

Two New Species of the Genus *Pedetontinus* (Archaeognatha, Machilidae) from Korea

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Two new species, *Pedetontinus aureus* and *Pedetontinus rhombeus* are described. *Pedetontinus aureus* is characterized by the peculiar scale pattern and long ovipositor, and *Pedetontinus rhombeus* by the large body size and field of short suberect setae of article III of maxillary palpus. The genus *Pedetontinus* amounts to four species including two new species of this study in Korea. Descriptions, remarks and biological notes are given.

The genus *Pedetontinus* can be recognized by the following characteristics: 1) absence of scales on flagellum of antenna 2) yellow portion of oculus; 3) dumbbell-shaped lateral ocellus; 4) short appendages; 5) numerous suberect setae of maxillary palpus of male; 6) abdominal segments I-VII each with one pair of exsertile vesicles; 7) ovipositor primary type; and 8) one pair of paramere.

Pedetontinus Silvestri is a genus of Machilidae (Petrobiinae) known endemic to Asia (Japan and Korea). Five species of the genus *Pedetontinus* have been known from Japan (Silvestri, 1943), and two from Korea (Mendes, 1990a; Choe and Lee, 2001). We found two additional species, *Pedetontinus aureus* sp. nov. and *Pedetontinus rhombeus* sp. nov., from five sites of South Korea in this study.

The total number of species of Archaeognatha from Korea is ten species in four genera, all of which belong to the family Machilidae. They are: Petrobiinae - *Pedetontus coreanus* Silvestri, 1943; *Pedetontus unimaculatus* Machida, 1980; *Pedetontus silvestrii* Mendes, 1991; *Pedetontus longus* Lee and Choe, 1992; *Pedetontinus szepteyckii* Mendes, 1990b; *Pedetontinus lineatus* Choe and Lee, 2001; *Pedetontinus aureus* sp. nov.; *Pedetontinus rhombeus* sp. nov. Machilinae - *Coreamachilis coreanus* Mendes, 1991; and *Haslundichilis viridis* Lee and Choe, 1992.

Holotype and paratypes are deposited in the Department of Life Science, Jeonju University, Korea.

Materials and Methods

The specimens used in this study were collected under fallen broad-leaves and stones in South Korea between July, 1990 and August, 2001.

After photographed, they were preserved in alcohol. They were then dissected into several parts (antenna, eyes, mouthparts, legs, urosterna, external genitalia, cerci and median caudal filament, etc.) and mounted on slides with Canada balsam for observation.

We followed the treatments of Remington (1954), Paclt (1972) and Sturm & Bach de Roca (1993) for higher categories, and those of Wygodzinsky (1948), Paclt (1970), Mendes (1990b) and Sturm & Bach de Roca (1993) for genera and species.

Results

Family Machilidae Verhoeff, 1910
Genus *Pedetontinus* Silvestri, 1943
Pedetontinus aureus sp. nov.
(Figs. 1, 2)

Material examined: Holotype, ♂, Valley Baemsa-gol, Mt. Jiri-san, Sannae-myeon, Namwon-si, Jeonbug Province, 25. VIII. 1990 (G. H. Choe and Y. M. Cho). Paratypes, 6 ♂♂, 4 ♀♀, same data as the holotype; 1 ♂, 1 ♀, same locality as the holotype, 8. X. 2000 (G. H. Choe and Y. M. Cho); 1 ♂, 1 ♀, Valley Baekundong, Mt. Gaya-san, Suryun-myeon, Seongju-gun, Gyungbug Province, 3. VIII. 2001 (G. H. Choe and Y. M. Cho).

Description: Body length from head to tergum 8-10 mm. Ratio of antenna to body length 0.70-0.75. Median caudal filament approximately equal to body length. Ratio of cercus to median caudal filament 0.40-0.45. General body color ivory. Reddish brown hypodermal pigments on head, its appendages and legs; pigmentation pattern more or less variable among individuals. Scale pattern as shown in Fig. 1. Black spots prominent on both sides of tergum II. Most part of terga covered with golden scales, lateral sides with blackish brown scales.

