

# The spider genera *Araeoncus* Simon, 1884 and *Diplocephalus* Bertkau, 1883 (Arachnida, Araneae, Linyphiidae) of China

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## ABSTRACT

Four erigonine species are described and illustrated: *Araeoncus hyalinus* n. sp., *Araeoncus longispineus* n. sp., *Diplocephalus parentalis* n. sp. and *Diplocephalus mirabilis* Eskov, 1988. The genus *Araeoncus* Simon, 1884 is reported from China for the first time. The two new *Araeoncus* species are closely related and differ from congeners by the presence of posterior radical process and mesal tooth of male palp, as well as by the different path of copulatory ducts of vulva. Re-examination of material studied by Fei & Gao (1996) revealed that the distribution of *Diplocephalus permixtus* (O. P.-Cambridge, 1871) in China is due to the misidentification of this species. *Diplocephalus mirabilis* is unique among congeners by the presence of lamella characteristica of male palp and unciform apophyses of epigynum. *Diplocephalus parentalis* n. sp. differs from congeners, except *Diplocephalus hispidulus* Saito & Ono, 2001, by the unique shape of radix of embolic division and presence of a tuft of thick bristles at the apex of male palpal proteral tibial apophysis, and further distinguishes from *D. hispidulus* by the shape of proteral tibial apophysis and undeveloped embolic membrane of male palp, as well as by the slightly different path of copulatory ducts of vulva.

## KEY WORDS

Arachnida,  
Araneae,  
Linyphiidae,  
Erigoninae,  
*Araeoncus*,  
*Diplocephalus*,  
China,  
new record,  
new species.

## RÉSUMÉ

Les genres d'araignées *Araeoncus* Simon, 1884 et *Diplocephalus* Bertkau, 1883 (*Arachnida*, *Araneae*, *Linyphiidae*) de Chine.

Quatre espèces d'Erigoninae sont décrites et illustrées: *Araeoncus hyalinus* n. sp., *Araeoncus longispineus* n. sp., *Diplocephalus parentalis* n. sp. et *Diplocephalus mirabilis* Eskov, 1988. Le genre *Araeoncus* Simon, 1884 est mentionné de Chine pour la première fois. Les deux nouvelles espèces d'*Araeoncus* sont proches l'une de l'autre et diffèrent par la présence d'un processus radical postérieur et la dent mésale du palpe mâle, ainsi que par la disposition différente des canaux copulateurs de la vulve. Une réexamination du matériel étudié par Fei & Gao (1996) a révélé que la distribution de *Diplocephalus permixtus* (O. P.-Cambridge, 1871) en Chine résulte de mauvaises identifications de cette espèce. *Diplocephalus mirabilis* se distingue de ses congénères par la présence d'une lamella caractéristique sur le palpe mâle et les apophyses unciformes de l'épigynum. *Diplocephalus parentalis* n. sp. diffère de ses congénères, excepté de *Diplocephalus hispidulus* Saito & Ono, 2001, par la forme unique de la racine de la division embolique et la présence d'une touffe de poils épais à l'apex de l'apophyse palpale prolatérale du tibia mâle, et se distingue de *D. hispidulus* par la forme de l'apophyse prolatérale du tibia et la membrane embolique non développée du palpe mâle, ainsi que par la disposition légèrement différente des canaux copulateurs de la vulve.

## MOTS CLÉS

Arachnida,  
Araneae,  
Linyphiidae,  
Erigoninae,  
*Araeoncus*,  
*Diplocephalus*,  
Chine,  
mention nouvelle,  
espèces nouvelles.

## INTRODUCTION

The spider genera *Araeoncus* Simon, 1884 and *Diplocephalus* Bertkau, 1883 are treated as closely related genera (Millidge 1977; Roberts 1987; Bosmans 1996). Both are placed within a highly homogenous group of genera, which Millidge (1977) called the *Savignia* genus group, including the genera *Savignia* Blackwall, 1833, *Erigonella* Dahl, 1901, *Dicymbium* Menge, 1868, *Saloca* Simon, 1926, *Glyphesis* Simon, 1926, *Alioranus* Simon, 1926, *Diastanillus* Simon, 1926 and *Delorrrhipis* Simon, 1884. The genus *Delorrrhipis* was transferred to *Savignia* by Wunderlich (1995). In this group, genera have been based almost entirely on the form of male head. It is rather difficult or impossible to perceive any natural discontinuities corresponding with current generic boundaries based purely on genital organs (Bosmans 1996). Eskov (1988) however treated the phyletic relationships within this genus-group in a different way than Millidge (1977), and the genus *Savignia* was distinctly

diagnosed. It would be logical to recognize the close relationship of all these species as shown by the male palp, epigynum and chaetotaxy. A full revision of the *Savignia* genus group obviously is needed, which is beyond the scope of the present paper. For the time being, it is probably best to retain the old generic boundaries until more work has been done on related genera from other parts of the world.

*Araeoncus* was established by Simon (1884) for *Araeoncus altissimus* Simon, 1884, *A. anguineus* (L. Koch, 1869), *A. crassiceps* (Westring, 1861), *A. discedens* (Simon, 1881), *A. hanno* Simon, 1884, *A. humilis* (Blackwall, 1841) (the type species), *A. longiusculus* (O. P.-Cambridge, 1875) and *A. vaporariorum* (O. P.-Cambridge, 1875). According to Platnick's spider catalogue (2008), the genus currently comprises 33 species. Because *Araeoncus stigmatosus* Xia, Zhang, Gao, Fei & Kim, 2001 has already been transferred to the genus *Tibioploides* Eskov & Marusik, 1991 by Tanasevitch (2006), no species of this genus was recorded in China up

to the present. During our study, two new species, *A. hyalinus* n. sp. and *A. longispineus* n. sp. have been identified. The rather long embolus, U-shaped spermathecae and longitudinally divided epigynum support referring both species to the genus *Araeoncus*.

The genus *Diplocephalus* was erected by Bertkau (1883), with *Diplocephalus fallaciosus* Bertkau, 1883 as type species at that time. But *D. fallaciosus* was considered to be a *nomen dubium* (Wiehle 1960). *Diplocephalus* is a relatively large genus with 52 currently recognized species, with *Diplocephalus foraminifer* (O. P.-Cambridge, 1875) as type species (Platnick 2008). Up to the present, only two species were described in China, *D. mirabilis* Eskov, 1988 and *D. permixtus* (O. P.-Cambridge, 1871). However, by examining the material studied by Fei & Gao (1996), we found that the record of *D. permixtus* in China was a result of misidentification for *Savignia birostra* (Chamberlin & Ivie, 1947) and in fact only one species existed in China before. During our further study of *Diplocephalus* material from China, a new species, *D. parentalis* n. sp., has been identified. Therefore, a total of two *Diplocephalus* species are currently known from China.

## MATERIAL AND METHODS

Specimens were examined using an Olympus-SZ11 stereomicroscope and illustrated using an Olympus-BX41 compound microscope equipped with a drawing tube. Male left palps and female epigyna were illustrated after being separated from the body. Embolic divisions were dissected from the palpal bulbs using sharp pins and forceps. Genital organs were immersed in 75% alcohol and examined under a compound microscope; embolic divisions and vulvae were mounted in Hoyer's Solution and examined in strong transmitted light against a white background. In addition, the ventral tegument of epigyna was removed by sharp pins and forceps to study the duct system of the vulvae under a microscope.

Eye diameters were measured at their widest extent. Leg measurements are given as: total length (femur,

patella, tibia, metatarsus, tarsus). All measurements are in millimeters. Terminology of genital structures follows Hormiga (2000) and Tanasevitch (2006). For each species only the original description and new synonym are listed. Synonyms listed in the spider catalog of Platnick (2008) are not repeated here. Locality names and distribution data are given according to current Chinese standard (Peng *et al.* 2003).

## ABBREVIATIONS

ALE	anterior lateral eye;
AME	anterior median eye;
ARP	anterior radical process;
C	column;
cl	carapace length;
CD	copulatory duct;
CO	copulatory opening;
coll.	collector of specimens;
det.	determiner;
DP	dorsal plate;
DSA	distal supratregular apophysis;
E	embolus;
EM	embolic membrane;
F	a fissure in the center of ventral plate;
FD	fertilization duct;
FO	fertilization opening;
IBPN	Institute of Biological Problems of the North, Magadan, Russia;
IZCAS	Institute of Zoology, Chinese Academy of Sciences, Beijing;
JLU	Jilin University, Changchun, China;
LC	lamella characteristic;
MNHN	Muséum national d'Histoire naturelle, Paris;
MSA	marginal supratregular apophysis;
MT	mesal tooth;
PC	paracymbium;
PLE	posterior lateral eye;
PME	posterior median eye;
PRP	posterior radical process;
PT	protégulum;
PTA	prolateral tibial apophysis;
R	radix;
RBP	cymbial retrobasal process;
S	spermatheca;
SPT	supratégulum;
ST	subtégulum;
T	tegulum;
Tm I	position of trichobothrium on metatarsus of leg I;
Tm IV	trichobothrium on metatarsus of leg IV;
TP	tailpiece of radix;
VP	ventral plate.

## SYSTEMATICS

Order ARANEAE Clerck, 1757

Suborder OPISTHOTHELAEC Pocock, 1892

Infraorder ARANEOMORPHAE Smith, 1902

Family LINYPHIIDAE Blackwall, 1859

Genus *Araeoncus* Simon, 1884*Araeoncus hyalinus* n. sp.

(Figs 1-3)

TYPE MATERIAL. — Holotype: China, Yunnan Province, Dêqên Zangzu Zizhizhou, Shangri-La County, Bitahai Nature Reserve, 27.83°N, 99.96°E, 15.VI.2006, coll. Y. Song, Z. Cui & J. Xu, ♂ (MNHN).

Paratypes: same data as for holotype, 2 ♂♂, 10 ♀♀ (IZCAS); 1 ♂, 7 ♀♀ (MNHN). — Yunnan Province, Lijiang Naxizu Zizhixian, Yak Lawn Scenic Area, 27.17°N, 100.25°E, 23.VII.2006, coll. Y. Song, Z. Cui & J. Xu, 1 ♂, 23 ♀♀ (IZCAS). — Yunnan Province, Lijiang Naxizu Zizhixian, Dragon Spruce Meadow, 27.14°N, 100.23°E, 21.VII.2006, coll. Y. Song, Z. Cui & J. Xu, 1 ♀ (IZCAS).

ETYMOLOGY. — Specific name from the Greek adjective *hyalinus* = transparent, in reference to the slightly sclerotized embolus which appears transparent.

DISTRIBUTION. — Known from Yunnan and Sichuan provinces, China (Fig. 12).

