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# FOUR NEW SPECIES OF SIX-EYED PHOLCID SPIDERS (ARANEAE: PHOLCIDAE) FROM HAINAN ISLAND, CHINA

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***ABSTRACT.* –** Four new six-eyed pholcid spiders belonging to two genera are reported from Hainan Island, China. They are: *Belisana aliformis* (female, male), *B. huberi* (female, male), *B. lamellaris* (female, male) and *Khorata diaoluoshanensis* (female, male). The genus *Khorata* Huber, 2005, is newly recorded from China. All the species are diagnosed, described and illustrated.

***KEY WORDS.* –** Hainan Island, Pholcidae, *Belisana*, *Khorata*, new species, new record, China.

## INTRODUCTION

Spiders of the family Pholcidae are small- to medium-sized, haplogyne spiders, having six or eight eyes. They can be easily distinguished from other families by the following characters: prosoma about as long as wide; clypeus about as high as chelicerae; male palp with prominent retrolateral paracymbium (procursus), which is rarely reduced; male chelicerae usually with sexual modifications; and tarsi usually pseudosegmented (Huber, 2000). Pholcids occupy a wide range of ecosystems and habitats, ranging from deserts to rainforests, from sea level to over 3,500 m altitude, and from leaf litter to the canopy (Huber, 2005a). At present, a total of 81 genera and 967 species are recorded worldwide. In terms of the described species number, the family is the ninth among spiders (Platnick, 2007). However, considering some recent revisions of pholcids, it is reasonable to deduce that only a small percentage of species have been described (Huber, 2005a).

Six-eyed pholcids are usually tiny, leaf-litter dwelling spiders. Traditionally, almost any small pholcid with six eyes had been assigned to *Spermophora*. As a result, it is probably the most chaotic genus in the family. Recently, some revisions (Wunderlich, 1992; Huber, 2000, 2001, 2003a, 2003b, 2003c, 2005a, 2005b; Senglet, 2001) have greatly alleviated the situation. Now it is clear that most Chinese six-eyed pholcid species belong to the genus *Belisana* (Song et al., 1999; Huber, 2005a; Zhang et al., 2006). Exceptions are the synanthropic *Spermophora senoculata* and *S. elongata* which are probably representatives of the genus *Pholcus* (Huber, 2001).

Hainan Island, situated at the southernmost part of China, is considered as a tropical-biodiversity-rich region. No six-eyed pholcid spiders have previously been reported from the Island. In an expedition to Hainan Island from March to April 2005 with the objective of collecting spiders, we collected some six-eyed pholcids. Four new species belonging to two genera, including the first record of the genus *Khorata* from China, are reported in the present paper.

## MATERIALS AND METHODS

Taxonomic descriptions and terminology followed Huber (2000, 2005a). Specimens were examined using an Olympus® SZX12 stereomicroscope [Olympus Corporation, Tokyo, Japan]. Further details were studied under an Olympus® BX51 compound microscope [Olympus Corporation, Tokyo, Japan]. All illustrations were made using a drawing tube [Olympus Corporation, Tokyo, Japan] and inked on ink jet plotter paper [Canson, Arjowiggins group, Qingdao, China]. Photos were made with an Olympus® C7070 wide zoom digital camera (7.1 megapixels) mounted on an Olympus® SZX12 dissecting scope. Vulvae of females were cleared in lactic acid. All measurements given are in milimetres (mm).

The following abbreviations are used in the illustrations: ba = bulbal apophysis; e = embolus; ep = epigynal pocket; f = membranous flap on procursus; pr = procursus; used in the text: ALE = anterior lateral eyes; AME = anterior median eyes; PME = posterior median eyes.

The specimens studied here are deposited in the Institute of Zoology, Chinese Academy of Sciences in Beijing (IZCAS).

## TAXONOMY

### Pholcidae C. L. Koch, 1850

### *Belisana* Thorell, 1898

*Belisana* Thorell, 1898: 278; Simon, 1903: 988; Simon, 1909: 81; Deeleman-Reinhold, 1986: 46–48; Huber, 2001: 124–126; Huber, 2005a: 1–126. Type species: *Belisana tauricornis* Thorell, 1898.

### *Belisana aliformis*, new species
(Figs. 1A–C, 2A–H)

***Material examined.* –** Holotype: male (IZCAS), Wuzhishan Natural Reserve (18°49'N 109°39'E), Hainan Island, China, coll. Y. Song, X. Han, G. Deng and Y. Tong, 16 Apr.2005.

Paratypes: 8 males and 17 females (IZCAS), same data as holotype; 3 males and 7 females (IZCAS), Jianfengling Natural Reserve, Hainan Island, China, coll. Y. Song, X. Han, G. Deng and Y. Tong, 5 Apr.2005.

