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TWO NEW SPECIES AND ONE NEW RECORD OF *DEUTEREULOPHUS* SCHULZ (HYMENOPTERA: EULOPHIDAE) FROM SOUTH CHINA

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ABSTRACT. – Two new species of Eulophidae, *Deutereulophus interruptus* and *D. marginatus*, are described from China. Another new record, *D. tennysoni* (Girault) is also reported. Compared with some other species of the genus, *D. interruptus* is most similar to *D. tennysoni*, while *D. marginatus* is unique in this genus for its united sublateral grooves on the scutellum. Using Scanning Electronic Microscopy, we carried out detailed morphological study of *D. interruptus* and further discussed the status of *Deutereulophus* Schulz.

KEY WORDS. – *Deutereulophus*, new species, China, Hymenoptera, Eulophidae, taxonomy.

INTRODUCTION

To better understand Chinese Eulophidae, we recently conducted series of taxonomic studies (Zhu et al., 1999, 2000a, b; Zhu & Huang, 2001a, b). One of the major problems for classification within Eulophidae is the group of genera related to *Elachertus* Spinola (LaSalle & Schauff, 1992). *Deutereulophus* Schulz is one within the group close to *Elachertus*. It was erected as a new name for *Eulophopteryx* Ashmead (1904) by Schulz (1906). It includes 10 described species from Australia (Girault, 1913, 1915, 1922, 1938; Girault & Dodd, 1915; Yoshimoto & Ishii, 1965), two from Brazil (Ashmead, 1904). Without examination of Ashmead's South American material of *Deutereulophus*, Boucek (1988) subdivided this genus under the name *Entedonomorpha* into two species-groups based on Australian species. All species found in China are grouped within the *tennysoni*-group. LaSalle & Schauff (1992) considered *Entedonomorpha* Girault another synonym of *Deutereulophus* Ashmead, and discussed the identity of this genus. But no detailed morphological or systematic study of this genus has been presented previously.

MATERIALS AND METHODS

This study is based on specimens deposited in the following collections: 1) the Institute of Zoology, Chinese Academy of Sciences (IZCAS); 2) the Natural History Museum, London, UK (BMNH); 3) the Insect Collection, Taiwan Agricultural Research Institute (TARI); and 4) the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research, National University of Singapore. Morphological terms follow Gibson (1997). Absolute measurements, in millimeters (mm), are used for the body and forewing length. For all other dimensions, relative measurements are used.

TAXONOMY

Deutereulophus interruptus, new species
(Figs. 1-16)

Material examined. – Holotype – female, C. Taiwan, Nantou Xian, Tungpu, coll. Lin T. & Tang W.-S., 18-23 Nov.1981, 1200 m (IZCAS).

Paratypes – 1 female, Fujian, Wuyishan, coll. Liao Ding-xi, 23 Aug.1981 (IZCAS); 3 females, C. Taiwan, Nantou Xian, Meifeng, coll. Lin K.-S. & Lin S.-C., 7-9 May.1981, 2150 m (TARI); 1 male, 2 females, C. Taiwan, Nantou Xian, Meifeng, coll. Chou L.-Y. & Chen C.-C., 2-4 Jun.1980, 2150 m (TARI); 1 female, C. Taiwan, Nantou Xian, Meifeng, coll. Chen C.-C. & Chien C.-C., 5-9 Oct.1980, 2150 m (TARI); 1 female, C. Taiwan, Hwalian Xian, Tayuling, coll. Chou L.-Y. & Chou K.-C., 6-9 Sep.1981, 2560 m (TARI). 39 males, 35 females, C. Taiwan, Nantou Xian, Tungpu, coll. Lin T. & Tang W.-S., 18-23 Sep.1981, 1200 m (TARI); 2 males, 3 females, C. Taiwan, Nantou Xian, Tungpu, coll. Lin T. & Tang W.-S., 18-23 Sep.1981, 1200 m (ZRC).

