

## 高黎贡山派模蛛属一新种

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**摘要:** 本文描述了来自中国云南高黎贡山常绿阔叶林下派模蛛科 (Pimoidae) 派模蛛属 (*Pimoa*) 的一个新种—李氏派模蛛 (*Pimoa lihengae*)<sup>\*</sup>。从雄蛛和雌蛛外雌器的结构来看, 本种相似于产于印度及尼泊尔喜马拉雅山区的派模蛛属蜘蛛。

**关键词:** 李氏派模蛛, 派模蛛科, 新种, 高黎贡山

**分类号:** Q 949

## A New Spider of the Genus *Pimoa* from Gaoligong Mountains, Yunnan, China (Araneae, Araneoidea, Pimoidae)

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**Abstract:** A new pimoid spider, *Pimoa lihengae*, is described from the montane forests in the Gaoligong Mountains of western Yunnan Province, China. The structure of male and female genitalia suggests that this species is closely related to *Pimoa* from the Himalayas of India and Nepal.

**Key words:** *Pimoa lihengae*, New species, Pimoidae, Gaoligong Mountains

The Gaoligong Mountains extend north - south along the border between China and Myanmar, dividing the watersheds of the Irrawaddy (Dulongjiang) and Salween (Nujiang) rivers. Because of its physical isolation and long standing political instability the area is less disturbed than most other regions in Yunnan. Two nature reserves, the Nujiang Nature Reserve and Gaoligong Mountains Nature Reserve, protect parts of the range. Large tracts of old growth forest persist in the mountains. This area, part of the 'East Himalayan Region', has been recognized as an area of biotic richness and endemism (Myers, 1988).

In October and November of 1998 the first Sino - American expedition to the Gaoligong Mountains aimed to collect plants and animals endemic to the native mixed hardwood/conifer forests of these

\* 本新种以首次中美高黎贡山生物多样性联合考察队队长李恒研究员的名字命名

mountains. Among the material collected by authors Griswold and Long and colleague David Kavanaugh were males and females of a new species of pimoid spider. Pimoids live in the Himalayas, the Alps and Cantabrian Mountains (northern Spain), and western North America. Twenty one species of pimoid were known previously; the discovery of this species brings the total to twenty two species. *Pimoides anatolica* Hormiga has been previously described from Tsuyung(楚雄), Yunnan, a locality close to the capital of Yunnan (Hormiga 1994). Discovery of a second *Pimoides* species in Yunnan from the far eastern Himalayas underscores the potential richness of the Himalayas in new Pimoidae as suggested by Hormiga (1994: 19). In the structure of male and female genitalia *Pimoides lihengae* new species is most similar to the India - Nepal Himalayan species *Pimoides crista* (Fage), *P. gandhii* Hormiga and *P. indiscreta* Hormiga, rather than to *P. anatolica*, highlighting the Himalayan character of the Gaoligong Mountains biota.

Females of *Pimoides lihengae* new species were collected from sheet webs woven between large boulders along a large, fast moving stream in good, mixed hardwood forest. Some of these webs were more than 45cm across the exposed edge. Spiders hung beneath the sheets; during the night they ventured to near the outer edge of the web but during the day remained under that part of the web hidden within dark recesses between boulders. Males were found through general collecting by beating or hand picking from the vegetation.

This is Scientific Contribution from the California Academy of Sciences (CaAS) Center for Biodiversity Research and Information (CBRI).

## 1 Materials and Methods

Prior to examination with a Hitachi S - 520 Scanning Electron Microscope all structures were critical point dried. Vulvae were cleaned by exposure to trypsin, bleached in Chloral Bleach, stained with Chlorazol Black, and mounted in Hoyer's Medium for examination and photography. Examination was via Olympus SZH and Leitz Ortholux II microscopes. Small structures were examined in temporary mounts as described in Coddington (1983).

The description and conventions follow Hormiga (1994). Abbreviations are listed in Table 1. Figures in this paper are listed as 'Plates', all those from other papers as 'Plates'. All measurements are in mm. The position of the metatarsal trichobothrium I is expressed as in Millidge (1980:105): the ratio of the distance from the base of the metatarsus to the trichobothrial base divided by the length of the metatarsus. Specimens measured were chosen to encompass largest and smallest individuals.

## 2 Taxonomy

Pimoidae Wunderlich

Pimoinae Wunderlich 1986: 119.

Pimoidae, Hormiga 1993, 1994. Platnick 1993: 339; 1997: 311.

DIAGNOSIS. - Pimoidae is the sister group of Linyphiidae and shares with that family the synapomorphies of stridulatory striae on the ectal side of the chelicera, autospasy of the legs at the

patella - tibia junction, and a sticky silk sheet web. Pimoids may be distinguished from linyphiids by having the paracymbium continuous with the base of the cymbium (Plate III : 8, V : 17), having a retrolateral pimoidcymbial sclerite (PCS: Plate III : 10, V : 15) and denticulate process (CDP: Plate III : 8, V : 15, 17) on the cymbium, and lacking an embolic division of the palpal bulb.

**科**的描述: 派模蛛科 (新拟, Pimoidae) 是皿网蛛科 (Linyphiidae) 的姊妹群, 它们的螯肢外侧发音器呈突触状, 步足的膝节与胫节连接处具箭突, 用粘丝布水平网。派模蛛科与皿网蛛科所不同的是跗舟基部具副跗舟 (Plate III : 8, V : 17), 跗舟后侧部具派模型舟状骨片 (Plate III : 10, V : 15) 及齿突 (Plate III : 8, V : 15, 17), 插入器简化。

*Pimoa* Chamberlin and Ivie

*Metella* Fage 1931: 195 ~ 197, 1946: 387. Roewer 1942: 920. Bonnet 1957: 2820. [Preoccupied by *Metella* Müller 1839].