## DESCRIPTION

*Male*

Total length 1.54. Carapace 0.80 long, 0.62 wide, raised into a lobe carrying posterior median eyes, and with cephalic pits within the post-ocular sulci, as well as many moderately long hairs scattered within the ocular area (Fig. 2A, B). Clypeus 0.17 high. AME diameter 0.04, ALE 0.06, PME 0.05, PLE 0.05, AME interdistance 0.83 times their diameter, AME-ALE interdistance 1.11 times ALE diameter, PME interdistance 1.38 times their diameter, PME-PLE interdistance 1.38 times PLE diameter. Sternum 0.43 long, 0.44 wide. Coxa IV interdistance 1.11 times their width. Chelicerae with 5 promarginal teeth, 4 retromarginal teeth (Fig. 2C). Tibia I 5.85 times longer than deep. Tm I 0.38, Tm IV absent. Dorsal spines on tibia of leg IV: 2-2-1-1; dorsal spine on patella of leg IV: 1-1-1-1. Leg measurements: I: 2.05 (0.61, 0.18,

0.48, 0.43, 0.36); II: 1.87 (0.54, 0.18, 0.43, 0.40, 0.33); III: 1.55 (0.42, 0.18, 0.31, 0.34, 0.29); IV: 2.05 (0.61, 0.18, 0.50, 0.43, 0.33).

Palp: femur nearly twice long as patella. Tibia with one prolateral apophysis, which is composed of 1 thin S-shaped and 1 thick rhombic sclerite (Fig. 1A); with 1 prolateral and 2 retrolateral trichobothria (Fig. 1E). Paracymbium spiral with terminal part hooked (Fig. 1D). Tegulum distal to subtegulum in unexpanded palp (Fig. 1B). Protegulum vestigial (Fig. 1C). Suprattegulum produced into a dentiform marginal apophysis and a bifurcate distal apophysis (Fig. 2F, G), as well as a rectangular extension at the base of the distal apophysis (Fig. 1C). Embolic division (Fig. 2D, E): anterior radical process filmy, pointed obliquely upwards (Fig. 1B); mesal tooth long claviform, pointed distally (Fig. 2D); posterior radical process transparent, elongate with nearly parallel margins but pointed distally (Fig. 1D); embolic membrane long and large, curved to accommodate distal half of the embolus (Fig. 1B); tailpiece narrow basally, strongly broadened to be hunched in the middle, narrowed again towards the end (Fig. 1C).

*Female*

Total length 1.67. Carapace 0.65 long, 0.52 wide, similar to male in general appearance and coloration, but without cephalic lobe and sulci. Clypeus 0.09 high. AME diameter 0.04, ALE 0.07, PME 0.06, PLE 0.05, AME interdistance 0.50 times their diameter, AME-ALE separation 0.27 times ALE diameter, PME interdistance 0.58 times their diameter, PME-PLE separation 0.56 times PLE diameter. Sternum 0.41 long, 0.43 wide. Coxa IV interdistance 1.65 times their width. Chelicerae with 5 promarginal teeth, 5 retromarginal teeth. Tibia I 5.00 times longer than deep. Tm I 0.35, Tm IV absent. Dorsal spines on tibia of leg IV: 2-2-1-1; dorsal spine on patella of leg IV: 1-1-1-1. Leg measurements: I: 1.79 (0.53, 0.18, 0.41, 0.35, 0.32); II: 1.75 (0.49, 0.18, 0.38, 0.36, 0.34); III: 1.48 (0.44, 0.18, 0.29, 0.29, 0.28); IV: 1.98 (0.59, 0.18, 0.48, 0.38, 0.34).

Epigynum prominent in lateral view (Fig. 3C). Ventral plate with postero-median triangular prolongations separated by a long fissure, anteriorly

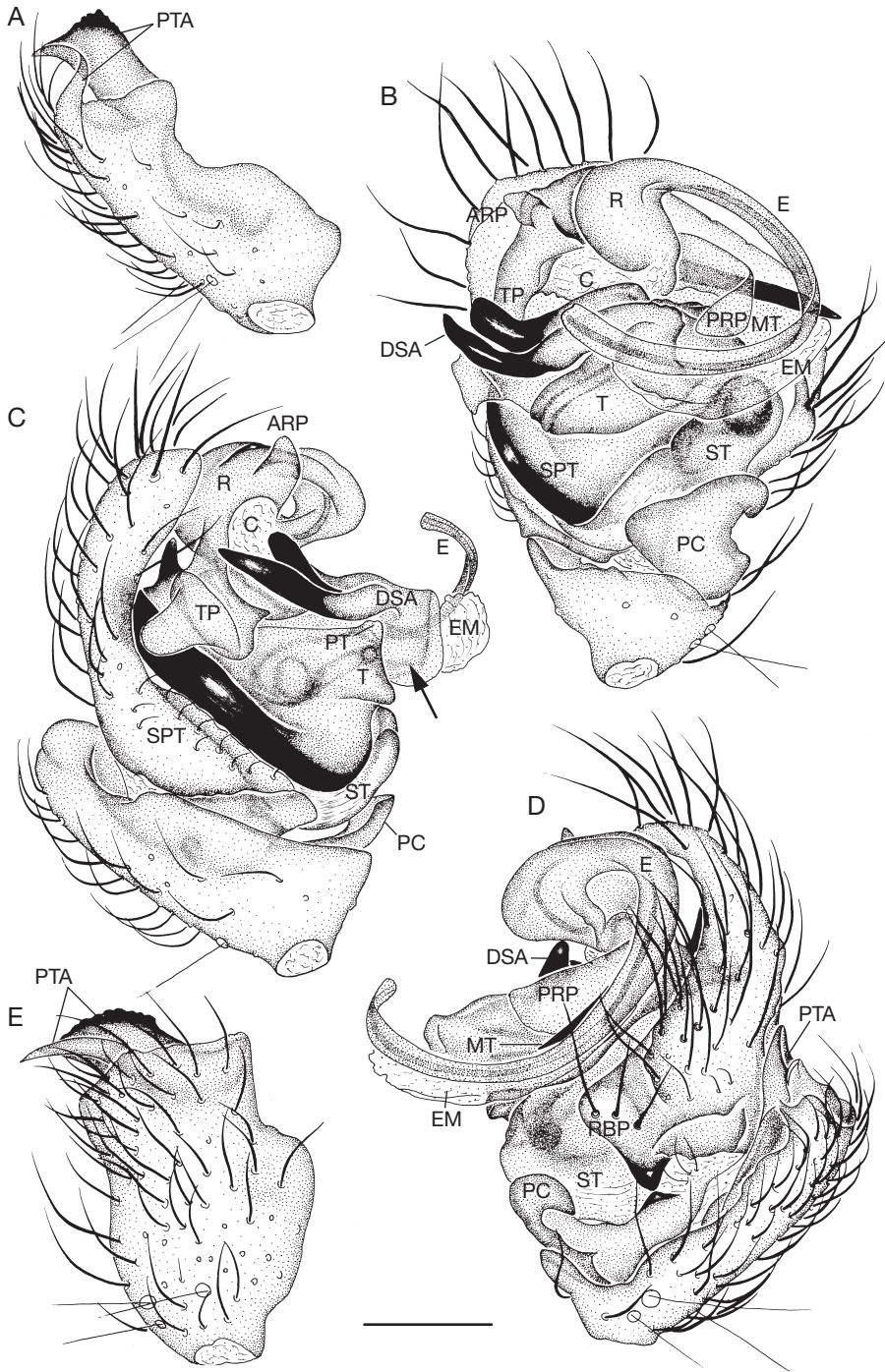


FIG. 1. — *Araeoncus hyalinus* n. sp., holotype, ♂ cl 0.80 mm (MNHN), Bitahai Nature Reserve: **A**, tibia of left palp, mesodorsal view; **B**, left palp, ventral view; **C**, same, prolateral view (arrow refers to a rectangular extension); **D**, same, retrolateral view; **E**, tibia of left palp, dorsal view. Abbreviations: see text. Scale bar: 0.1 mm.

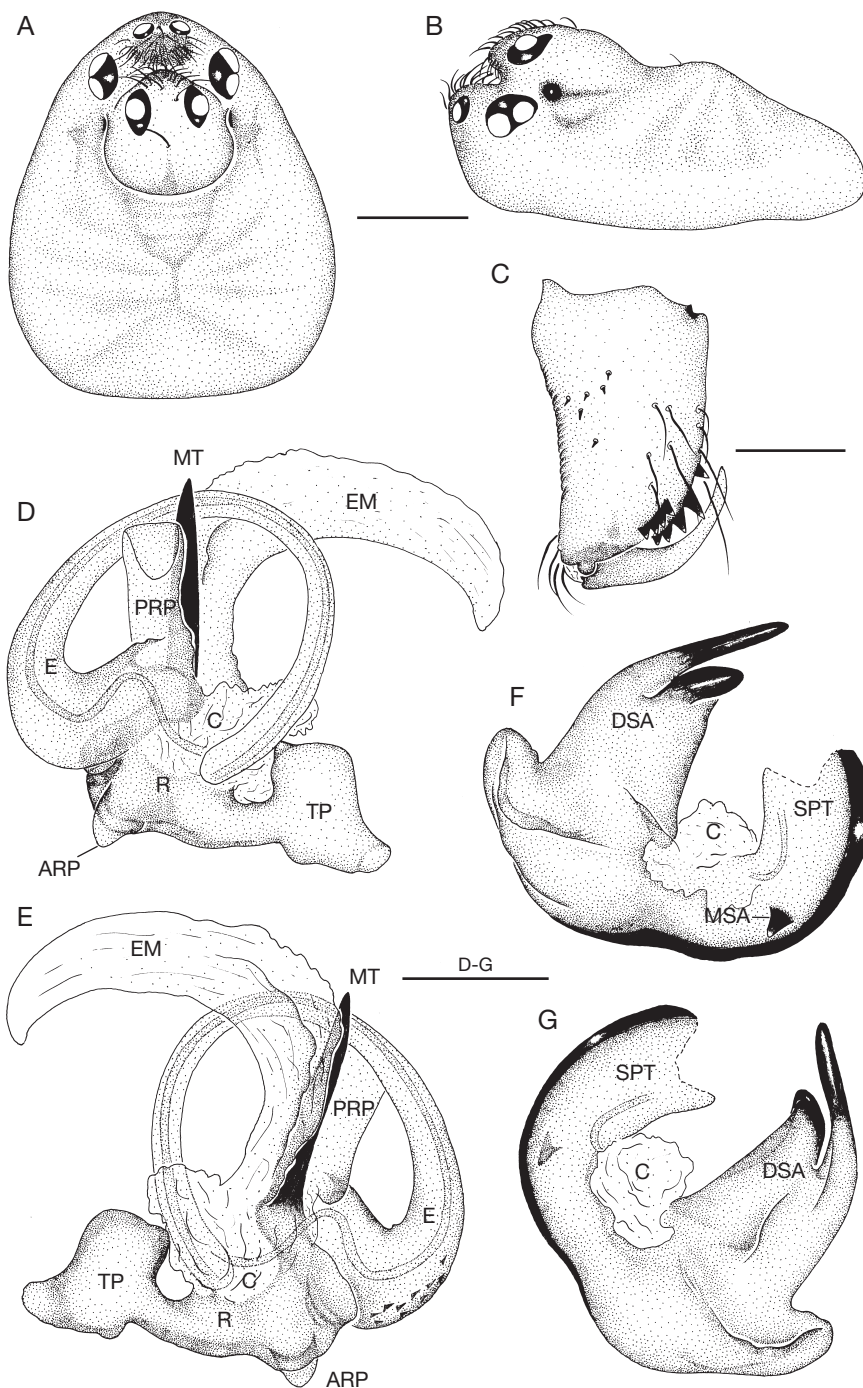


FIG. 2. — *Araeoncus hyalinus* n. sp., holotype, ♂ cl 0.80 mm (MNHN), Bitahai Nature Reserve: **A**, carapace, dorsal view; **B**, same, lateral view; **C**, left chelicera, posterior view; **D**, embolic division, ventral view; **E**, same, dorsal view; **F**, suprategulum, ventral view; **G**, same, dorsal view. Abbreviations: see text. Scale bars: A, B, 0.2 mm; C-G, 0.1 mm.