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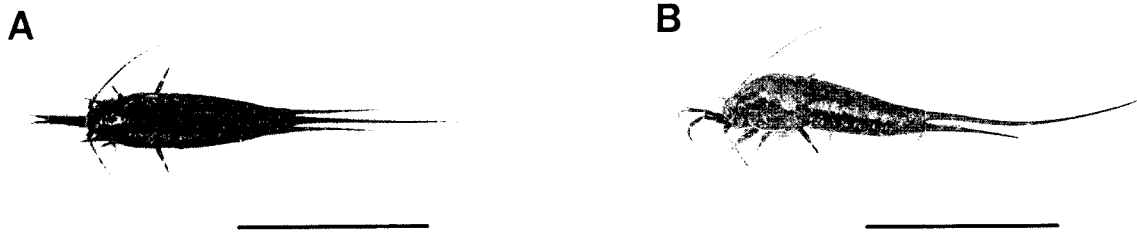


Fig. 1. *Pedetontinus aureus* sp. nov. A, Dorsal view. B, Lateral view. Scale bars = 1 cm.

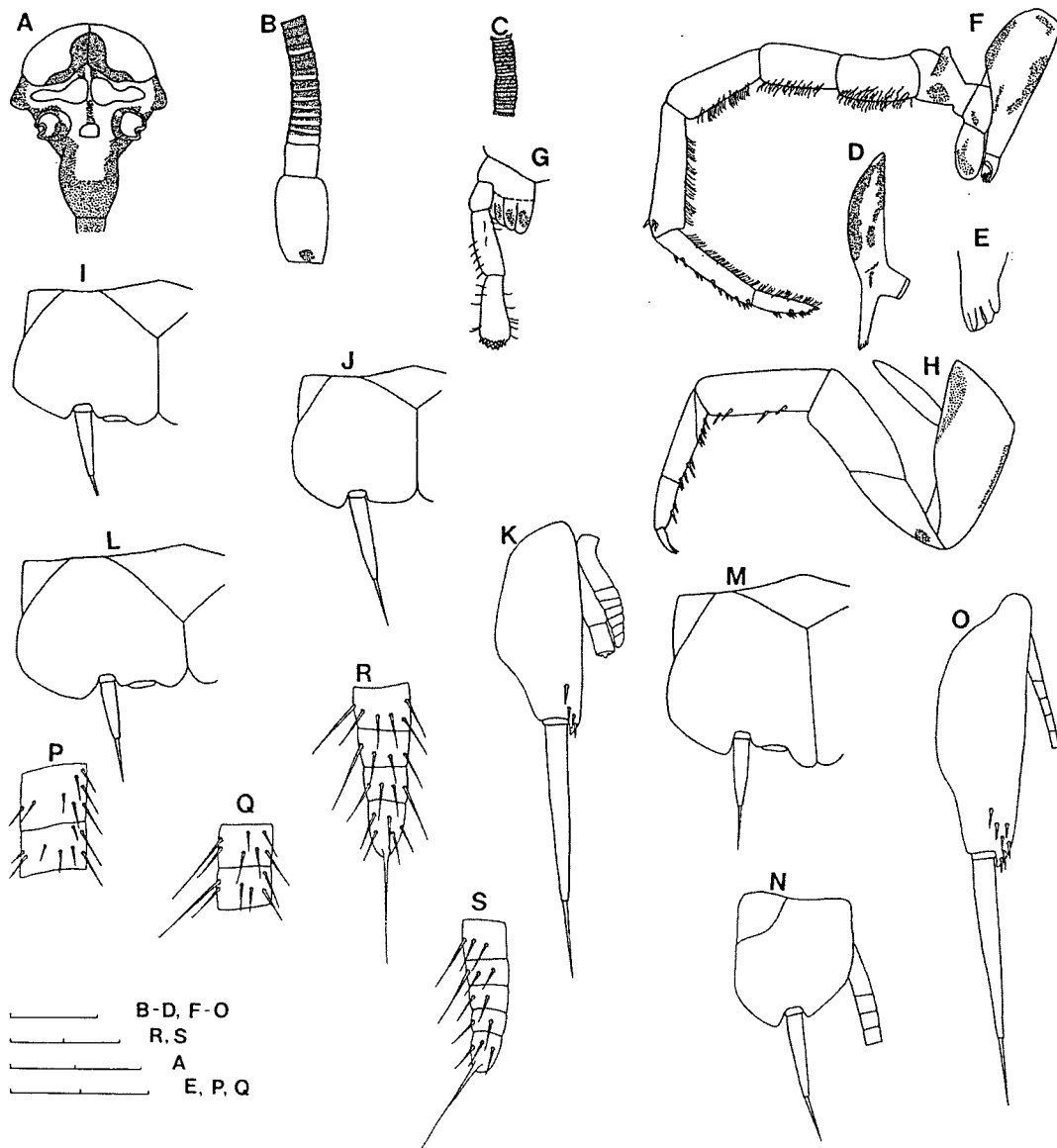


Fig. 2. *Pedetontinus aureus* sp. nov. A, Head, frontal view with hypodermal pigmentation (oculi, golden yellow area dotted). B, Antenna with pigmentation on basal portion. C, Median segments (16, 17th) of flagellum. D, Mandible with pigmentation, anterior view. E, Apical portion of mandible. F, Maxilla and its palpus of male with chaetotaxy and pigmentation. G, Labium and its palpus of male with pigmentation and chaetotaxy. H, Hindleg of male, anterior view with pigmentation and spines. I, Urosternum VII of male. J, Urosternum VIII of male. K, Urosternum IX of male with penis and paramere. L, Urosternum V of female. M, Urosternum VII of female. N, Urosternum VIII of female. O, Urosternum IX of female. P, Basal annuli (7, 8th) of anterior gonapophysis of female. Q, Median annuli (25, 26th) of anterior gonapophysis. R, Apical annuli of anterior gonapophysis. S, Apical annuli of posterior gonapophysis. Scale bars = 0.1 mm (R, S), 0.2 mm (E, P, Q), 0.5 mm (B-D, F-O), and 1 mm (A).

Table 1. Number of spines on uppersurface of maxillary palpus of *Pedetontinus aureus* sp. nov

Maxillary palpus	No. of spines	
	♂	♀
Article V	1-4 (2-4) *	2-6 (3-4)
Article VI	10-12 (12)	9-16 (12-13)
Article VII	7-12 (10-11)	9-14 (12)

* Usual number of spines.

Shape and hypodermal pigmentation of head as shown in Fig. 2A. Frons scaled between bases of antenna, pigmented specially in a straight line on central portion of frons. Clypeolabrum with dense hairs, pigmented.

Oculus relatively small, wider than long (length/width 0.75-0.85, usually 0.80-0.83); its line of contact/length 0.60-0.65. Ground color of oculus reddish brown; the median portion and/or lower portion golden yellow in living insects. Lateral ocellus reddish brown, dumbbell-shaped, transverse, situated anteriorly to margin of oculus, slightly narrower than oculus (ocellus/oculus 0.8-0.9) (Fig. 2A).