***Diagnosis.* –** The new species is similar to *B. nujiang* Huber, 2005, and *B. pianma* Huber, 2005, but can be distinguished by the unpaired modification of the male clypeus, the less widely spaced cheliceral apophyses, the shapes of procursus and embolus, and the different female vulval structure.

***Description.* – Male** (holotype). Total length 2.95 (3.15 with clypeus), carapace width 1.28. Leg 1: 28.95 (6.99+0.44+7.14+12.28+2.1), tibia 2: 4.57, tibia 3: 2.99, tibia 4: 4.14; tibia 1 L/d: 64. Habitus as in Figs. 1A and 1B. Carapace ochre-yellow, brown margins laterally, sternum whitish, Legs ochre-yellow except brown on patella and joints of tibia to metatarsus, without darker rings. Opisthosoma whitish gray, with two pairs of darker spots dorsolaterally. Ocular area not elevated, thoracic furrow absent; distance PME-PME 0.23; diameter PME 0.10; distance PME-ALE 0.02; AME absent. Clypeus with duck-beak shaped apophysis

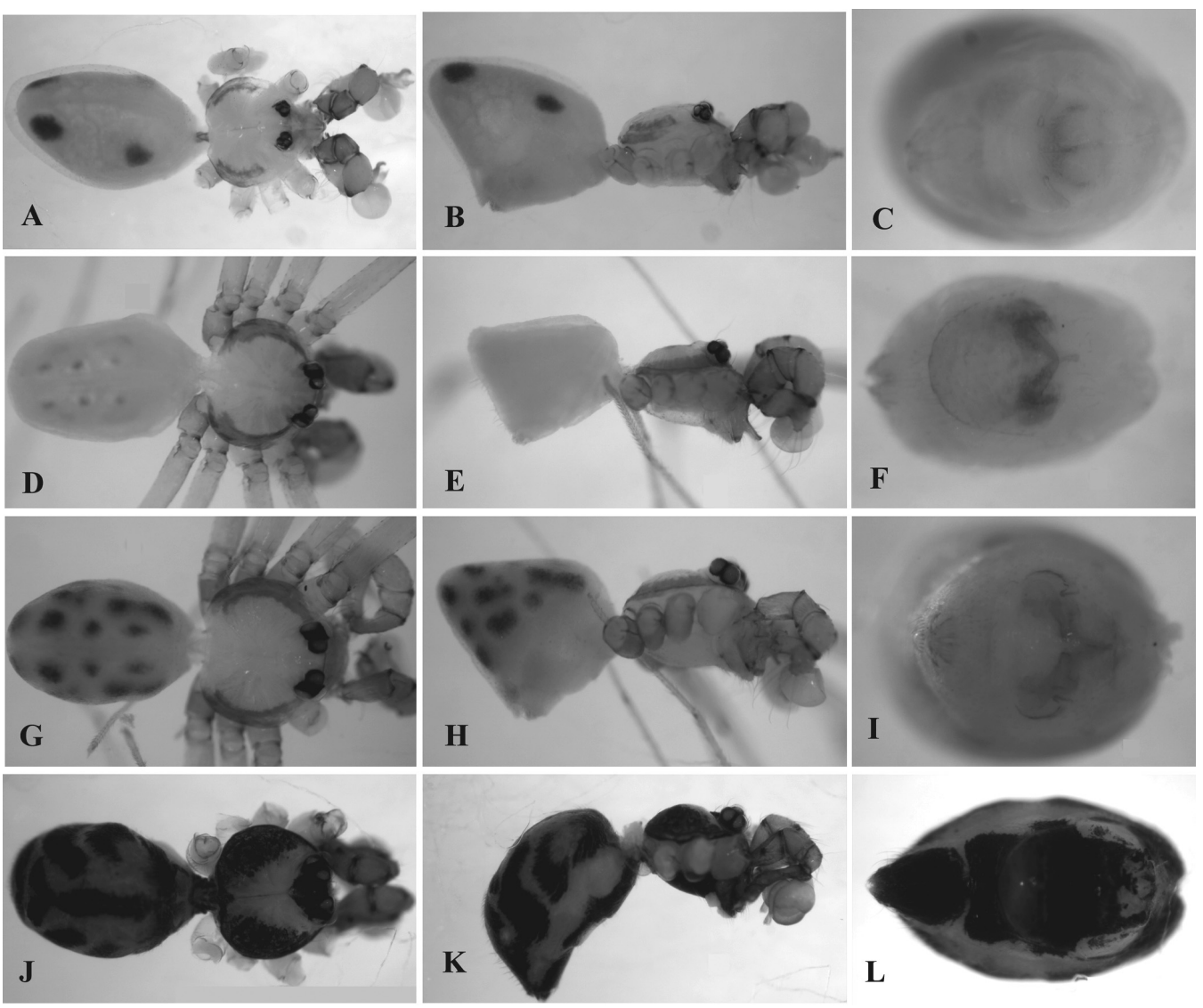


Fig. 1. A–C, *Belisana aliformis*, new species; D–F, *Belisana huberi*, new species; G–I, *Belisana lamellaris*, new species; J–L, *Khorata diaoluoshanensis*, new species. A, D, G, J, male habitus, dorsal view; B, E, H, K, male habitus, lateral view; C, F, I, L, female abdomen, ventral view.