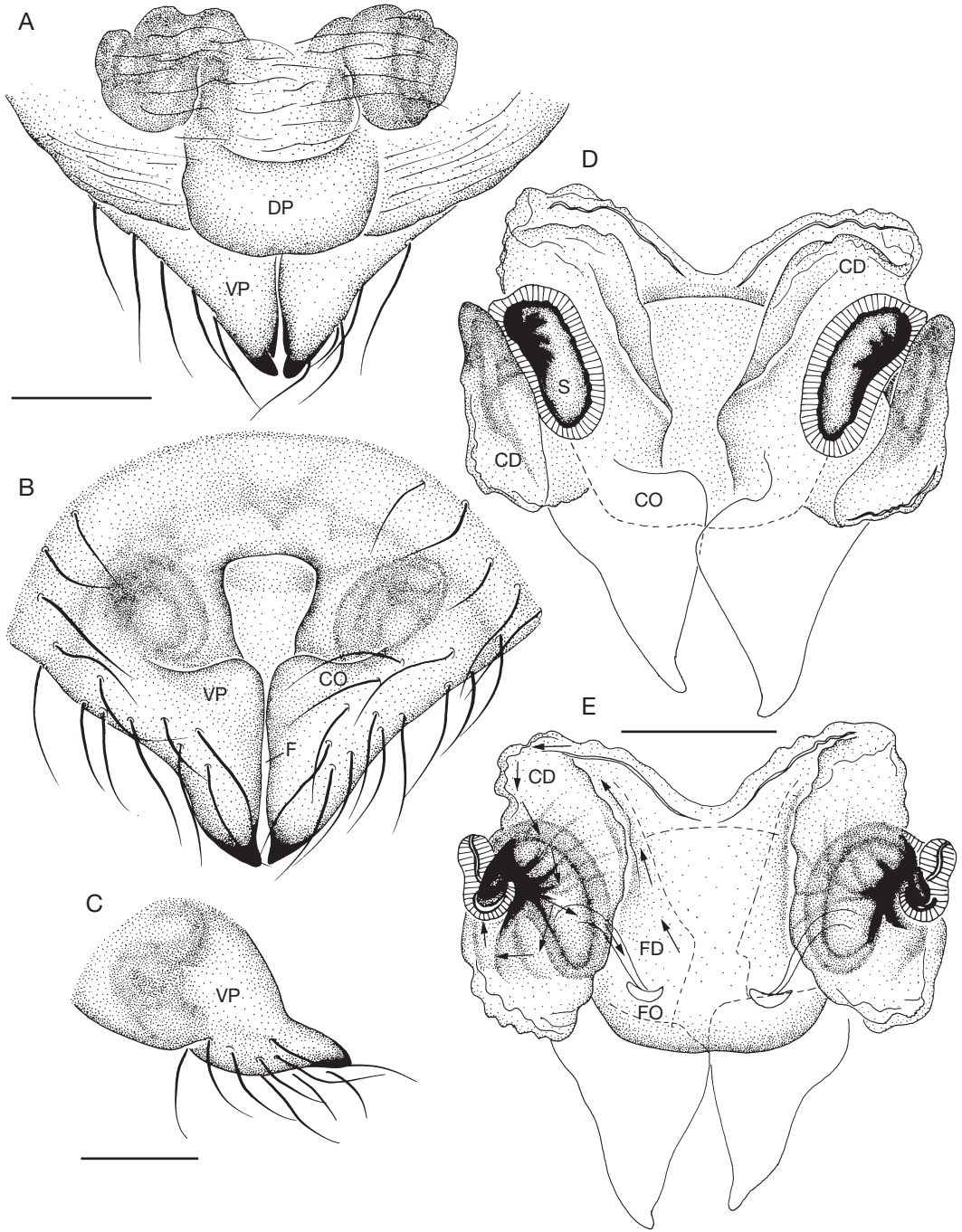


FIG. 3. — *Araeoncus hyalinus* n. sp., paratype, ♀ cl 0.65 mm (MNHN), Bitahai Nature Reserve: **A**, epigynum, dorsal view; **B**, same, ventral view; **C**, same, lateral view; **D**, vulva, ventral view; **E**, same, dorsal view (arrows show the schematic course of internal duct system). Abbreviations: see text. Scale bars: 0.1 mm.

limited by a rectangular ridge (Fig. 3B). Rectangular dorsal plate totally covered by the ventral plate in ventral view (Fig. 3A). Spermathecae U-shaped; one arm of the “U” is long oblong while the other is small and almost half long the former (Fig. 3E). Copulatory ducts enclosed in a slightly sclerotized capsule, broad and extended with almost parallel margins from copulatory openings, narrowed a bit after turning to the dorsal side, gradually widened again and extended to the ventral side near spermathecae (Fig. 3D, E). The path of copulatory duct is shown in Figure 3E. Fertilization ducts short, mesally oriented (Fig. 3E).

#### REMARKS

*Araeoncus hyalinus* n. sp. and *A. longispineus* n. sp. have a conformation closely similar to *A. humilis* (the type species), in having a long coiled and wide, curving ventrally downwards embolus which is unique among the *Savignia* group genera mentioned by Millidge (1977). Embolus of *Dicymbium nigrum* (Blackwall, 1834) (the type species; see Roberts 1987: fig. 10c), *Diastanillus pecuarius* (Simon, 1884) (the type species; see Millidge 1977: fig. 138) and *Erigonella hiemalis* (Blackwall, 1841) (the type species; see Roberts 1987: fig. 36a) is spiral and situated at the anterior end of the embolic division. The form of embolus in *Alioranus pauper* (Simon, 1881) (the type species; see Millidge 1977: fig. 128), *Diplocephalus foraminifer* (the type species; see Deltshv 1985: fig. 8) and *Glyphesis servulus* (Simon, 1881) (the type species; see Millidge 1977: fig. 123) is short and obliquely downwards or upwards. As to *Saloca diceros* (O. P.-Cambridge, 1871) (the type species; see Millidge 1977: fig. 132) and *Savignia frontata* Blackwall, 1833 (the type species; see Millidge 1977: fig. 135), their emboli are moderately long, slightly curved, directed backwards or downwards. Besides the form of embolus, both new species are very close to *A. humilis* in the form of anterior radical process (triangular, pointed obliquely upwards), tailpiece (slightly curved upwards), embolic membrane (running along the embolus), distal suprategular apophysis (extended ventrally and curved more or less upwards) and marginal suprategular apophysis (dentiform). The bisected epigynum, U-shaped spermathecae and path of copulatory ducts of vulva (see Wiehle 1960:

fig. 124) is similar too. Furthermore, the chaetotaxy (dorsal spines on tibia of leg IV 2-2-1-1, Tm I 0.35-0.43, Tm IV absent) is also closely similar to *A. humilis* (dorsal spines on tibia of leg IV 2-2-1-1, Tm I 0.40-0.42, Tm IV absent; see Wiehle 1960). To sum up, both new species have a basically identical conformation with the type species of the genus *Araeoncus* and hence despite the extra presence of posterior radical process and mesal tooth of embolic division, not present in the other *Araeoncus* species, both species are placed in the genus *Araeoncus*.

*Araeoncus hyalinus* n. sp. and *A. longispineus* n. sp. share a number of characteristics, including similar body size, body coloration and genital structures, but differ in details. Males can be distinguished by 1) the shape of cephalic lobe, which is much smaller in *A. hyalinus* n. sp. (Fig. 2B) than in *A. longispineus* n. sp. (Fig. 5A); 2) the presence of 3 trichobothria on the palpal tibia in *A. hyalinus* n. sp. (Fig. 1A) versus 2 in *A. longispineus* n. sp. (Fig. 4D); 3) the shape of the palpal prolateral tibial apophysis, which is composed of a S-shaped and a rhombic sclerite in *A. hyalinus* n. sp. (Fig. 1E), but only a long pointed apophysis with membranous base in *A. longispineus* n. sp. (Fig. 4D); 4) the presence of a long thick spine on the cymbial retrobasal process of the palp in *A. longispineus* n. sp. (Fig. 4C), absent in *A. hyalinus* n. sp. (Fig. 1D); 5) the presence of a rectangular extension at the base of the distal suprategular apophysis in *A. hyalinus* n. sp. (Fig. 1C), absent in *A. longispineus* n. sp. (Fig. 5A); 6) the shape of embolus, slightly sclerotized and with almost even dimensions in *A. hyalinus* n. sp. (Fig. 2D), versus highly sclerotized and strongly widened distally in *A. longispineus* n. sp. (Fig. 5D); 7) the relatively short anterior radical process in *A. hyalinus* n. sp. (Fig. 1B), but long and with an extra tooth behind in *A. longispineus* n. sp. (Fig. 4B); and 8) the shape of posterior radical process, which is narrow and almost even in *A. hyalinus* n. sp. (Fig. 2D), wide at the base and strongly narrowed in *A. longispineus* n. sp. (Fig. 5D) and the shape of tailpiece of radix, hunched in the middle, blunt distally and slightly upwards in prolateral view in *A. hyalinus* n. sp. (Fig. 1C), but different in *A. longispineus* n. sp. (Fig. 4A).