Scapus and pedicellus of antenna densely scaled; no scales on flagellum. Scapus rather long (width/length about 0.6); pedicellus as long as wide (Fig. 2B). Flagellum divided up to 31 segments. Proximal segments (up to 7, 8th) of flagellum not subdivided; median segments divided into 2-8 subsegments; terminal ones into 9-11. Pigmentation pattern of antenna as shown in Fig. 2B, C. Segments of distal half of flagellum uniformly brownish; junction between segments pale.

Mandible 4-toothed, pigmented (Fig. 2D, E).

Maxillary palpus stouter in male; ratio of article VII to VI 0.55-0.60; apex more pointed in female. Maxilla and its palpus of male with chaetotaxy and hypodermal pigmentation as Fig. 2F. Maxillary palpus with numerous setae of moderate size; generally those in articles V-VII denser than in articles I-IV in number. Numerous short suberect setae on undersurface of articles II-VII in male, but sparse in female. Spines on uppersurface of articles VI-VII and anterior portion of article V of maxillary palpus in both sexes; those of apex of article VII of male smaller than in female. The number of spines variable (Table 1); denser in female. Articles II-V of maxillary palpus scaled densely, articles VI and VII slightly sparse, and article I rare.

Labium and its palpus of male with pigmentation and chaetotaxy (Fig. 2G); palpus of male larger than that of female. Apical portion of labial palpus with many sensory cones in both sexes. Numerous setae of moderate size on article III, less in number on article II, and rare on article I. Short suberect setae present in labial palpus, rare on article I. All articles of labial palpus sparsely scaled, glossae and paraglossae pigmented.