on anterior margin. Sternum slightly wider than long (0.75/0.62). Chelicerae as in Fig. 2F, with pair of curved apophyses, tips with cuticular ridges laterally, 0.36 apart. Palps as in Figs. 2B, 2C and 2D; trochanter with short retrolateral apophysis, femur with indistinct hump proximo-dorsally, procursus complicated distally, with ventral membranous flap, bulb with hooked apophysis and complicated embolus. Retrolateral trichobothrium of tibia 1 at 7%; legs without spines, vertical hairs, and curved hairs; tarsus 1 apparently with > 20 pseudosegments, but only about 15 quite distinct distally.

Variation. Tibia 1 in other males (n = 8) from Wuzhishan: 6.28–7.18 (mean: 6.68); in the males from Jianfengling (n = 3): 6.81, 7.12, 7.52. Distance between tips of distal cheliceral apophyses in other males from Wuzhishan (n = 8): 0.31–0.37 (mean: 0.33); in the males from Jianfengling (n = 3): 0.29, 0.32, 0.33.

**Females**. In general, similar to male. Body colour lighter than male's; dorsal spots on opisthosoma indistinct (nearly invisible in some specimens from Jianfengling). Tibia 1 in females from Wuzhishan (n = 17): 5.04–6.08 (mean: 5.45); in females from Jianfengling (n = 7): 5.44–6.02 (mean: 5.72). Epigynum simple and flat externally, with distinctive internal dark structures visible through cuticle (Figs. 1C and 2G), pockets 0.19 apart. Dorsal view as in Fig. 2H.

***Etymology.* –** The specific name is an adjective from Latin, in reference to the wing-shaped dark structure visible through the epigynal cuticle.

***Distribution.* –** Hainan, China (present study).

### *Belisana huberi*, new species

(Figs. 1D–F, 3A–G)

***Material examined.* –** Holotype: male (IZCAS), Bawangling National Natural Reserve (19°04'N 109°08'E), Changjiang County, Hainan Island, China, coll. G. Deng, 22 Mar.2005.

Paratypes: 2 males and 7 females (IZCAS), same data as holotype.

***Diagnosis.* –** The new species can be easily distinguished from known congeners by the modifications of chelicerae (pair of upward-directed proximal apophyses), the shape of procursus, and the unique female vulval structures.

***Description.* – Male** (holotype). Total length 1.75 (1.86 with clypeus), carapace width 0.75. Leg 1: 11.87 (3.05+0.27+2.95+4.5+1.1), tibia 2: 1.92, tibia 3: 1.3, tibia 4: 1.87; tibia 1 L/d: 39. Habitus as in Fig. 2D and 2E. Carapace yellowish, brown margins laterally, sternum whitish. Legs yellow except brown on patella and joints of tibia to metatarsus, without darker rings. Opisthosoma whitish-grey, with some indistinct darker spots dorsally. Ocular area not elevated, thoracic furrow absent; distance PME-PME 0.12; diameter PME 0.08; distance PME-ALE 0.03; AME absent. Clypeus unmodified. Sternum slightly wider than long (0.51/0.47). Chelicerae as in Fig. 3B and 3C, with pair of curved frontal apophyses, tips with cuticular ridges laterally, 0.14 apart; with pair of upward-directed proximal apophyses and pair of proximolateral apophyses. Palps as in Fig. 3A, 3D and 3E; trochanter with short retrolateral apophysis, femur with distinctive hump proximo-dorsally, procursus complicated distally, with ventral membranous flap, bulb with hooked apophysis and complicated embolus. Retrolateral trichobothrium of tibia 1 at 16%; legs without spines, vertical hairs, and curved hairs; tarsus 1 with about 15 quite distinct pseudosegments distally.

Variation. Tibia 1 in other males (n = 2): 3.05, 3.07. Distance between tips of distal cheliceral apophyses in other males (n = 2): 0.09, 0.13. One male with obscure moustache-like marks on median of carapace; dorsal spots on opisthosoma nearly invisible.