Females can be further distinguished by the size of the dorsal plate, which is wider than the length of the long



arm of the spermatheca in *A. hyalinus* n. sp. (Fig. 3A), but narrower in *A. longispineus* n. sp. (Fig. 5F); by the shape of slightly sclerotized capsule where copulatory ducts are embedded, much wider in *A. hyalinus* n. sp. (Fig. 3D, E) than in *A. longispineus* n. sp. (Fig. 5F, H) and by the length of the short arm of the U-shaped spermatheca, which is half the long arm of the spermatheca in *A. hyalinus* n. sp. (Fig. 3E), but more than half in *A. longispineus* n. sp. (Fig. 5H).

Furthermore, both new species can be easily diagnosed from other *Araeoncus* species by the shape of palpal tibial apophyses (Figs 1E; 4D), which are not typical biforked shape as in *A. humilis* (see Wiehle 1960: fig. 431), by the presence of posterior radical process and mesal tooth of embolic division (Figs 2E; 5D) and by the postero-median triangular prolongations of the bisected epigynum (Figs 3B; 5G).

Specimens of *A. hyalinus* n. sp. were found under leaf litter or among the roots of moss in mountains above 3000 m. 4 ♂♂ and 40 ♀♀ were measured. Total length varies from 1.53-1.56 in males, 1.36-1.77 in females. Carapace length is 0.78-0.81 in males, 0.64-0.69 in females; width 0.60-0.62 in males, 0.48-0.56 in females. Coloration of carapace varies from dull-yellow to nut-brown, abdomen light grey to dark grey.

*Araeoncus longispineus* n. sp.  
(Figs 4; 5)

TYPE MATERIAL. — Holotype: China, Sichuan Province, Jiulong County, Wuxuhai Lake, 29.05°N, 101.55°E, 26.VII.2006, coll. Y. Song & Y. Tong, ♂ (MNHN). Paratype: same data as for holotype, 1 ♀ (MNHN).

ETYMOLOGY. — Specific name from Latin adjective *spineus* = spiny, combined with prefix *longi*, in reference to a long spine on the cymbial retrobasal process of the male palp.

DISTRIBUTION. — Only known from Wuxuhai Lake in Sichuan Province, China (Fig. 12).

DESCRIPTION

*Male*

Total length 1.69. Carapace 0.74 long, 0.54 wide, dark brown, highly raised to form a large lobe carrying posterior median eyes, as well as several hairs scattered

in the ocular area; a sulcus running back from each posterior lateral eye (Fig. 5A). Abdomen dark grey. Clypeus 0.14 high. AME diameter 0.04, ALE 0.05, PME 0.04, PLE 0.03, AME interdistance 0.67 times their diameter, AME-ALE interdistance 1.50 times ALE diameter, PME interdistance 2.43 times their diameter, PME-PLE interdistance 4.00 times PLE diameter. Sternum 0.38 long, 0.39 wide. Coxa IV interdistance 1.22 times their width. Chelicerae with 5 promarginal teeth, 5 retromarginal teeth (Fig. 5C). Tibia I 5.50 times longer than deep. Tm I 0.43, Tm IV absent. Dorsal spines on tibia of leg IV: 2-2-1-1; dorsal spine on patella of leg IV: 1-1-1-1. Leg measurements: I: 1.79 (0.53, 0.18, 0.41, 0.39, 0.29); II: 1.70 (0.48, 0.18, 0.38, 0.36, 0.31); III: 1.43 (0.41, 0.18, 0.30, 0.30, 0.25); IV: 1.88 (0.55, 0.18, 0.44, 0.43, 0.28).

Palp: tibia with 1 claviform prolateral apophysis, membranous near its junction with tibia; with 1 prolateral and 1 retrolateral trichobothrium (Fig. 4D). Cymbial retrobasal process (Fig. 4C) with a strong obliquely upwards spine (Fig. 4D). Paracymbium spiral, with terminal part hooked (Fig. 4C). Tegulum distal to subtegulum in unexpanded palp (Fig. 4C). Protegulum vestigial (Fig. 4A). Suprattegulum with a dentiform marginal apophysis and a bifurcate distal apophysis (Fig. 5B). Embolic division (Fig. 5D, E): anterior radical process relatively long and narrow compared with *A. hyalinus* n. sp., with an extra tooth behind; mesal tooth long claviform, pointed distally; posterior radical process broad at the base, strongly narrowed and pointed distally, accompanied by a strongly sclerotized long embolus which is evenly elongate at first but expanded abruptly near the end; embolic membrane wide with almost parallel margins; tailpiece slightly upwards, with distal end extended downwards to hold suprattegulum (Figs 4A; 5E).

*Female*

Total length 1.69. Carapace 0.70 long, 0.53 wide, similar to male in general appearance and coloration, but without cephalic lobe and sulci. Clypeus 0.09 high. AME diameter 0.03, ALE 0.06, PME 0.05, PLE 0.05, AME interdistance 0.45 times their diameter, AME-ALE interdistance 0.78 times ALE diameter, PME interdistance 0.76 times their diameter, PME-PLE interdistance 0.76 times PLE diameter. Sternum 0.38 long, 0.39 wide. Coxa IV interdistance 1.30

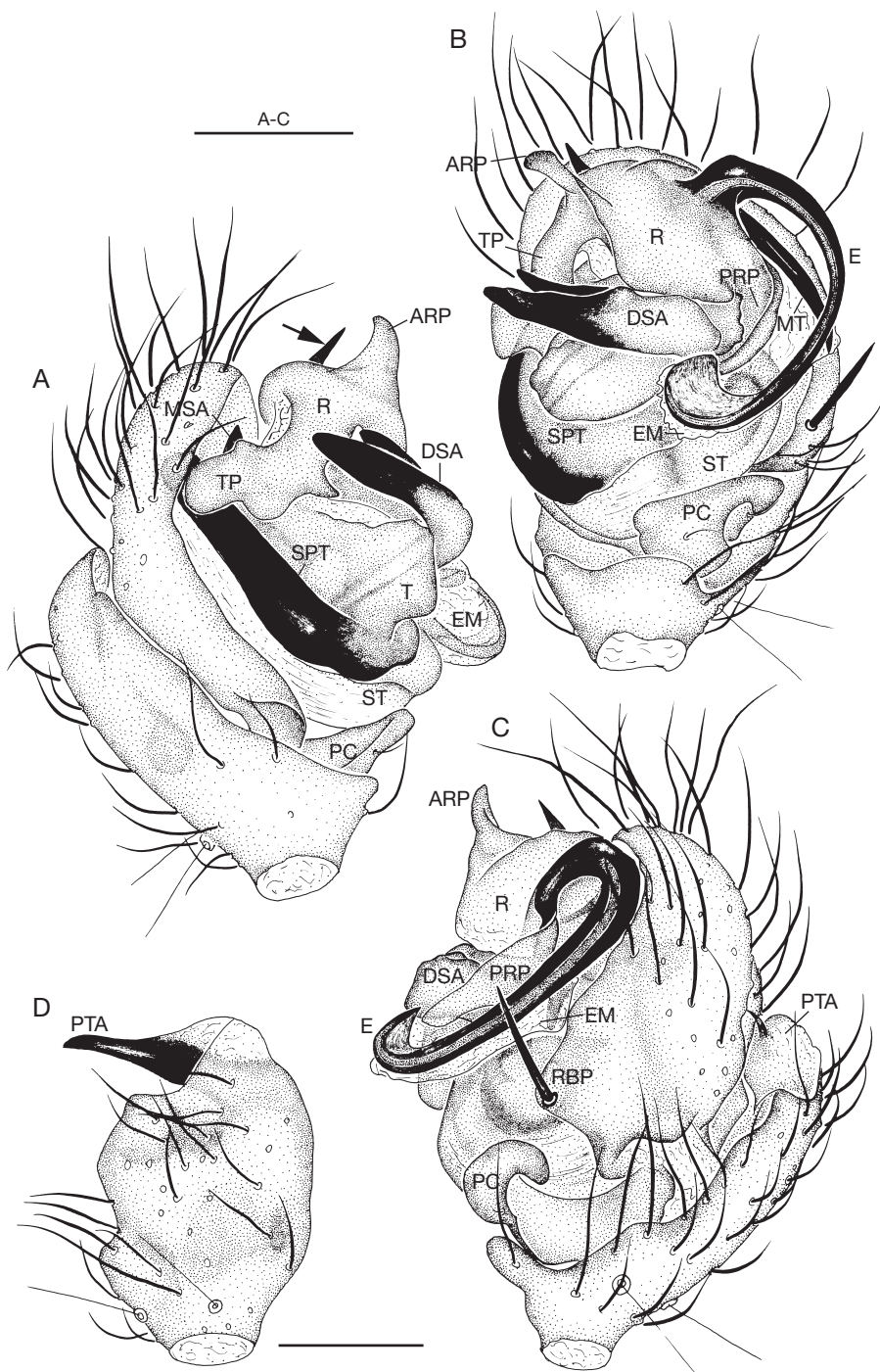


FIG. 4. — *Araeoncus longispineus* n. sp., holotype, ♂ cl 0.74 mm (MNHN), Wuxuhai Lake: **A**, left palp, prolateral view (arrow refers to a tooth behind the anterior radial process); **B**, same, ventral view; **C**, same, retrolateral view; **D**, tibia of left palp, dorsal view. Abbreviations: see text. Scale bars: 0.1 mm.

