, R. F. Chao. TAICHUNG: 3 ♀, 2 ♂, same data as for holotype; Anmashan 2,100 m, 1 ♀, 1 ♂, 9-IX-1994, R. F. Chao.

**Distribution:** Taiwan.

**Etymology:** *lapillus*, L., jewel; *oculus*, L., the eye, meaning with a globule on the pseudoculus.

**Remarks:** The foretarsus of this

species resembles that of *Eosentomon pusillum* Ewing, 1940 (Ewing, 1940; Tuxen, 1976), but can be differentiated in the position of a' and the shape of t-3. There are 2 other characteristics in this species. One is the shape of a and the other is 1 globule in the pseudoculus. These 2 characters are different from the other species of *Eosentomon* in Taiwan.

***Eosentomon maai* sp. nov.** (Fig. 6; Tab. 6)

**Female:** body length 1,300-1,640  $\mu\text{m}$ . **Head:** elliptical, length 140-180  $\mu\text{m}$ , width 80-110  $\mu\text{m}$ , L1=1.4-1.8. Pseudoculus nearly circular, with longitudinal striae and a globule in center, 10.4  $\mu\text{m}$  in diameter, PR=12.7-15.1. Labial palpus with a large sensillum and tuft of 6-7 setae. **Thorax:** foretarsus length 96-110  $\mu\text{m}$ , width 19.2-21.2  $\mu\text{m}$ , claw length 16.8-21.6  $\mu\text{m}$ , TR=4.2-4.9; empodium length 20-24  $\mu\text{m}$ , EU=0.9-1.0. Sensilla t-1 baculiform, BS=4.2-4.9; t-2 linear; t-3 short club-shaped. Exterior sensilla a and c linear; b filiform, apex of b surpassing base of e; d linear, apex of d reaching base of  $\alpha 5$ ; e and g spatulate; f-1 and f-2 club-shaped, f-2 shorter than f-1 in length. Interior sensilla a' linear, base of a' higher than  $\alpha 3$  in position; b'-1 filiform, b'-2 linear, base of b'-2 lower than d in position; c' short club-shaped. Middle tarsus length 46-64  $\mu\text{m}$ , claw length 12-14  $\mu\text{m}$ ; hind tarsus length 64-76  $\mu\text{m}$ , claw length 16-22  $\mu\text{m}$ . Middle and hind tarsi with short empodia, less than  $1/9$  of their claws in length, respectively. Spiracle diameter 10.4-11.2  $\mu\text{m}$ . **Abdomen:** chaetotaxy as shown in Table 6. Abdominal appendages I-III with terminal vesicles and 5 setae. Squama genitalis, caput processus-shaped, like a duck's head, beak broad and obtuse; corpus processus broad and heavily sclerotized; filum processus filiform, lateral sclerotization distinct.