Hypodermal pigmentation and spines of leg as shown in Fig. 2H, pigmentation almost the same in all legs. Ratio of width to length of tarsomere III 0.35-0.40 in both sexes; in case of hindleg ratio small in both sexes. Ratio of coxal styli in length to coxae 0.5-0.6. Chaetotaxy fundamentally same in all legs and in both sexes. Numerous setae on tarsus and tibia, slightly less in number on femur and trochanter, and rare on coxae. The number of spines on undersurface of leg variable (Table 2). Coxae and proximal portion of trochanter pigmented. All articles of legs and styli scaled.

Abdominal segments I-VII each with one pair of exsertile vesicles. Shape of urosterna V, VII, VIII and IX as shown in Fig. 2I-O. Posterior angle of 5th median plate approximately 85 degrees in male, 90-95 degrees in female. Inner posterior lobes of coxite VII of female projected. Inner distal half of coxite IX with 4-9 (usually 6-8) spines. Ratio of stylus (without spine) to coxite: urosternum V 0.5-0.6 in male; urosternum VII 0.45-0.55 in male; urosterna V and VII 0.4-0.5 in female; urosternum VIII 0.50-0.65 in male; urosternum IX 0.8-0.9 in male; urosterna VIII and IX 0.6-0.7 in female.

Shape of penis and paramere as shown in Fig. 2K. Ratio in length of penis to coxite IX 0.6-0.7. Ratio of basal part of penis to apical part 2.2-2.6. Penis slightly surpassing paramere (ratio of penis to paramere 1.0-1.1). Apical part of penis with numerous short setae; less in number on basal part. Paramere with 1 + 5 or 6 annuli. Inner portion of annulated part of paramere provided with numerous spine-like short setae.

Ovipositor of primary type, surpassing apex of stylus IX by 2/3 - 1 of the stylus IX length. Anterior and posterior gonapophyses with 41-53 (usually 47, 48) annuli (Fig. 2N, O). Chaetotaxy of gonapophyses as illustrated in Fig. 2P-S. Basal half of posterior gonapophysis glabrous, while all annuli of anterior gonapophysis setose. Sensory cones rarely 1 cone/annulus on approximately 6 most apical annuli of both gonapophyses.

Table 2. Number of spines on undersurface of leg of *Pedetontinus aureus* sp. nov

Leg	No. of spines					
	Foreleg		Midleg		Hindleg	
	♂	♀	♂	♀	♂	♀
Tibia	0	0	0-8 (6)	2-4	4-10 (7-8)	4-8
Tarsomere I	1-3 (2-3) *	2-3	1-4 (3-4)	2-3	2-5	3-4
Tarsomere II	4-7	3-7	4-8 (4-5)	4-5	4-8 (5-6)	4-6
Tarsomere III	1-4 (2-3)	2-3	1-3 (3)	3	2-3	3-4

* Usual number of spines.

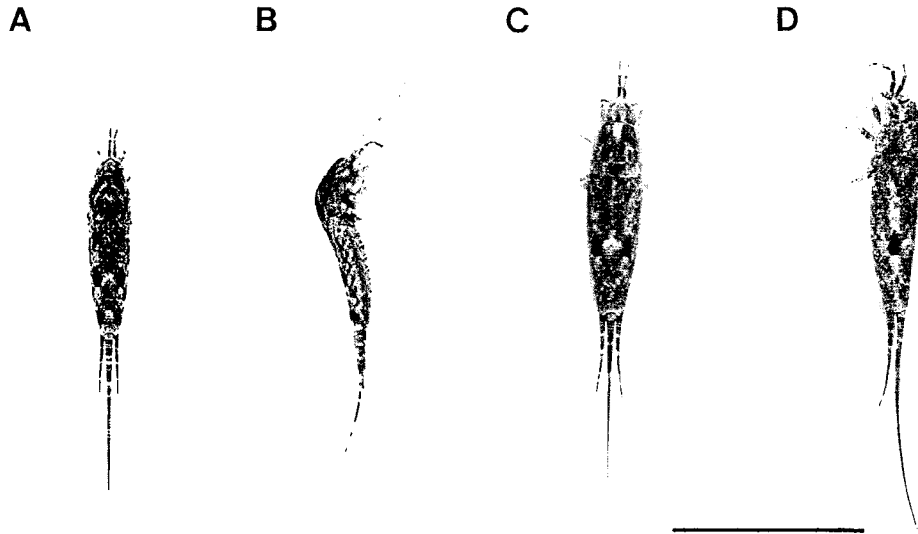


Fig. 3. *Pedetontinus rhombeus* sp. nov. A, Dorsal view, young. B, Lateral view, ditto. C, Dorsal view, adult. D, Lateral view, ditto. Scale bar = 1 cm.