**Females.** In general, similar to male. Some specimens with distinctive moustache-like marks on median of carapace. Tibia 1 in females (n = 7): 2.27–2.87 (mean: 2.58). Epigynum simple and flat externally, with distinctive internal dark structures visible through cuticle (Figs. 1F and 3F); with pair of posterior pockets, 0.09 apart. Dorsal view as in Fig. 3G.

***Etymology.* –** Named for Dr. Bernhard A. Huber from the Alexander Koenig Zoological Research Museum who contributed to our understanding of the taxonomy of this genus.

***Distribution.* –** Hainan, China (present study).

### *Belisana lamellaris*, new species

(Figs. 1G–I, 4A–F)

***Material examined.* –** Holotype: male (IZCAS), Diaoluoshan Natural Reserve, Hainan Island, China, coll. Y. Song, X. Han and Y. Tong, 19 Apr.2005.

Paratypes: 2 males and 7 females (IZCAS), same data as holotype.

***Diagnosis.* –** The new species is similar to *B. phurua* Huber, 2005, but can be distinguished by the absence of distal spine on procursus, the shape of bulbal apophyses, and the different female vulval structure.

***Description.* – Male** (holotype). Total length 1.85 (1.94 with clypeus), carapace width 0.78. Leg 1: 13.48 (3.28+0.30+3.30+5.07+1.53), tibia 2: 1.87, tibia 3: 1.27, tibia 4: 1.90; tibia 1 L/d: 42. Habitus as in Fig. 1G and 1H. Carapace ochre-yellow, light brown margins laterally, sternum yellowish, Legs ochre-yellow except brown patella, without darker rings. Opisthosoma ochre-gray, with some dorsal darker spots. Ocular area not elevated, thoracic furrow absent; distance PME-PME 0.10; diameter PME 0.11; distance PME-ALE 0.02; AME absent. Clypeus unmodified. sternum slightly wider than long (0.57/0.53). Chelicerae as in Fig. 4B, with pair of curved apophyses, tips unmodified, 0.4 apart. Palps as in Fig. 4A, 4C and 4D; trochanter with small retrolateral apophysis, femur with indistinct hump