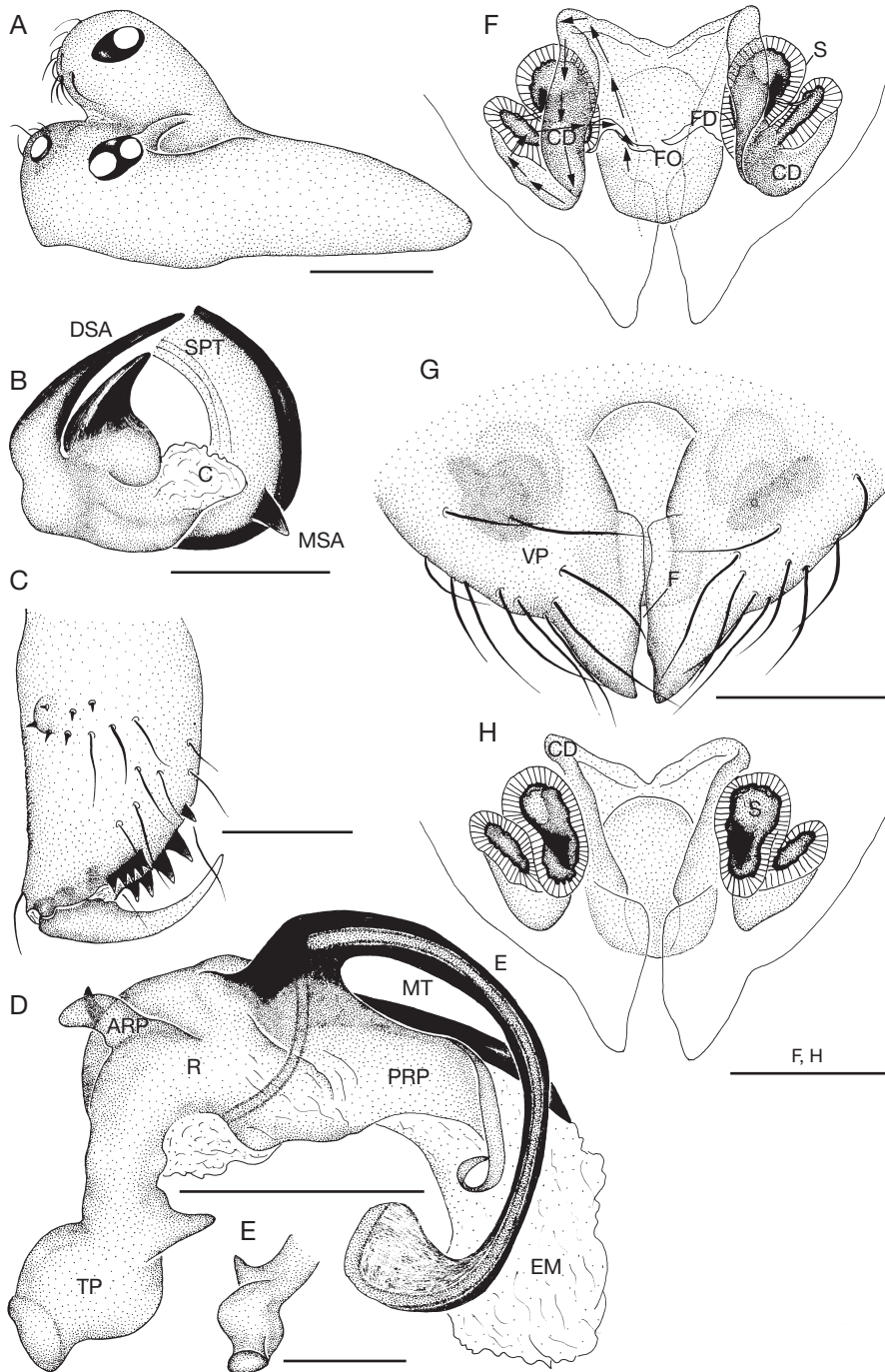


FIG. 5. — *Araeoncus longispineus* n. sp., Wuxuhai Lake: **A-E**, holotype, ♂ cl 0.74 mm (MNHN); **A**, carapace, lateral view; **B**, suprategulum, ventral view; **C**, left chelicera, posterior view; **D**, embolic division, ventral view; **E**, tailpiece of radix, dorsal view; **F-H**, paratype, ♀ cl 0.70 mm (MNHN); **F**, vulva, dorsal view (arrows show the schematic course of internal duct system); **G**, epigynum, ventral view; **H**, vulva, ventral view. Abbreviations: see text. Scale bars: A, 0.2 mm; B-H, 0.1 mm.

times their width. Chelicerae with 6 promarginal teeth, 5 retromarginal teeth. Tibia I 5.08 times longer than deep. Tm I 0.39, Tm IV absent. Dorsal spines on tibia of leg IV: 2-2-1-1; dorsal spine on patella of leg IV: 1-1-1-1. Leg measurements: I: 1.78 (0.51, 0.18, 0.38, 0.38, 0.33); II: 1.68 (0.49, 0.17, 0.37, 0.34, 0.30); III: 1.49 (0.43, 0.17, 0.31, 0.32, 0.26); IV: 1.93 (0.58, 0.18, 0.48, 0.40, 0.29).

Epigynum with similar postero-median triangular prolongations as those of *A. hyalinus* n. sp. (Fig. 5G). Dorsal plate rectangular (Fig. 5F). Spermathecae U-shaped; the short arm longer than half of the long arm (Fig. 5H). Copulatory ducts enclosed in a slightly sclerotized capsule, with almost the same path as *A. hyalinus* n. sp., but narrower than the former (Fig. 5F, H). Fertilization ducts short, mesally oriented (Fig. 5F). The path of copulatory duct is shown in Figure 5F.

#### REMARKS

*Araeoncus longispineus* n. sp. is closely related to *A. hyalinus* n. sp. See the remarks under *A. hyalinus* n. sp. for details. Specimens of *A. longispineus* n. sp. were found among the roots of moss in a mountain, at an altitude of 3500 m.

Genus *Diplocephalus* Bertkau, 1883

*Diplocephalus mirabilis* Eskov, 1988  
(Figs 6-8)

*Diplocephalus mirabilis* Eskov, 1988: 18, figs 18-24 (type locality: Magadan Area, Russia).

MATERIAL EXAMINED. — **Russia.** Russia Far East, Aborigine field station, Sibit-Tyellakh River Basin, Upper Kolyma River, summer 1986, coll. Yura M. Marusik, det. Yura M. Marusik, 2 ♀♀, 2 ♂♂ (IBPN).

**China.** Jilin Province, Mt Changbaishan, 42.03°N, 127.98°E, 11.VIII.1985, 6 ♀♀, 3 ♂♂ (JLU).

DISTRIBUTION. — Russia, China (Jilin) (Song *et al.* 1999; Platnick 2008) (Fig. 12).

#### DESCRIPTION

##### Male

Total length 1.53. Carapace 0.76 long, 0.61 wide, dull yellow, slightly swollen, bearing shallow post-

ocular sulci; with hairs densely distributed in the ocular area and on the clypeus (Fig. 7A). Abdomen grey yellow. Clypeus 0.16 high. AME diameter 0.03, ALE 0.04, PME 0.03, PLE 0.04, AME interdistance 0.75 times their diameter, AME-ALE interdistance 1.00 times ALE diameter, PME interdistance 2.20 times their diameter, PME-PLE interdistance 1.33 times PLE diameter. Sternum 0.40 long, 0.42 wide. Coxa IV interdistance 1.20 times their width. Chelicerae with 6 promarginal teeth, 5 retromarginal teeth (Fig. 6D). Tibia I 5.46 times longer than deep. Tm I 0.43, Tm IV absent. Dorsal spines on tibia of leg IV: 2-2-1-1; dorsal spine on patella of leg IV: 1-1-1-1. Leg measurements: I: 1.89 (0.55, 0.21, 0.44, 0.35, 0.34); II: 1.74 (0.51, 0.19, 0.39, 0.34, 0.30); III: 1.54 (0.43, 0.20, 0.33, 0.32, 0.28); IV: 2.03 (0.58, 0.21, 0.52, 0.42, 0.30).

Palp: tibia produced into a strongly curved, acerate prolateral apophysis whose base extended retrolaterally to form a triangular membrane; with 1 retrolateral and 1 prolateral trichobothrium (Fig. 6E). Paracymbium spiral, with terminal part hooked (Fig. 6B). Tegulum distal to subtegulum in unexpanded palp. Suprattegulum produced into a dentiform marginal apophysis and a bifurcate distal apophysis modified with mini membrane distally (Fig. 7D). Somewhat rounded embolic membrane totally covered by embolic division (Fig. 7C). Anterior radical process crescent-shaped in retrolateral view (Fig. 6B), almost parallel with moderately long embolus (Fig. 6C). Tailpiece nearly straight and broad distally (Fig. 7B, C). Lamella characteristica is cupped distally to accommodate the distal end of the embolus (Fig. 6C).

##### Female

Total length 1.50. Carapace 0.69 long, 0.50 wide, similar to male in general appearance and coloration, but without cephalic sulci. Abdomen light grey. Clypeus 0.12 high. AME diameter 0.03, ALE 0.05, PME 0.09, PLE 0.09, AME interdistance 0.44 times their diameter, AME-ALE interdistance 0.63 times ALE diameter, PME interdistance 1.00 times their diameter, PME-PLE interdistance 0.50 times PLE diameter. Sternum 0.43 long, 0.40 wide. Coxa IV interdistance 1.00 times their width. Chelicerae with 6 promarginal teeth, 5 retromarginal teeth.