Diagnosis. – Female funicle 4-segmented, clava 3-segmented, with F1 nearly as long as clava, at least two times as long as broad (Fig. 13); male funicle 4-segmented, weakly to distinctly protuberant; scutellum with weak, engraved reticulation, almost smooth; sublateral grooves on scutellum

broad, straight, punctate on bottom, not united posteriorly (Fig. 4c); occiput rounded behind posterior ocelli (Fig. 3); antenna dark (Figs. 13-16); pronotum reticulate; petiole with longitudinal rugae dorsally.

Description. – Holotype female – From the frontal view: head (Fig. 1) wider than high; vertex very vaguely reticulate, rounded into face anteriorly; face smooth; toruli located well above lower margin of eyes; epistomal sulcus very unique in Eulophidae, sculptured at bottom (Fig. 2a); eyes setose, with inner margins nearly parallel; four strong setae present on anterior margin of clypeus (Fig. 2b); inner margins of mandibles bare, with at least 3 strong teeth (Fig. 2c). From the posterior view (Fig. 3): occipital carina absent from behind posterior ocelli; occiput with regular, slightly raised reticulations near posterior ocelli; post occipital carina absent; one pair of pits present closer to base of mouth parts than to foramen magnum; distinct sulcus present between foramen magnum and these pits; maxillae and labium smooth; maxillary palpi 2-segmented and labial palpi 1-segmented, cylindrical. Antenna: anelli 2-segmented, with 1st segment bare, while the 2nd setose; funicle 3-segmented, all more than twice length of width, as long as clava (Fig. 13). Relative measurements: head breadth 66, head length 14, head height 45, POL 13, OOL 10, eye length 28, eye breadth 18, distance between eyes 37, malar space 15, mouth opening 25, toruli to median ocellus 31, toruli to mouth margin 15, scape 32, pedicel 9, F1 17, F2 15, F3 14, clava 13.

From the dorsal view: pronotum extensively with raised reticulations, without distinct, transverse carina anteriorly; mid lobe of mesoscutum with large raised reticulations (Fig. 4a), with only 2 pairs of strong setae on posterior half; notauli straight, converging, ending at inner tip of axillae; scapular flange with a few weaker setae and slightly weaker reticulations than those on mid lobe; axillae weakly advanced, smooth, without setae; two large depression present between posterior half of axillae and scutellum (Fig. 4b); scutellum completely smooth, with two pairs of strong setae; sublateral grooves on scutellum wide, slightly curved inward at posterior ends (Fig. 4c); two oblique pits present at anterior end of each of latter, deeper than sublateral grooves (Fig. 4d); dorsellum smooth, with an unusual, broad groove between itself and propodeum, in which groove, several longitudinal short carinae present (Fig. 5a); propodeum smooth; median carinae on propodeum strong, divergent posteriorly, forming one adpetiole cell with posterior margin of propodeum (Fig. 5b); broad groove present along lateral margin of median panel of propodeum (Fig. 5c); propodeal spiracle medium-sized, rounded, separated from anterior margin at the distance of its diameter; rounded paraspiracular carinae present (Fig. 5d); strong, long setae present on callus. From the lateral view (Fig. 6): prepectus depressed anteriorly, with posterior part forming one narrow stripe (Fig. 6a); acropleural sulcus, mesopleural sulcus and transepisternal sulcus continuous, forming one medium-sized depression on mesopleuron, at bottom of which depression distinctly sculptured (Fig. 6b); mesopleural sulcus and transepisternal sulcus incomplete to base of hind coxae, neither in contact with transepimeral sulcus; transepimeral sulcus depressed at upper part, linear at lower part, complete and reaching base of hind coxae (Fig. 6c). From the ventral view (Fig. 7): ventral parts of propleuron in contact with each other medially (Fig. 7a); posterior margin of propleuron in a line; ventral part of propleuron completely with engraved reticulations; depressions present at ventral part of prepectus (Fig. 7b); lower part of transepisternum smooth, with one distinct longitudinal groove medially and one transverse groove posteriorly; two medium-sized depressions respectively present at anterior and posterior part of lower mesepisternum (Fig. 7c); a few strong setae present along the posterior depression on lower part of transepisternum; two longitudinal carinae present on metasternum medially (Fig. 8a); two transverse carinae present between metasternum and ventral part of propodeum (Fig. 8b); median carina present on ventral part of propodeum, divergent anteriorly between longitudinal and transverse carinae (Fig. 8c). Relative measurements: thorax length 28, thorax breadth 21, pronotum 10, mesoscutum 9, scutellum 11, dorsellum 1, propodeum 7.