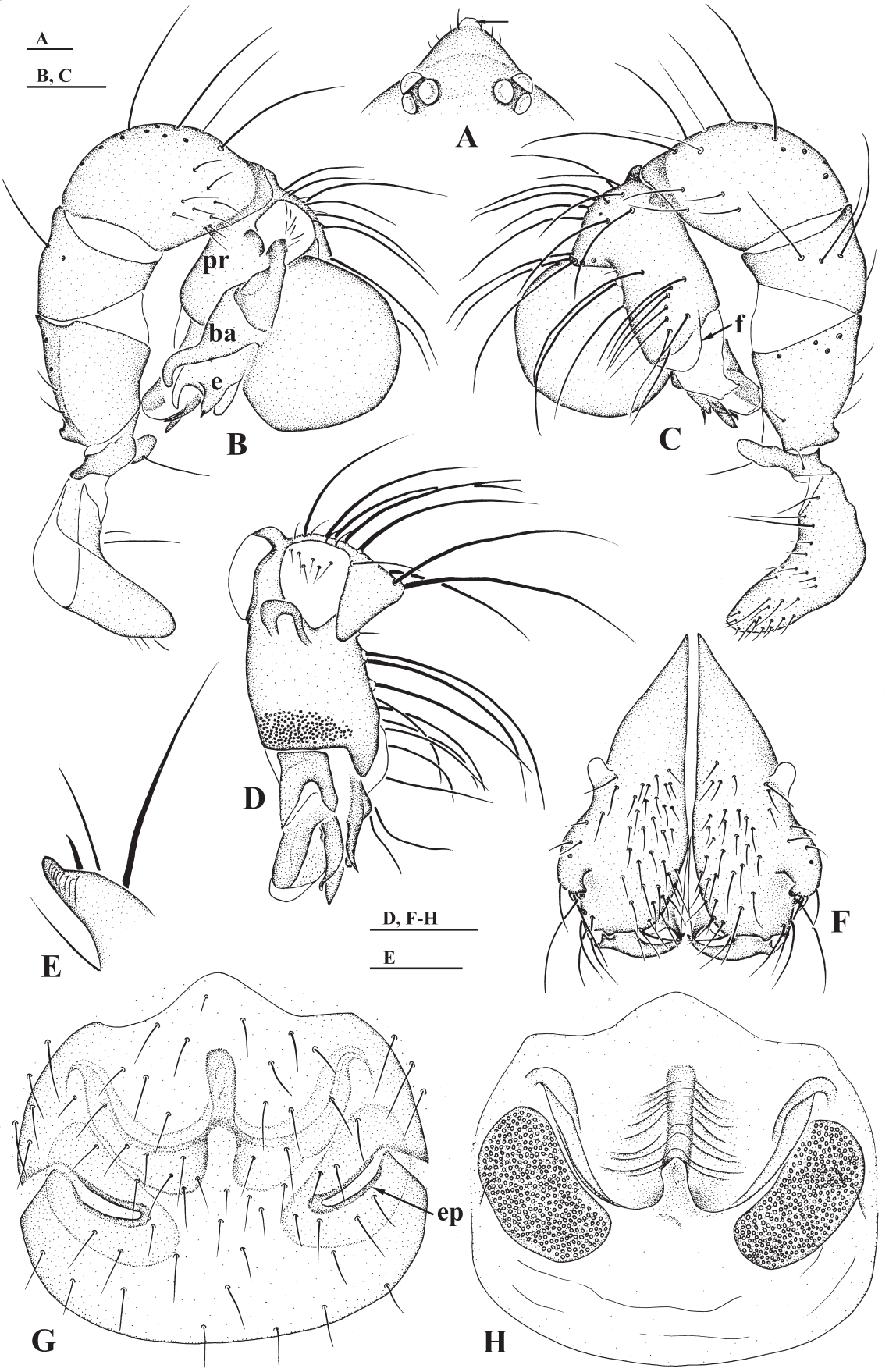


Fig. 2. A, *Belisana aliformis*, new species, anterior part of male prosoma (arrow shows the duck-beak shaped apophysis), dorsal view; B–C, male left palp, prolateral (B) and retrolateral (C) views; D, male left procursus, prolateral view; E, apical part of cheliceral frontal apophysis, internal view; F, male chelicerae, frontal view; G–H, cleared epigynum, ventral (G) and dorsal (H) views. Scale bars: A–D, F–H = 0.2 mm; E = 0.05 mm.