*Pimoa* Chamberlin and Ivie 1943: 9 ~ 10. Brignoli 1983: 231. Crawford 1988: 23. Roth 1988: 45. Platnick 1989: 275; 1993: 339; 1997: 311. Hormiga 1993: 534, 1994: 19.

*Louisfagea* Brignoli 1971: 161, 163. Ribera 1980: 226. Platnick 1989: 259. Hormiga 1993: 534 (regarded as junior synonym of *Pimoa*).

*Pimoa lihengae*, new species, Plates I ~ V

**TYPES.** - Male holotype and paratype from native forest at Nankang pass over Gaoligong Mountains at 2100 m, 24°50'N, 98°47'E, 36 air km from Bawan Township, Baoshan Prefecture, Yunnan China, collected 4 ~ 7 November 1998 by C. Griswold, D. Kavanaugh, and C. - L. Long. Holotype male deposited in Biology Department, Hunan Normal University, Changsha, China, paratype male in CaAS.

**ETYMOLOGY.** - It is our pleasure to name this species in honor of Professor Li Heng, leader of the first Sino - American expedition to the Gaoligong Mountains.

**DIAGNOSIS.** - The male palp is most like that of *P. crista* (Fage) (Hormiga, 1994, Plate 233, 234) in having a hook - shaped pimoid cymbial sclerite (PCS) and a large, blunt cymbial denticulate process (CDP) with many conspicuous denticles (Plate V : 15, 17), but differs from this species in having the E longer than the PEP (Plate V : 15), having the pedipalpal tibia no longer than wide (Plate V : 15 ~ 17), and having the MA (media apophysis) more slender (Plate III : 9, V : 17). The female genitalia are most like those of *P. gandhii* Hormiga (Hormiga, 1994, Plate 226 ~ 229) and *P. indiscreta* Hormiga (Hormiga, 1994, Plate 251 ~ 253) in having the copulatory ducts (CD) contiguous or fused along the midline (Plate V : 20, 21); *P. lihengae* differs from these in having the spermathecae (S) inconspicuous, only slightly raised (Plate V : 21, 22), the CD narrowly contiguous both distal and proximad of the S (Plate V : 20, 21), and the CD (Plate V : 21) more strongly curved than in *P. gandhii* and less curved than in *P. indiscreta*.

**特征描述:** 雄蛛触肢器具一钩状的派模型舟状骨片及一钝圆形的舟状齿突, 齿突上明显具有多数小齿, 近似于 *Pimoa crista* (Hormiga, 1994, Plate 233, 234)。但所不同的是, 本种插入器长于派模式插入器盾板突起 (Plate V : 15), 触肢胫节不长于其宽度 (Plate V : 15 ~ 17), 大壶状腺较纤细 (Plate III : 9, V : 17)。本种雌蛛外雌器与 *P. gandhii* Hormiga

(Hormiga, 1994; Plate 226 ~ 229) 及 *P. indiscreta* Hormiga (Hormiga, 1994; Plate 251 ~ 253) 的十分相似, 具有粘合的或沿中线融合的交合管 (Plate V : 20, 21)。但本种受精囊不明显, 仅有少许隆起 (Plate V : 21, 22), 交合管仅与受精囊的远侧和近侧粘合 (Plate 20, 21), 交合管较 *P. gandhii* 的弯曲但曲率不如 *P. indiscreta*, 从而易于区别。

*Pimoa crista* (Hormiga, 1994, Plate 233, 234)(Plate V :15)(Plate V :15 ~ 17)(Plate III :9, V :17); *P. gandhii* Hormiga (Hormiga, 1994; Plate 226 ~ 229); *P. indiscreta* Hormiga (Hormiga, 1994; Plate 251 ~ 253) (Plate V :20, 21)(Plate V :21, 22)(Plate V :20, 21); *P. gandhii*; *P. indiscreta*.

NOTE. - Males of the new species *P. lihengae* key out to male couplet 9 in Hormiga (1994): they can be distinguished from *P. nematoides* Hormiga by having the CDP blunt Plate V :16) and lacking thick spines on the proximal third of femur I, from *P. sinuosa* Hormiga by not having the CDP curved toward the PCS (Plate III :8, V :17), and from both of these species by having more than 15 conspicuous denticles on the CDP (Plate V :15). Females key out to female couplet 6 in Hormiga (1994), having the apex of the epigynum rounded (Plate III :4, 6, V :18). They can be distinguished from *P. hespera* (Gertsch and Ivie) and *P. mono* Hormiga by having the CD length greater than the spermathecal width (Plate V :20, 21) and from *P. haden* Chamberlin and Ivie and *P. jellisoni* (Gertsch and Ivie) by having the ventral plate of the epigynum (VP) oval and tapering distally rather than keyhole - shaped (Plate III :6, V :21).

