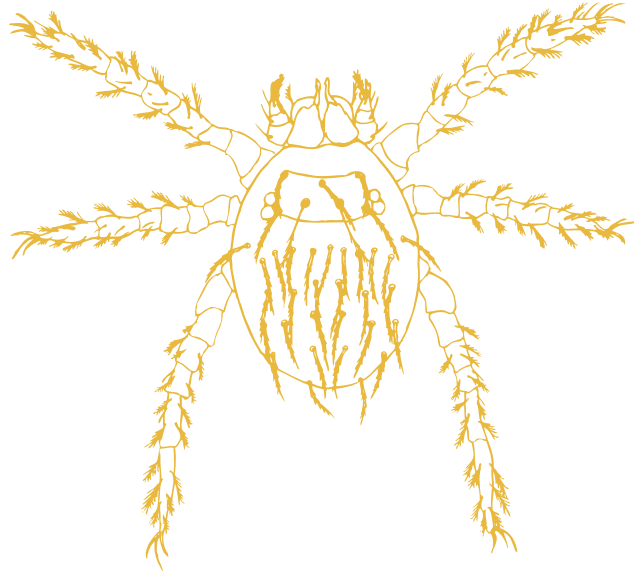


Chigger Mite Fauna of Taiwan

(Acari: Trombiculidae and Leeuwenhókiidae)

臺灣恙蟎誌



編輯群

Lo-Hsuan Chung 鍾珞璿

Centers for Disease Control,
Ministry of Health and Welfare, Taiwan

Wen-Jer Wu 吳文哲

Department of Entomology,
National Taiwan University, Taipei, Taiwan

Hsi-Chieh Wang 王錫杰

Centers for Disease Control,
Ministry of Health and Welfare, Taiwan

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Contents

序	001
Preface.....	002
Systematic Taxonomy of Chigger Mites.....	004
Morphology and Terminology of Chigger Mites	004
Key to the families and subfamilies of chigger mites in Taiwan	011
Key to the genera of chigger mites in Taiwan	011
Family Trombiculidae Ewing, 1944 恙蟎科	013
Subfamily Trombiculinae Ewing, 1929 恙蟎亞科.....	013
Genus <i>Ascoshöngastia</i> Ewing, 1946 囊棒恙蟎屬.....	013
Key to the species of the genus <i>Ascoshöngastia</i> in Taiwan.....	013
<i>Ascoshöngastia indica</i> (Hirst, 1915) 印度囊棒恙蟎.....	014
<i>Ascoshöngastia paishaensis</i> (Chen, Hsu and Wang, 1958) 白沙囊棒 恙蟎	018
<i>Ascoshöngastia rattinorvegici</i> Wen, 1984a 褐鼠囊棒恙蟎	021
Genus <i>Eutrombicula</i> Ewing, 1938 真恙蟎屬.....	025
Key to the species of the genus <i>Eutrombicula</i> in Taiwan	025
<i>Eutrombicula ablephara</i> (Womersley, 1952) 石龍真恙蟎	026
<i>Eutrombicula wichmanni</i> (Oudemans, 1905) 威氏真恙蟎	030
Genus <i>Helenicula</i> Audy, 1954 合輪恙蟎屬	034
<i>Helenicula kohlsi</i> (Philip and Woodward, 1946a) 柯氏合輪恙蟎	035
Genus <i>Herpetacarus</i> Vercammen-Grandjean, 1960 爬蟲恙蟎屬.....	039
Subgenus <i>Herpetacarus</i> Vercammen-Grandjean, 1960 爬蟲恙蟎亞屬.....	039
<i>Herpetacarus (Herpetacarus) longdongensis</i> (Mo, Li, Chen and Hsu, 1990) 龍洞爬蟲恙蟎.....	040
Genus <i>Leptotrombidium</i> Nagayo, Miyagawa, Mitamura and Imamura, 1916 纖恙蟎屬.....	043
Subgenus <i>Leptotrombidium</i> Nagayo, Miyagawa, Mitamura and Imamura, 1916 纖恙蟎亞屬.....	043
Key to the species of the subgenus <i>Leptotrombidium</i> in Taiwan.....	043
<i>Leptotrombidium (Leptotrombidium) akamushi</i> (Brumpt, 1910) 紅纖 恙蟎	045
<i>Leptotrombidium (Leptotrombidium) apodemi</i> Wen and Sun, 1984 姬鼠纖恙蟎	049



<i>Leptotrombidium (Leptotrombidium) cangjiangense</i> Yu, Yang and Gong, 1981 滄江織恙蟎	052
<i>Leptotrombidium (Leptotrombidium) deliense</i> (Walch, 1922) 地里織恙蟎	055
<i>Leptotrombidium (Leptotrombidium) fujianense</i> Liao and Wang, 1983 福建織恙蟎	061
<i>Leptotrombidium (Leptotrombidium) imphalum</i> Vercammen-Grandjean and Langston, 1975 英帕織恙蟎	064
<i>Leptotrombidium (Leptotrombidium) kawamurai</i> (Fukuzumi and Obata, 1953) 川村織恙蟎	069
<i>Leptotrombidium (Leptotrombidium) pallidum</i> (Nagayo, Miyagawa, Mitamura and Tamiya, 1919) 粗毛織恙蟎	073
<i>Leptotrombidium (Leptotrombidium) rubellum</i> Wang and Liao, 1984 微紅織恙蟎	077
<i>Leptotrombidium (Leptotrombidium) scutellare</i> (Nagayo, Miyagawa, Mitamura, Tamiya and Tenjin, 1921) 小板織恙蟎	081
<i>Leptotrombidium (Leptotrombidium) xianglinense</i> Wen, 1984c 香林織恙蟎	086
<i>Leptotrombidium (Leptotrombidium) yui</i> (Chen and Hsu, 1955) 于氏織恙蟎	089
Genus <i>Neoschöngastia</i> Ewing, 1929 新棒恙蟎屬	093
<i>Neoschöngastia posekanyi</i> Wharton and Hardcastle, 1946 波氏新棒恙蟎	094
Genus <i>Toritrombicula</i> Sasa, 1954 烏恙蟎屬	097
<i>Toritrombicula densipiliata</i> (Walch, 1923) 密毛烏恙蟎	098
Genus <i>Trombiculindus</i> Radford, 1948 葉片恙蟎屬	102
Subgenus <i>Trombiculindus</i> Radford, 1948 葉片恙蟎亞屬	102
Key to the species of the subgenus <i>Trombiculindus</i> in Taiwan	102
<i>Trombiculindus (Trombiculindus) hunanye</i> (Wen, 1984b) 湖南葉片恙蟎	103
<i>Trombiculindus (Trombiculindus) spinifolius</i> (Wang, Li and Tien, 1985) 刺葉葉片恙蟎	107
Genus <i>Walchiella</i> Fuller, 1952 毫前恙蟎屬	110
<i>Walchiella wuyiensis</i> Wang and Liao, 1981 武夷毫前恙蟎	111
Subfamily Gahrlepiinae Womersley, 1952 背展恙蟎亞科	114
Genus <i>Gahrlepiea</i> Oudemans, 1912 背展恙蟎屬	114
Subgenus <i>Gateria</i> Ewing, 1938 革脫恙蟎亞屬	114

Key to the species of the subgenus <i>Gateria</i> in Taiwan	114
<i>Gahrliopia (Gateria) lienii</i> Chung, Wu, Kuo and Wang, 2015 連氏背 展恙蟎	116
<i>Gahrliopia (Gateria) linguipelta</i> Jeu, Yu and Wan, 1983 舌板背展恙蟎	120
<i>Gahrliopia (Gateria) longipedalis</i> Yu and Yang, 1986 長足背展恙蟎	123
<i>Gahrliopia (Gateria) minuta</i> Chung, Wu, Kuo and Wang, 2015 微小 背展恙蟎	127
<i>Gahrliopia (Gateria) yilanensis</i> Chung, Wu, Kuo and Wang, 2015 宜蘭背展恙蟎	130
Genus <i>Walchia</i> Ewing, 1931 無前恙蟎屬	133
Subgenus <i>Walchia</i> Ewing, 1931 無前恙蟎亞屬	133
Key to the species of the subgenus <i>Walchia</i> in Taiwan	133
<i>Walchia (Walchia) acugastia</i> Wen, Yu and Yang, 1984 尖棒無前恙蟎	134
<i>Walchia (Walchia) chinensis</i> (Chen and Hsu, 1955) 中華無前恙蟎	137
<i>Walchia (Walchia) fragilis</i> Schluger, 1955 脆弱無前恙蟎	141
<i>Walchia (Walchia) jiangxiensis</i> Wang and Song, 1981 江西無前恙蟎	145
<i>Walchia (Walchia) kritochoeta</i> (Traub and Evans, 1957) 瓣毛無前恙蟎	148
<i>Walchia (Walchia) pacifica</i> (Chen and Hsu, 1955) 太平洋無前恙蟎	151
<i>Walchia (Walchia) parapacifica</i> (Chen, Hsu and Wang, 1956) 似太 平洋無前恙蟎	155
<i>Walchia (Walchia) xishaensis</i> Zhao, Tang and Mo, 1986 西沙無前恙蟎	159
Family Leeuwenhökiiidae Womersley, 1944 列恙蟎科	162
Subfamily Leeuwenhökiiinae Womersley, 1944 列恙蟎亞科	162
Genus <i>Odontacarus</i> Ewing, 1929 螯齒恙蟎屬	162
<i>Odontacarus majesticus</i> (Chen and Hsu, 1955) 巨螯齒恙蟎	163
References	167
Index	176

