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Taxonomic Study of *Anteon* in East Asia, with Two New Species from Taiwan and Japan (Hymenoptera: Dryinidae: Anteoninae)

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Abstract. *Anteon peculiare* Olmi is newly recorded from Taiwan and its additional description is provided. *Anteon. crassum* sp. nov. (Taiwan and Japan) and *A. tadauchii* sp. nov. (Taiwan) are described as new to science. The morphological diversity of ventral structure on foretarsomere V is demonstrated. The shape of the projection of TV and the alignment of lamellae are considered to show important difference to classify the *Anteon* species.

Key words: classification, morphology, parasitoid.

Introduction

The genus *Anteon* Jurine is one of the largest genera of the family Dryinidae Haliday. The structure of the raptorial foreleg of the female is much more species-specific than that of the other large genera, *Dryinus* Latreille (Dryininae) and *Gonatopus* Ljungh (Gonatopodinae). However, the comparative morphology of the foreleg, especially on the chela, has not been well understood. Tentatively 26 species are known from Taiwan (He & Xu, 2002) and 14 species are from Japan (Olmi, 1984, 1995, 1999; He & XU, 2002; Mita et al, 2009) in the genus *Anteon*. During a taxonomic research of the Dryinidae in East Asia, three unknown species of *Anteon* were recognized from Taiwan and Japan. They show good examples of the morphological diversity. Two of them are described herein as new to science; the other species is newly recorded from Taiwan. Importance of the inner structure of chela will be discussed.

Materials and methods

Specimens examined are deposited in the following institutions: Taiwan Agricultural Research Institute, Taichung, Taiwan (TARI); Meijo University, Aichi, Japan (ELMU); Tokyo University of Agriculture, Kanagawa, Japan (TUA). TI–TV represents foretarsomere numbers; FI–FVIII represents flagellomere numbers. The chela ratio is the proportion of the projection of TV. It is calculated by the formula: chela ratio = distal part (Fig. 16 A) / [distal part + basal part (Fig. 16 B)]. The distal part represents the projection. The length of the basal part represents the distance from basal margin of TV to basal margin of arolium. The inside of chela (Fig. 17) is the lateral surface of chela directed toward the axis of the body when the projection of TV is orientated ahead. The outside of chela (Fig. 17) is the lateral surface of chela against the axis of the body. Other terms follow those established by Olmi (1984, 1994, 1999).

The chelae were first mounted in the glycerin jelly in order to observe the ventral surface of TV, then rearranged to observe inside of the chelae. They were finally mounted in the Canada balsam and pinned together with the specimens.

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Anteon peculiare Olmi
(Figs. 1-5, 16-17)

Anteon peculiare Olmi, 1992, Frustula Entmol. N.S. 15(28): 27.

Additional description. Female (n =1). Head (Figs. 1-3) 0.83 × longer than wide; frons 0.49 × wider than head, flat; lateral aspect of frons producing from eye (Fig. 3); frontal line complete (partly present in front of anterior ocellus in holotype); orbital keel indistinct; maximum length of gena 0.35 × eye in lateral view; temple as long as maximum length of gena (Fig. 3); vertex flat.

Pronotum (Figs. 1, 4-5) 0.73 × longer than wide, rounded in lateral view; anterior transverse groove, deep apical notch and transversal impression present (Fig. 4). Scutum 0.53 × wide; punctures stronger anteriorly and weaker posteriorly; epicnemium microreticulated; mesepisternum reticulated. Metanotum rugose (smooth in holotype); metapleural region striated; propodeum 1.84 × as long as wide in full length; dorsal surface 0.58 × longer than posterior surface.

Foretarsomere showing following ratio: 46: 18: 26: 88: 152; tarsomere I 0.52 × tarsomere IV (0.38 in holotype); chela ratio = 0.78; inner margin of projection of tarsomere V bearing two rows of 18 + 30 lamellae, and one row of 18 bristles (Figs. 16-17); apex of projection sinuate; apex of enlarged claw reaching tarsomere III.