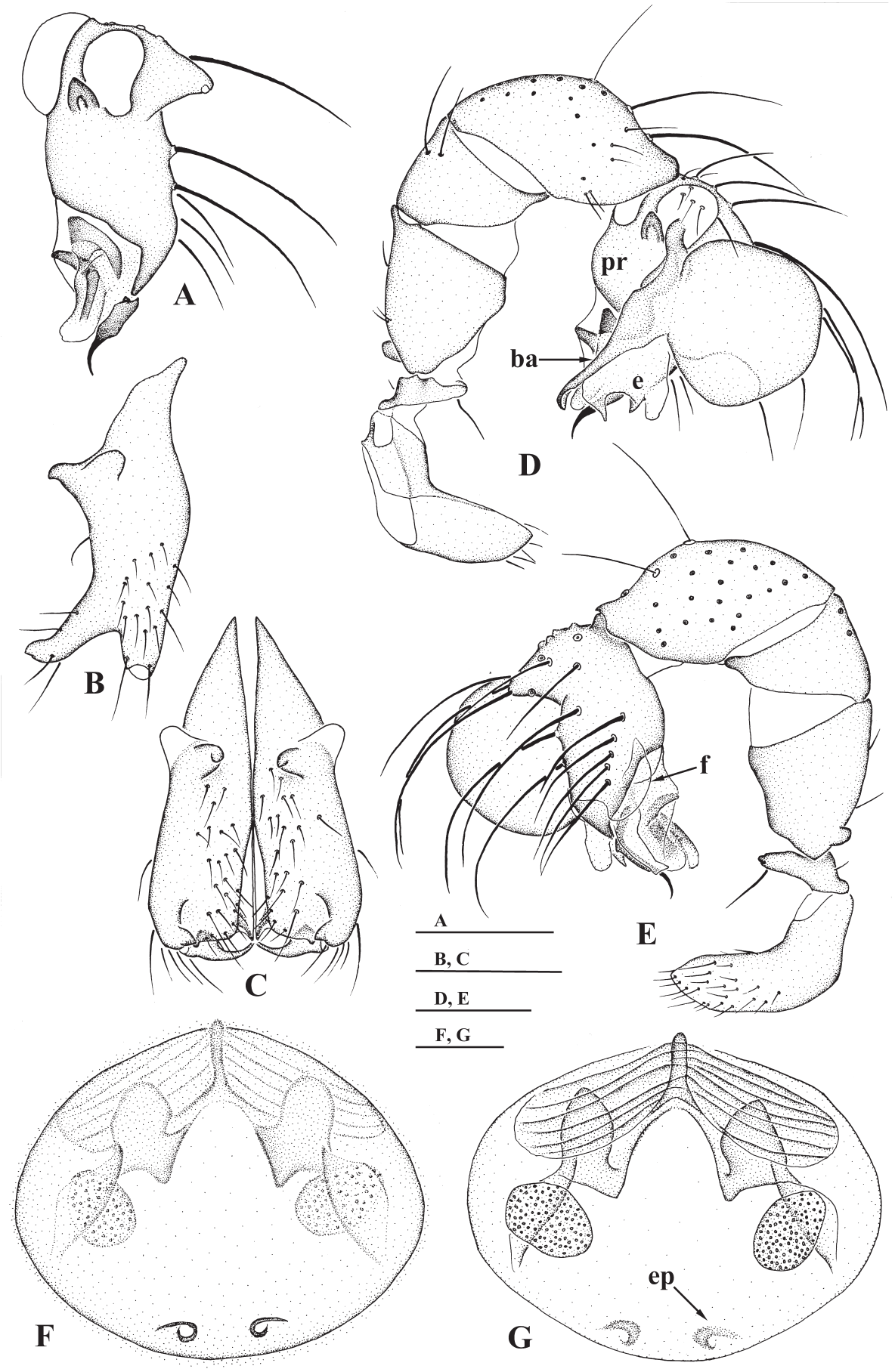


Fig. 3. A, *Belisana huberi*, new species, male left procursus, prolateral view; B, male chelicerae, lateral view; C, male chelicerae, frontal view; D–E, male left palp, prolateral (D) and retrolateral (E) views; F–G, cleared epigynum, ventral (F) and dorsal (G) views. Scale bars: A–E = 0.2 mm; F, G = 0.1 mm.