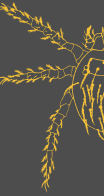
List of Tables

Table 1. Standard measurements (in μm) of <i>Ascoshöngastia indica</i> larval scutum.....	015
Table 2. Standard measurements (in μm) of <i>Ascoshöngastia paishaensis</i> larval scutum.....	019
Table 3. Standard measurements (in μm) of <i>Ascoshöngastia rattinorvegici</i> larval scutum.....	022
Table 4. Measurements of scutum and idiosomal setae of the anomalous <i>Ascoshöngastia rattinorvegici</i> (IW0048-9-4).....	023
Table 5. Standard measurements (in μm) of <i>Eutrombicula ablephara</i> larval scutum.....	027
Table 6. Standard measurements (in μm) of <i>Eutrombicula wichmanni</i> larval scutum.....	031
Table 7. Standard measurements (in μm) of <i>Helenicula kohlsi</i> larval scutum.....	036
Table 8. Standard measurements (in μm) of <i>Herpetacarus (Herpetacarus) longdongensis</i> larval scutum.....	041
Table 9. Standard measurements (in μm) of <i>Leptotrombidium (Leptotrombidium) akamushi</i> larval scutum.....	046
Table 10. Standard measurements (in μm) of <i>Leptotrombidium (Leptotrombidium) apodemi</i> larval scutum.....	050
Table 11. Standard measurements (in μm) of <i>Leptotrombidium (Leptotrombidium) cangjiangense</i> larval scutum.....	053
Table 12. Standard measurements (in μm) of <i>Leptotrombidium (Leptotrombidium) deliense</i> larval scutum.....	056
Table 13. Standard measurements (in μm) of <i>Leptotrombidium (Leptotrombidium) fujianense</i> larval scutum.....	062
Table 14. Standard measurements (in μm) of <i>Leptotrombidium (Leptotrombidium) imphalum</i> larval scutum.....	065
Table 15. Standard measurements (in μm) of <i>Leptotrombidium (Leptotrombidium) kawamurai</i> larval scutum.....	070
Table 16. Standard measurements (in μm) of <i>Leptotrombidium (Leptotrombidium) pallidum</i> larval scutum.....	074



Table 17. Standard measurements (in μm) of <i>Leptotrombidium (Leptotrombidium) rubellum</i> larval scutum	078
Table 18. Standard measurements (in μm) of <i>Leptotrombidium (Leptotrombidium) scutellare</i> larval scutum	082
Table 19. Standard measurements (in μm) of <i>Leptotrombidium (Leptotrombidium) xianglinense</i> larval scutum	087
Table 20. Standard measurements (in μm) of <i>Leptotrombidium (Leptotrombidium) yui</i> larval scutum.....	090
Table 21. Standard measurements (in μm) of <i>Neoschöngastia posekanyi</i> larval scutum.....	095
Table 22. Standard measurements (in μm) of <i>Toritrombicula densipiliata</i> larval scutum.....	099
Table 23. Standard measurements (in μm) of <i>Trombiculindus (Trombiculindus) hunanye</i> larval scutum	104
Table 24. Standard measurements (in μm) of <i>Trombiculindus (Trombiculindus) spinifolius</i> larval scutum.....	108
Table 25. Standard measurements (in μm) of <i>Walchiella wuyiensis</i> larval scutum	112
Table 26. Standard measurements (in μm) of <i>Gahrlepiea (Gateria) lieni</i> larval scutum.....	117
Table 27. Standard measurements (in μm) of <i>Gahrlepiea (Gateria) linguipelta</i> larval scutum.....	121
Table 28. Standard measurements (in μm) of <i>Gahrlepiea (Gateria) longipedalis</i> larval scutum.....	124
Table 29. Standard measurements (in μm) of <i>Gahrlepiea (Gateria) minuta</i> larval scutum.....	128
Table 30. Standard measurements (in μm) of <i>Gahrlepiea (Gateria) yilanensis</i> larval scutum.....	131
Table 31. Standard measurements (in μm) of <i>Walchia (Walchia) acugastia</i> larval scutum.....	135
Table 32. Standard measurements (in μm) of <i>Walchia (Walchia) chinensis</i> larval scutum.....	138
Table 33. Standard measurements (in μm) of <i>Walchia (Walchia) fragilis</i> larval scutum.....	142

Table 34. Standard measurements (in μm) of <i>Walchia (Walchia) jiangxiensis</i> larval scutum.....	146
Table 35. Standard measurements (in μm) of <i>Walchia (Walchia) kritochaeta</i> larval scutum.....	149
Table 36. Standard measurements (in μm) of <i>Walchia (Walchia) pacifica</i> larval scutum.....	152
Table 37. Standard measurements (in μm) of <i>Walchia (Walchia) parapacifica</i> larval scutum.....	156
Table 38. Standard measurements (in μm) of <i>Walchia (Walchia) xishanensis</i> larval scutum.....	160
Table 39. Standard measurements (in μm) of <i>Odontacarus majesticus</i> larval scutum.....	164



List of Figures

Fig. 1. Dorsal and ventral view of chigger mite	008
Fig. 2. A. Dorsal gnathosoma; B. ventral gnathosoma; leg I (C), leg II (D) and leg III (E) of <i>Gahrlepiea (Gateria) lienii</i> ; leg III (F) of <i>Eutrombicula wichmanni</i>	009
Fig. 3. Scutum of: A. <i>Leptotrombidium (L.) pallidum</i> ; B. <i>Ascoshöngastia rattinorvegici</i> ; C. <i>Odontacarus majesticus</i> ; D. <i>Walchia (W.) acugastia</i> ; E. <i>Gahrlepiea (Gateria) longipedalis</i>	010
Fig. 4. <i>Ascoshöngastia indica</i> (Hirst, 1915) larva.....	017
Fig. 5. <i>Ascoshöngastia paishaensis</i> (Chen, Hsu and Wang, 1958) larva	020
Fig. 6. <i>Ascoshöngastia rattinorvegici</i> Wen, 1984a larva	024
Fig. 7. <i>Eutrombicula ablephara</i> (Womersley, 1952) larva	029
Fig. 8. <i>Eutrombicula wichmanni</i> (Oudemans, 1905) larva	033
Fig. 9. <i>Helenicula kohlsi</i> (Philip and Woodward, 1946a) larva	038
Fig. 10. <i>Herpetacarus (Herpetacarus) longdongensis</i> (Mo, Li, Chen and Hsu, 1990) larva.....	042
Fig. 11. <i>Leptotrombidium (Leptotrombidium) akamushi</i> (Brumpt, 1910) larva ...	048
Fig. 12. <i>Leptotrombidium (Leptotrombidium) apodemi</i> Wen and Sun, 1984 larva	051
Fig. 13. <i>Leptotrombidium (Leptotrombidium) cangjiangense</i> Yu, Yang and Gong, 1981 larva	054
Fig. 14. <i>Leptotrombidium (Leptotrombidium) deliense</i> (Walch, 1922) larva	060
Fig. 15. <i>Leptotrombidium (Leptotrombidium) fujianense</i> Liao and Wang, 1983 larva.....	063
Fig. 16. <i>Leptotrombidium (Leptotrombidium) imphalum</i> Vercammen-Grandjean and Langston, 1975 larva	068
Fig. 17. <i>Leptotrombidium (Leptotrombidium) kawamurai</i> (Fukuzumi and Obata, 1953) larva.....	072
Fig. 18. <i>Leptotrombidium (Leptotrombidium) pallidum</i> (Nagayo, Miyagawa, Mitamura and Tamiya, 1919) larva	076
Fig. 19. <i>Leptotrombidium (Leptotrombidium) rubellum</i> Wang and Liao, 1984 larva	080

Fig. 20. <i>Leptotrombidium (Leptotrombidium) scutellare</i> (Nagayo, Miyagawa, Mitamura, Tamiya and Tenjin, 1921) larva	085
Fig. 21. <i>Leptotrombidium (Leptotrombidium) xianglinense</i> Wen, 1984c larva	088
Fig. 22. <i>Leptotrombidium (Leptotrombidium) yui</i> (Chen and Hsu, 1955) larva ...	092
Fig. 23. <i>Neoschöngastia posekanyi</i> Wharton and Hardcastle, 1946 larva	096
Fig. 24. <i>Toritrombicula densipiliata</i> (Walch, 1923) larva.....	101
Fig. 25. <i>Trombiculindus (Trombiculindus) hunanye</i> (Wen, 1984b) larva	106
Fig. 26. <i>Trombiculindus (Trombiculindus) spinifolius</i> (Wang, Li and Tien, 1985) larva.....	109
Fig. 27. <i>Walchiella wuyiensis</i> Wang and Liao, 1981 larva	113
Fig. 28. <i>Gahrliepia (Gateria) lienii</i> Chung, Wu, Kuo and Wang, 2015 larva	119
Fig. 29. <i>Gahrliepia (Gateria) linguipelta</i> Jeu, Yu and Wan 1983 larva.....	122
Fig. 30. <i>Gahrliepia (Gateria) longipedalis</i> Yu and Yang 1986 larva.....	126
Fig. 31. <i>Gahrliepia (Gateria) minuta</i> Chung, Wu, Kuo and Wang, 2015 larva ...	129
Fig. 32. <i>Gahrliepia (Gateria) yilanensis</i> Chung, Wu, Kuo and Wang, 2015 larva	132
Fig. 33. <i>Walchia (Walchia) acugastia</i> Wen, Yu and Yang, 1984 larva.....	136
Fig. 34. <i>Walchia (Walchia) chinensis</i> (Chen and Hsu, 1955) larva	140
Fig. 35. <i>Walchia (Walchia) fragilis</i> Schluger, 1955 larva.....	144
Fig. 36. <i>Walchia (Walchia) jiangxiensis</i> Wang and Song, 1981 larva	147
Fig. 37. <i>Walchia (Walchia) kritochaeta</i> (Traub and Evans, 1957) larva.....	150
Fig. 38. <i>Walchia (Walchia) pacifica</i> (Chen and Hsu, 1955) larva.....	154
Fig. 39. <i>Walchia (Walchia) parapacifica</i> (Chen, Hsu and Wang, 1956) larva.....	158
Fig. 40. <i>Walchia (Walchia) xishaensis</i> Zhao, Tang and Mo, 1986 larva.....	161
Fig. 41. <i>Odontacarus majesticus</i> (Chen and Hsu, 1955) larva	166