**Male and larva:** unknown.

**Specimens examined:** Holotype ♀, TAICHUNG: Anmashan 2,100 m, 9-IX-1994, R. F. Chao. Paratypes: CHIAYI:

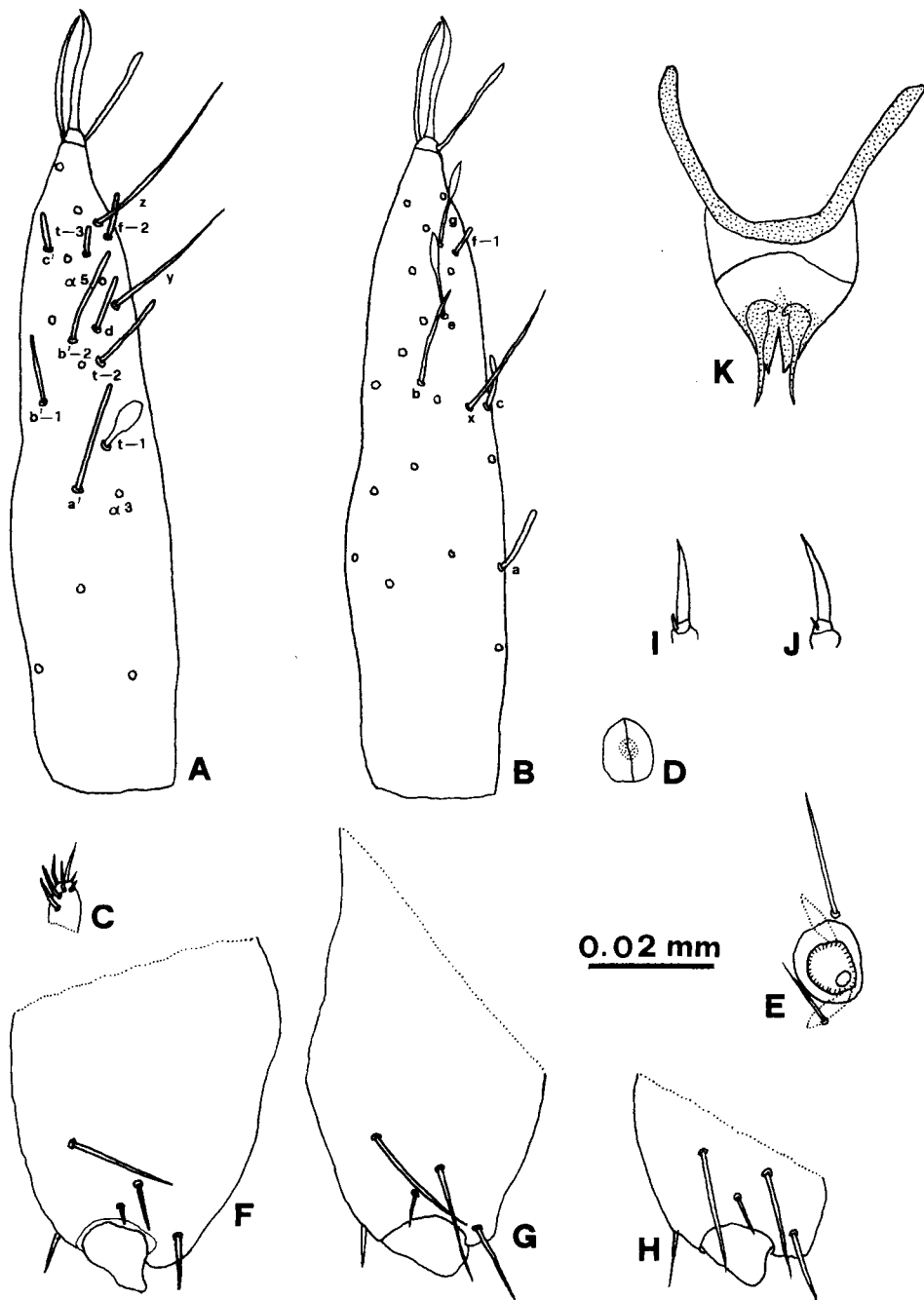


Fig. 6. *Eosentomon maai* sp. nov. A: Interior side of foretarsus, B: Exterior side of foretarsus, C: Labial palpus, D: Pseudoculus, E: Spiracle, F: Abdominal leg I, G: Abdominal leg II, H: Abdominal leg III, I: Distal end of middle tarsus, J: Distal end of hind tarsus, K: Female squama genitalis.

Table 6. Chaetotaxy of *Eosentomon maai* sp. nov.

	Formula	Composition of setae
Dorsal		
Thorax		
I	4	A1, 2,
II - III	8 / 14	A1, 2, 3, 4 P1, 1a, 2, 2a, 3, 3a, 4
Abdomen		
I	4 / 10	A1, 2 P1, 1a, 2, 3, 3a
II - IV	10 / 16	A1, 2, 3, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5
V - VI	4 / 16	A4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5
VII	2 / 16	A5 P1, 1a, 2, 2a, 3, 4, 4a, 5
VIII	4 / 7	A1, 5 Pc, 1a, 2, 4
IX	8	
X - XI	4	
XII	9	
Ventral		
Thorax		
I - II	6-2 / 6	A1, 2, 3, M P1, 2, 3
III	8-2 / 8	A1, 2, 3, 4, M P1, 1a, 2, 3
Abdomen		
I	4 / 4	A1, 3 P1, 2
II - III	4 / 6	S1, 2 P1, 2, 3
IV - VII	6 / 10	A1, 2, 3 P1a, 2, 2a, 3, 4
VIII	0 / 7	Pc, 1, 2, 3
IX - X	4	
XI	8	
XII	12	