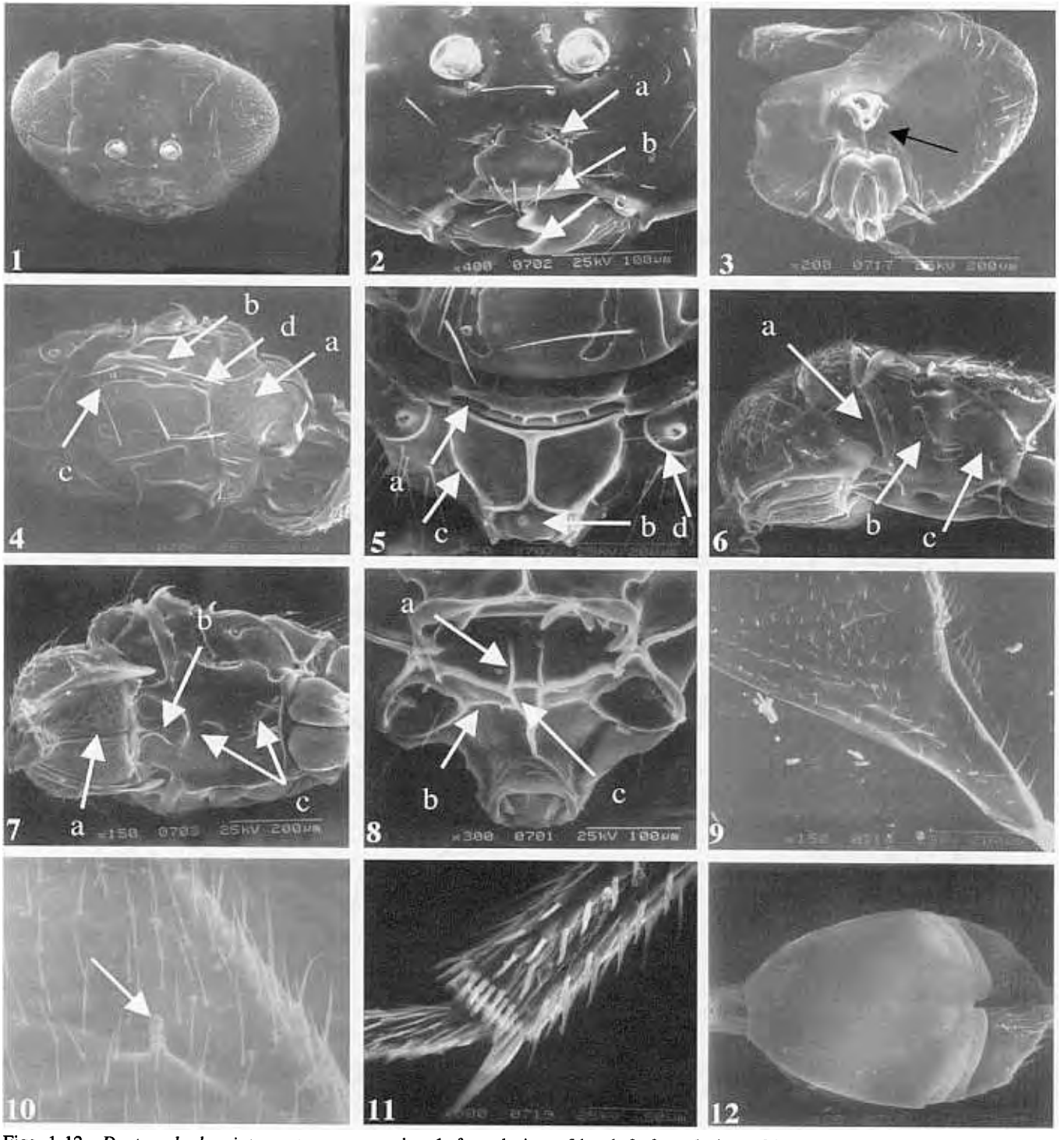
Forewing hyaline (Figs. 9, 10): several setae present at apical half and on upper surface of costal cell; submarginal vein with 9 setae on dorsal surface; cubital vein straight at base. Basal cell with one setal line parallel to submarginal vein; speculum medium-sized, closed on lower side, but open between itself and submarginal vein (Fig. 9); four globular sensory organs present in stigmal uncus (Fig. 10). Hind wing nearly subacute apically. Relative measurements: forewing length 70, forewing breadth 30, submarginal vein 39, costal cell 56, parastigma 18, marginal vein 65, postmarginal vein 26, stigmal vein 18. Hind leg with spines present along hind tibia; regular pegs and one strong spur, which is shorter than 1st tarsomere present on apex of hind tibia (Fig. 11).