Remarks: The specific name refers to the scale pattern. *Pedetontinus aureus* has a field of numerous short suberect setae on undersurface of maxillary palpus in male as in *Pedetontinus lineatus* Choe and Lee, 2001. This species is very similar to *Pedetontinus lineatus* Choe and Lee, 2001, but is easily separable from the latter by the scale pattern and long ovipositor.

This new species can be readily distinguished from other *Pedetontinus* species by the following characteristics: 1) body size small (8-10 mm); 2) scale pattern of golden color and two black spots; 3) numerous short suberect setae on undersurface of articles II-VII of maxillary palpus present in male; 4) oculus wider than long (length/width 0.75-0.85); 5) ovipositor surpassing apex of stylus IX by 2/3 - 1 of the stylus IX length; gonapophyses usually with 47, 48 annuli; 6) ratio of each stylus to coxites V-IX larger than in *Pedetontinus lineatus* in both sexes; and 7) number of sensory cones of gonapophyses rare.

Biology: In Mt. Jiri-san and Mt. Gaya-san, *Pedetontinus aureus* was usually found under the forest leaf litters. They appear to occur in both dry and humid conditions as *Pedetontinus lineatus*. It is not easy to collect this species because the color and pattern of their scales are cryptic among dead broad-leaves.

Pedetontinus rhombeus sp. nov.
(Figs. 3, 4)

Material examined: Holotype, ♂, Is. Hong-do, Heuksan-myeon, Sinan-gun, Jeonnam Province, 29. VII. 1990 (G. H. Choe and Y. M. Cho). Paratypes, 9 ♂♂, 10 ♀♀, same data as the holotype; 1 ♂, 1 ♀, same locality as

the holotype, 29. VII. 2001 (G. H. Choe and J. A. Jeong); 1 ♂, 3 ♀♀, Valley Baemsa-gol, Mt. Jiri-san, Sannae-myeon, Namwon-si, Jeonbug Province, 25. VII. 1990 (G. H. Choe and Y. M. Cho); 1 ♂, 1 ♀, Temple Baekyang-sa, Bukha-myeon, Jangseong-gun, Jeonnam Province, 21. VII. 1990 (G. H. Choe and B. C. Cho); 1 ♂, 1 ♀, Yullim-ri, Dolsan-eup, Yeosu-si, Jeonnam Province, 27. XII. 2000 (G. H. Choe and Y. M. Cho).

Description: Body length from head to tergum usually 11-14 mm. Ratio of antenna to body length 0.7-0.8. Median caudal filament (mcf) equal to or slightly longer than body length (mcf/body length 1.0-1.15); longer than antenna (mcf/antenna 1.2-1.8). Ratio of cerci to median caudal filament 0.4-0.5.

General body color ivory. Reddish brown hypodermal pigments on head, its appendages and legs; pigmentation pattern more or less variable among individuals. Scale pattern as shown in Fig. 3A-D. Spots of black scales present on both sides of nota II, III, and terga II, VI, IX; also on center of notum II and terga III, IV, V, VII, VIII (spots of terga IV, VI and VII prominent).

Shape and hypodermal pigmentation of head as shown in Fig. 4A. Frons scaled between bases of antenna, pigmented specially in a straight line on central portion of frons. Clypeolabrum with many hairs; several long hairs surpassing labrum.

Oculus large, so convex, slightly wider than long (length/width usually 0.85-0.90); its line of contact/length 0.70-0.85. Ground color of oculus predominantly reddish brown with some irregular yellow design; the median portion or also lower portion golden yellow in living insects. Lateral ocellus reddish brown, dumbbell-shaped, transverse, situated anteriorly to margin of

Table 3. Number of spines on uppersurface of maxillary palpus of *Pedetontinus rhombeus* sp. nov

Maxillary palpus	No. of spines	
	♂	♀
Article V	2-7 (3-4) *	4-8 (5-7)
Article VI	9-21 (11-14)	15-27 (20-24)
Article VII	8-12 (10-12)	10-22 (13-16)

* Usual number of spines.

oculus, slightly narrower than oculus (ocellus/oculus 0.85-0.95) (Fig. 4A).