序

恙蟎係屬蛛形綱 (Arachnida)，蜱蟎亞綱 (Acari)，真蟎目 (Acariformes)，前氣孔亞目 (Prostigmata)，絨蟎總科 (Trombidioidea)，恙蟎科 (Trombiculidae) 及列恙蟎科 (Leeuwenhökidae)，為一群具有人畜醫學重要性的微小節肢動物，幼蟲為寄生性，若蟲與成蟲則於地表自由生活。恙蟎幼蟲微小，體長約 0.2~0.3 mm，肉眼幾乎看不見，因其為寄生性，容易採集，因此恙蟎之分類幾乎完全依據幼蟲之形態。恙蟎幼蟲的寄主非常廣泛，包括哺乳類、鳥類、爬蟲類及兩棲類，多數恙蟎種類沒有寄主專一性。目前全世界有記錄之恙蟎種類約 3,000 多種（黎家燦等, 1997），但能傳播人類恙蟲病的恙蟎，以 *Leptotrombidium* 屬之 *Leptotrombidium* 亞屬最重要。恙蟲病流行於東亞地區，因此東亞各國對恙蟲病及其傳播媒介多有研究，發現會傳播恙蟲病的種類只佔恙蟎科及列恙蟎科一小部分。臺灣過往有許多國內外學者進行恙蟲病病媒調查，發現許多恙蟎種類，共計 15 屬 18 個已知種及 7 個未知種，但未經形態描述。本書以臺灣數量最多的野生哺乳動物低海拔鼠類、鼯鼠類為主，並延伸至高海拔鼠類、鼯鼠類動物及其他野生動物如蝙蝠、鳥類、蜥蜴及食肉目動物等，進行恙蟎採集、整理、鑑定，撰寫成本書，共詳述臺灣現存恙蟎種類 2 科 2 亞科 12 屬 38 種的分布及形態特徵，包括 23 個新紀錄種及 3 個新種，並建立屬檢索表及種檢索表，以為後繼研究者參考，希冀充實臺灣生物多樣性資料庫，增進臺灣生物資源監測、維護與永續利用。

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Preface

Chigger mites are tiny arthropods of significant medical and veterinary importance and belong to the families Trombiculidae and Leeuwenhökiiidae of the superfamily Trombidioidea, the suborder Prostigmata, the order Acariformes in the class Arachnida. Only the larval stage (chiggers) is parasitic, while nymphal and adult chigger mites are free living on the ground. Because the parasitic form is easier to be collected, even though their body length is 0.2-0.3 mm and hard to see, the identification of chigger mites is based mainly on the larval stage. The host range of chiggers are broad, including mammals, birds, reptiles and amphibians, and most of them are not host specific. According to Li et al. (1997), about 3,000 species of chiggers were recorded in the world; however, only species belong to the subgenus *Leptotrombidium*, genus *Leptotrombidium* were main vectors of scrub typhus. Scrub typhus is endemic in East Asia, where only a small proportion of chigger mite species is found to be capable of vectoring the disease. In Taiwan, at least 25 chigger mite species belonging to 15 genera, including seven unidentified species, have been recorded but their morphology is still not fully described and compared. We recovered chiggers in Taiwan from wildlife ranging from low to high altitudes; mainly include rodents, shrews, bats, birds, lizards and carnivores. A total of 38 chigger mite species belonging to 12 genera, 2 subfamilies, 2 families have been identified, including 3 new species and 23 new record species in Taiwan. Their detailed information on morphological characters, illustrations, distributions and keys were provided for further research. This volume can not only assist the identification of chigger mites but also supplement the biodiversity database of Taiwan.

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Systematic Taxonomy of Chigger Mites

Chigger mites are larvae of trombiculid mites, which belong to:

Kingdom Animalia 動物界

Phylum Arthropoda 節肢動物門

Class Arachnida 蛛形綱

Subclass Acari 蟎亞綱

Order Acariformes 真蟎目

Suborder Prostigmata 前氣門亞目

Families Trombiculidae and Leeuwenhökidae 恙蟎科及列
恙蟎科

Nymphs and adults of trombiculid mites are characterized with body similar to the number “8” in shape. Chigger mites, on the other hand, are usually oval. Tarsus of palpus thumb-like, situates on the ventral side of palpotibia, forming a thumb-claw complex with palpal claw. Dorsal idiosoma bears a scutum with a pair of sensillae.

Morphology and Terminology of Chigger Mites

Chigger mites are usually oval in shape, consisting of a gnathosoma at anterior, an idiosoma and six legs (Fig. 1).

Gnathosoma is composed of a pair of chelicerae, siding with a pair of palpi (Figs. 2A–B).

Chelicera locates in the central gnathosoma, composed of a cheliceral base and a distal cheliceral blade. The apex of cheliceral blade usually bears a tricuspid cap; different types and numbers of teeth can be observed in certain species.

Palpus consists of six segments: gnathosomal base, trochanter, palpofemur, palpogenu, palpotibia and palpotarsus. The trochanter is usually small and fused with gnathosomal base. Gnathosomal base is round, bearing a pair of setae near basal. The distal end of gnathosomal base is projected anteriorly, forming galea, which can be seen from dorsal with a galeal seta on apex. Palpofemur and palpogenu each bears a seta on dorsal side, and palpotibia bears three setae on dorsal, lateral and ventral side, respectively. Distal end of palpotibia forms



furcated palpal claw. Palpotarsus situates at the inner-ventral side of palpotibia, and usually bears 4–7 branched setae (4B–7B) and one thick and blunt solenidion (always present; sensory function). A nude seta (subterminala) can be seen on the palpotarsus in certain species, e.g., “7Bs” represents a species with seven branched setae and one nude subterminala on palpotarsus. The form and number of palpal setae are important features for chigger mite identification.

Scutum locates on the anterior-dorsal side of idiosoma, and can be seen in numerous shapes (rectangular, pentagonal, hexagonal, trapezoidal...) (Figs. 3A–E). Anterolateral shoulders of scutum (anterolateral setae not on the anterior margin) are present in some species (Fig. 3B). In some species of Leeuwenhökiiidae, an anteromedian projection can be observed in the middle of scutal anterior margin (Fig. 3C). Scutum bears scutal setae and a pair of sensillae. Different species of chigger mites have various numbers of scutal setae, and based on different location on the scutum, the scutal setae generally include anteromedian seta (AM), anterolateral seta (AL), posterolateral seta (PL), and post-posterolateral seta (PPL). Relative position between PLs and sensillary bases (SB) is also examined, e.g., SB/PL represents SB above PL; SB-PL represents SB and PL are on the same level; PL/SB represents PL above SB. Eyes are usually present besides scutum, and absent in certain species.

In addition to scutum, idiosoma also bears plenty of idiosomal setae, including humeral setae (HS) (first row on dorsal idiosoma, usually 1–2 pairs), dorsal setae (DS) (setae on dorsal idiosoma), sternal setae (ST) (anterior half of ventral idiosoma, usually 2–3 pairs) and ventral setae (VS) (rest of the setae on ventral idiosoma). Separated by anus on venter, VS can be divided into preanal setae and postanal setae. In chigger mite taxonomic study, the shape of scutum, number and form of scutal setae, sensillae and idiosomal setae, and measurements of the characteristics mentioned above are all extremely significant for morphological identification.

Chigger mites have six legs in three pairs, and each pair consists of six or seven segments (Figs. 1, 2C–F). From proximal to distal, the segments are: coxa, trochanter, femur (basifemur and telofemur in 7-segmented species), genu, tibia, and tarsus. Close to antero-distal edge of coxa I lies an urstigma (Fig. 1), which is a pore-like sensory organ. Coxae I–III each bears at least one coxal seta, and various branched setae covered the other segments. Besides branched setae, other types of setae may also be found on tarsi, tibiae, genua, and femora, e.g., long flagellum-like setae (mastitarsala, mastitibiala, mastigenuala, mastifemorala...),

thick and stout nude setae (tarsala, tibiala, genuala, femorala), and minute spine-like setae (microtarsala, microtibiala, microgenuala...). Each leg also bears two claws and one slender empodium at distal end. On tarsus I and II, a nude pretarsala can be observed near distal, and subterminala and parasubterminala are found on dorsal tarsus I. Numbers and forms of setae on legs are also crucial features for identification.

Terminology and abbreviation given below basically follow Goff et al. (1982), with some alterations.

AL: anterolateral seta; length of AL.

AM: anteromedian seta; length of AM.

AP: distance from base of AL to base of PL on the same side.

ASB: distance from extreme anterior margin of scutum to the level of sensillary base.

AW: distance between bases of ALs.

B: branched seta.

CS: caudal seta.

DS: dorsal idiosomal seta; number of DS.

fD: DS arrangement formula.

fPp: palpal setal formula; e.g., fPp = N/N/BNN/7B, where N/N = nude setae on palpofemur and palpogenu; BNN = branched seta on dorsal palpotibia and nude setae on lateral and ventral palpotibia, respectively; 7B = seven branched setae on palpotarsus.

fsp: leg segmentation formula.

HS: humeral seta; length of HS.

Ip: total length of leg I–III on one side.

N: nude seta.

NDV: numbers of dorsal and ventral setae.

PL: posterolateral seta; length of PL.

PP: distance from base of PL to extreme posterior margin of scutum.

PPL: post-posterolateral seta.

PS: distance from sensillary base to base of PL on the close side.

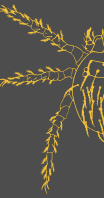
PSB: distance from the level of sensillary base to extreme posterior margin of scutum.

PW: distance between bases of PLs.

SB: sensillary bases; distance between sensillary bases.

SD: ASB + PSB; length of scutum.

SIF: synthetic identification formula; e.g., SIF = 7Bs-B-3-2111.0000, where 7Bs = seven branched setae and one subterminala on palpotarsus; B = branched



galeal seta; 3 = palpal claw 3-pronged; 2111 = two genualae on leg I, one genuala on leg II, one genuala on leg III, and one tibiala on leg III; 0000 = number of mastitarsala, mastitibiala, mastigenuala or presence of more than one genuala III (0 or 1), and mastifemorala, respectively.

SN: sensillae; length of SN.

ST: sternal seta.

SW: width of hexagonal scutum.

VS: ventral idiosomal setae; number of VS.

VS (post): medial ventral setae of first postanal row.

VS (pre): medial ventral setae of first preanal row.