Metasoma (Fig. 12) subovate, as broad as thorax, with first tergite more than half length of whole; apex of metasoma acute; tip of ovipositor sheath visible from the dorsal view. Relative measurements: petiole length 6, petiole breadth 4.5, metasoma length 18, metasoma breadth 18.

Remarks. – *Deutereulophus interruptus*, new species, is most similar to *D. tennysoni* (Girault) (BMNH). But the latter species is different in having F1 distinctly shorter than the clava, at most two thirds length of latter. We also compared the studied material with *D. spadicicornis* (Girault) (BMNH). Both species are similar in having: 1) the sublateral grooves on the scutellum not united posteriorly; 2) the occiput rounded behind the posterior ocelli; and 3) the antenna more or less dark. However, *D. spadicicornis* is quite different in having the sublateral grooves curved inwards to nearly meeting with each other posteriorly on the scutellum, and F1 at most is 1.5 times longer than wide.

Measurements. – Length: body 2.15 mm, forewing 2.09 mm.

Coloration. – Body metallic green; eyes black; ocellus yellow; antenna brown except scape yellow; setae brown; legs yellow, with hind coxa dark brown dorsally.



Figs. 1-12. *Deutereulophus interruptus*, new species. 1. frontal view of head; 2. frontal view of lower face: a. sculptured corners of epistomal sulcus, b. strong setae on margin of clypeus, c. mandibular teeth; 3. posterior view of head; 4. dorsal view of mesosoma: a. large reticulations on mid lobe of mesoscutum, b. depression on posterior half of axilla, c. posterior end of sublateral grooves on scutellum, d. small, deeper pits at anterior end of sublateral grooves; 5. dorsal view of propodeum: a. grooves along posterior margin of dorsellum, b. adpetiolar cell, c. broad, lateral grooves on propodeum, d. paraspiracular carina; 6. lateral view of mesosoma: a. straight line on prepectus, b. sculptured depression circled by acropleural, mesopleural and transepisternal sulci, c. transepimeral sulcus; 7. ventral view of mesosoma: a. median line between propleura, b. depressions; 8. ventral part of metasternum and propodeum: a. two pairs of longitudinal carinae, b. four transverse carinae between metasternum and propodeum, c. triangle between carinae; 9. base of forewing; 10. stigmal vein on forewing showing four globular sensory organs; 11. apex of hind tibia; 12. ventral view of metasoma showing large first sternite.

Male. – Same as female except for the shape of antenna. Males collected in same locality and same date of holotype have three distinct types shown in the figure (Figs. 14, 15).

Etymology. – This species is unusual in having sublateral grooves on the scutellum slightly curved inwards posteriorly, but distinctly separated (interruptus = separated).