Scapus and pedicellus of antenna densely scaled; no scales on flagellum. Scapus rather long (width/length about 0.6); pedicellus as long as wide (Fig. 4B). Flagellum divided up to 42 segments. Proximal segments (up to 8, 9th) of flagellum not subdivided; median segments divided into 2-7 subsegments; terminal ones into 11 maximum observed (usually 7-10). Pigmentation pattern of antenna as shown in Fig. 4B, C. Segments of distal half of flagellum uniformly brownish; junction between segments pale.

Mandible 4-toothed, pigmented (Fig. 4D).

Maxillary palpus stouter in male; ratio of article VII to VI 0.60-0.75 (0.6-0.7 in male; 0.70-0.75 in female); apex more pointed in female (Fig. 4G). Maxilla and its palpus of male with pigmentation and chaetotaxy as Fig. 4E, F. All segments of maxillary palpus with numerous setae of moderate size and several long suberect setae; generally those in articles V-VII denser than in articles I-IV in number. Many long and strong setae on article I; numerous normal setae on distal half undersurface of article II; field of numerous short suberect setae on distal half undersurface of article III; numerous short suberect setae on undersurface of articles VI and VII in male. But in female, only normal setae present on articles II, III, VI and VII. Maxillary palpus of female with spines as Fig. 4G. Spines on uppersurface of articles VI, VII and anterior portion of article V of maxillary palpus in both sexes; those of apex of article VII of male small than in female. The number of spines variable (Table 3); denser in female. Articles III-V of maxillary palpus scaled densely, articles II and VI sparse, and rare on articles I and VII.

Labium and its palpus of male with pigmentation and chaetotaxy (Fig. 4H, I). Apical portion of labial palpus with many sensory cones in both sexes. Many setae of moderate size on article II and III, less in number on

article I. Suberect setae present on labial palpus, rare on article I. Articles II and III of labial palpus sparsely scaled.

Pigmentation and spines of leg as shown in Fig. 4J, K, pigmentation almost the same in all legs; pigmentation on coxae conspicuous in both sexes. Ratio of width to length of tarsomere III 0.35-0.40 in both sexes. Ratio of coxal styli in length to coxae 0.55-0.60. Chaetotaxy fundamentally same in all legs and in both sexes. Numerous setae on tarsus and tibia, slightly less in number on femur and trochanter, and rare on coxae. The number of spines on undersurface of leg variable (Table 4); A male with 1 spine on femur of midleg were found. Femur and tibia of all legs and coxal styli densely scaled; coxae, trochanter and tarsus sparse.

Abdominal segments I-VII each with one pair of exsertile vesicles. Shape of urosterna V, VII, VIII and IX as shown in Fig. 4L-S. Posterior angle of 5th median plate approximately 80-90 degrees in male and 95-100 degrees in female. Inner posterior lobes of coxite VII of female projected. Inner distal half of coxite IX 4-11 (usually 7, 8) spines. Ratio of stylus (without spine) to coxite: urosterna V and VII 0.45-0.55 in male and 0.4-0.5 in female; urosternum VIII 0.5-0.6 in male and 0.6-0.7 in female; urosternum IX 0.8-0.9 in male and 0.55-0.65 in female.

Shape of penis and paramere as shown in Fig. 4O. Ratio in length of penis to coxite IX 0.55-0.65. Ratio of basal part of penis to apical part 1.8-2.6. Ratio of penis to paramere 0.9-1.1. Apical part of penis with numerous short setae; less in number on basal part. Paramere with 1 + 6 annuli. Inner portion of annulated part of paramere provided with numerous spine-like short setae.

Ovipositor of primary type, slightly surpassing apex of stylus IX. Anterior and posterior gonapophyses with 44-61 (usually 51-58) annuli (Fig. 4R, S). Chaetotaxy of gonapophyses as illustrated in Fig. 4T-W. Basal half of posterior gonapophysis glabrous, while all annuli of anterior gonapophysis setose. Sensory cones on first apical annulus of anterior gonapophysis 0-4 (usually 3), posterior gonapophysis 0-3 (usually 1-2); 1 cone usually on second apical annulus of both gonapophyses; rarely 1 cone/annulus on 3rd-40th apical annuli of anterior gonapophysis; frequently 1 cone/annulus on 3rd and 4th apical annuli of posterior gonapophysis (one

Table 4. Number of spines on undersurface of leg of *Pedetontinus rhombeus* sp. nov.