Measurements (*in mm*). Head 0.85 long, 1.02 wide; antenna 2.35 long; eye 0.55 long, 0.30 wide in dorsal view; mesosoma 1.88 long; pronotum 0.54 long, 0.74 wide; scutum 0.50 long, 0.95 wide; scutellum 0.25 long; metanotum 0.13; propodeum 0.38 long in full length, 0.70 wide; forecoxa 0.70 long; foretrochanter 0.10 long; forefemur 1.08 long; foretibia 0.65 long; TV 0.76 long; forewing 3.10 long; metasoma 1.80 long; total body length 4.53 long (3.56 in holotype).

Male. Unknown.

Specimens examined. [TAIWAN] 1♀, Nantou Hsien, Tungpu (1200m alt.). 20-24. VI. 1983, K.C. Chou & C.Y. Wong (with identification label written as "ANTEON JAVANUM OLMI M., OLMI DET.") (TARI).

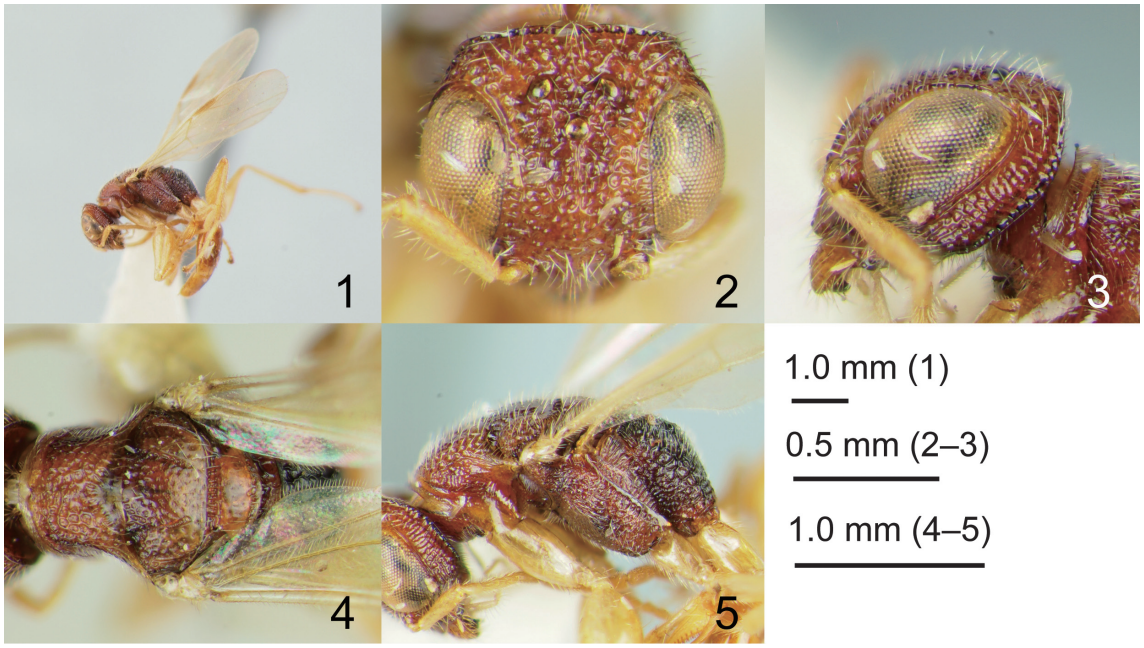
Distribution. Sri Lanka; Taiwan (Nantou Hsien). New record from Taiwan.

Host. Unknown.

Remarks. This new species resembles the Oriental *A. javanum* Olmi and the Palaearctic *A. ephippiger* Dalman in the developed chela and the pale body color, but *A. peculiare* can be distinguished from the latter by the densely located large punctures on head (Fig. 2) and scutum (Fig. 4) and the straight apex on the projection of TV (Fig. 17).