MALE. (holotype): Total length 6.67. Cephalothorax 3.13 long, 2.58 wide, 1.03 high; carapace yellow - brown, dusky on ocular area, pars cephalica with dark longitudinal band extending between PER and thoracic fovea, narrowest posteriorly; clypeus and lateral margins of pars thoracica mottled dusky gray. Sternum 1.93 long, 1.64 wide; sternum, labium and coxae yellow - brown, sternum dusky gray at sides, palpal coxae with transverse dusky mottling, leg coxae with dusky mottling spreading broadly on anterodistal surface and forming narrow proximal band. Abdomen 3.93 long, 2.58 wide, 2.58 high; dark gray except paler around pedicle, dorsum with four transverse light marks, anterior two and fourth paired, third entire across abdomen, venter with paired longitudinal light marks. AME diameter 0.13. PME 1.25, PLE 1.50, ALE 1.62 times one AME diameter. AME separation 0.46 times their diameter, PME separation 0.80 times their diameter. PME - PLE separation 0.90 times one PME diameter, AME - ALE separation 0.46 times one ALE diameter. Clypeus height 2.87 times one AME diameter. Chelicerae with 2 prolateral teeth and three minute retrolateral denticles. Cheliceral stridulating files conspicuous. Legs orange - brown, femora III and IV with basal, median and distal dark annuli. Leg measurements (Femur + Patella + Tibia + Metatarsus + Tarsus = [Total]): I : 7.33 + 1.13 + 7.80 + 7.27 + 2.53 = [26.06]; II : 7.13 + 1.07 + 7.00 + 6.93 + 2.13 = [24.26]; III : 4.53 + 0.80 + 3.60 + 4.00 + 1.47 = [14.40]; IV : 6.07 + 1.00 + (missing) + (missing) + (missing) = [?]; Palp: 1.07 + 0.36 + 0.43 + (absent) + 0.87 = [2.73]. Legs (of paratype) 1423. Femur I 2.27 times length of cephalothorax. Legs covered with short setae. Metatarsus I trichobothrium 0.86. Palpus as in Plates II : 3, III : 7 ~ 10, V : 15 ~ 17; tibia as wide as long, with 3 retrolateral and 2 prolateral trichobothria (Plate V : 17); cymbium

with PC hook - shaped (Plate V : 15), CDP with more than 15 cuspules (Plate V : 15, 17), PCS spindle - shaped (Plate II : 3, 17), with fine transverse striae (Plate III : 10); bulb with PEP simple, shorter than filiform E (Plate V : 15), C broad, covered with filiform processes (Plate III : 9, V : 15), largely hiding threadlike MA (Plate III : 9, V : 17).

**FEMALE.** (from ESE of Pianma): Total length 7.58. Cephalothorax 3.06 long, 2.42 wide, 0.87 high; markings as in male. Sternum 1.61 long, 1.45 wide; sternum, labium and coxae yellow - brown, unmarked. Abdomen 4.52 long, 3.42 wide, 3.55 high; markings as in male except dorsum with three pairs of procurved, transverse light marks (Plate : 1). AME diameter 0.19. PME 0.92, PLE 1.00 and ALE 1.00 times one AME diameter. AME separation 0.50 times their diameter, PME separation 0.91 times their diameter. PME - PLE separation 1.09 times one PME diameter, AME - ALE separation 0.58 times one ALE diameter. Clypeus height 1.67 times one AME diameter. Chelicerae with three large prolateral and three small retrolateral teeth. Cheliceral stridulating files inconspicuous. Legs orange - brown, femora and tibiae with basal, median and distal dark annuli (Plate I : 2). Leg measurements (Femur + Patella + Tibia + Metatarsus + Tarsus = [Total]): I :  $5.53 + 1.07 + 5.53 + 5.07 + 2.40 = [19.60]$ ; II :  $4.67 + 1.07 + 4.07 + 4.27 + 2.00 = [16.08]$ ; III :  $3.33 + 0.93 + 2.67 + 2.87 + 1.40 = [11.20]$ ; IV :  $4.60 + 1.00 + 4.00 + 3.80 + 3.07 = [16.47]$ ; Palp:  $1.07 + 0.37 + 0.43 + (\text{absent}) + 1.40 = [3.27]$ . Legs 4123. Femur I 1.74 times length of cephalothorax. Leg setation as in male. Metatarsus I trichobothrium 0.86. Spinnerets as in Plates IV : 11 ~ 14; PMS and PLS lacking AC spigots. Epigynum as in Plates II : 4 ~ 6, V : 18, 19, longer than wide, tapering to rounded tip; DP gradually narrowed distally. Vulva as in Plates V : 22 ~ 22, S inconspicuous, only slightly raised, CD strongly curved and narrowly contiguous both distad and proximad of the S.

**VARIATION.** - Male cephalothorax (N = 2) ranges in length from 2.61 to 3.13, female (N = 10) from 2.58 to 3.68. The abdominal dorsum may have one or two transverse, procurved light bands, and these bands may be divided (Plate 1) or meet in the middle.

**ADDITIONAL MATERIAL EXAMINED.** - CHINA: Yunnan: Nujiang Prefecture: Lushui County, native forest at 9.5 road km ESE Pianma, 25°59'N, 98°40'E, elev. 2 500 m, 15 ~ 18. X. 1998, C. Griswold, D. Kavanaugh, C. L. Long; Baoshan Prefecture: Bawan Township, pass over Gaoligong Mountains at 2100 m, Nankang, 36 air km SE Tengchong, 24°50'N, 98°47'E, native forest, 4 ~ 7. XI. 1998, C. Griswold, D. Kavanaugh, C. L. Long, 17 females, 9 in Biology Department, Hunan Normal University, Changsha, China, 8 in CaAS.

**DISTRIBUTION.** - Known from native forest in the Gaoligong Mountains between 2000 and 2500 m and from 26°N to 24°50'N.