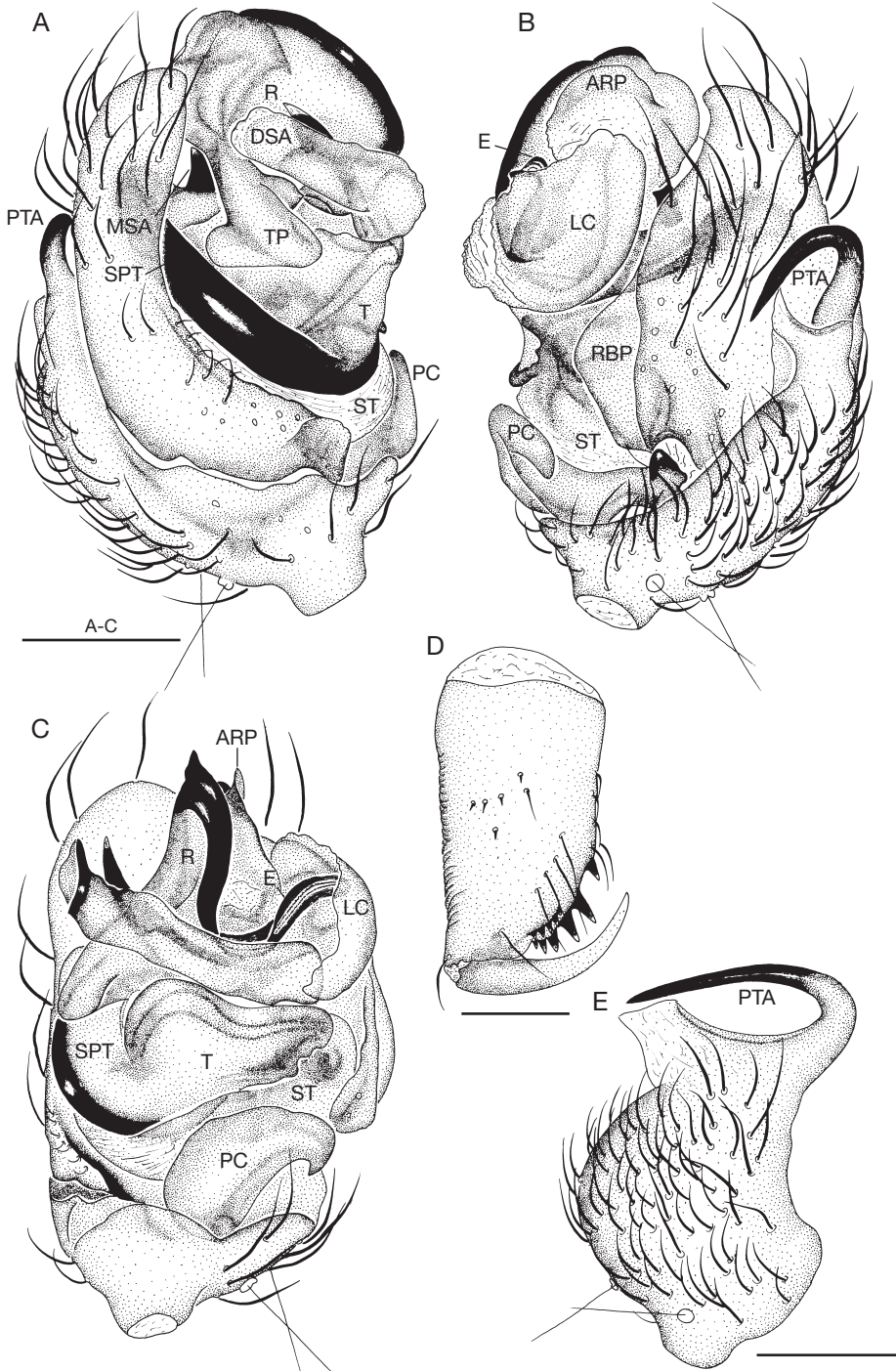


FIG. 6. — *Diplocephalus mirabilis* Eskov, 1988, ♂ cl 0.76 mm (JLU), Mt Changbaishan: **A**, left palp, prolateral view; **B**, same, retrolateral view; **C**, same, ventral view; **D**, left chelicera, posterior view; **E**, tibia of left palp, dorsal view. Abbreviations: see text. Scale bars: 0.1 mm.

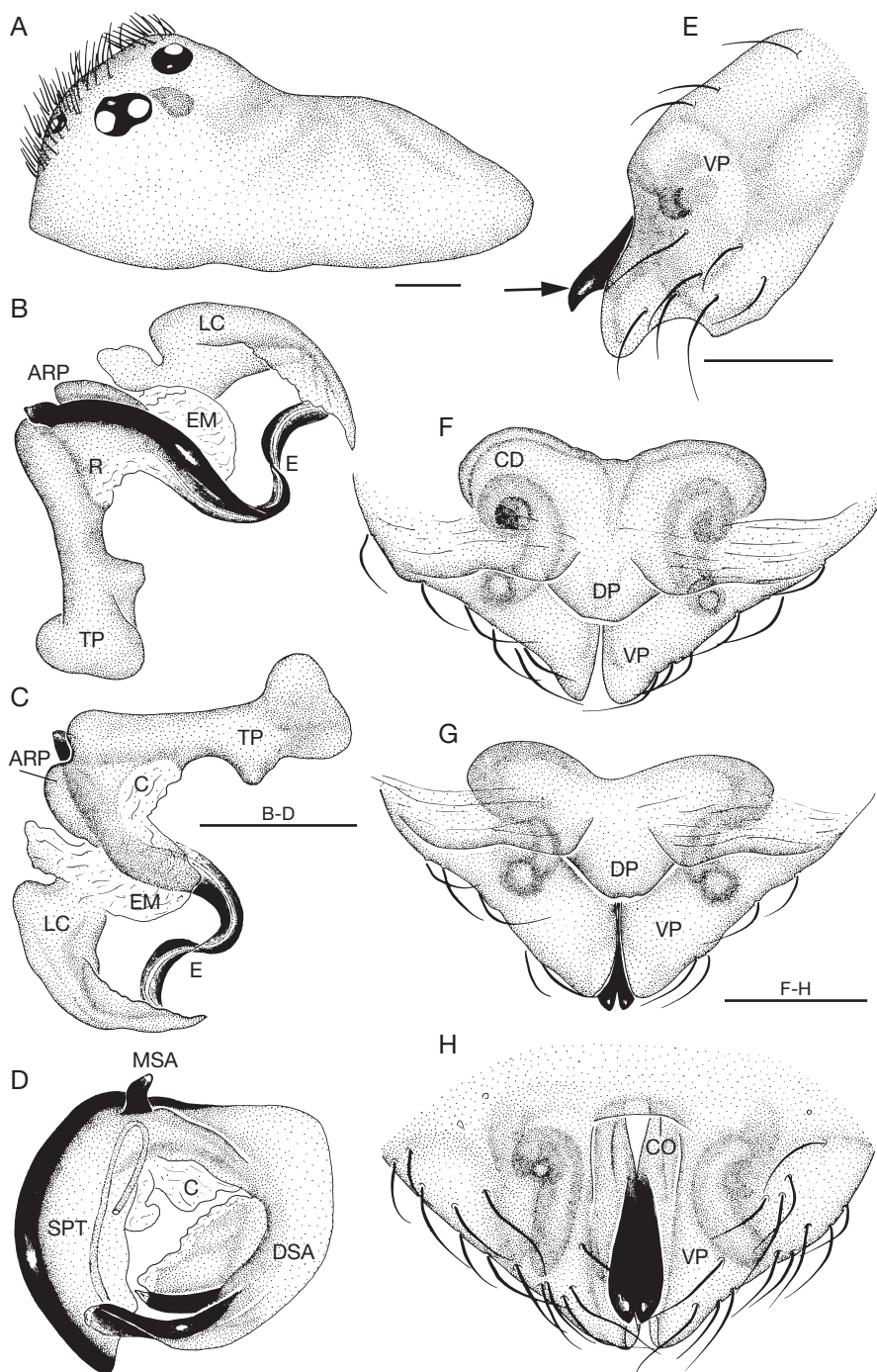


FIG. 7. — *Diplocephalus mirabilis* Eskov, 1988, Mt Changbaishan: **A-D**, ♂ cl 0.76 mm (JLU); **A**, carapace, lateral view; **B**, embolic division, ventral view; **C**, same, dorsal view; **D**, suprategulum, ventral view; **E-H**, ♀ cl 0.69 mm (JLU); **E**, epigynum, lateral view (arrow refers to an unciform apophysis); **F**, same, dorsal view; **G**, same, posterior view; **H**, same, ventral view. Abbreviations: see text. Scale bars: 0.1 mm.

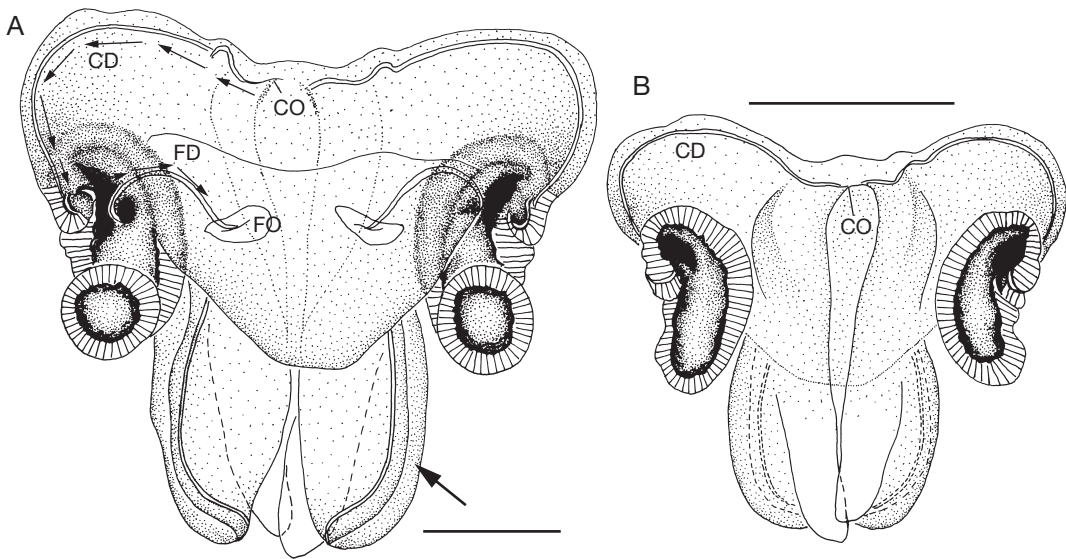


FIG. 8. — *Diplocephalus mirabilis* Eskov, 1988, ♀ cl 0.69 mm (JLU), Mt Changbaishan: **A**, vulva, dorsal view (arrow refers to a groove along the outer margin of the linguiform extension; arrows show the schematic course of internal duct system); **B**, same, ventral view. Abbreviations: see text. Scale bars: 0.1 mm.

Tibia I 4.57 times longer than deep. Tm I 0.47, Tm IV absent. Dorsal spines on tibia of leg IV: 2-2-1-1; dorsal spine on patella of leg IV: 1-1-1-1. Leg measurements: I: 1.80 (0.53, 0.20, 0.40, 0.36, 0.31); II: 1.64 (0.48, 0.18, 0.34, 0.33, 0.30); III: 1.46 (0.41, 0.19, 0.29, 0.31, 0.26); IV: 1.92 (0.58, 0.18, 0.48, 0.41, 0.28).

Epigynum seems to be unique among the congeners by the presence of unciform apophyses holding more or less perpendicular to the surface of the axis of the body (Fig. 7E, H). Dorsal plate small, totally covered by the ventral plate in ventral view (Fig. 7F-H). Copulatory openings may be at the anterior end of the fissure (Fig. 7H). Copulatory ducts enclosed in a sclerotized capsule (Fig. 8A, B). Two extra linguiform extensions exposed after the tegument of epigynum was removed (Fig. 8A, B). A deep groove presented at the outer margin of each extension (Fig. 8A). Ducts were also observed along the outer margins of the grooves, but it is difficult to confirm what they really are at present (Fig. 8A). Maybe they are parts of the copulatory ducts. Fertilization ducts thin, moderately long, mesally oriented (Fig. 8A). Spermathecae reniform and separated by a distance of their length

(Fig. 8B). The path of copulatory ducts is shown in Figure 8A.

#### REMARKS

Based on the shape of moderately long embolus and male palpal tibial apophysis, *D. mirabilis* displays certain affinities with Eurasian species, *Diplocephalus bifurcatus* Tanasevitch, 1989 (Turkmenistan), *Diplocephalus connatus* Bertkau, 1889 (Palearctic), *Diplocephalus dentatus* Tullgren, 1955 (Northern Central Europe to Ukraine), *Diplocephalus graecus* (O. P.-Cambridge, 1872) (Southern, Central Europe, North Africa), *Diplocephalus helleri* (L. Koch, 1869) (Europe), *Diplocephalus hungaricus* Kulczynski, 1915 (Hungary), *Diplocephalus latifrons* (O. P.-Cambridge, 1863) (Europe, Russia), *Diplocephalus protuberans* (O. P.-Cambridge, 1875) (Europe), *Diplocephalus sphagnicola* Eskov, 1988 (Russia, Canada) and *Diplocephalus subrostratus* (O. P.-Cambridge, 1873) (Holarctic) and African species, *Diplocephalus algericus* Bosmans, 1996 (Algeria), but differs by the presence of large cradle-shaped lamella characteristic of male palp. Furthermore, females of *D. mirabilis* can be separated from all the worldwide known

congeners by the presence of unciform apophyses of epigynum.