Anteon crassum sp. nov.
(Figs. 6-10, 18-19)

Description. Female (n = 4). Head (Figs. 6-8) 0.67–0.76 (mean 0.72) × longer than wide, reticulated; frons 0.45–0.57 (0.51) × wider than head, flat; lateral aspect of



Figs. 1-5. *Anteon peculiare* Olmi. 1 Lateral habitus; 2 head in dorsal view; 3 ditto, lateral view; 4 mesosoma in dorsal view; 5 ditto, lateral view.

frons rounded, exposed (Fig. 8); frontal line and orbital keel complete; OL = 3.5–4.5 (4.0); POL = 5.0–7.0 (6.0); OOL = 5.0–6.0 (5.5); OPL = 5.0–7.5 (6.0); OL 0.50–0.80 (0.63) × POL; maximum diameter of anterior ocellus 2.5–3.0 (2.5); temple 0.33–0.55 (0.46) × maximum length of gena (Fig. 8); vertex flat; occipital carina complete; antenna distally thickened; each segment showing following ratio: 13.0–14.0 (13.6): 6.0–7.0 (6.8): 7.0–9.0 (8.1): 7.0–9.5 (8.1): 7.0–7.5 (7.1): 6.0–8.0 (7.0): 6.0–7.0 (7.5): 6.0–7.0 (6.3): 6.0–7.0 (6.3): 8.0–9.0 (8.8); FI 0.5–0.7 (0.6) × scape.

Pronotum (Figs. 9-10) 0.58–0.63 (0.61) × longer than wide, rounded in lateral view; anterior surface transversely striate; dorsal surface rugose with posterior margin smooth; anterior transverse groove, deep apical notch, and transversal impression present (Fig. 9). Scutum 0.41–0.53 (0.48) × wide; surface longitudinally rugose excluding median and posterior part almost smooth (Fig. 9); notaulices 0.26–0.60 (0.42) × scutum; scutellum smooth, flat in lateral view; epicnemium reticulate; mesepisternum reticulate, sometimes partly smooth (Fig. 10). Metanotum rugose; metapleural region striated; propodeum 1.08–2.34 (1.57) × as long as wide in full length, with strong transverse keel; pair of posterior longitudinal keels absent; dorsal surface 0.33–0.67 (0.47) × longer than posterior surface, reticulate rugose; posterior surface reticulate.

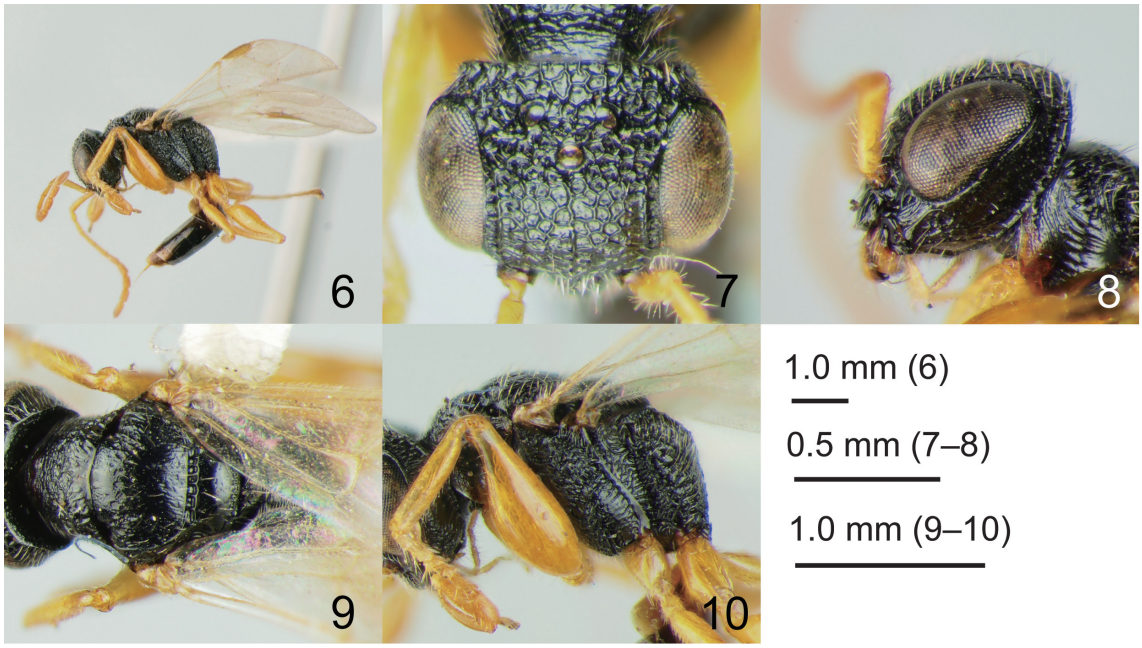
Foreleg apically chelate, each tarsomere showing following ratio: 40–48 (45): 15: 18–22 (20): 24–30 (28): 83–91 (87); tarsomere I 1.47–1.68 (1.60) × tarsomere IV; chela ratio = 0.47–0.55 (0.51); tarsomere V stout; ventral surface of projection bearing row of (15–19) lamellae normal in size, row of (9–10) small lamellae, and two rows of (10–11) + (10–17) bristles (Figs. 18-19); apex of projection sinuate, bearing row of 4–5 lamellae; furrow between inner margin and apex tightly holding enlarged claw when closed (Figs. 18-19); apex of enlarged claw reaching tarsomere III. Wing hyaline, without dark band (Fig. 6); veins tinged with yellow; distal part of radial vein 0.3–0.4 (0.4) × proximal part.