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#### List of Anatomical Abbreviations Used in the Text and Plates

AC	aciniform gland spigot	FL	flagelliform gland spigot
AG	aggregate gland spigot(s)	MAP	major ampullate gland spigot
ALE	anterior lateral eyes	mAP	minor ampullate gland spigot
AME	anterior median eyes	PC	paracymbium
C	conductor	PCS	pimoid cymbial sclerite
CD	copulatory duct	PEP	pimoid embolic - tegular process
CDP	cymbial denticulate process	PER	posterior eye row
CO	copulatory opening	PI	piriform gland spigot(s)
CY	cylindrical gland spigot(s)	PLE	posterior lateral eyes
DP	dorsal plate of the epigynum	PME	posterior median eyes
E	embolus	S	spermatheca
FD	fertilization duct	VP	ventral plate of the epigynum

### References

- Bonnet P, 1957. *Bibliographia Araneorum* Volume 2, part 3. Toulouse: Les Frères Douladoure, 1927 ~ 3026
- Brignoli P M, 1971. Note sy ragni cavernicoli Italiana (Araneae). *Fragmenta Entomologica*, 7(3): 121 ~ 229
- Brignoli P M, 1983. A catalogue of the Araneae described between 1940 ~ 1981. Manchester: Manchester University Press, 755.
- Chamberlin R & Ivie W, 1943. New genera and species of North American linyphiid spiders. *Bulletin of the University of Utah, Biological Series*, 33(10): 1 ~ 39
- Coddington J A, 1983. A temporary slide mount allowing precise manipulation of small structures. *Verh. Naturwiss. Ver. Hamburg (NF)*, 26: 291 ~ 292
- Crawford R, 1988. An annotated checklist of the spiders of Washington. *Burke Museum Contributions in Anthropology and natural History*, 5: 1 ~ 48
- Fage L, 1931. *Biospeologica LV: Araneae; précédée d'un essai sur l'Evolution souterraine et son déterminisme. Archives de Zoologie Expérimentale et Générale, series 5*, 71: 99 ~ 291
- Fage L, 1946. Araignées cavernicoles de l'Inde. *Bulletin de Muséum d'Histoire Naturelle, Paris, second series*, XVIII (5): 382 ~ 388
- Horniga G, 1993. Implications of the phylogeny of Pimoidae for the systematics of linyphiid spiders (Araneae, Araneioidea, Linyphiidae). In M. S. Harvey, W. F. Humphreys, B. Y. Main & R. J. Raven (eds.); *Proceedings of the XII International Congress of Arachnology, Memoirs of the Queensland Museum*, 33(2): 533 ~ 542
- Horniga G, 1994. A revision and cladistic analysis of the spider family Pimoidae (Araneioidea; Araneae). *Smithsonian Contributions to Zoology*, 549: 1 ~ 104
- Myers N, 1988. Threatened Biotas: "Hotspots" in tropical forest. *The Environmentalist*, 8(3): 1 ~ 20
- Millidge A F, 1980. The erigonine spiders of North America. Part 1: Introduction and taxonomic background (Araneae; Linyphiidae). *Journal of Arachnology*, 8(2): 97 ~ 107
- Platnick N I, 1989. Advances in spider taxonomy: a supplement to Brignoli's A Catalogue of the Araneae described between 1940 and 1981. Manchester: Manchester Univ. Press, 673.

- Platnick N I, 1993. Advances in spider taxonomy, 1988 ~ 1991; with synonymies and transfers 1940 ~ 1980. New York Entomological Society, 846.
- Platnick N I, 1997. Advances in spider taxonomy, 1992 ~ 1995; with redcriptions 1940 ~ 1980. New York Entomological Society, 976.
- Ribera C, 1980. Araneidos Cavernícolas Ibéricos. Doctoral Dissertation. University of Barcelona, Spain
- Roewer C F, 1942. Katalog der Araneae von 1758 bis 1940. Bremen: Natura, 1: 1 ~ 1040
- Roth V D, 1988. Linyphiidae of America north of Mexico: Checklists, synonymy and literature cited. Published by the American Arachnological Society, available from Dr. Jonathan Reiskind, Dept. Zoology, University of Florida, Gainesville, FL 32611, 62.
- Wunderlich J, 1986. Spinnenfauna gestern und heute. Weisbaden: Erich Bauer Verlag, 283.