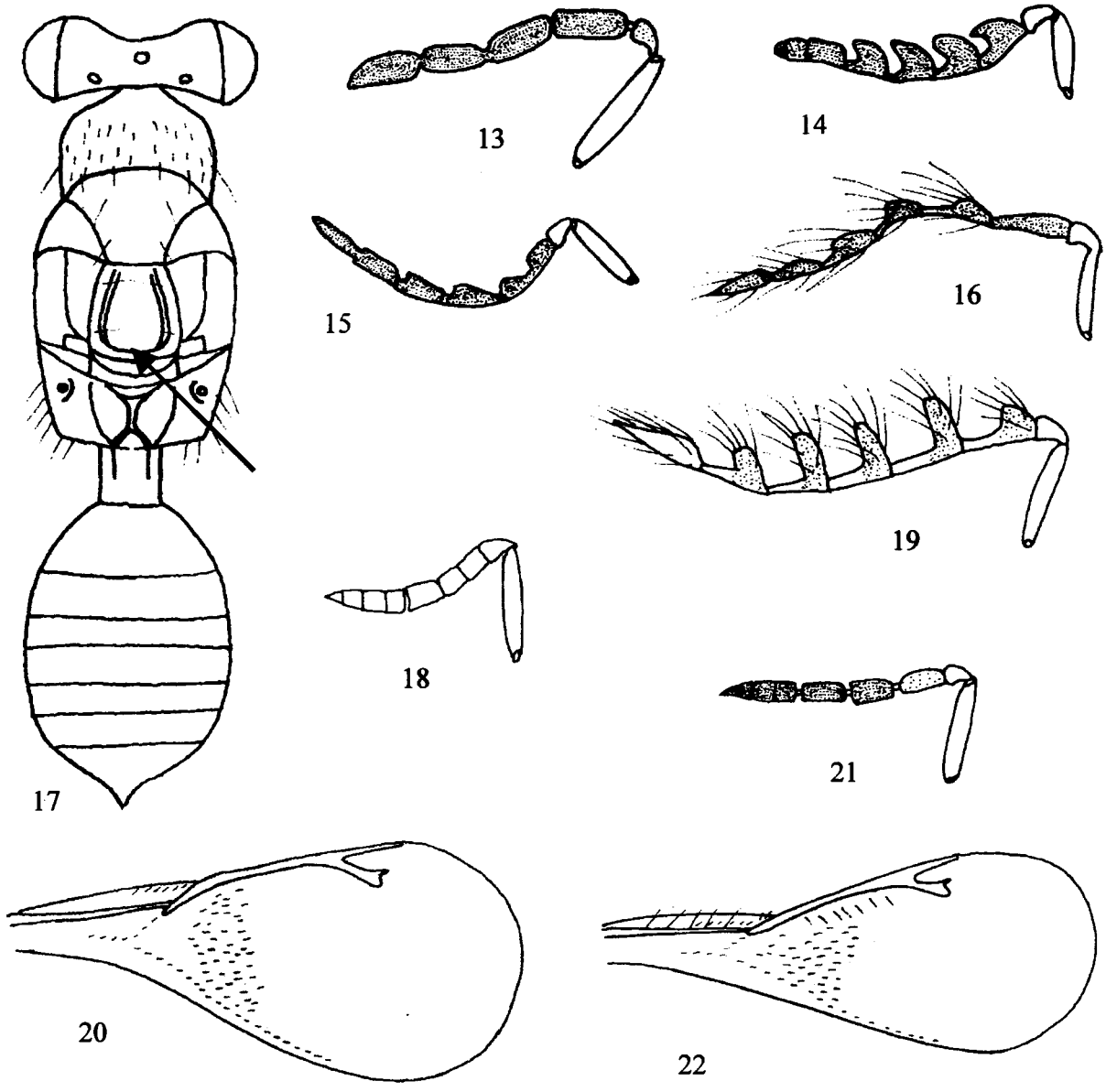
Deutereulophus marginatus, new species
(Figs. 17-20)

Material examined. – Holotype – female, Fujian, Wuyi Mountains, coll. Xu J.–F., 14 Apr.1982 (IZCAS).

Paratypes – 1 male, Fujian, Chong'an, Guadun, coll. Zhao J.-W., 23 Jun.1980 (IZCAS); 1 male, Fujian, Wuyi Mountains, Pikeng, coll. Lin N.–Q., 12 Sep.1987 (IZCAS); 1 male, C. Taiwan, Nantou Xian, Tungpu, coll. Lin T. & Tang W. –S., 18-23 Sep.1981, 1200 m (TARI).