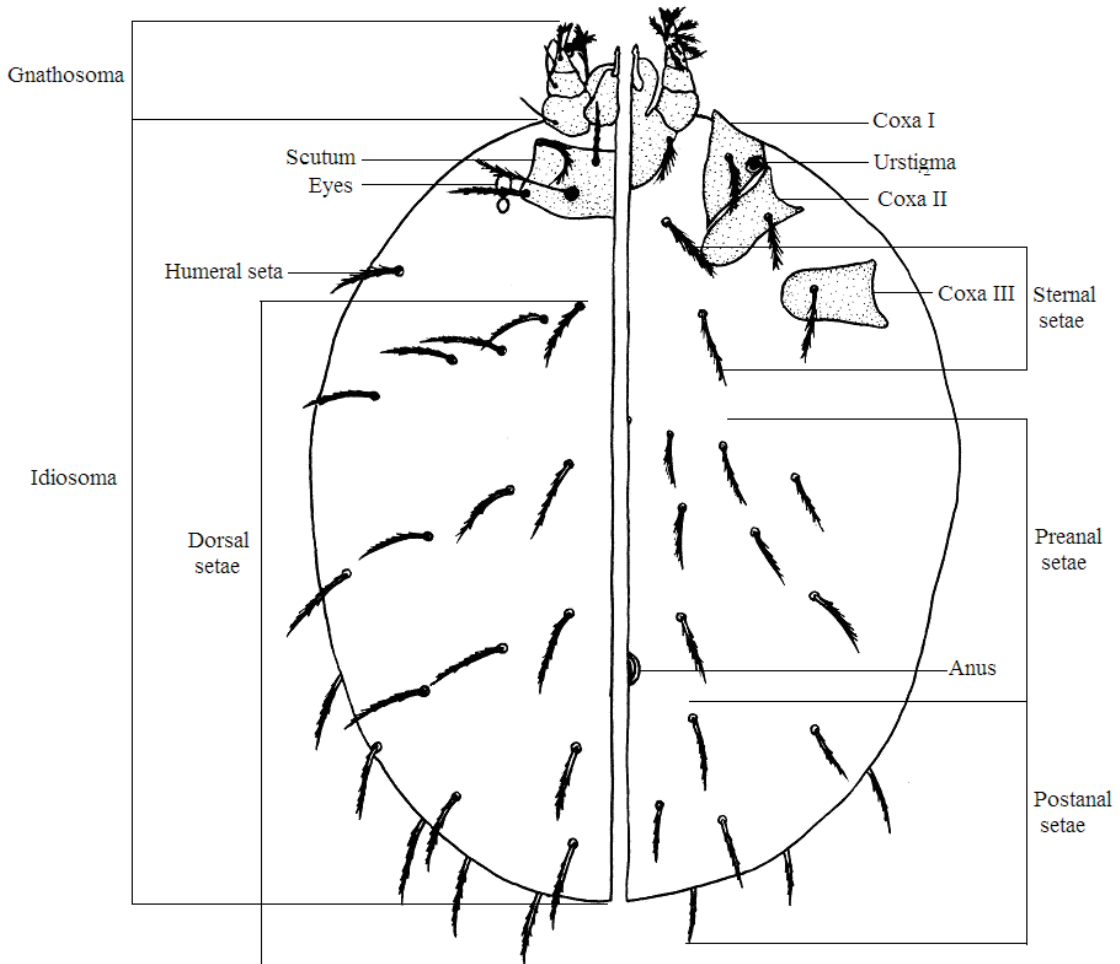
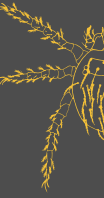


Fig. 1. Dorsal and ventral view of chigger mite.

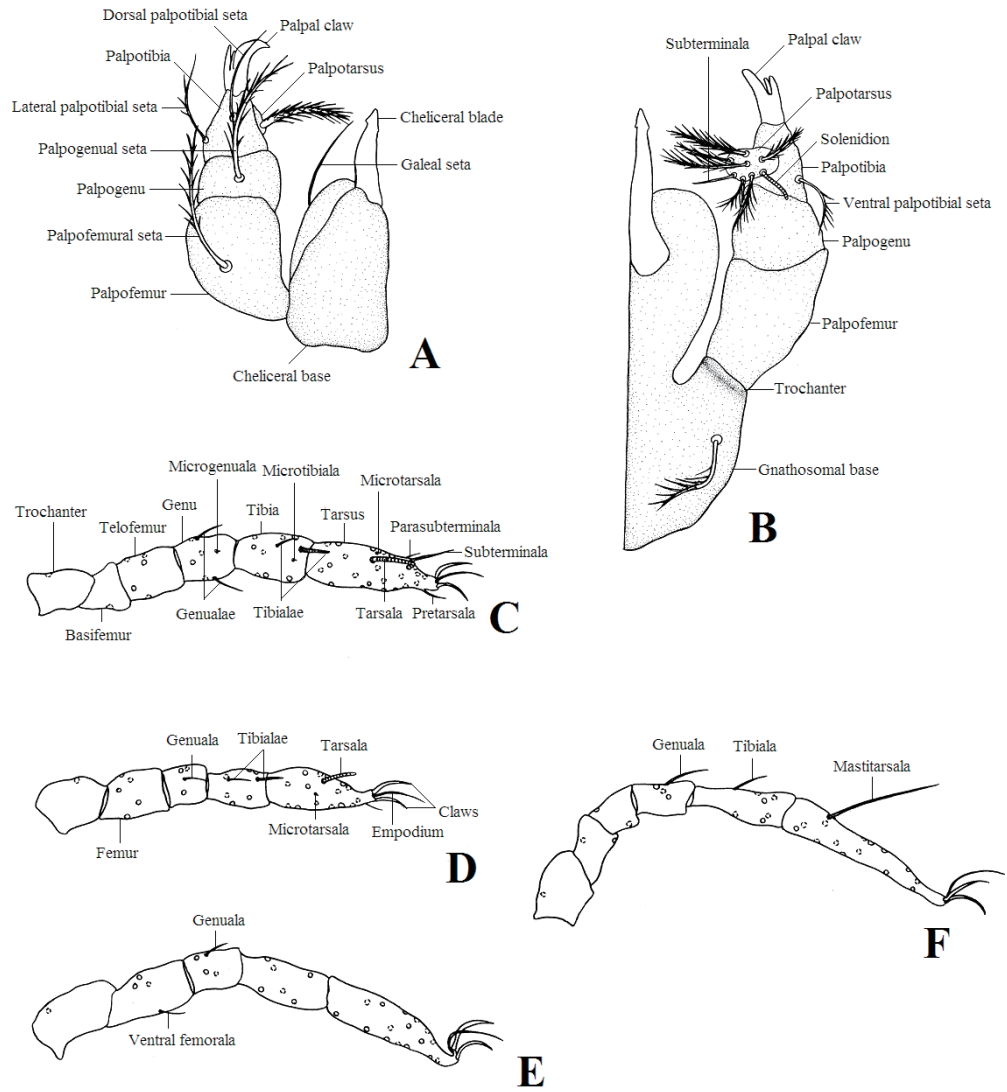


Fig. 2. A. Dorsal gnathosoma; B. ventral gnathosoma; leg I (C), leg II (D) and leg III (E) of *Gahrlepiea (Gateria) lieni*; leg III (F) of *Eutrombicula wichmanni*.

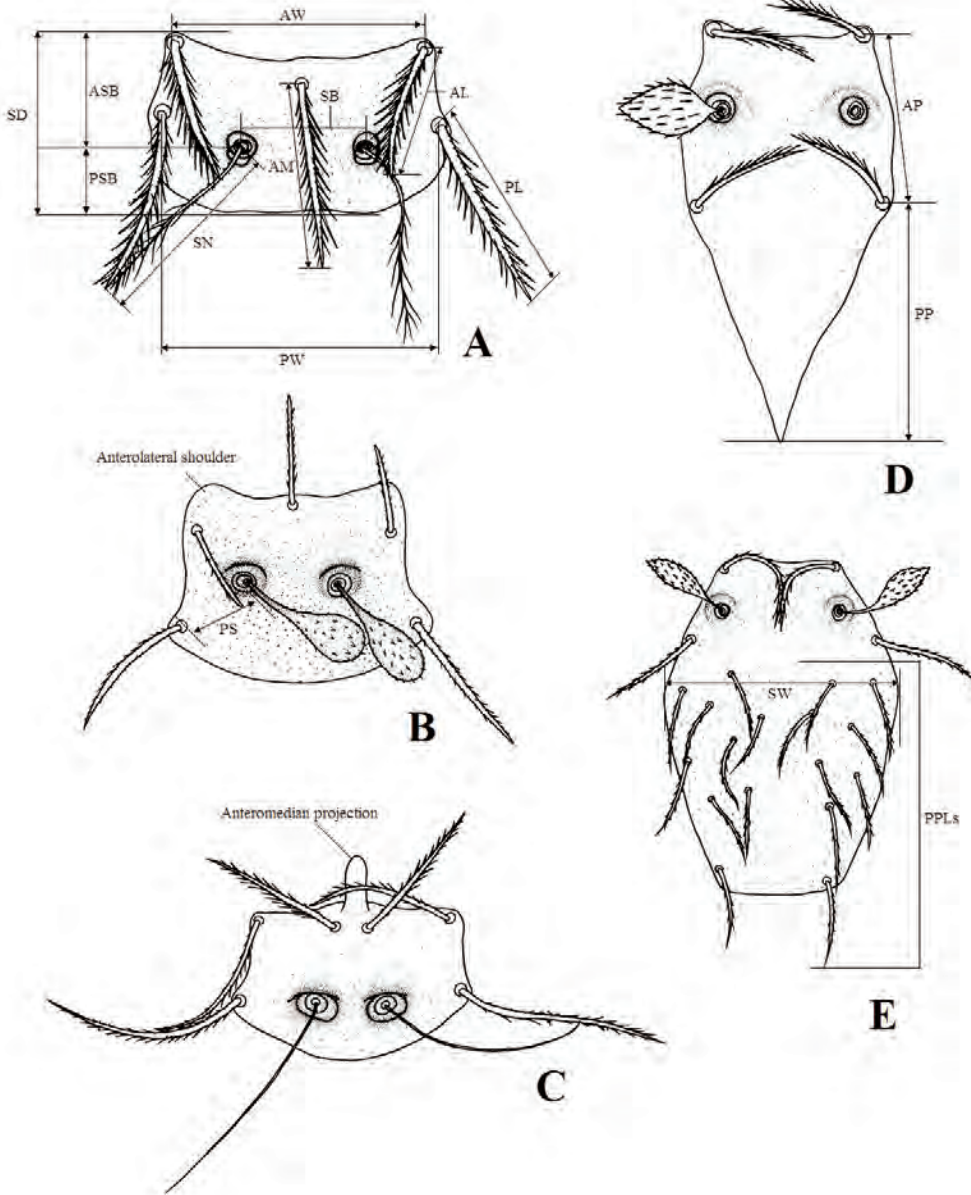


Fig. 3. Scutum of: A. *Leptotrombidium (L.) pallidum*; B. *Ascoschöngastia rattinorvegici*; C. *Odontacarus majesticus*; D. *Walchia (W.) acugastia*; E. *Gahrlepiea (Gateria) longipedalis*. Terminologies used for measurements are listed and explained in pages 6 and 7.