### Explanations of Plates

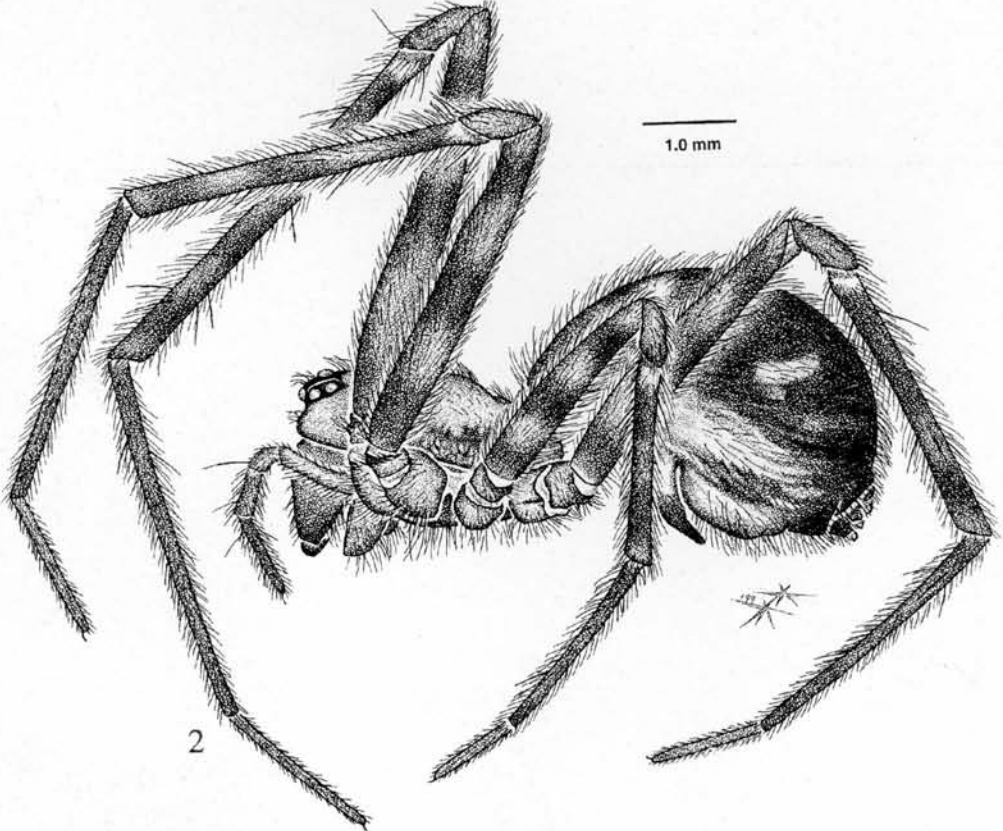
- plate I 1 ~ 2. *Pimoa lihengae*, new species, female from ESE of Pianma. 1, Dorsal. 2, lateral.
- plate II 3 ~ 6. *Pimoa lihengae*, new species. 3, Paratype male. 4 ~ 6, Female from ESE of Pianma. 3, Left palpus, ventral. 4, Epigynum, ventral. 5, Epigynum, lateral. 6, Epigynum, posterodorsal. DP - dorsal plate of the epigynum, EF - epigynal fold, VP - ventral plate of the epigynum. Scale bars for Plate 3 = 300  $\mu\text{m}$ , Plate 5 = 200  $\mu\text{m}$ , Plate 4 and 6 = 150  $\mu\text{m}$ .
- plate III 7 ~ 10. *Pimoa lihengae*, new species, paratype male, left palpus. 7, Prodistal. 8, Retrolateral. 9, Prodistal. 10, Cymbium, retrolateral. C - conductor, CDP - cymbial denticulate process, E - embolus, MA - median apophysis, PC - paracymbium, PCS - pimoid cymbial sclerite, PEP - pimoid embolic - tegular process. Scale bars for Plate 7 = 250  $\mu\text{m}$ , Plate 8 = 300  $\mu\text{m}$ , Plate 9 = 100  $\mu\text{m}$ , Fig 10 = 150  $\mu\text{m}$ .
- plate IV 11 ~ 14. *Pimoa lihengae*, new species, female from ESE of Pianma, left spinneret group. 11, Overview. 12, ALS. 13, PMS. 14, PLS. AG - aggregate gland spigot(s), CY - cylindrical gland spigot(s), FL - flagelliform gland spigot, MAP - major ampullate gland spigot, mAP - minor ampullate gland spigot, PI - piriform gland spigot(s). Scale bars for Plate 11 = 150  $\mu\text{m}$ , Plate 12 = 60  $\mu\text{m}$ , Plate 13 = 30  $\mu\text{m}$ , Plate 14 = 43  $\mu\text{m}$ .
- plate V 15 ~ 22. *Pimoa lihengae*, new species, genitalia. 15 ~ 17, holotype male, left palpus. 18 ~ 22, female from ESE of Pianma, vulva. 15, Ventral. 16, Dorsal. 17, Retrolateral. 18, Ventral. 19, Lateral. 20, Ventral, cleared. 21, Dorsal, cleared. 22, Lateral, cleared. CD - copulatory duct, CDP - cymbial denticulate process, CO - copulatory opening, DP - dorsal plate of the epigynum, FD - fertilization duct, PC - paracymbium, PCS - pimoid cymbial sclerite, PEP - pimoid embolic - tegular process, S - spermatheca, VP - ventral plate of the epigynum.