Color. Body black; mandible testaceous with reddish teeth; antenna testaceous; tegula testaceous; legs testaceous.

Measurements (*in mm*). Head 0.68–0.87 (0.75) long, 0.98–1.15 (1.04) wide; antenna 2.03–2.22 (2.12) long; eye 0.47–0.62 (0.52) long, 0.22–0.30 (0.25) wide in dorsal view; mesosoma 1.56–1.65 (1.60) long; pronotum 0.35–0.45 (0.39) long, 0.60–0.73 (0.63) wide; scutum 0.38–0.50 (0.44) long, 0.87–0.96 (0.92) wide; scutellum 0.20–0.22 (0.22) long; metanotum 0.14–0.15 (0.15); propodeum 0.35–0.60 (0.48) long in full length, 0.65–0.82 (0.71) wide; forecoxa 0.57–0.60 (0.58) long; foretrochanter 0.20–0.25 (0.22) long; forefemur 0.92–0.96 (0.93) long; foretibia 0.65–0.75 (0.69) long; TV 0.42–0.46 (0.44) long; forewing 2.52–3.00 (2.74) long; metasoma 1.33–1.90 (1.59) long; total body length 3.59–4.37 (3.94) long.

Male. Unknown.

Specimens examined. Holotype ♀, (first label)



Figs. 6-10. *Anteon crassum* n. sp. 6 Lateral habitus; 7 head in dorsal view; 8 ditto, lateral view; 9 mesosoma in dorsal view; 10 ditto, lateral view.

"JAPAN: Nagoya, Tempaku, Yagoto, 20. VIII. 2002, S. Endow (SW)" (second label) "HOLOTYPE *Anteon crassum* Mita, 2011" (ELMU). Paratypes: [Japan] 1♀, Takamoto-sen, Nakano-shima Isl., Tokara Isls., 5. V. 2005 (FIT), J. Kantô leg. (TUA); [Taiwan] 2♀, Tungpu, 1200m. Nantou Hsien, 18–23. XI. 1981, T. Lin & W. S. Tang leg. (with identification label as "*Anteon borneanum* Ol., M. OLMI det. 95") (TARI).

Distribution. Taiwan (Nantou Hsien); Japan (Honshu, Tokara Isls.).

Host. Unknown.

Etymology. The Latin *crassum* meaning thick, referring to the stout, enlarged claw.