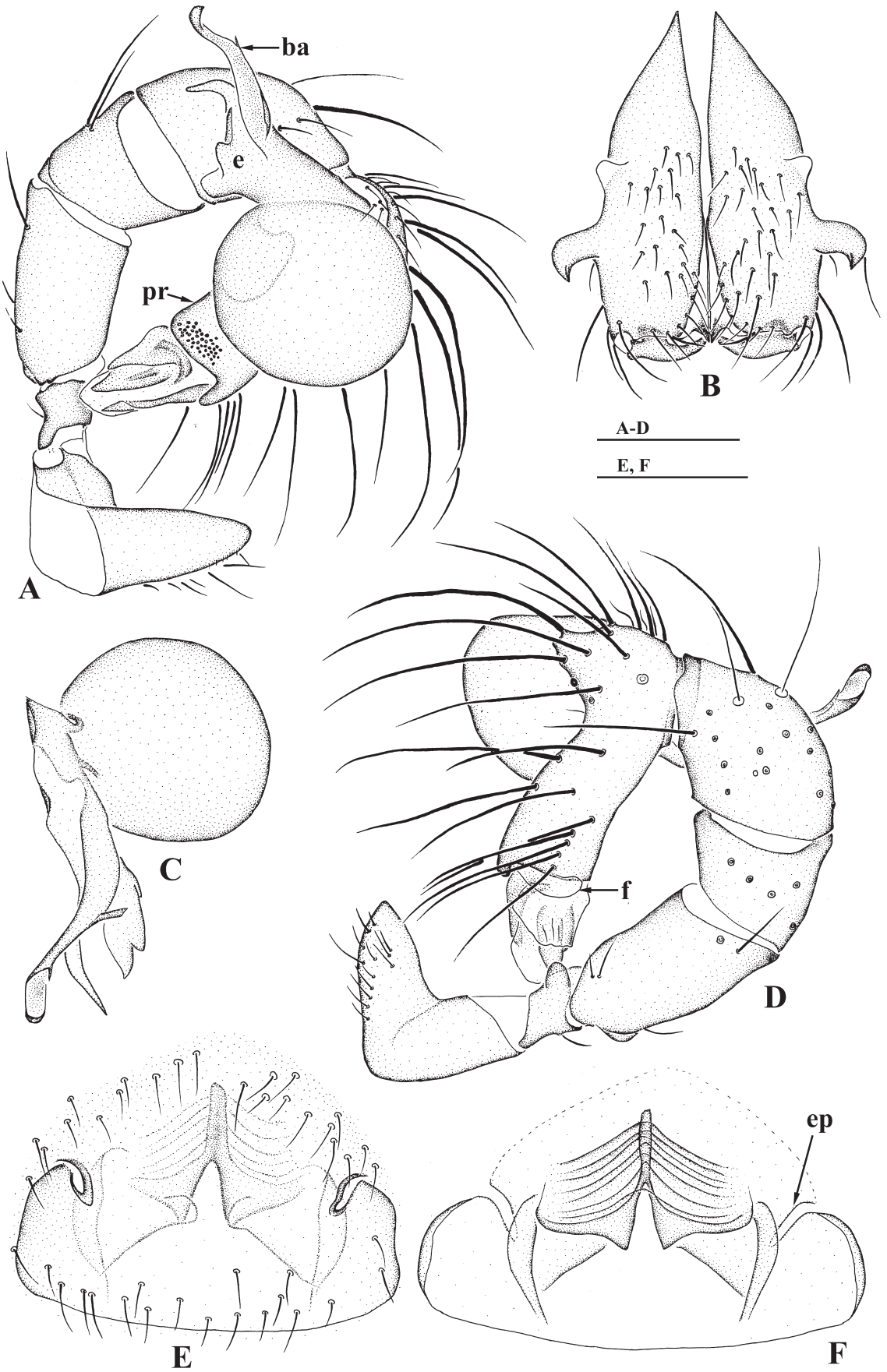


Fig. 4. A, *Belisana lamellaris*, new species, male left palp, prolateral view; B, male chelicerae, frontal view; C, male bulb with bulbal apophysis and embolus, laterodorsal view; D, male left palp, retrolateral view; E–F, cleared epigynum, ventral (E) and dorsal (F) views. Scale bars = 0.2 mm.

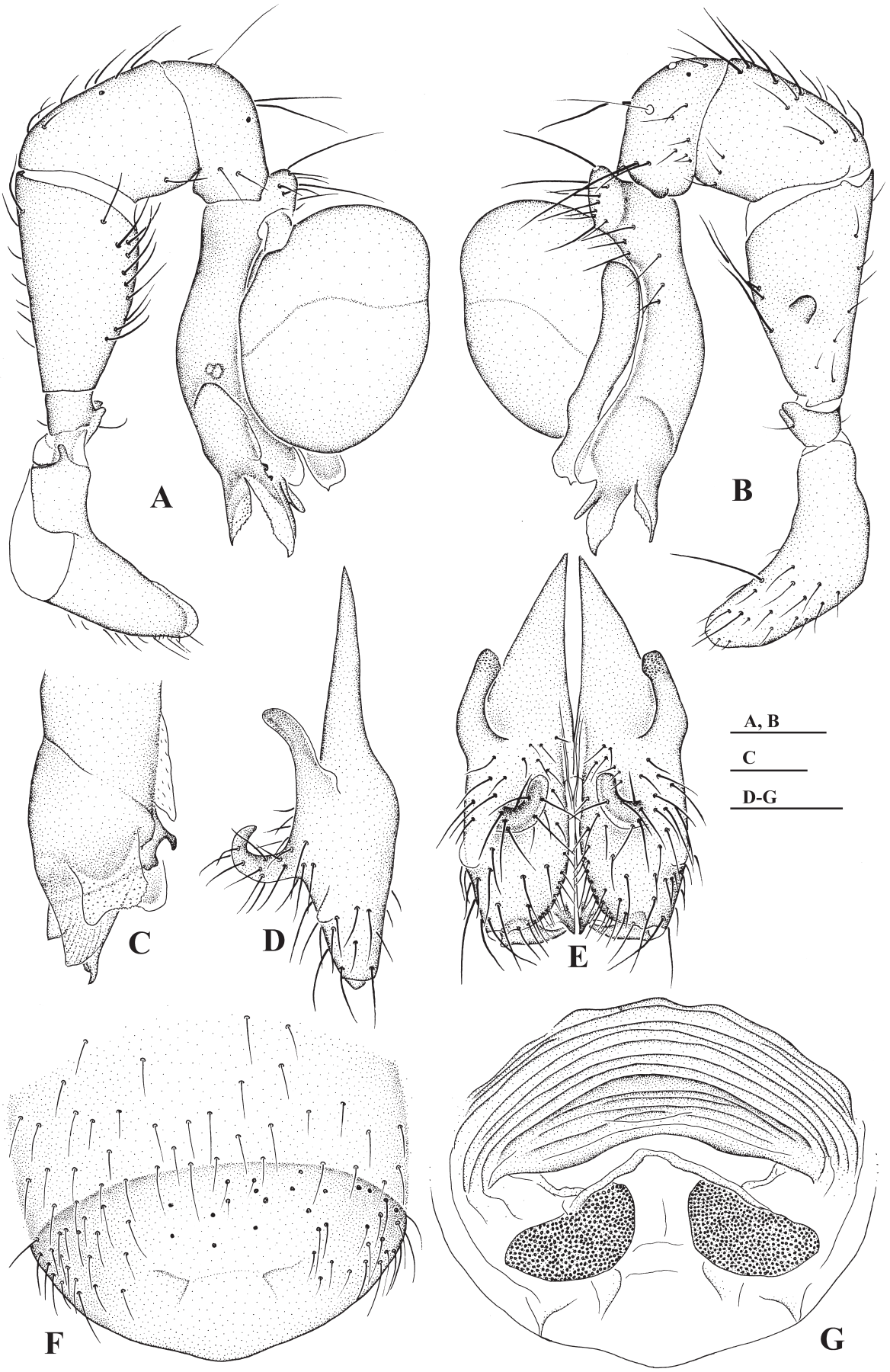


Fig. 5. A–B, *Khorata diaoluoshanensis*, new species, male left palp, prolateral (A) and retrolateral (B) views; C, apical part of male procursus, ventral view; D, male chelicerae, lateral view; E, male chelicerae, frontal view; F–G, cleared epigynum, ventral (F) and dorsal (G) views. Scale bars: A, B, D–G = 0.2 mm, C = 0.1 mm.