Key to the families and subfamilies of chigger mites in Taiwan

1. Scutum with 1 AM or without AM; lack of anteromedian projection; legs 7-6-6 or 7-7-7 segmented Trombiculidae 恙蟎科 ... 2
 Scutum with 2 AMs; with or without anteromedian projection; legs 6-6-6 segmented Leeuwenhökiiidae 列恙蟎科
2. Scutum with 1 AM; legs 7-6-6 or 7-7-7 segmented Trombiculinae 恙蟎亞科
 Scutum without AM; legs 7-6-6 segmented Gahrlepiinae 背展恙蟎亞科

Key to the genera of chigger mites in Taiwan

1. Scutum with 2 AMs; with anteromedian projection; legs 6-6-6 segmented
 Leeuwenhökiiidae 列恙蟎科 *Odontacarus* 螫齒恙蟎屬
 Scutum with 1 AM or without AM; lack of anteromedian projection; legs 7-6-6 or 7-7-7 segmented Trombiculidae 恙蟎科 ... 2
2. Scutum with 1 AM; wider than long; legs 7-6-6 or 7-7-7 segmented
 Trombiculinae 恙蟎亞科 ... 3
 Scutum without AM; longer than wide; legs 7-6-6 segmented
 Gahrlepiinae 背展恙蟎亞科 ... 11
3. SN expanded, usually clavate, long-clavate or globose 4
 SN flagelliform, with branches on distal 8
4. Legs 7-6-6 segmented; AM usually longer than PL *Walchiella* 毫前恙蟎屬
 Legs 7-7-7 segmented; usually AM ≤ PL 5
5. Sensillary bases very close to each other; distance between bases less than the diameter of either base *Helenicula* 合輪恙蟎屬
 Distance between sensillary bases longer than the diameter of either base 6
6. Posterior scutum covered with cuticular striations; parasubterminala plumose; parasitize in birds *Neoschöngastia* 新棒恙蟎屬
 Scutum without cuticular striations; parasubterminala nude; mainly parasitize in non-bird species..... 7
7. Scutum with anterolateral shoulders; small-to-medium mite; Ip < 650 μm
 *Ascoshöngastia* 囊棒恙蟎屬
 Scutum without anterolateral shoulders; medium-to-large mite; Ip > 800 μm
 *Herpetacarus* 爬蟲恙蟎屬
8. PLs and DSs expanded or foliate, with lines of spikes on surface
 *Trombiculindus* 葉片恙蟎屬
 Scutal and idiosomal setae branched or plumose, not expanded 9



9. Anterior eyes strongly sclerotized or lens-liked, significantly larger than posterior pair (at least two times larger); parasubterminala plumose; mostly parasitize in birds *Toritrombicula* 鳥恙蟎屬
Eyes, if present, not as the traits mentioned above; difference between anterior and posterior eyes are insignificant; parasubterminala nude; parasitize in a wide variety of hosts (mammals, birds, reptiles...) 10
10. Scutum large and rectangular, usually covered with distinct punctations; some even with cuticular striations; gnathosomal base and coxae usually with punctations and transverse striations; palpal claw 2-pronged
..... *Eutrombicula* 真恙蟎屬
Scutum medium in size; scutum, gnathosomal base and coxae usually lightly or evenly punctate; palpal claw mostly 3-pronged..... *Leptotrombidium* 纖恙蟎屬
11. Scutum pentagonal; with only 2 ALs and 2 PLs *Walchia* 無前恙蟎屬
Scutum hexagonal; besides 2 ALs and 2 PLs, also bears multiple pairs of PPLs *Gahrlepiea* 背展恙蟎屬

Family Trombiculidae Ewing, 1944

恙蟎科

Subfamily Trombiculinae Ewing, 1929

恙蟎亞科

Diagnosis. Scutum with one AM, two ALs and two PLs; without anteromedian projection; legs 7-7-7 or 7-6-6 segmented.

Genus *Ascoshöngastia* Ewing, 1946

囊棒恙蟎屬

Type species. *Neoschöngastia malayensis* Gater, 1932.

Diagnosis. Small-to-medium mite; scutum lightly punctate, usually square or trapezoid with conspicuous anterolateral shoulders. SN claviform; pedicels without setules and spikes. Cheliceral blade simple, with sub-apical tooth. Leg I with three genualae.

Key to the species of the genus *Ascoshöngastia* in Taiwan

1. fPp = N/N/NNN/6B; SN broadly claviform; PW/AP = 1.86–2.30; DS = 33–34; VS = 28–36; NDV = 62–70; Ip 474–509 μm *A. indica* 印度囊棒恙蟎
fPp = B/B/BBB/6B; SN long-clavate; PW/AP = 2.31–3.00; DS = 29–32 or 39–44; VS = 29–43; NDV = 59–65 or 77–86; Ip 517–609 μm 2
2. ST 2-2; PW/SD = 1.10–1.33; DS = 39–44; VS = 36–43; NDV = 77–86; anterior half of DS usually arranged with two or three sub-rows; leg III without mastitarsala *A. rattinorvegici* 褐鼠囊棒恙蟎 (new record)
ST 2-2-2; PW/SD = 1.36–1.56; DS = 29–32; VS = 29–35; NDV = 59–65; DS arranged into rows orderly; leg III with one nude mastitarsala
..... *A. paishaensis* 白沙囊棒恙蟎 (new record)

Ascoschöngastia indica (Hirst, 1915)

印度囊棒恙蟎

(Fig. 4; Table 1)

References.

Schöngastia indica Hirst, 1915: 187, fs. 5–6.

Euschöngastia indica Wharton & Fuller, 1952: 77; Audy, 1954: 154; Audy & Harrison, 1954: 17; Harrison, 1954: 181; Radford, 1954: 264; Traub & Audy, 1954: 77; Traub & Evans, 1954: 103; Domrow, 1955: 132.

Neoschöngastia indica Gunther, 1952: 26.

Euschöngastia (Laurentella) indica Audy, 1956a: 7, 21; Audy, 1956b: 64; Audy, 1956c: 96.

Ascoschöngastia (Laurentella) indica Audy, 1957: 262.

Ascoschöngastia indica Vercammen-Grandjean, 1968: 93; Nadchatram, 1972: 193; Hadi & Carney, 1977: 455; Wen, 1984e: 313; Li, Wang & Chen, 1997: 372, f. 2-27-5.

Diagnosis of Larva. fPp = N/N/NNN/6B; scutum nearly trapezoidal; PW/AP = 1.86–2.30; PL > AM > AL; SB/PL; SN broadly claviform, with round tips and spiked setules on surface. fD = 2H, 8, 6, 6, 6, 4, 2 (1); DS 33–34 in number (including HS); VS 28–36 in number; NDV = 62–70.

Description of Larva. (n = 12) Live larva oval, pale yellow (Li et al., 1997). Size small to medium. Measurements of body length and width are as follows (in μm). Semi-engorged body length 255–352, width 173–264. Eyes 2+2, located by scutum; anterior pair sometimes indistinct.

Gnathosoma. Gnathosomal base sparsely punctate, with a pair of pectinate setae; cheliceral base round and lightly punctate; cheliceral blade with a sub-apical tooth. Galeal setae nude; fPp = N/N/NNN/6B, slightly forked in setae of palpogenu and lateral- and ventraltibial setae in some specimens; palpotarsus with blunt solenidium; palpal claw 3-pronged.

Scutum. Shape nearly trapezoidal, with conspicuous anterolateral shoulders; anterior margin slightly biconcave; lateral margins between bases of ALs and PLs roughly curved inward; posterior margin slightly convex; scutum evenly punctate except around bases of AM and ALs. PW/AP = 1.86–2.30; PW/SD = 1.43–1.81; SB/PL; SN broadly claviform, with round tips and slender spikeless pedicels; heads of SN covered with short spikes on surface. PL > AM > AL; AM, ALs and PLs covered with fine setules, shafts tapering to apex. Standard measurements of

scutum are presented in Table 1.

Idiosomal Setae. DS 33–34 in number (including HS), arranged in 2H, 8, 6, 6, 6, 4, 2 (1); HS and DS similar to PLs, with fine setules and tapering to apex. ST 2-2 (2-1 in a few specimens), short and with tiny setules, some nearly nude; anterior pair longer. VS 28–36 in number; preanal setae 20–22, similar to ST but shorter; postanal setae 8–16, similar to posterior pairs of DS. NDV = 62–70. Measurements of idiosomal setae are as follows (in μm). HS 27–35; medial setae of first post-humeral row 21–27; VS (pre) 10–16; VS (post) 15–21.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, with conspicuous punctations. Ip 474–509 μm . All segments with various numbers of branched setae (B), some less barbed, even nude.

Leg I. 176–186 μm ; coxa with 1 nearly nude seta; trochanter 1B; basifemur 1B; telofemur 4B; genu 4B, 3 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microtibiala; tarsus 21B, with 1 central tarsala, 1 microtarsala next to it, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 137–152 μm ; coxa with 1 nearly nude seta; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, with 1 genuala; tibia 5B, with 2 tibialae; tarsus 15B, with 1 central tarsala, 1 microtarsala next to it, and 1 pretarsala.

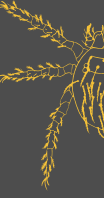
Leg III. 161–177 μm ; coxa with 1 nearly nude seta; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, with 1 genuala; tibia 6B, with 1 tibiala; tarsus 14B, with 1 nude and flagelliform mastitarsala.

SIF = 6B-N-3-3111.1000.