Alishan 2,200 m, 1 ♀, 3-X-1994, R. F. Chao. TAICHUNG: Maling 1,000 m, 2 ♀, 7-IX-1994, R. F. Chao; 18 ♀, same data as for holotype.

**Distribution:** Taiwan.

**Etymology:** The name is dedicated to the entomologist, Prof. Tsing-Chao Maa.

**Remarks:** The foretarsus and pseudo-

culus of this species resemble *Eosentomon monlaense* Yin, 1982 (Yin, 1982), but the terminal of sensilla e and g in *E. monlaense* are broader than in this species. Besides, the shape of the globule in the pseudoculus and the chaetotaxy of thorax I-III and abdomen X-XI are also different between these 2 species.

***Eosentomon sakura* Imadate et Yosii, 1959 (Fig. 7; Tab. 7)**

*Eosentomon sakura* Imadate et Yosii, 1959. Contri. Biol. Lab. Kyoto Univ. 6: 7-9; Imadate, 1964. Kontyu 32: 236; Imadate, 1965. Nature & Life in SE Asia 4: 243-244; Imadate, 1974. Fauna Japonica, Protura 261-268.

**Female:** body length 1,150-1,400  $\mu\text{m}$ . **Head:** elliptical, length 120-142  $\mu\text{m}$ , width 98-110  $\mu\text{m}$ , L1=1.2-1.4. Pseudoculus nearly circular, 10.4  $\mu\text{m}$  in diameter, PR=10-11.8. Labial palpus with a large sensillum and tuft of 6-7 setae. **Thorax:** foretarsus length 83.2-97.2  $\mu\text{m}$ , width 19.2-21.2  $\mu\text{m}$ , claw length 15.2-18.4  $\mu\text{m}$ , TR=4.2-4.9; empodium length 15.2-16.0  $\mu\text{m}$ , EU=0.9-1.0. Sensilla t-1 baculiform, closer to  $\alpha 3'$  than to  $\alpha 3$ , BS=1.2-1.3; t-2 short filiform; t-3 short, club-shaped. Exterior sensilla a and b linear, a broader than b, apex of b reaching base of  $\gamma 4$ ; c linear, shorter than b in length, apex of c reaching base of  $\gamma 3$ ; d filiform, apex of d reaching base of  $\alpha 6$ ; e and g spatulate; f-1 filiform, f-2 short, club-shaped, f-2 shorter than t-3. Interior sensilla a' linear and slightly broad; b'-1 and b'-2 linear; c' short club-shaped, subequal to t-3 in length. Middle tarsus length 42.4-50.4  $\mu\text{m}$ , claw length 13.6-15.2  $\mu\text{m}$ ; hind tarsus length 58.4-67.2  $\mu\text{m}$ , claw length 14.4-17.6  $\mu\text{m}$ . Middle and hind tarsi with short empodia, less than 1/9 of their claws in length, respectively. Spiracle diameter 9.6-11.2  $\mu\text{m}$ . **Abdomen:** chaetotaxy as shown in Table 7. Abdominal appendages I-III with terminal vesicles and 5 setae. Squama genitalis, caput processus-shaped, like a duck's head, heavily sclerotized; corpus processus