Leg	No. of spines					
	Foreleg		Midleg		Hindleg	
	♂	♀	♂	♀	♂	♀
Femur	0	0	0	0	0-1 (1)	0-1 (1)
Tibia	0	0	5-9 (6-7)	4-7 (4-5)	8-15 (9-12)	7-15 (7-9)
Tarsomere I	2-6 (5) *	3-7 (4-5)	4-7 (5-7)	3-6 (4-5)	2-9 (6-7)	5-7
Tarsomere II	6-9 (7-8)	6-9	3-9 (6-8)	3-8 (5-8)	6-10 (7-10)	6-8 (7-8)
Tarsomere III	2-4 (3-4)	2-4 (3)	3-5 (3-4)	2-4	4-5 (4)	1-5 (3-4)

* Usual number of spines.

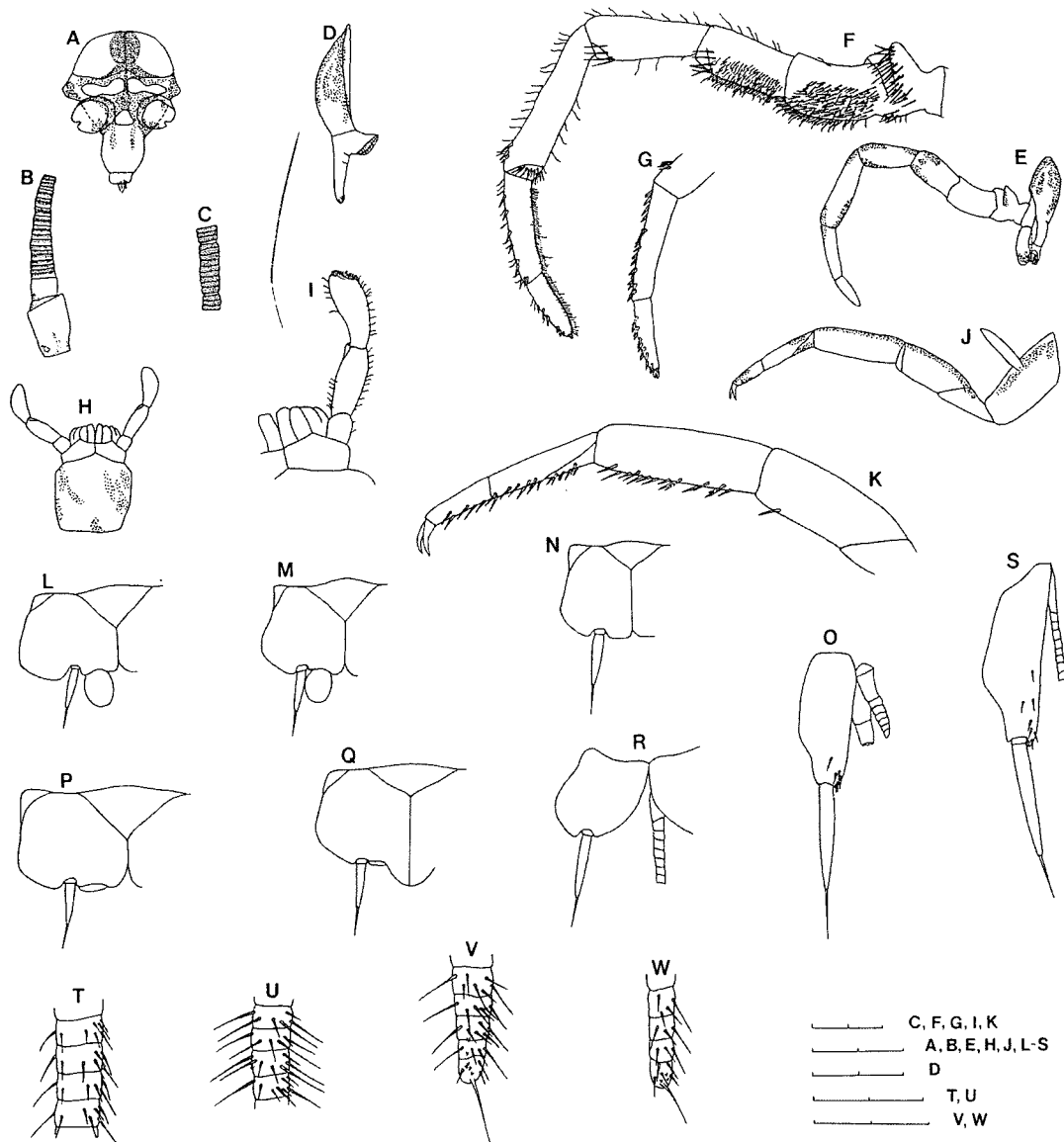


Fig. 4. *Pedetontinus rhombeus* sp. nov. A, Head, frontal view with hypodermal pigmentation (oculi, golden yellow area dotted). B, Antenna with pigmentation on basal portion. C, Median segment (30th) of flagellum. D, Mandible with pigmentation, anterior view. E, Maxilla and its palpus of male with pigmentation. F, Maxillary palpus of male with chaetotaxy. G, Maxillary palpus of female with spines. H, Labium of male with pigmentation. I, Labial palpus of male with chaetotaxy. J, Hindleg of male, anterior view with pigmentation. K, Hindleg of male with spines. L, Urosternum V of male. M, Urosternum VII of male. N, Urosternum VIII of male. O, Urosternum IX of male with penis and paramere. P, Urosternum V of female. Q, Urosternum VII of female. R, Urosternum VIII of female. S, Urosternum IX of female. T, Basal annuli (13-16th) of anterior gonapophysis of female. U, Median annuli (37-40th) of anterior gonapophysis. V, Apical annuli of anterior gonapophysis. W, Apical annuli of posterior gonapophysis. Scale bars = 0.2 mm (V, W), 0.3 mm (T, U), 0.4 mm (C, F, G, I, K), 0.6 mm (D), and 1 mm (A, B, E, H, J, L-S).

individual with 1 cone on 15th apical annulus of posterior gonapophysis).

Remarks: *Pedetontinus rhombeus* sp. nov. is the most widely distributed of the Archaeognatha in Korea. The specific name is derived from the rhombic design of scale pattern. At first glance, the scale pattern of this species resembles that of *Pedetontus okajimae* (Silvestri, 1943; Machida, 1985). The comparisons of characteristics among the South Korean *Pedetontinus*