Table 1. Standard measurements (in μm) of *Ascoshöngastia indica* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 12 specimens	38	54	22	19	14	34	26	21	16	27	28	20
Observed range												
Min.	35	50	21	17	12	31	25	19	12	24	26	19
Max.	40	58	25	21	17	37	30	24	19	30	31	22

Specimens Examined. KINMEN COUNTY: 4 larvae (7115-1-1, 7115-2-1~2, 7115-4-1), Kincheng, Hsiaokukang (金門縣金城鎮小古崗), 3 Nov. 1999, ex *Rattus tanezumi*, male; 3 larvae (7641-2-1, 7641-5-1, 7641-6-1), same locality, 12 June 2000, ex *Rattus tanezumi*, male; 3 larvae (7162-4-1, 7162-5-1, 7162-6-1), Kinning, Lake Hou (金門縣金寧鄉后湖), 4 Nov. 1999, ex *Rattus norvegicus*, male; 1 larva (7679-3-1), same locality, 14 June 2000, ex *Rattus tanezumi*, female; 1 larva (7685-1-1), same locality and date, ex *Rattus tanezumi*, male.



Distribution. Australia, Burma, China, India, Japan (Tokunoshima), Java, Malaysia, Papua New Guinea, Philippine, Taiwan (Kinmen County), Thailand, and Vietnam (Mitchell et al., 1966; Nadchatram, 1972; Hadi & Carney, 1977; Goff, 1979; Nadchatram et al., 1980; Suzuki, 1980; Wen, 1984e; Li et al., 1997; Wang et al., 2004).

Remarks. Among the other congeners, *Ascoshöngastia indica* most closely resembles *A. aliena* Wang and Liao, 1981 in China, but it differs from the latter in the following features (*A. aliena* in parentheses): fPp = N/N/NNN/6B (fPp = B/N/BNB/6B); DS 33–34 in number (26–31); SN broadly claviform (SN long-clavate) (Wang & Liao, 1981).

Biology. *Ascoshöngastia indica* is a small-to-medium mite (Ip 474–509 µm), which has been reported extensively over broad geographical regions. The habitats of *A. indica* show great diversity, from grassland, savannah, forest edge to evergreen forest (Mitchell et al., 1966; Goff, 1979). Goff (1979) reported that *A. indica* was the only member of the genus *Ascoshöngastia* from the collections of Papua New Guinea in 1967 and 1968 that was recovered from disturbed habitats.

Ascoshöngastia indica has been recorded from a wide variety of hosts, including several rodents (*Callosciurus erythraeus castaneiventris*, *Rattus exulans*, *R. flavipectus*, *R. norvegicus*, *R. rattus*, *R. tanezumi*, *Hydromys chrysogaster*), bird (*Megalaima oorti faber*), bat (*Pipistrellus pipistrellus*) and primate (*Nyctcebus coucang*) (Mitchell et al., 1966; Goff, 1979; Wen, 1984e).

Medical Importance. *Ascoshöngastia indica* has been proven to be a carrier of *Orientia tsutsugamushi* (Chen & Hsu, 1955), and its role of possible carrier for *Rickettsia typhi* has long been postulated (Gispen, 1950a, b; Nadchatram et al., 1980).

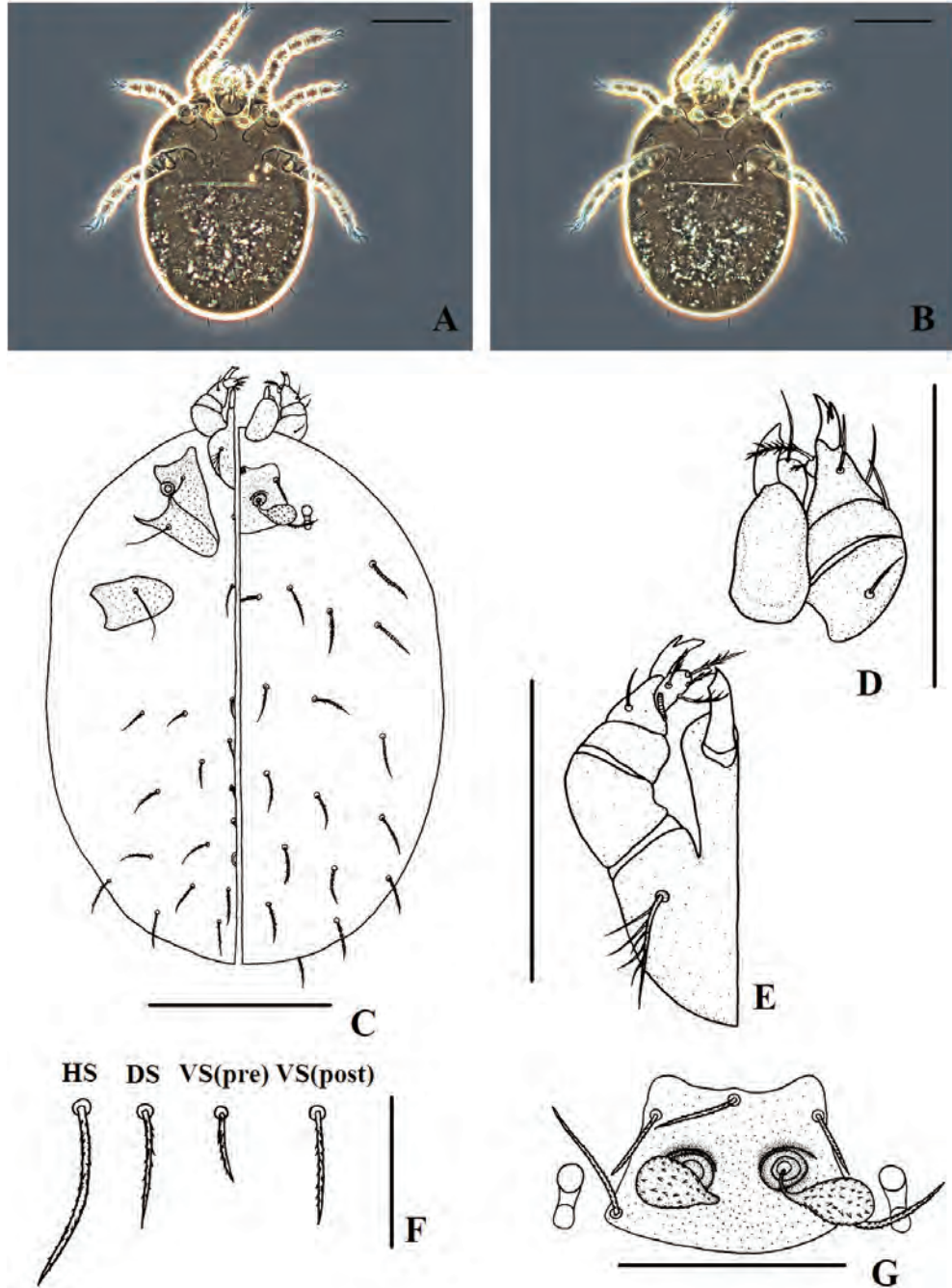


Fig. 4. *Ascoshöngastia indica* (Hirst, 1915) larva. A. phase contrast image of the ventral view; B. phase contrast image of the dorsal view; C. ventral and dorsal view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.

Ascoschöngastia paishaensis (Chen, Hsu and Wang, 1958)

白沙囊棒恙蟎

(Fig. 5; Table 2)

References.

- Euschöngastia audyi* var. *paishaensis* Chen, Hsu & Wang, 1958: 391, fs. 16–22.
Ascoschöngastia paishaensis Vercammen-Grandjean, 1968: 93; Wen, 1984e: 314;
Li, Wang & Chen, 1997: 379, f. 2-27-13.

Diagnosis of Larva. fPp = B/B/BBB/6B; scutum rectangular or trapezoidal, with conspicuous anterolateral shoulders; PW/AP = 2.62–3.00; PL > AM > AL; SN long claviform with spiked setules on surface. DS 29–32 in number (including HS), usually arranged in 2H, 8 (7), 6 (5), 6 (4), 4 (5), 4, (2); ST three pairs; VS 29–35 in number; NDV = 59–65.

Description of Larva. (n = 6) Live larva oval, red (Li et al., 1997). Measurements of body length and width are as follows (in μm). Semi-engorged body length 286–408, width 213–332. Eyes 2+2, located by scutum; posterior pair larger.

Gnathosoma. Gnathosomal base round, lightly punctate, with a pair of pectinate setae; cheliceral base round; cheliceral blade with a sub-apical tooth. Galeal setae nude; fPp = B/B/BBB/6B; palpotarsus with blunt solenidium; palpal claw 3-pronged.

Scutum. Shape rectangular or trapezoidal, with conspicuous anterolateral shoulders; anterior margin biconcave; lateral margins nearly straight or slightly curved inward; posterior margin convex; scutum evenly punctate except around bases of AM and ALs. PW/AP = 2.62–3.00; PW/SD = 1.36–1.56. SB/PL; SN long claviform with spikeless pedicels and short spiked setules on surface. PL > AM > AL; AM, ALs and PLs covered with fine setules, shafts tapering to apex. Standard measurements of scutum are presented in Table 2.

Idiosomal Setae. One pair of HS and 27–30 DS, arranged in 2H, 8 (7), 6 (5), 6 (4), 4 (5), 4, (2); HS and DS similar to PLs, with fine setules and tapering to apex. ST three-paired, arranged in 2-2-2, short and nearly nude. VS 29–35 in number; preanal setae 24–28, similar to ST; postanal setae 5–9, similar to posterior pairs of DS. NDV = 59–65. Measurements of idiosomal setae are as follows (in μm). HS 35–40; medial setae of first post-humeral row 31–33; VS (pre) 17–20; VS (post) 26–28.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, lightly punctate. Ip 517–575 μm . All segments with various numbers of branched setae (B), some less barbed, even nude.

Leg I. 183–209 μm ; coxa with 1 slender branched seta; trochanter 1B; basifemur 1B; telofemur 4B; genu 4B, 3 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microtibiala; tarsus 21B, 1 central tarsala, 1 microtarsala posterior to it, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 150–167 μm ; coxa with 1 slender and slightly branched seta; trochanter 1B; basifemur 1B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 15B, with 1 central tarsala, 1 microtarsala posterior to it, and 1 pretarsala.

Leg III. 181–199 μm ; coxa with 1 slender and slightly branched seta; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 1 tibiala; tarsus 12B, with 1 nude and flagelliform mastitarsala.

SIF = 6B-N-3-3111.1000.

Table 2. Standard measurements (in μm) of *Ascoshöngastia paishaensis* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 6 specimens	48	65	26	24	21	45	24	28	22	36	38	22
Observed range												
Min.	46	61	24	21	20	45	21	25	21	36	37	21
Max.	51	69	27	25	24	46	26	31	22	37	40	22

Specimens Examined. YILAN COUNTY: 6 larvae (IW0053-7-1, IW0053-8-1, IW0053-9-1~2, IW0053-10-1, IW0053-12-1), Tatung, Szuyuan Wukou (宜蘭縣大同鄉思源埡口), 13 Aug. 2008, ex *Niviventer coninga*, male.