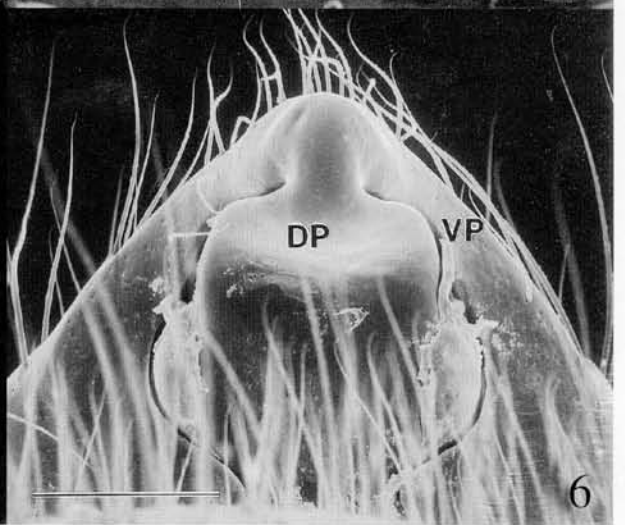
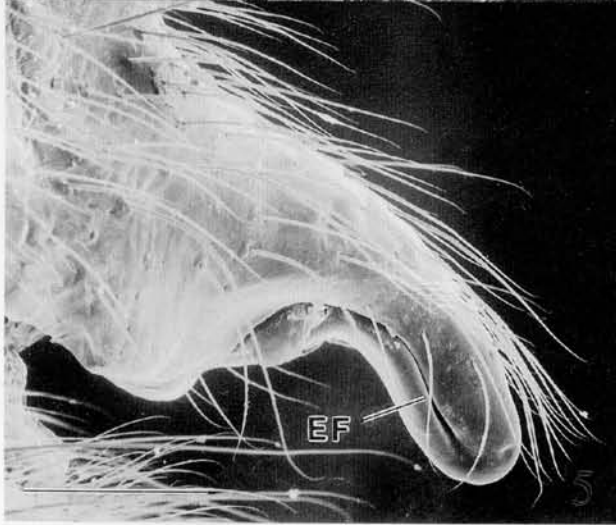
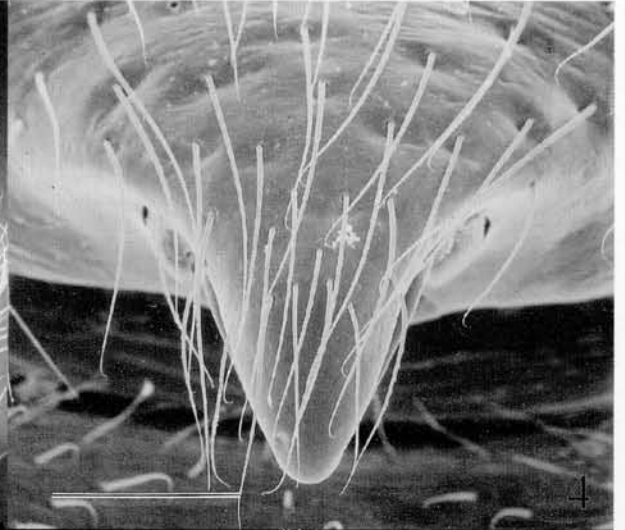
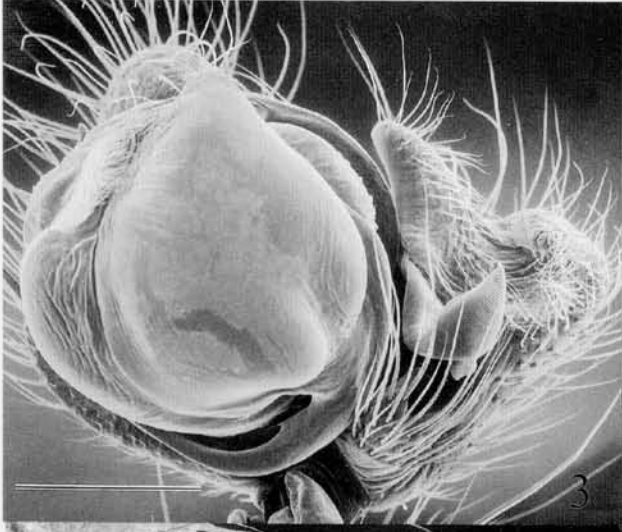


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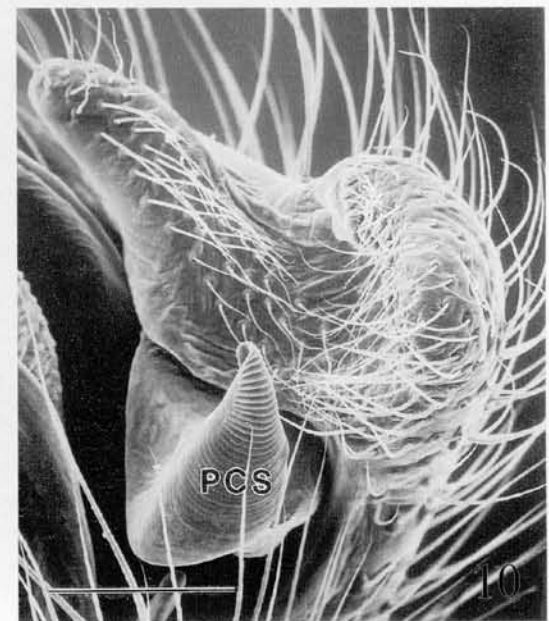
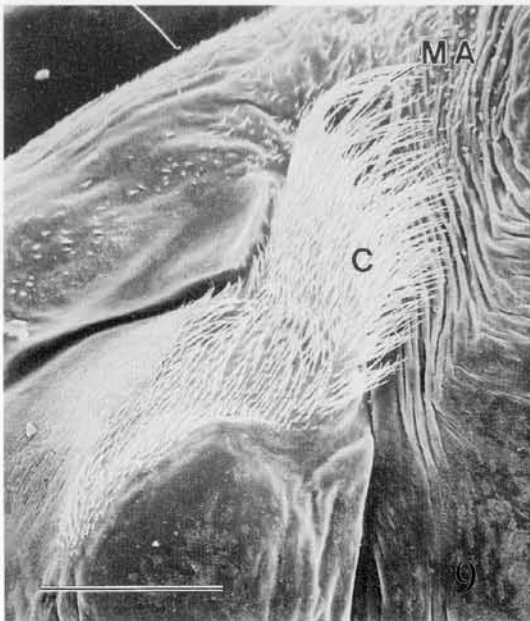
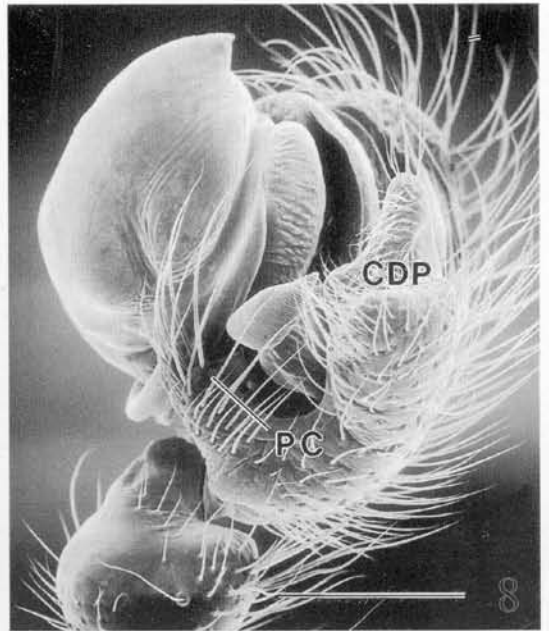
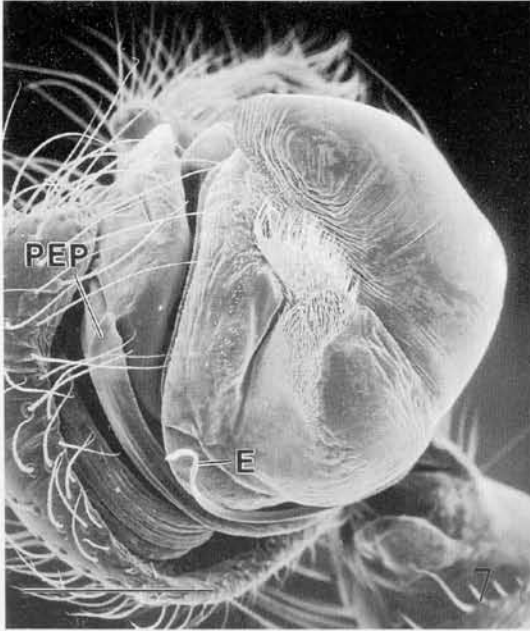