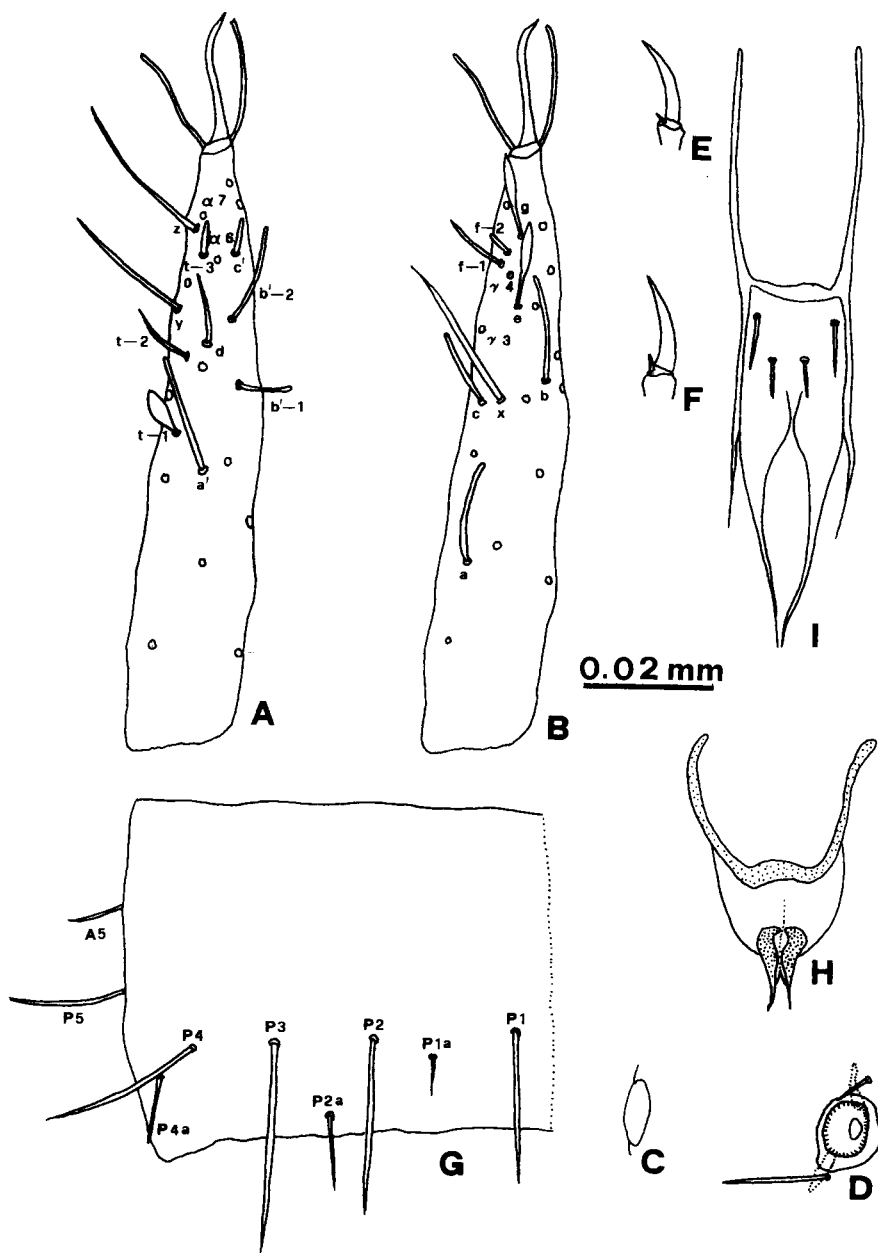


Fig. 7. *Eosentomon sakura* Imadate et Yosii. A: Interior side of foretarsus, B: Exterior side of foretarsus, C: Pseudoculus, D: Spiracle, E: Distal end of middle tarsus, F: Distal end of hind tarsus, G: Tergite VII, H: Female squama genitalis, I: Male squama genitalis.