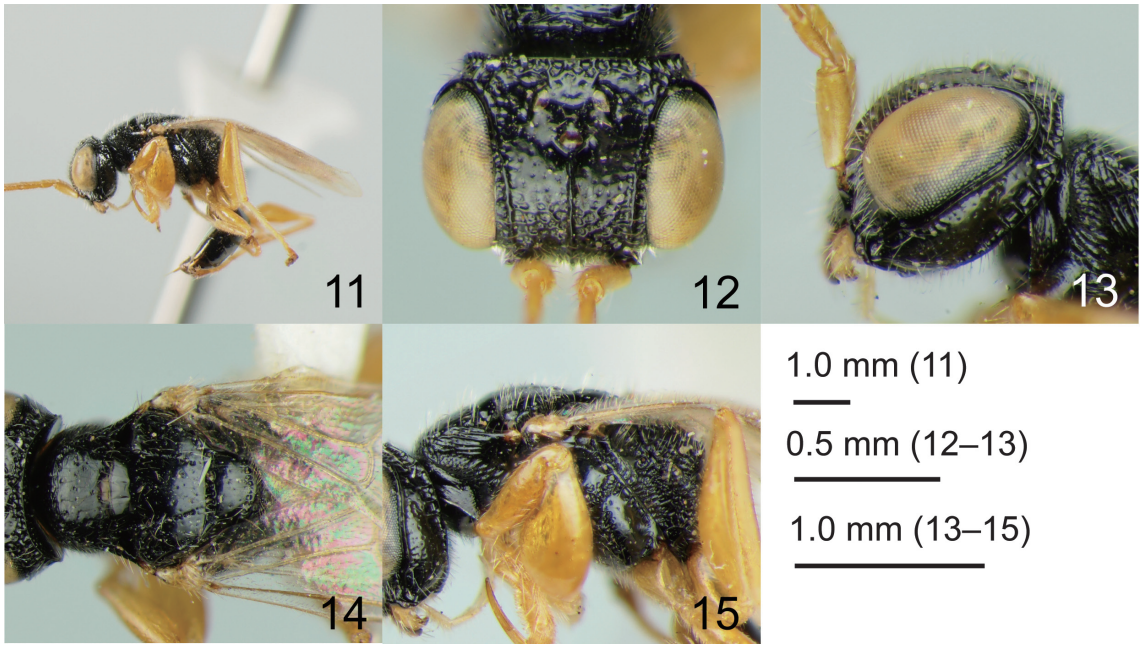
Remarks. The character states of *Anteon crassum* are similar to the Palaearctic *A. jurineanum* Latreille, 1809 and the Oriental *A. borneanum* Olmi, 1984. However, *A. crassum* is clearly distinguishable from the two species by the rows of lamellae on TV which holds an enlarged claw (Figs. 18-19) and longer projection of TV (chela ratio = ca. 0.5). The TV of *A. jurineanum* and *A. borneanum* cannot serve to hold an enlarged claw because of the absence of stout lamellae and short projection (chela ratio = ca. 0.2).