5 ♂♂ and 8 ♀♀ were measured. Total length varies from 1.47-1.67 in males, 1.45-1.56 in females. Carapace length is 0.70-0.78 in males, 0.67-0.69 in females; width 0.59-0.61 in males, 0.48-0.50 in females. The shape of post-ocular sulci is variable. Specimens collected from Russia show deep post-ocular sulci, but specimens from China appear less deep or only strongly pigmented.

*Diplocephalus parentalis* n. sp.  
(Figs 9-11)

TYPE MATERIAL. — Holotype: China, Zhejiang Province, Fenghua City, Shangsong Village, Mt Long'ao, 29.92°N, 121.00°E, 15.X.2006, coll. Y. Song & X. Yin, ♂ (MNHN).

Paratype: same data as for holotype, 1 ♀ (MNHN).

ETYMOLOGY. — Specific name from Latin *parentalis* = parental, in order to express the first author's sincere appreciation to her parents for their collecting specimens of this new species.

DISTRIBUTION. — Known from Mt Long'ao in Zhejiang Province, China (Fig. 12).

DESCRIPTION

*Male*

Total length 2.23. Carapace 1.11 long, 0.86 wide, bright reddish-brown, bearing cephalic pits within the post-ocular sulci (Fig. 10B); several moderately long hairs scattered in the ocular area and on the clypeus (Fig. 10A). Abdomen dark grey. Clypeus 0.21 high. AME interdistance 0.05, ALE 0.08, PME 0.08, PLE 0.09, AME interdistance 0.50 times their diameter, AME-ALE interdistance 0.62 times ALE diameter, PME interdistance 0.62 times their diameter, PME-PLE interdistance 1.20 times PLE diameter. Sternum 0.57 long, 0.61 wide. Coxa IV interdistance 1.00 times their width. Chelicerae with 6 promarginal teeth, 5 retromarginal teeth (Fig. 10H). Tibia I 7.47 times longer than deep. Tm I 0.55, Tm IV absent. Dorsal spine on tibia of leg IV: 1-1-1-1; dorsal spine on patella of leg IV: 1-1-1-1. Leg measurements: I: 2.98 (0.88, 0.24, 0.70, 0.63, 0.53); II: 3.04 (0.88, 0.26, 0.73, 0.68,

0.51); III: 2.51 (0.71, 0.25, 0.57, 0.57, 0.42); IV: 3.13 (0.87, 0.25, 0.80, 0.69, 0.52).

Length of femur and patella in ratio 5:2. Tibia curved retrolaterally to form a long prolateral apophysis whose apex armed with a tuft of thick bristles and distal part swollen, as well as lots of papillae on the mesal surface; with 1 retrolateral and 1 prolateral trichobothrium (Fig. 9D). Paracymbium spiral with terminal part hooked (Fig. 9B). Cymbium with a long and wide retrobasal process, as well as a longitudinal narrow ridge near the base (Fig. 9B). Tegulum distal to subtegulum in unexpanded palp. Protegulum vestigial (Fig. 9A). Suprattegulum armed with a typical dentiform marginal apophysis and a long curved upwards distal apophysis, slightly bifurcate distally and strongly sclerotized basally to shape triangular teeth (Fig. 10C). Embolic membrane similar to that of *D. mirabilis* (Fig. 10D). Radix large, with a transversally membranous extension at the base; outer rectangular margins strongly sclerotized to be dark black (Fig. 10E). Tailpiece relatively long, slightly upwards, ending in being rounded and slightly concave in the center (Fig. 10E). Embolus short, curved backwards to the dorsal side (Fig. 9B).

*Female*

Total length 2.44. Carapace 1.11 long, 0.81 wide, similar to male in general appearance and coloration, but without cephalic pits and sulci. Abdomen light grey. Clypeus 0.19 high. AME interdistance 0.05, ALE 0.10, PME 0.08, PLE 0.08, AME interdistance 0.38 times their diameter, AME-ALE interdistance 0.29 times ALE diameter, PME interdistance 0.52 times their diameter, PME-PLE interdistance 0.70 times PLE diameter. Sternum 0.61 long, 0.58 wide. Coxa IV interdistance 1.04 times their width. Chelicerae with 6 promarginal teeth, 5 retromarginal teeth. Tibia I 7.50 times longer than deep. Tm I 0.55, Tm IV absent. Dorsal spine on tibia of leg IV: 1-1-1-1; dorsal spine on patella of leg IV: 1-1-1-1. Leg measurements: I: 3.25 (0.94, 0.29, 0.84, 0.69, 0.48); II: 3.08 (0.89, 0.27, 0.75, 0.68, 0.48); III: 2.64 (0.74, 0.27, 0.60, 0.63, 0.40); IV: 3.31 (0.95, 0.28, 0.89, 0.76, 0.43).

Epigynum with a long fissure in the middle (Fig. 10G). Ventral plate armed with column-shaped



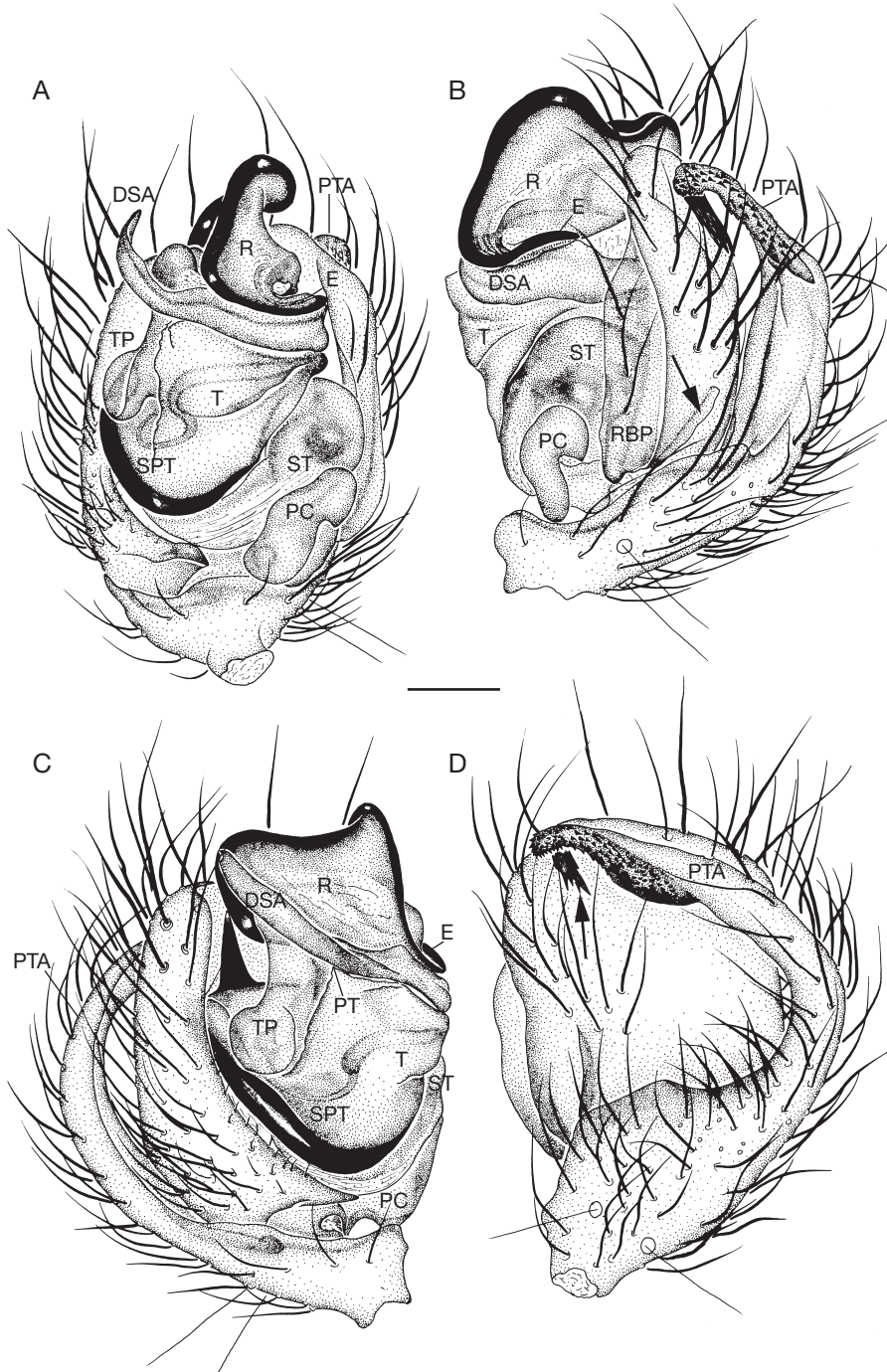


FIG. 9. — *Diplocephalus parentalis* n. sp., holotype, ♂ cl 1.11 mm (MNHN), Mt Long'ao: **A**, left palp, ventral view; **B**, same, retrolateral view (arrow refers to the longitudinal ridge); **C**, same, prolateral view; **D**, same, dorsal view (arrow refers to a tuft of thick bristles). Abbreviations: see text. Scale bar: 0.1 mm.