Table 7. Chaetotaxy of *Eosentomon sakura* Imadate et Yosii

		Larva I		Larva II		Maturus junior		Imago	
		Formula Primary setae		Formula Second ary setae		Formula Tertiary setae		Formula Comple- mentary setae	
Dorsal									
Thorax									
I	2	A1		4	A2	4		4	
II	4/12	A2, M P1, 1a, 2, 3, 4, 5		4-2/14	A4	4-2/16		4-2/16	
III	4/10	A2, M P1, 1a, 2, 3, 4		4-2/12	A4	4-2/16		4-2/16	
Abdamen									
I	0/6	P1, 1a, 2		0/10	P3, 3a		4-10 A1, 2		4-10
II	0/12	P1, 1a, 2, 3, 4, 5		0/16	P2a, 4a		10-16 A1, 2, 3, 4, 5		10-16
III	0/12	P1, 1a, 2, 3, 4, 5		2/16	A4	10-16 A1, 2, 3, 5		10-16	
IV	0/12	P1, 1a, 2, 3, 4, 5		4/16	A4, 5	10-16 A1, 2, 3		10-16	
V-VI	0/12	P1, 1a, 2, 3, 4, 5		4/16	A4, 5	4-16		4-16	
VII	0/12	P1, 1a, 2, 3, 4, 5		2/16	A5	2-16		2-16	
VIII	6/7	A2, 4, 5 Pc, 1, 2, 3		6/9	P2a		6/9		
IX				8			8		
X							4		
XI							4		
XII	9			9			9		
Ventral									
Thorax									
I-II	4-2/2	A1, 2, M P2		6-2/6	A3	6-2/6		6-2/6	
III	4-2/2	A1, 2, M1 P2		6-2/6	A3	6-4/8 M2 P2a		6-4/8	
Abdomen									
I	4/2	A1, 2 P1		4/4	P2		4/4		4/4
II-III	2/4	A1 P1, 2		4/4	A2	6/4 A3		6/4	
IV-VII	2/6	A1 P1, 2, 3		4/8	A2	6/10 A3 P2a		6/10	
VIII	0/5	Pc, 1, 2		0/7	P1a	0/7		0/7	
IX				4			4		
X							4		
XI							4		
XII	12			12			12		



broad; filum processus filiform, with lateral sclerotization.

**Male:** shape of sensilla in foretarsus and chaetotaxy of thorax and abdomen similar to those of female. Squama genitalis normal.

**Maturus junior:** body length 950-1,100  $\mu\text{m}$ . Foretarsus length 76-84  $\mu\text{m}$ , shape and position of sensilla in foretarsus similar to those of female. Chaetotaxy as shown in Table 7.

**Larva II:** body length 680-920  $\mu\text{m}$ . Clypeal apodeme not visible. Foretarsus length 65.6-73.6  $\mu\text{m}$ , shape and position of sensilla in foretarsus similar to those of maturus junior. Chaetotaxy as shown in Table 7.

**Larva I:** body length 600-740  $\mu\text{m}$ . Foretarsus length 56.0-58.4  $\mu\text{m}$ , shape and position of sensilla in foretarsus similar to those of larva II, but sensilla shorter and rudimentary. Chaetotaxy as shown in Table 7.

**Specimens examined:** CHIAYI: Alishan 2,200 m, 1 ♀, 1 maturus junior, 3-X-1994, R. F. Chao; Tatungshan 1,300 m, 1 ♀, 3 maturus junior, 2 larva II, 3-X-1993, R. F. Chao. NANTOU: Chitou 1,150 m, 1 ♀, 1 larva II, 29-V-1994, R. F. Chao; 1 ♀, 1 ♂, 1 larva I, 13-VI-1994, C. Y. Chen; Fenghuangshan 1,300 m, 1 maturus junior, 1 larva II, 2-X-1994, C. Y. Chen; 2 ♀, 1 larva II, 14-XI-1994, R. F. Chao. PINTUNG: Shuangliu 200 m, 5 ♀, 2 larva II, 7-VII-1994, R. F. Chao. TAICHUNG: Kukuan 730 m, 2 ♀, 2 ♂, 3 maturus junior, 7-IX-1994, R. F. Chao; Pahsienshan 750 m, 2 ♀, 2 ♂, 3 maturus junior, 2 larva II, 3-VI-1994, R. F. Chao; Maling 1,000 m, 3 ♀, 1 maturus junior, 7-IX-1994, R. F. Chao; Anmashan 2,100 m, 7 ♀, 8 maturus junior, 3 larva II, 1 larva I, 9-IX-1994, R. F. Chao. TAITUNG: Chihpen, 1 ♀, 20-V-1994, R. F. Chao.