***Anteon tadauchii* sp. nov.**
(Figs. 11-15, 20-21)

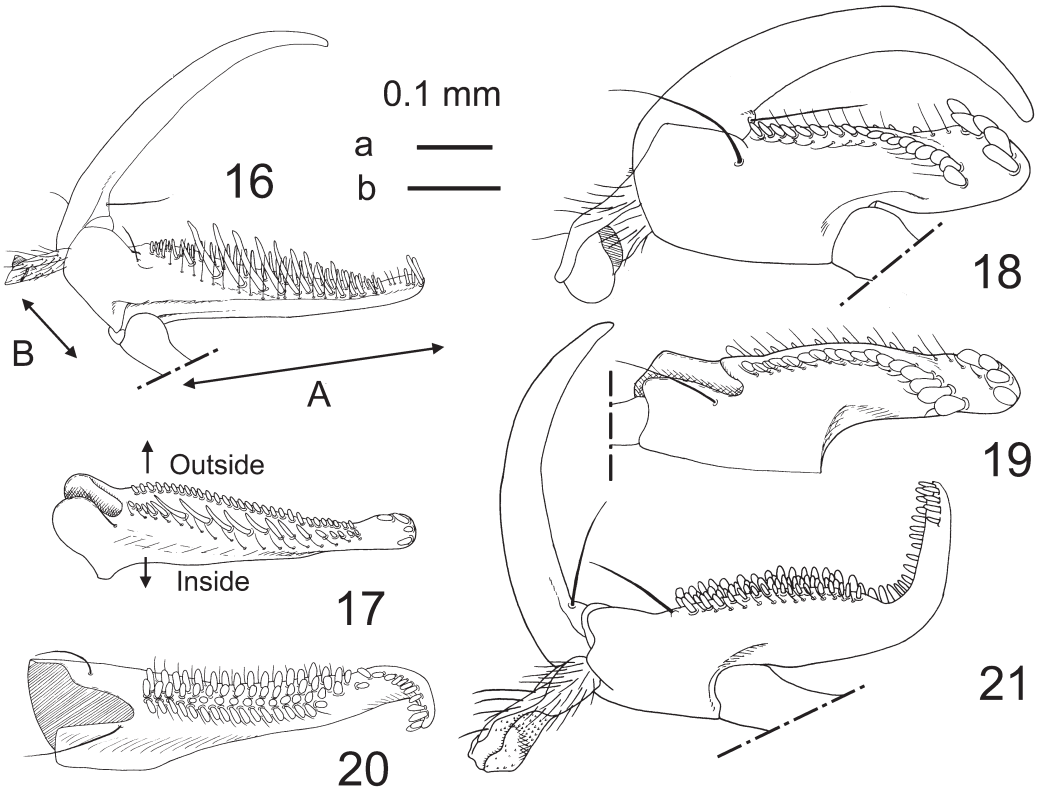
Description. Female (n = 1). Head (Figs. 11-13) 0.74 × longer than wide, reticulated excluding surface around anterior ocellus, sides of posterior ocelli and gena smooth; frons 0.48 × wider than head, flat; lateral aspect of frons rounded, producing from eye (Fig. 13); frontal line and orbital keel complete; OL = 1.0; POL = 1.3; OOL = 2.2; OPL = 1.2; OL 0.77 × POL; maximum diameter of anterior ocellus 0.7; temple 0.4 × maximum length of gena (Fig. 13); vertex flat; occipital carina complete; antenna distally thickened; each segment showing following ratio: 3.6: 2.0: 2.6: 2.3: 2.0: 2.4: 2.4: 2.3: 2.0: (FVIII broken); FI 0.72 × scape.

Pronotum (Figs. 14-15) 0.58 × longer than wide, forming distinct corner in lateral view, transversely striated on anterior surface, smooth on dorsal surface; anterior transverse groove, deep apical notch, and transversal impression present (Fig. 14); dorsal surface 0.75 × full length. Scutum 0.58 × wide, smooth; notaulices 0.90 × scutum; scutellum smooth, flat in lateral view; epicnemium and mesepisternum reticulated with smooth area. Metanotum rugose; metapleural region striated; propodeum with strong transverse keel and pair of posterior longitudinal keels; dorsal surface 0.46 × longer than posterior surface, reticulate rugose; posterior surface reticulate rugose.

Foreleg apically chelate, each tarsomere showing following ratio: 40: 17: 25: 52: 112; tarsomere I 0.77 × tarsomere IV; chela ratio = 0.67; tarsomere V strongly curving (Fig. 21); ventral surface of projection bearing four rows of ca. 17 + 11 + 17 + 17 lamellae and two rows of ca. 16 + 16 bristles (Fig. 20); apex sinuate (Fig. 20), bearing row



Figs. 11-15. *Anteon tadauchii* n. sp. (holotype). 11 Lateral habitus; 12 head in dorsal view; 13 ditto, lateral view; 14 mesosoma in dorsal view; 15 ditto, lateral view.



Figs. 16-21. Chela. 16 *Anteon peculiare* Olmi, inside; 17 ditto, ventral view; 18 *A. crassum* n. sp. (holotype), inside; 19 ditto (Taiwan), ventral view; 20 *A. tadauchii* n. sp. (holotype), inside; 21 ditto, ventral view. Scale represents 0.1 mm (a = 16-17, 20-21, b = 18-19).

of 16 lamellae; apex of enlarged claw reaching tarsomere III. Wing hyaline (Fig. 11), without dark band; veins tinged with yellow; distal part of radial vein 0.4 × proximal part.

Color. Head black; mandible testaceous with blackish teeth; antenna testaceous; mesosoma black excluding testaceous tegula; legs testaceous; metasoma brownish black.