Diagnosis. – Sublateral grooves straight anteriorly, united posteriorly (Fig. 17); occiput sharply margined behind posterior ocelli; antenna completely yellow (Figs. 18, 19); pronotum reticulate; petiole with longitudinal rugae dorsally; female funicle 4-segmented, clava 3-segmented (Fig. 18); male funicle distinctly petiolate, 5-segmented, with strong protuberances (Fig. 19).

Description. – Holotype female –From the frontal view: head wider than high; vertex rugose, rounded into face anteriorly; face rugulose on upper parts, smooth on lower parts; toruli located at lower margin of eyes; epistomal sulcus linear; eyes sparsely setose, with inner margins nearly parallel; inner margins of mandibles bare, with at least 3 strong teeth. From



Figs. 13-16. Antennae of *Deutereulophus interruptus*, new species: 13. female antenna, 14-16. three types of male antennae; Figs. 17-20. *D. marginatus*, new species: 17. dorsal view of body, showing posteriorly united sublateral grooves on scutellum, 18. female antenna, 19. male antenna, 20. forewing; Figs 21-22. D. *tennysoni* (Girault): 21. female antenna, 22. forewing.

the posterior view: occipital carina absent from behind posterior ocelli; occiput with regular, slightly raised reticulations near posterior ocelli; postoccipital carina absent. Antenna: funicle 3-segmented, all more than 1.5 length of width, shorter clava (Fig. 18). Relative measurements: POL 13, OOL 8, scape 25, pedicel 9, F1 7, F2 7, F3 7, clava 20. From the dorsal view: pronotum extensively with raised reticulations, without distinct, transverse carina anteriorly; mid lobe of mesoscutum with large raised reticulations, with at least 2 pairs of strong setae on posterior half; notauli straight, converging, ending at inner tip of axillae; scapular flange with a few weaker setae and slightly weaker reticulations than those on mid lobe; axillae weakly advanced, weakly reticulate, with a few setae; scutellum completely covered by engraved reticulations, with two pairs of strong setae; sublateral grooves on scutellum wide and straight anteriorly, curved inwards to meet with each other posteriorly; dorsellum smooth; propodeum smooth; median carinae on propodeum strong, without clearly raised cup anteriorly; propodeal median carina divergent posteriorly, forming one adpetiole cell with posterior margin of propodeum; broad groove present between median panel of propodeum and callus or posterolateral margins of propodeum; propodeal spiracle medium-sized, rounded, separated from anterior margin at the distance of its diameter; rounded paraspiracular carinae present just medial to the spiracle (Fig. 5d); strong, long setae present on callus. From the lateral view: prepectus smooth, without any sulcus or depressions; mesopleural sulcus abruptly joining acropleural sulcus at a right angle or less; transepisternal sulcus absent; transepimeral sulcus depressed at upper part, linear at lower part, complete and reaching base of hind coxae.

Forewing (Fig. 20) hyaline; cubital vein straight at base; basal cell with several setae below submarginal vein; speculum medium-sized, closed on lower side. Hindwing acute apically. Relative measurements: submarginal vein 29, costal cell 40, parastigma 12, marginal vein 33, postmarginal vein 16, stigmal vein 12.

Metasoma (Fig. 17) subovate, as broad as thorax, with first tergite nearly one-quarter length of whole, around twice length of the second; apex of metasoma acute; tip of ovipositor sheath visible from the dorsal view. Relative measurements: petiole length 6, petiole breadth 4.5, metasoma length 18, metasoma breadth 18.