**Distribution:** Bismarck Islands, China, Hong Kong, Japan, Korea, Solomon Islands, Taiwan, and Vanuatu.

**Remarks:** This species is widely distributed throughout East and South-

east Asia. The first record of this species in Taiwan was made by Dr. G. Imadate in 1964 at Yangmingshan. This species resembles *Eosentomon collarum* Yin, 1963 (Yin, 1963; 1965), but can be differentiated in the chaetotaxy of abdomen VIII-XI.

***Eosentomon udagawai* Imadate, 1961 (Fig. 8; Tab. 8)**

*Eosentomon udagawai* Imadate, 1961. Kontyu 29: 136-138; Imadate, 1965. Nature & Life in SE Asia 4: 245; Imadate, 1974. Fauna Japonica, Protura 297-303.

**Male:** body length 850-980  $\mu\text{m}$ . **Head:** elliptical, length 98-104  $\mu\text{m}$ , width 76-80  $\mu\text{m}$ , L1=1.3-1.4. Pseudoculus nearly circular, 7.2 in diameter, PR=14.5-15.0. Labial palpus with a large sensillum and tuft of 6-7 setae. **Thorax:** foretarsus length 67.2-72.5  $\mu\text{m}$ , width 14.4-14.8  $\mu\text{m}$ , claw length 12.8-13.4  $\mu\text{m}$ , TR=5.2-5.4; empodium length 11.5-12.8, EU=0.9-1.0. Sensilla t-1 baculiform, BS=0.8-0.9; t-2 and t-3 linear. Exterior sensilla a, b, and d linear, apex of d surpassing base of  $\alpha 5$ ; e and g spatulate; f-1 and f-2 short, f-2 shorter than f-1 in length. Interior sensilla a' linear, slightly broad; b'-1 and b'-2 linear; c' rudimentary. Middle tarsus length 29.6-31.2  $\mu\text{m}$ , claw length 8.8-9.2  $\mu\text{m}$ , empodium nearly 1/3 of claw length; hind tarsus length 32.6-33.2  $\mu\text{m}$ , claw length 9.6-9.8  $\mu\text{m}$ , empodium more than 1/2 of claw length. Spiracle diameter 7.2-7.4  $\mu\text{m}$ . **Abdomen:** chaetotaxy as shown in Table 8. Abdominal appendages I-III with terminal vesicles and 5 setae. Squama genitalis normal.

**Female and larva:** unknown.

**Specimens examined:** TAICHUNG: Pahsienshan 750, 1 ♂, 3-VI-1994, R. F. Chao; 2 ♂, 20-VIII-1995, R. F. Chao.

**Distribution:** Japan, Korea, and Taiwan (new record).

**Remarks:** This species is a new record species of Taiwan. The 2 major characters of the species are: empodium of hind tarsus long, more than 1/2 of claw