proximo-dorsally, procursus with ventral membranous flap, bulb with hooked apophysis and complicated embolus. Retrolateral trichobothrium of tibia 1 at 14%; legs without spines, vertical hairs, and curved hairs; tarsus 1 apparently with > 20 pseudosegments, only about 15 quite distinct distally.

Variation. Tibia 1 in other males (n = 2): 3.37, 3.5. Distance between tips of distal cheliceral apophyses in other males (n = 2): 0.45, 0.38. Dorsal darker spots on opisthosoma indistinctive in one male.

**Females.** In general, similar to male. Tibia 1 in females (n = 7): 2.22–2.65 (mean: 2.48). Epigynum simple and flat externally, with distinctive internal dark structures visible through cuticle (Figs. 1I and 4E), pockets 0.33 apart. Dorsal view as in Fig. 4F.

***Etymology.*** **–** The specific name is an adjective from Latin, and refers to the narrow sheet-like elongation on the bulbal apophysis of the male palp.

***Distribution.*** **–** Hainan, China (present study).

### *Khorata* Huber, 2005

*Khorata* Huber, 2005b: 79–83. Type species: *K. khammouan* Huber, 2005.

### *Khorata diaoluoshanensis*, new species
(Figs. 1J–L, 5A–G)

***Material examined.*** **–** Holotype: male (IZCAS), Diaoluoshan Natural Reserve, Hainan Island, China, coll. Y. Song, X. Han and Y. Tong, 19 Apr.2005.

Paratypes: 7 males and 14 females (IZCAS), same data as holotype.

***Diagnosis.*** **–** The new species is similar to *K. schwendingeri* Huber, 2005, and *K. bangkok* Huber, 2005, but can be easily distinguished by the longer proximal apophyses of the male chelicerae, and by the shape of the distal elements of the procursus; from the other two species of this genus, *K. khammouan* Huber, 2005, and *K. jaegeri* Huber, 2005, by the male chelicerae (distal apophyses close together), the male palpal bulb (absence of hump or projection retrolaterally), and by the distal elements of the procursus.

***Description.*** **– Male** (holotype). Total length 2.25 (2.4 with clypeus), carapace width 1.12. Leg 1: 22.28 (5.67+0.42+5.37+8.35+2.47), tibia 2: 3.3, tibia 3: 2.4, tibia 4: 3.17; tibia 1 L/d: 54. Habitus as in Fig. 1J and 1K. Carapace ochre with black margins and dark mark behind ocular area; sternum black. Legs ochre, with slightly darker rings on femora (subdistally) and tibiae (proximally and subdistally). Opisthosoma gray with large black spots, also ventrally. Ocular area slightly elevated and separated from carapace, thoracic furrow shallow but distinct; distance PME-PME 0.14; diameter PME 0.14; distance PME-ALE 0.02; AME absent. Clypeus unmodified. Sternum slightly wider than long (0.67/0.58). Chelicerae as in Fig. 5D and 5E, with pair of long frontal apophyses (distance between tips: 0.1), strong proximal apophyses provided with scales, and pair of small, nearly transparent apophyses at frontolateral surface and basal part of proximal apophyses, respectively, without modified hairs. Palps as in Fig. 5A, 5B and 5C; trochanter with retrolateral apophysis and small ventral projection, femur with retrolateral apophysis, patella very large, procursus relatively simple except distally, bulb very simple, no projection apart from embolus. Retrolateral trichobothrium of tibia 1 at 7%; legs without spines, vertical hairs, and curved hairs; tarsus 1 with barely visible pseudosegments, only about 10 distinct distally.

Variation. Tibia 1 in other males (n = 7): 5.25–5.92 (mean: 5.59).

**Females.** In general similar to male. Tibia 1 in females (n = 14): 4.82–5.53 (mean: 5.12). Epigynum simple brown plate, with internal structures nearly invisible through cuticle (Figs. 1L and 5F), apparently without pockets. Dorsal view as in Fig. 5G.

***Etymology.*** **–** The specific name refers to the type locality.

***Distribution.*** **–** Hainan, China (present study).

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