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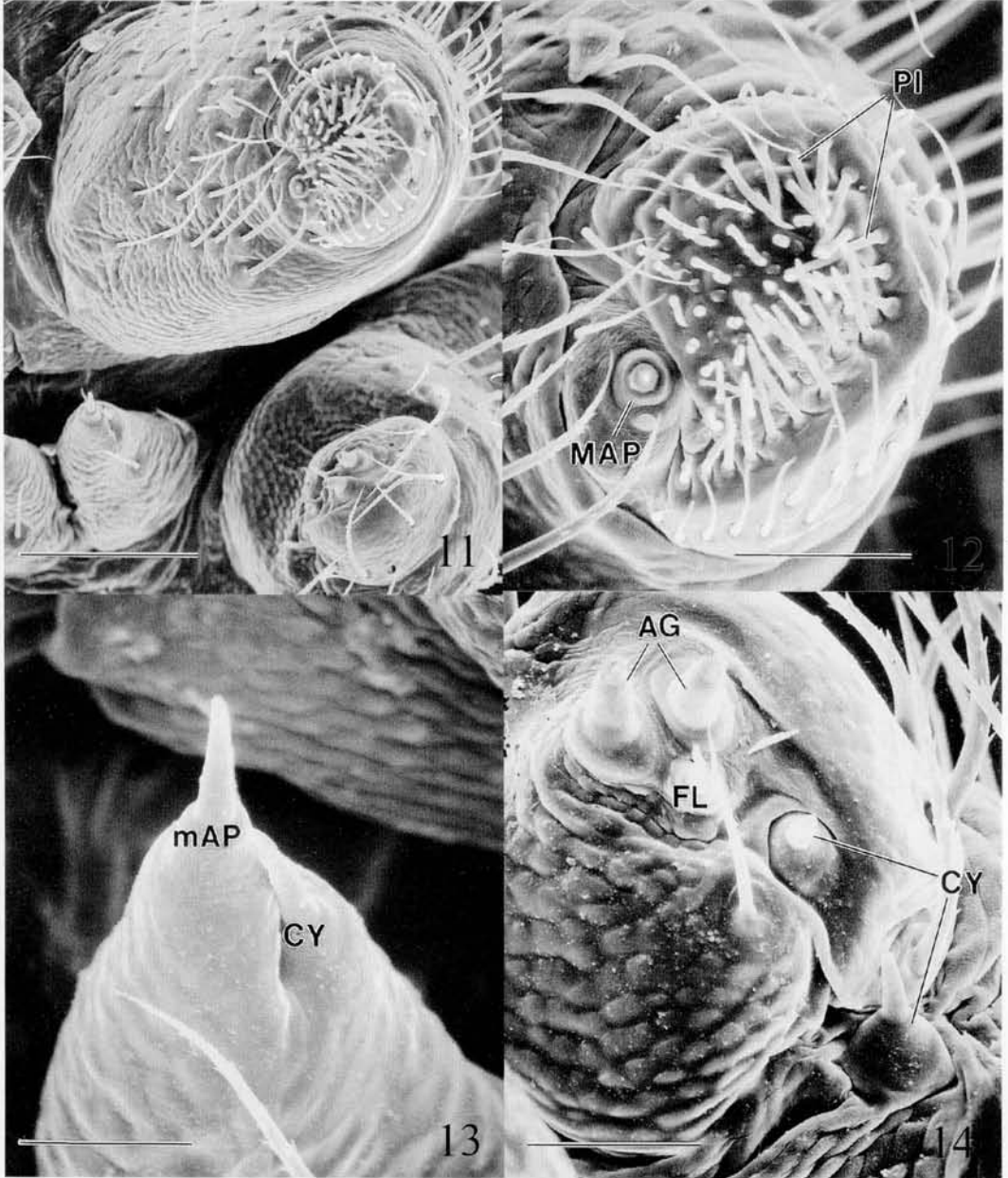
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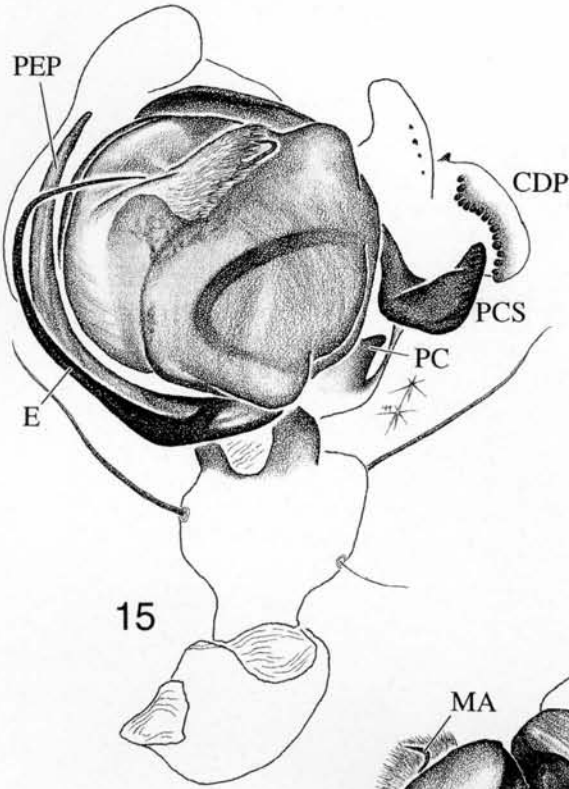
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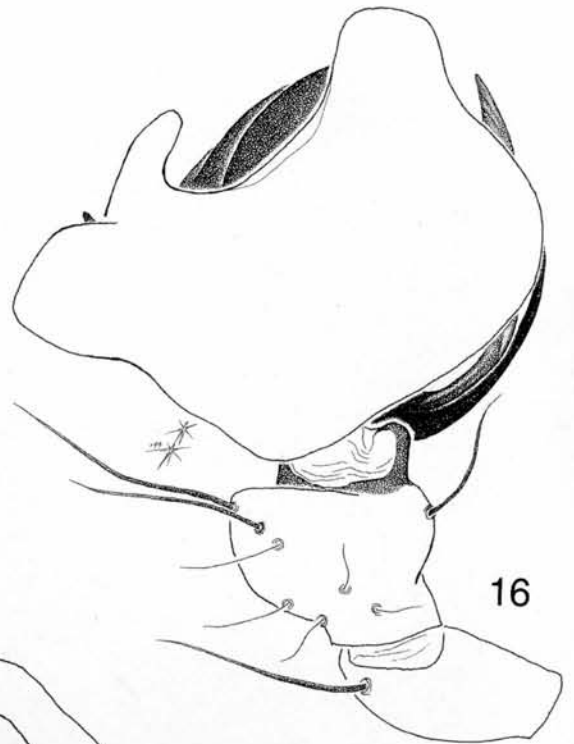
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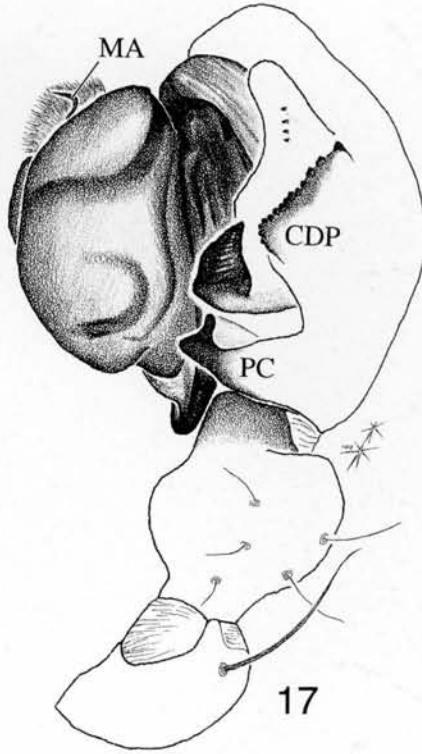
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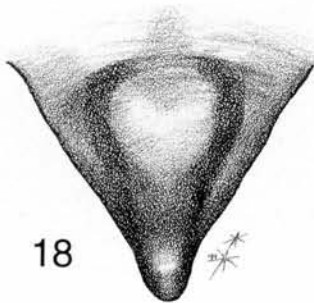