Distribution. China (Hainan Province) and Taiwan (new record) (Wen, 1984e; Li et al., 1997).

Remarks. *Ascoshöngastia paishaensis* most closely resembles *A. audyi* (Womersley, 1952), but it can be distinguished from the latter by the following characteristics (*A. audyi* in parentheses): live larva red in color (yellow); PW/AP = 2.62–3.00 (PW/AP = 2.2); DS usually arranged in 2H, 8 (7), 6 (5), 6 (4), 4 (5), 4, (2) (2H, 6, 6, ...); VS 29–35 in number (29–41) (Li et al., 1997).

Biology. *Ascoshöngastia paishaensis* is a limited-distributed species, only reported in winter from Hainan Province of China, and the recorded hosts of *A. paishaensis* are few, such as a kind of woodpecker (*Megalaima oorti faber*) (Chen et al., 1958). Based on the specimens collected in Taiwan, we found *Niviventer coninga* as a newly-recorded host of *A. paishaensis*.

Medical Importance. Unknown.

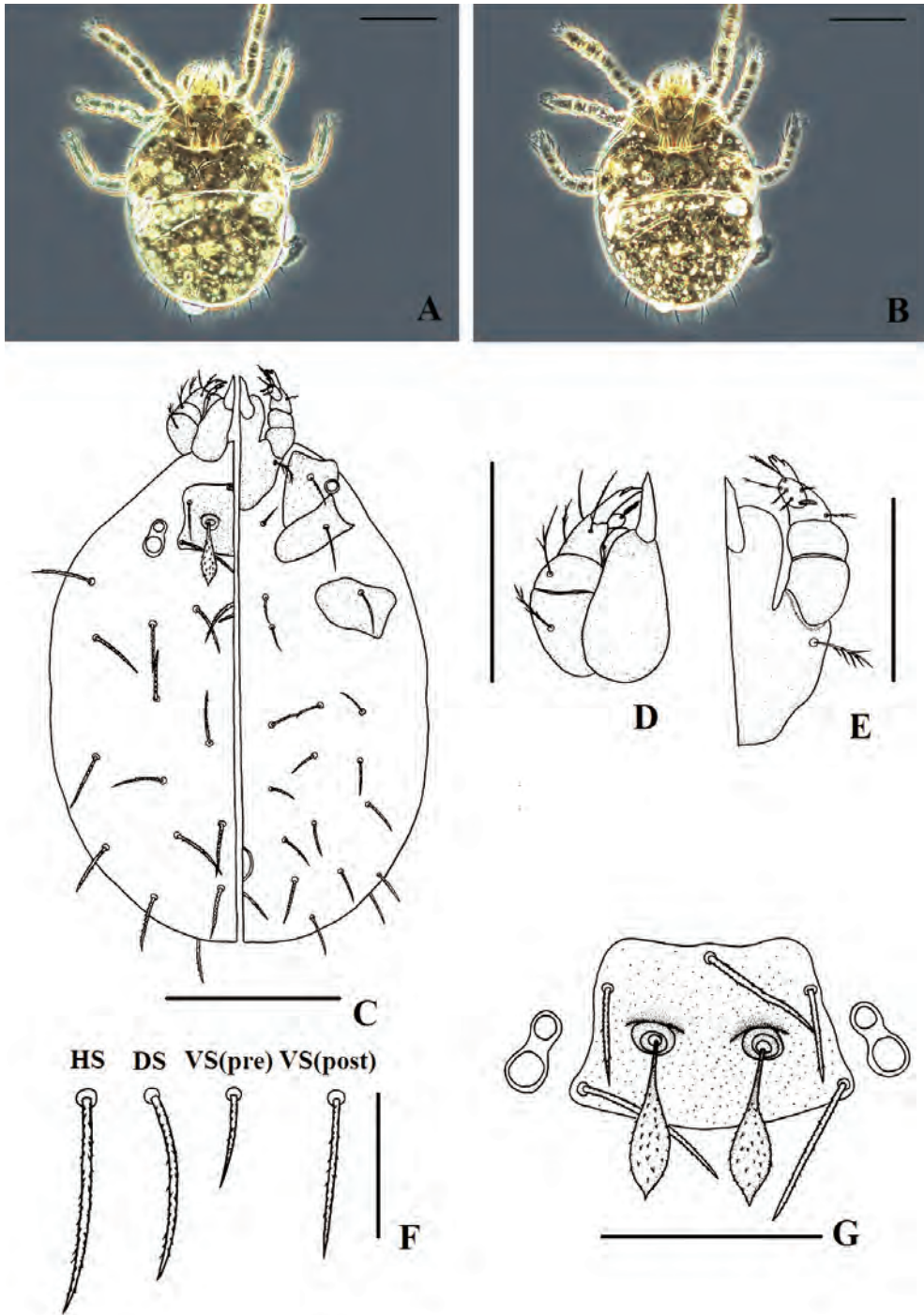


Fig. 5. *Ascoshöngastia paishaensis* (Chen, Hsu and Wang, 1958) larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.



Ascoshöngastia rattinorvegici Wen, 1984a

褐鼠囊棒恙蟎

(Fig. 6; Tables 3–4)

References.

Ascoshöngastia rattinorvegici Wen, 1984a: 155, f. II-65; Li, Wang & Chen, 1997: 380, f. 2-27-15.

Diagnosis of Larva. Scutum square or trapezoidal, with anterior margin concave or biconcave and posterior margin arced outward; $PW/AP = 2.31-2.94$; $PL > AM > AL$. SN long-clavate, with spiked setules on surface. $fPp = B/B/BBB/6B$. Anterior half of DS arranged disorderly, usually including two or three sub-rows; DS 39–44 in number (including HS); VS 36–43 in number; $NDV = 77-86$.

Description of Larva. ($n = 22$) Larva oval, color unknown. Size medium. Measurements of body length and width are as follows (in μm). Semi-engorged body length 338–465, width 240–315. Eyes 2+2, located by scutum.

Gnathosoma. Gnathosomal base lightly punctate, with a pair of pectinate setae; cheliceral base round; cheliceral blade with a sub-apical tooth. Galeal setae nude; $fPp = B/B/BBB/6B$; lateral- and ventral-tibial setae serrated in some specimens; palpotarsus with blunt solenidium; palpal claw 3-pronged.

Scutum. Nearly square or trapezoidal, with conspicuous anterolateral shoulders; anterior margin concave or biconcave; lateral margins curved inward; posterior margin arced outward; scutum with distinct punctations except around base of AM. $PW/AP = 2.31-2.94$; $PW/SD = 1.11-1.33$; SB/PL ; SN long-clavate with spikeless pedicels and short spiked setules on surface. $PL > AM > AL$; AM, ALs and PLs covered with fine setules, shafts tapering to apex. Standard measurements of scutum are presented in Table 3.

Idiosomal Setae. One pair of HS and 37–42 DS; anterior half arranged disorderly, consisting of two to three sub-rows of DS. HS and DS similar to PLs, with fine setules and tapering to apex. ST 2-2, short and branched. VS 36–43 in number; preanal setae 30–36, similar to ST; postanal setae 3–10, similar to posterior pairs of DS; anus close to caudal, surrounded by three pairs of setae (indistinct in some specimens). $NDV = 77-86$. Measurements of idiosomal setae as follows (in μm). HS 33–43; medial setae of first post-humeral row 24–28; VS (pre) 14–19; VS (post) 21–26.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae



I-III unisetose, with conspicuous punctations. Ip 527–609 μm . All segments with various numbers of branched setae (B), some less barbed.

Leg I. 188–220 μm ; coxa with 1 slender seta, branched at basal; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 3 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microtibiala; tarsus 21B, with 1 central tarsala, 1 microtarsala, and 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 149–182 μm ; coxa with 1 slightly branched seta; trochanter 1B; basifemur 1B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 15B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 186–209 μm ; coxa with 1 slightly branched seta; trochanter 1B; basifemur 1B; telofemur 2B; genu 3B, with 1 genuala; tibia 6B, with 1 tibiala; tarsus 12B.

SIF = 6B-N-3-3111.0000.

Table 3. Standard measurements (in μm) of *Ascoschöngastia rattinorvegici* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 22 specimens	46	55	22	23	23	45	21	25	20	34	33	20
Observed range												
Min.	42	51	20	21	20	43	19	21	19	28	31	17
Max.	50	61	25	25	26	50	24	30	22	37	36	22

Specimens Examined. YILAN COUNTY: 21 larvae (IW0048-2-1, IW0048-5-1, IW0048-6-1, IW0048-9-1~5, IW0048-10-1~2, IW0048-11-1~3, IW0048-12-1~5, IW0048-13-1~3), Tatung, Szuyuan Wukou (宜蘭縣大同鄉思源埡口), 12 Aug. 2008, ex *Niviventer coninga*, female; 1 larva (IW0053-12-2), same locality, 13 Aug. 2008, ex *Niviventer coninga*, male.

Distribution. China and Taiwan (new record) (Wen, 1984a; Li et al., 1997).

Remarks. *Ascoschöngastia rattinorvegici* most closely resembles *A. latyshevi* (Schluger, 1955) occurring across Europe and China, but it differs from the latter in the following features (*A. latyshevi* in parentheses): galeal setae nude (branched); scutum close to square, PW/SD = 1.10–1.33 (PW/SD = 1.50); tarsus of leg III without mastitarsala (with one mastitarsala) (Wen, 1984a; Li et al., 1997).

Among the 22 specimens examined, one specimen (IW0048-9-4) was found

with two AMs instead of one. However, it showed other similar characteristics of *A. rattinorvegici*: scutum nearly square or trapezoidal, with conspicuous anterolateral shoulders; $PW/SD = 1.11$; ST 2-2; DS = 40 (including HS); VS = 39 (32 preanal and 7 postanal setae); galeal setae nude; all legs 7-segmented. The measurements of scutum of the specimen are presented in Table 4. Based on the measurements and larval features observed, we considered the specimen an anomaly of *A. rattinorvegici*.