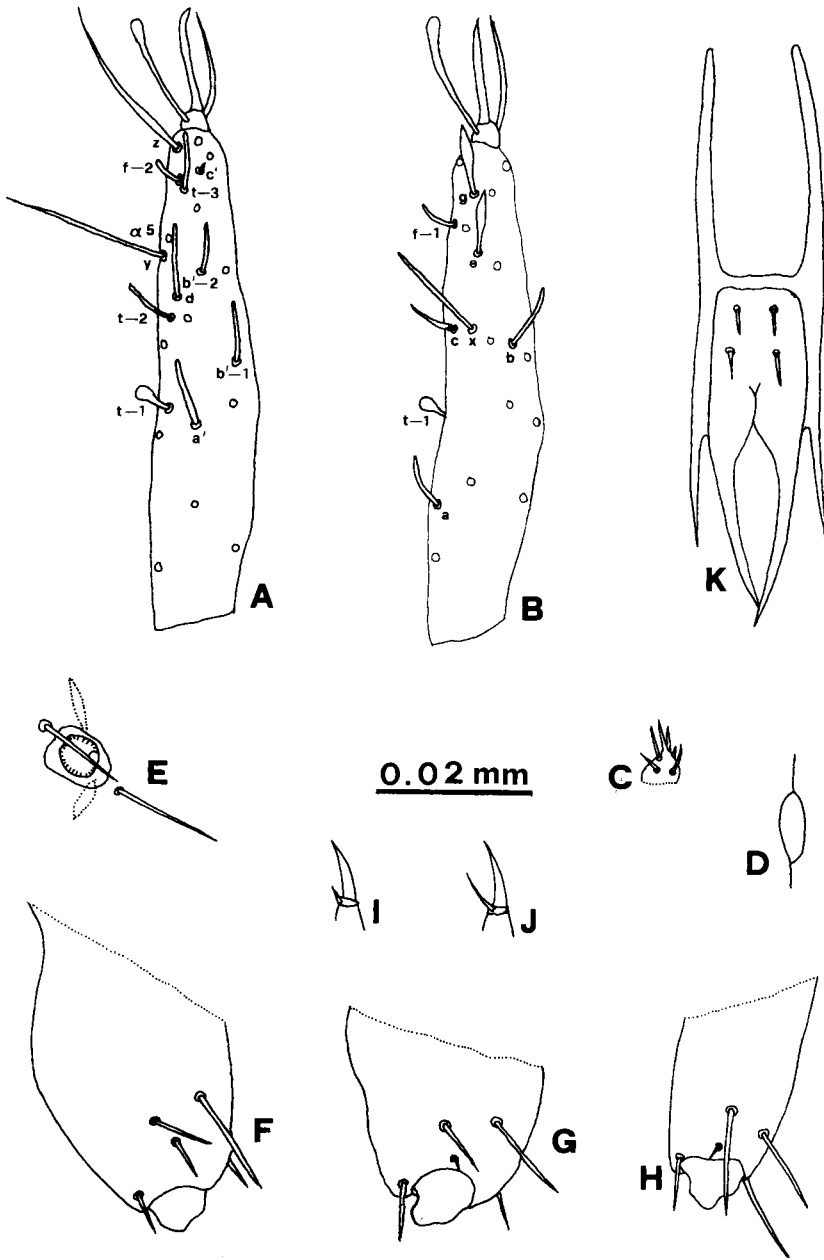


Fig. 8. *Eosentomon udagawai* Imadate. A: Interior side of foretarsus, B: Exterior side of foretarsus, C: Labial palpus, D: Pseudoculus, E: Spiracle, F: Abdominal leg I, G: Abdominal leg II, H: Abdominal leg III, I: Distal end of middle tarsus, J: Distal end of hind tarsus, K: Male squama genitalis.

length; and rudimentary c'. In the world, there are only 4 *Eosentomon* species reported in which the empodia of the hind tarsus are more than 1/2 of the claw

length, i.e., *E. pusillum* Ewing, 1940, *E. udagawai* Imadate, 1961, *E. brevicorpusculum* Yin, 1965, and *E. yilingense* Yin et Zhang, 1982 (Ewing, 1940; Bonet and Tu-