species are given in Table 5.

This species can be recognized by the following characteristics: 1) body size large (11-14 mm) among the genus *Pedetontinus* species; 2) flagellum of antenna divided up to 42 segments; 3) field of numerous short suberect setae on distal half under-surface of article III of maxillary palpus present in male; 4) many spines of maxillary palpus, leg and coxite IX; 5) pigmentation on coxae conspicuous; 6) posterior angle of 5th median plate 95-100° in female;

Table 5. Comparisons of characteristics among the South Korean *Pedetontinus* species

Characteristics	<i>Pedetontinus lineatus</i>	<i>P. aureus</i> sp. nov.	<i>P. rhombeus</i> sp. nov.
1. Body length	Small size: 8-9 mm	Small size: 8-10 mm	Large size: 11-14 mm
2. Scale color and pattern	A pair of median black scales on terga	Golden color and black spots on tergum II	Many spots of black scales on nota and terga
3. Chaetotaxy of maxillary palpus in male	Numerous suberect setae on undersurface	Numerous suberect setae on undersurface	Field of short suberect setae on article III
4. Ovipositor length in female	Slightly surpassing apex stylus IX	Surpassing apex of stylus IX by 2/3-1 of stylus IX length	Slightly surpassing apex stylus IX
5. Gonapophyses	45-48 annuli usually	47, 48 annuli usually	51-58 annuli usually

7) ratio of stylus to coxite: urosternum IX 0.8-0.9 in male, urosternum VIII 0.6-0.7 in female; and 8) ovipositor slightly surpassing apex of stylus IX; gonapophyses usually with 51-58 annuli.

Biology: *Pedetontinus rhombeus* was usually found under the forest leaf litters and on the rocks covered with green algae. They were hibernating in the soil and clefts of rocks during winter, but relatively active under the warmer laboratory even in winter. Peculiarly, this species was frequently found on the bark of maples in Temple Baekyang-sa, and on the bark of Camellia in ls. Hong-do.

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