Remarks. – This species is morphologically unique for it has the sublateral grooves united posteriorly, 5-segmented and petiolate male funicular segments. Comparing with *D. albiclava* (Girault) and *D. froudei* (Girault) deposited in BMNH, it is different in having: 1) the pronotum reticulated; 2) female funicle 3-segmented and subquadrate; and 3) the sublateral grooves on the scutellum almost straight at anterior parts. While latter two species with distinctly alveolate pronotum, 4-segmented funicle in female, and the sublateral grooves on scutellum strongly sinuate, arcuately approximated medially. Comparing with *D. spadicicornis* (Girault) (BMNH), *D. interruptus*, new species (IZCAS, TARI) and *D. tennysoni* (Girault) (IZCAS, BMNH), it is also unique in having: 1) the sublateral grooves united posteriorly; 2) the occiput sharply margined behind the posterior ocelli; and 3) the antenna completely yellow.

Measurements. – Length: body 1.54 mm, forewing 1.23 mm.

Coloration. – Body metallic blue; eyes yellow; ocelli brown; antennae yellow; mandibles yellow; setae yellow with those on forewing and marginal fringe brown; venation yellow; legs yellow; metasoma yellow.

Male. – Same as female except funicle with short protuberances, and elongate between protuberances.

Etymology. – The species name is derived from the Latin 'marginis' (= margin), referring to its sharply margined occiput.

Deutereulophus tennysoni (Girault), new record
(Figs. 21, 22)

Entedonomorpha tennysoni Girault, 1913: 262.
Deutereulophus tennysoni (Girault) – LaSalle & Schauff, 1992: 17.

Material examined. – 1 female, Hainan, Jianfeng Mountains, coll. Li C. -F., 6 Apr.1984, 70 m (IZCAS); 1 female, Australia: Queensland, North of Mossman, Bamboo Ck., near Miallo, coll. D. H. Colless, 23 Apr.1967 (BMNH).

Diagnosis. – First funicular segment at most 2/3 length of clava; sublateral grooves on scutellum not curved inwards to nearly meeting with each other posteriorly; occiput rounded behind posterior ocelli; funicle of Chinese material darkened apically, with first segment yellowish (Fig. 21), while Australian one uniformly dark brown; pronotum reticulate.

This species is very similar to *D. interruptus*, new species. The main difference between the two species is the shape of the funicle. It is also similar to *D. spadicicornis* Girault, but the latter species has the sublateral grooves curved inwards to nearly meeting with each other medially, and the first funicular segment at most 1.5 times longer than width.

Host range. – Unknown.

Distribution. – Newly recorded from China: Hainan. Australia-Queensland.

DISCUSSION

We follow Bouček's (1988) key to genera of Eulophinae to define *Deutereulophus* (=*Entedonomorpha*). Chinese material of this genus could be diagnosed by the following characters: 1) pronotum with more or less concave long sides, with anterior slope sculptured, hind margin as well as scutellum and whole scapular flange smooth; 2) mid lobe of mesoscutum with only 2 pairs of setae, with different

sculpture type from scutellum (Fig. 4); 3) scutellum with sublateral grooves unusually curved inward medially, or replaced by row of punctures (Fig. 2); 4) propodeum with middle part high, convex, at sides delimited by broad and deep grooves, posteriorly produced into a adpetiole cell (Fig. 4); 5) petiole short, sub-rectangular. Basing on detailed study of the external morphology of *D. interruptus* new species, several other characters are also helpful in distinguishing material of this genus from others in Eulophinae: 1) epistomal sulcus broad and distinctly sculptured at bottom; 2) paraspiracular carinae present just medial to propodeal spiracles; 3) acropleural, mesopleural, and transepisternal sulcus continuous to form a sculptured depression between them, while latter two sulcus not complete to base of hind coxae; 4) engraved reticulations present on ventral part of propleuron; 5) distinct depressions present on ventral parts of prepectus, and lower part of transepisternum; 6) two longitudinal carinae present on metasternum; 7) two transverse carinae present between metasternum and ventral part of propodeum.

Bouček (1988) wondered if there was a possible link between *Diglyphomorphomyia* Girault, *Elachertus* Spinola, and *Deutereulophus* Schulz. Schauff et al. (1997) considered this genus a unique one and placed it very early in their key to Nearctic genera of *Elachertus*-complex. Based on our study, we agree with Schauff et al. that it is a unique genus and future research will be undertaken to resolve the relationships between this genus and other Eulophinae.

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