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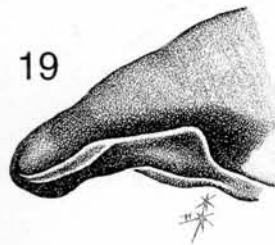
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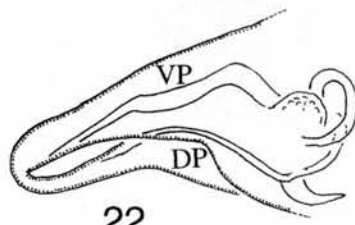
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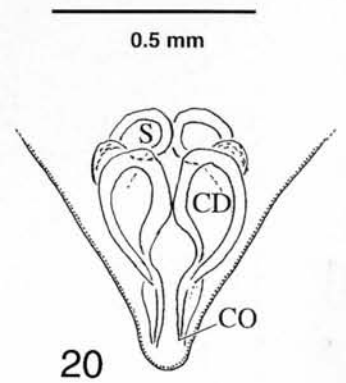
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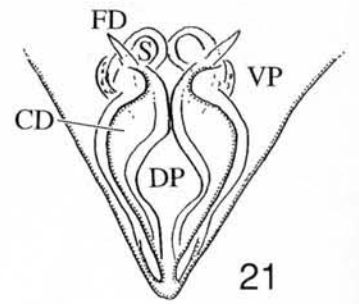
19



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See explanation at the end of text