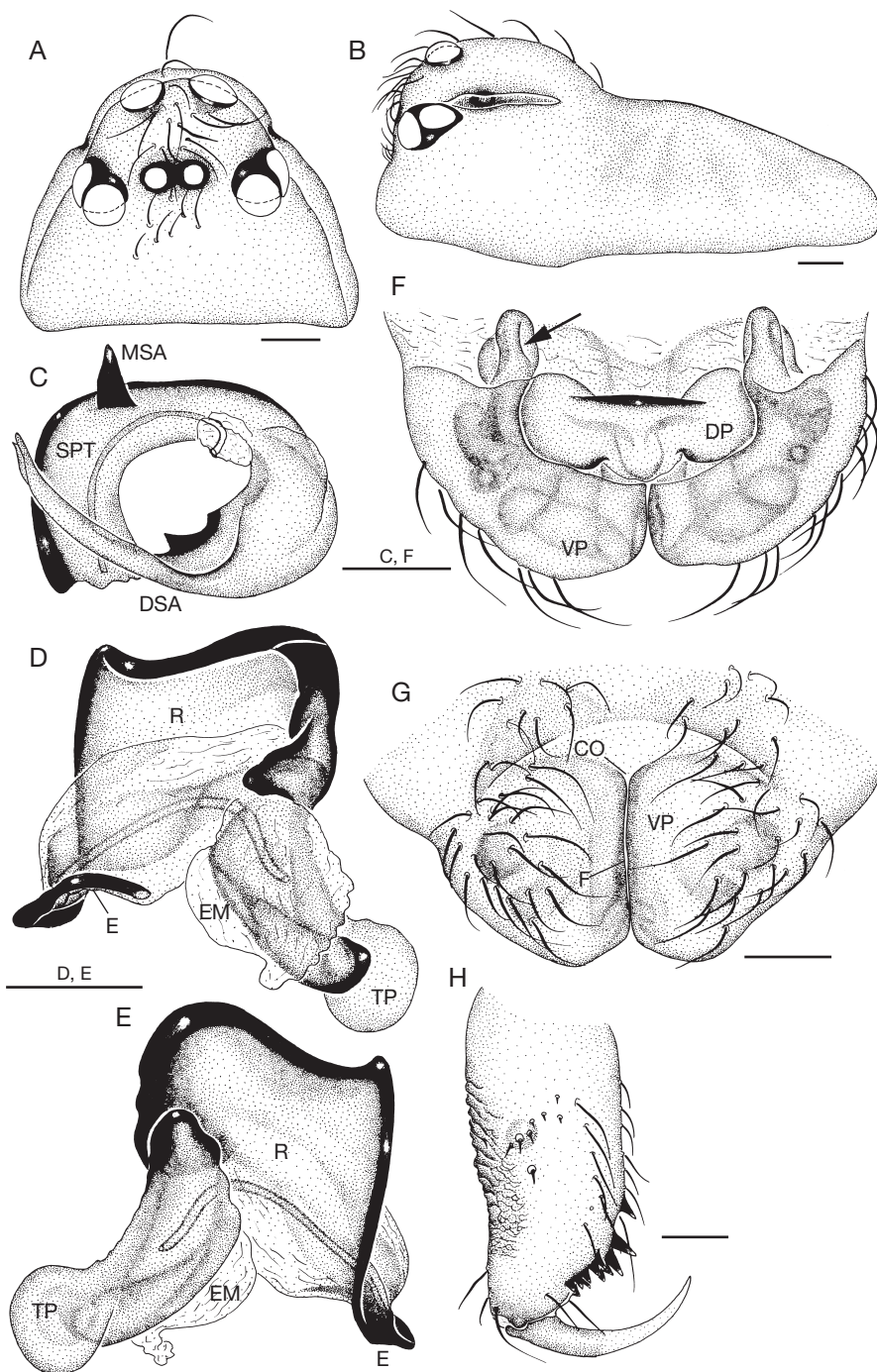


FIG. 10. — *Diplocephalus parentalis* n. sp., Mt Long'ao; **A-E, H**, holotype, ♂ cl 1.11 mm (MNHN); **F, G**, paratype, ♀ cl 1.11 mm (MNHN); **A**, carapace, frontal view; **B**, same, lateral view; **C**, supratégulum, ventral view; **D**, embolic division, dorsal view; **E**, same, ventral view; **F**, epigynum, posterior view (arrow refers to the column-shaped complex); **G**, same, ventral view; **H**, left chelicera, posterior view. Abbreviations: see text. Scale bars: 0.1 mm.

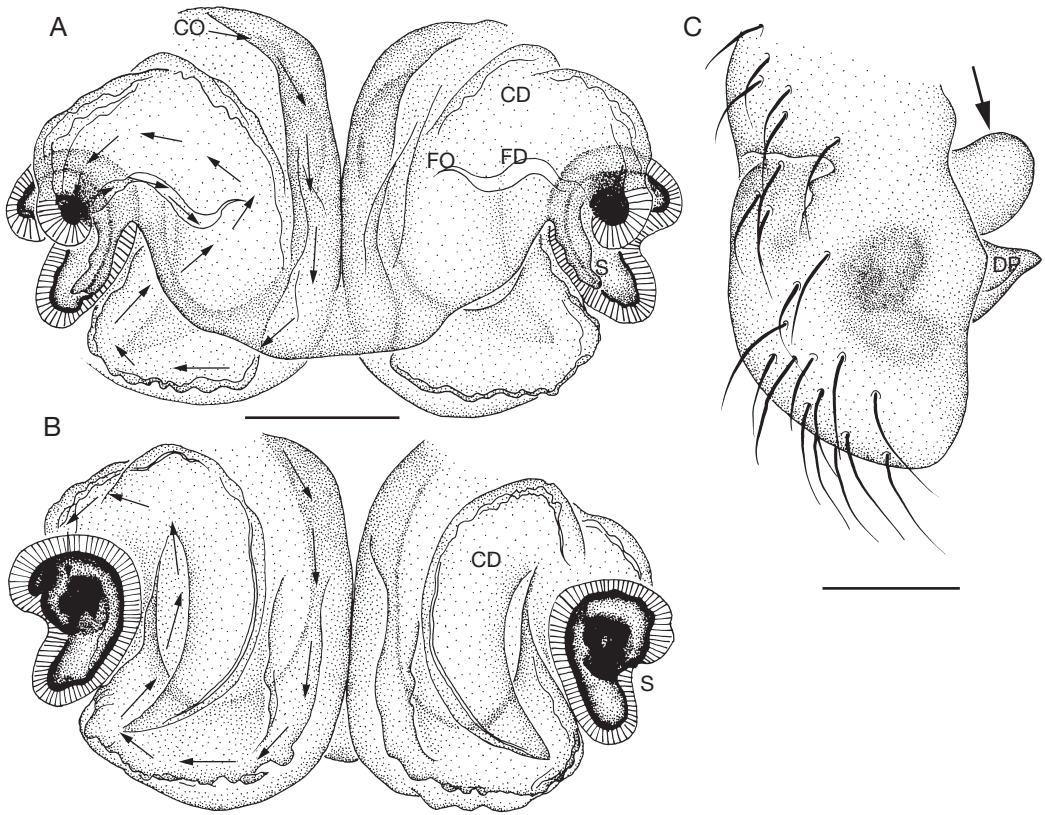


FIG. 11. — *Diplocephalus parentalis* n. sp., paratype, ♀ cl 1.11 mm (MNHN), Mt Long'ao: **A**, vulva, dorsal view (arrows show the schematic course of internal duct system); **B**, same, ventral view (arrows show the schematic course of internal duct system); **C**, epigynum, lateral view (arrow refers to the column-shaped complex). Abbreviations: see text. Scale bars: 0.1 mm.

complex anteriorly (Fig. 10F). Dorsal plate totally covered by ventral plate in ventral view (Fig. 10G), with its anterior part extended dorsally to form a cone-shaped apophysis in lateral view (Fig. 11C). Copulatory openings formed at the anterior end of the fissure (Fig. 10G). Copulatory ducts enclosed in a slightly sclerotized capsule, bearing large cavums (Fig. 11B). The path of copulatory ducts is shown in Figure 11A, B. Fertilization ducts thin, mesally oriented (Fig. 11A). Spermathecae U-shaped, separated by a distance of more than 2 times their length (Fig. 11B).

#### REMARKS

Embolic division of *D. parentalis* n. sp. seems to belong to the genus *Savignia* in having a slightly

curved and directed backwards embolus, but in fact this new species bears no anterior radical process of embolic division and its vulva is totally different from that of *S. frontata*. Its vulva is very similar to that of *A. humilis* and *D. foraminifer*. The copulatory ducts of *D. parentalis* n. sp. are very long and wide, but extremely short and totally fused with spermathecae in *S. frontata*. In addition, this new species is closely related to the Japanese *D. hispidulus*, so I place it in the genus *Diplocephalus* to serve a full revision of the genus *Diplocephalus* in the future. Due to its similarity in genital conformation to *Savignia* and *Diplocephalus* species, *D. parentalis* n. sp. may represent an intermediate species whose anterior radical process of somewhat T-shaped embolic division reduced, while the complexity of

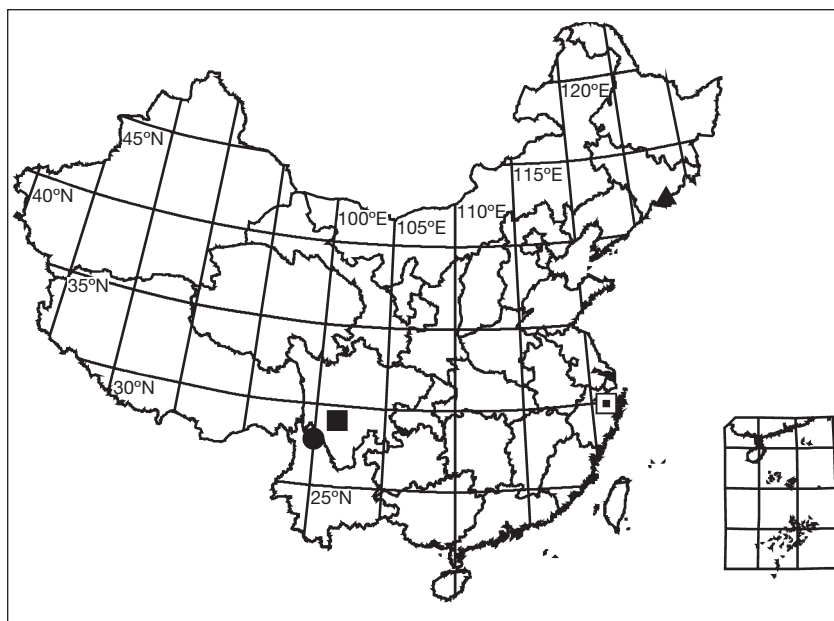


FIG. 12. — Recorded distributions of *Araeoncus hyalinus* n. sp. (●), *A. longispineus* n. sp. (■), *Diplocephalus mirabilis* Eskov, 1988 (▲) and *D. parentalis* n. sp. (□) in China.

the copulatory ducts increased to shape the type of *Diplocephalus* species.

Even though *D. parentalis* n. sp. is particularly closely related to *D. hispidulus* (Saito & Ono 2001: figs 88-91), it can be still distinguished by the under developed embolic membrane of the embolic division, the distally swollen proteral palpal tibial apophysis, the small but complicated dorsal plate of the epigynum, and slightly different path of copulatory ducts of female vulva. Furthermore, those two related species can be easily separated from all the congeners by the shape of embolic division and presence of a tuft of thick bristles at the apex of male palpal proteral tibial apophysis.

Specimens of *D. parentalis* n. sp. were found under leaf litter of shaded area in the evergreen broad-leaved forest in subtropics.

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