Table 8. Chaetotaxy of *Eosentomon udagawai* Imadate

	Formula	Composition of setae
Dorsal		
Thorax		
I	4	A1, 2
II - III	4-2/16	A1, 2, M P1, 1a, 2, 2a, 3, 3a, 4, 5
Abdomen		
I	4/10	A1, 2 P1, 1a, 2, 3, 3a
II - VI	10/16	A1, 2, 3, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5
VII	6/16	A2, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5
VIII	6/9	A2, 4, 5 Pc, 1a, 1b, 2, 2a
IX - XI	8	
XII	9	
Ventral		
Thorax		
I - II	6-2/6	A1, 2, 3, M P1, 2, 3
III	6-4/8	A1, 2, 3, M1, 2 P1, 2, 2a, 3
Abdomen		
I	4/4	A1, 2 P1, 2
II - III	6/4	A1, 2, 3 P1, 2
IV - VII	6/10	A1, 2, 3 P1, 2, 2a, 2b, 3
VIII	2/7	A1, Pc, 1, 1a, 2
IX - X	6	
XI	8	
XII	12	

xen, 1960; Imadate, 1961; Yin, 1965; Yin and Zhang, 1982), but only sensillum c' of *E. udagawai* is rudimentary. These 2 characters differ from those of any other species of *Eosentomon* in the world.

## References

Bonet, F., and S. L. Tuxen. 1960. Re-examination of species of Protura

described by H. E. Ewing. Proc. U. S. Nat. Mus. 112: 265-305.

Ewing, H. E. 1940. The Protura of North America. Ann. Ent. Soc. America 33: 495-551.

Imadate, G. 1961. Two new species of the genus *Eosentomon* Berlese from Japan. Kontyu 29: 132-141.

Imadate, G. 1964. Formosan proturans collected by Dr. K. Baba. Kontyu 32: 236-238.

Imadate, G. 1965. Protura-fauna of Southeast Asia. Nature and Life in SE Asia 4: 195-302.

Imadate, G. 1974. Fauna Japonica, Protura. Tokyo Med. and Dent. Univ., Tokyo. 351 pp.

Lee, H. R., and C. S. Chen. 1990. A study of Berberentomidae (Insecta: Protura) from Taiwan. Yushania 7: 29-43. (In Chinese, with English abstract). Romoser, W. S., and J. G. Stoffolano. 1994. The science of Entomology. Brown, Iowa. pp. 314-315.

Silvestri, F. 1907. Descrizione di un novo genere di insetti apterigoti, rappresente di un novo ordine. Boll. Lab. Zool. Portici 1: 296-311.

Tuxen, S. L. 1956. Neues uer die von Silvestri beschriebenen proturen. Boll. Lab. Zool. Gen. e Agr. Portici 33: 718-729.

Tuxen, S., L. 1976. The Protura (Insecta) of Brazil, especially Amazonas. Amazoniana 5: 417-463.

Tuxen, S. L. 1977a. Protura (Insecta) from Angola and Nigeria, with a key to Subsaharan Protura. Publ. Cult. Co. Diam. Angola, Lisboa 89: 175-193.

Tuxen, S. L. 1977b. Protura (Insecta) of the New Hebrides. Rec. S. Aust. Mus. 17(18): 299-307.

Yin, W. 1963. Two new species of Protura from China. Acta Ent. Sinica 12(3): 268-275. (In Chinese, with English resume).

Yin, W. 1965. Studies on Chinese Protura: I. the species of the genus *Eosentomon* from Nanking-Shanghai

regions. Acta Ent. Sinica 14(1): 71-92. (In Chinese, with English resume).

**Yin, W.** 1982. Studies on Chinese Protura: twelve species of the genus *Eosentomon* from Yunnan Province. Zool. Res. 3(1): 11-30. (In Chinese, with English resume).

**Yin, W., R. Xie, and G. Imadate.** 1995. Four new species of the genus *Eosentomon* (Protura) from Yunnan,

Southwest China. Jpn. J. Ent. 63(4): 799-810.

**Yin, W., and Z. Zhang.** 1982. Description of nine new species of *Eosentomon* from Guangxi. Entomotaxonomia 4(1): 79-91. (In Chinese, with English resume).

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## 臺灣的古蛻屬(昆蟲綱：原尾目)

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### 摘 要

報導8種臺灣產古蛻屬(*Eosentomon*)(原尾目)昆蟲，其中包含6種新種，1種新記錄種和1種舊記錄種。文中包括每個種類的描述、識別特徵及分佈。

**關鍵詞：**古蛻屬、原尾目、臺灣。