Measurements (*in mm*). Head 0.77 long, 1.04 wide; eye 0.55 long, 0.26 wide in dorsal view; mesosoma 1.70 long; pronotum 0.40 long, 0.69 wide; scutum 0.50 long, 0.86 wide; scutellum 0.23 long; metanotum 0.14; propodeum 0.62 long in full length; forecoxa 0.64 long; foretrochanter 0.25 long; forefemur 0.96 long; foretibia 0.70 long; TV 0.56 long; forewing 2.95 long; metasoma 1.31 long; total body length 3.78 long.

Male. Unknown.

Specimens examined. Holotype ♀, (first label) "C. TAIWAN: Tungpu, 1200m. Nantou Hsien, 18-23. XI. 1981, T. Lin & W. S. Tang", (second label) "ANTEON BAUENSE OLMI, M. OLMI DET", (third label)"*Anteon tadauchii* Mita, 2011" (TARI).

Distribution. Taiwan (Nantou Hsien).

Host. Unknown.

Etymology. Dedicated for Prof. Tadauchi (Kyushu University).

Remarks. The character states of *Anteon tadauchii* are similar to *A. insertum* Olmi, 1989. However, *A. tadauchii* is clearly distinguishable from *A. insertum* by the strongly curving TV (weakly curving in *A. insertum*).

Discussion

The three new species have interesting character states on TV and they are clearly recognizable especially from ventral aspect. The chela has been commonly illustrated with an enlarged claw situated upward (Figs. 16, 18, 19, 21), but females hold the enlarged claw downward (Figs. 1, 6, 11). Therefore, the ventral side of TV is the surface bearing lamellae (Figs. 17, 20). The ventral surface of TV in *A. peculiare* has two rows of lamellae; one row is composed of short lamellae and one row is composed of long lamellae (Fig. 16). The projection of TV is elongate and substraight (chela ratio = 0.8). In *A. crassum*, the lamellae forming the inner row are stout, and the row curves in order to hold an enlarged claw together with apical row (Figs. 18-19). Although the lamellae forming the outer row are visible outside of TV (Fig. 19), they are very short

and invisible when the chela is observed inside (Fig. 18). The projection is less developed (chela ratio = 0.5). The lamellae of *A. tadauchii* are normal in size, but forms four rows (Fig. 20). The apex of projection is developed (chela ratio = 0.7) and weakly twisted inside (Fig. 20). The above character states, especially on the inner structure of the projection of TV are difficult to recognize when the chela is observed in lateral view. The number of lamellae and rarely the number of rows of lamellae are more or less different within a species. However, the inner profile of the projection is rather stable. The lateral aspect of the chela of *A. peculiare* is quite similar to the Palaearctic *A. pinetellum* Rond and *A. pubicorne* (Dalman) species group (Olmi, 1991), which includes *A. crassifrons* (Moczar), *A. ephippiger*, *A. exuguum* (Haupt), *A. fulviventle* (Haliday), *A. gaullei* Kieffer, *A. hilare* Olmi, *A. pubicorne* and *A. tripertitum* Kieffer. It is also similar to some Oriental species, such as *A. javanum* Olmi. Most of the above species have twisted apex of the projection (as in Fig. 20). However, *A. pinetellum* and *A. peculiale* have straight apices. Rond (1998) divided *A. pinetellum* from *A. ephippiger* (Dalman) based on the difference of the inner structure on the projection. At the moment, no females showing intermediate condition have been found.

In the key to the species of *Anteon*, the relative length of TI against TIV has been used (cf., Olmi, 1984, 1994, 1999; He & Xu, 2002). Considering the association of tarsomere length and the shape of chela, it could be regarded that the longer TIV represents the longer projection of TV. Therefore, the outline of a chela could be retrieved from the proportion of TI. However, the profile of a chela can be depicted more precisely by the combination with the chela ratio. The longer TIV and projection (TI / TIV > ca. 1.0 and chela ratio > ca. 0.6) often imply the profile like *A. pubicorne* species group (as in Fig. 16), but strong modification, for example, the curving apex of *A. tadauchii* (Fig. 21) might not be retrievable. The inner structure of TV with the smaller chela ratio, like *A. jurineanum* (chela ratio = ca. 0.2), may be different from the above specs. The inner structure is considered to be important for species recognition and grouping especially for *Anteon*. Further discussion is required with precise examination using more taxa and samples.

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