Table 4. Measurements of scutum and idiosomal setae of the anomalous *Ascoshöngastia rattinorvegici* (IW0048-9-4).

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
IW0048-9-4	45	51	21	23	22	46	22	23	19	33	N/A	19

Biology. *Ascoshöngastia rattinorvegici* is a small-to-medium mite (Ip 527–609 μm) collected from the conchal fossa of *Rattus norvegicus* (Wen, 1984a). *Niviventer coninga* is a newly-recorded host from Taiwan.

Medical Importance. Unknown.

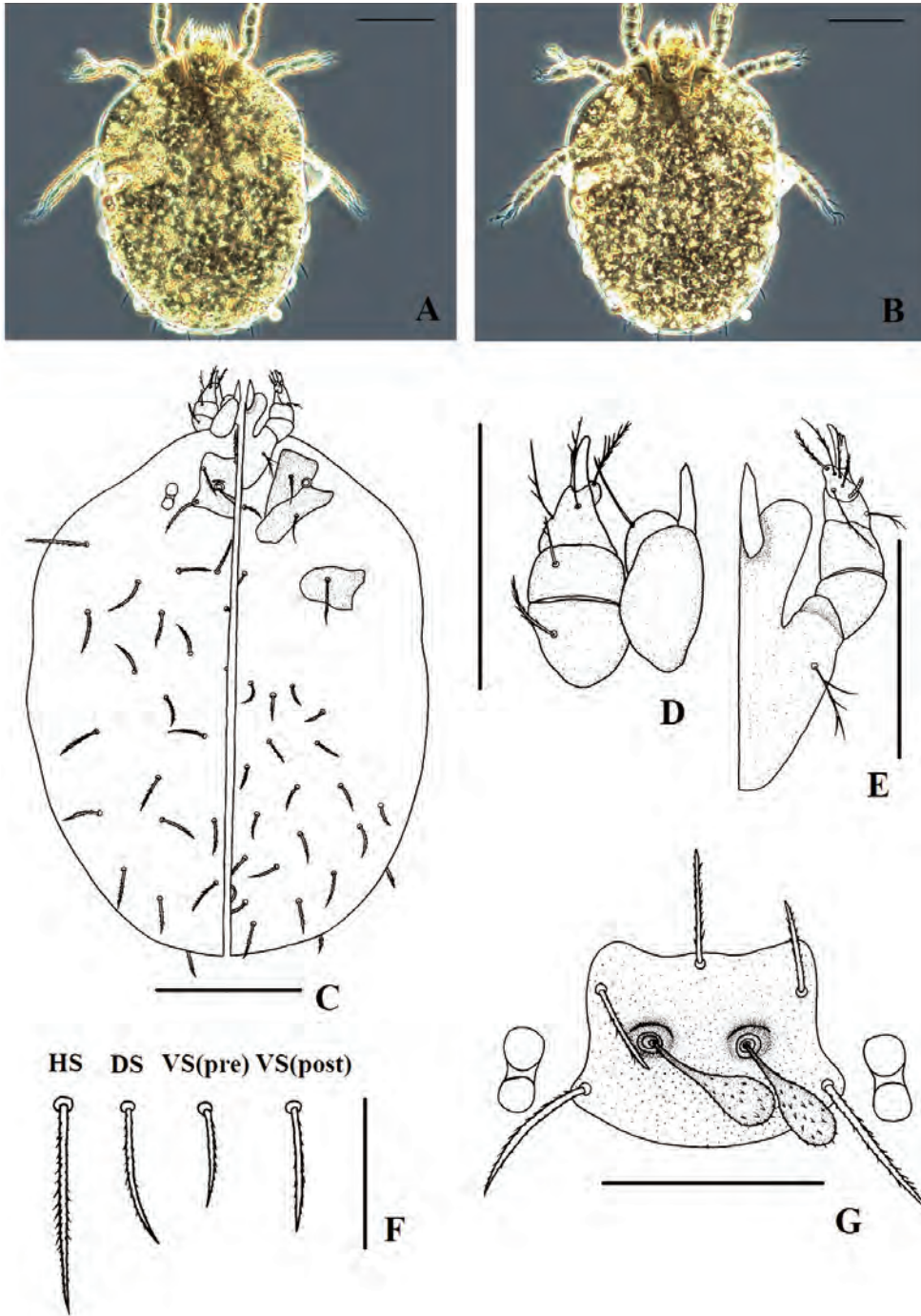
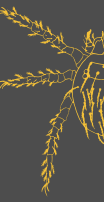


Fig. 6. *Ascoshöngastia rattinorvegici* Wen, 1984a larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.



Genus *Eutrombicula* Ewing, 1938

真恙蟎屬

Type species. *Microtrombidium alfreddugesi* Oudemans, 1910a.

Diagnosis. Medium-to-large mite; scutum large and usually rectangular, covered with distinct punctations; posterior margin of scutum circular-arcuated outward. SN flagelliform, with branches on distal. Gnathosomal base and coxae usually with punctations and transverse striations. Palpal claw 2-pronged.

Key to the species of the genus *Eutrombicula* in Taiwan

1. fPp = N/N/NNN/6Bs; anterior margin of scutum biconcave; DS 22 in number; Ip 739–790 μm *E. ablephara* 石龍真恙蟎
fPp = B/N/NNB/4Bs; anterior margin of scutum concave; DS 20 in number; Ip 936–1005 μm *E. wichmanni* 威氏真恙蟎

Eutrombicula ablephara (Womersley, 1952)

石龍真恙蟎

(Fig. 7; Table 5)

References.

Trombicula ablephara Womersley, 1952: 86; Radford, 1954: 250.

Eutrombicula ablephara Audy, 1956b: 31; Audy, 1957: 241; Wen, 1984e: 315; Li, Wang & Chen, 1997: 282, f. 2-11-2.

Diagnosis of Larva. Scutum large and rectangular, with posterior margin circular-arcuated outward; $PL > AL > AM$; SN flagelliform, with 7–9 branches on distal half. $fPp = N/N/NNN/6Bs$. $fD = 2H, 6, 6, 4, 2, (2)$; DS 19–22 in number (including HS); VS 11–12 in number, with 10 preanal setae; $NDV = 31–34$.

Description of Larva. ($n = 15$) Larva oval, color unknown. Size medium to large; measurements of body length and width are as follows (in μm). Unengorged body length 193, width 163; semi-engorged length 353–478, width 220–398; engorged body length 511–545, width 411–421. Eyes 2+2, distinct and located by scutum.

Gnathosoma. Gnathosomal base round and punctate, basal with denser punctations; covered with distinct transverse striations; bearing a pair of pectinate setae. Cheliceral base sparsely punctate; cheliceral blade long and straight, with tricuspid cap. Galeal setae nude; $fPp = N/N/NNN/6Bs$; palpotarsus with blunt solenidion; palpal claw 2-pronged, external prong usually longer than internal prong.

Scutum. Shape nearly rectangular, with indistinct anterolateral shoulders; anterior margin biconcave; lateral margins slightly curved inward; posterior margin circular-arcuated outward; scutum with distinct punctations except around base of AM. $PW/AP = 2.94–3.39$; SB/PL ; SN long flagelliform, with 7–9 branches on distal half. $PL > AL > AM$; AM, ALs and PLs covered with fine setules, shafts tapering to apex. Standard measurements of scutum are presented in Table 5.

Idiosomal Setae. One pair of HS and 17–20 DS, arranged in 2H, 6, 6, 4, 2, (2); HS and DS similar to PLs, with fine setules and tapering to apex; HS the longest, DS slightly curved. ST 2-2, slender and branched. VS 11–12 in number (mostly 12, with 10 preanal setae and 2 postanal setae; a few specimens with only 1 postanal seta); preanal setae similar to ST but shorter; the last two pairs of VS usually long and similar to HS. $NDV = 31–34$ (usually stable, mostly 34; few individuals with 31 and 33). Measurements of idiosomal setae are as follows (in μm). HS 41–46; medial setae of first post-humeral row 30–36; VS (pre) 23–27; VS (post) 40–45.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, with conspicuous punctations and transverse striations. Ip 739–790 μm . All segments with various numbers of branched setae (B), some less barbed or serrated.

Leg I. 250–290 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 3 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microtibiala; tarsus 21B, with 1 central tarsala, 1 microtarsala anterior to it, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 228–252 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala next to it, and 1 pretarsala.

Leg III. 238–266 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 3B, with 1 genuala; tibia 5B, with 1 tibiala; tarsus 12B, with 1 nearly nude and flagelliform mastitarsala.

SIF = 6Bs-N-2-3111.1000.

Table 5. Standard measurements (in μm) of *Eutrombicula ablephara* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 15 specimens	79	96	39	23	33	56	31	26	29	36	46	31
Observed range												
Min.	74	91	37	21	31	52	28	25	27	33	40	30
Max.	84	100	42	25	35	60	34	28	31	39	52	33

Specimens Examined. NANTOU COUNTY: 15 larvae (WFAS-1-1, 2-1~2, 3-1~3, 4-1~3, 5-1~4, 6-1~2), Chichi, Endemic Species Research Institute (南投縣集集鎮特有生物研究保育中心), 13 Aug. 2008, ex *Sphenomorphus indicus*, gender unknown.

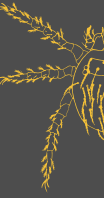
Distribution. Japan (Ryukyu Island), Papua New Guinea, and Taiwan (Womersley, 1952; Suzuki, 1980; Li et al., 1997).

Remarks. *Eutrombicula ablephara* most closely resembles *E. wichmanni* (Oudemans, 1905) which widely distributed across Southeast and East Asia, but it can be distinguished from the latter by smaller body size (former: Ip 739–790 μm ; latter: Ip 936–1005 μm), different palpal setation (former: N/N/NNN/6Bs; latter: B/N/NNB/4Bs), the shape of anterior margin of scutum (former: biconcave; latter: concave), and number of DS (former 22; latter 20).

Biology. *Eutrombicula ablephara* was first recorded from skink (*Ablepharus boutoni*) in Papua New Guinea (Womersley, 1952), and more reptile hosts of *E.*

ablephara were reported, including *Japalura polygonata* in Ryukyu Island (Suzuki, 1980), and *J. swinhonis* in Taiwan (Wen, 1984e; Li et al., 1997). *Sphenomorphus indicus* is first recorded as host of *E. ablephara*.

Medical Importance. Unknown.



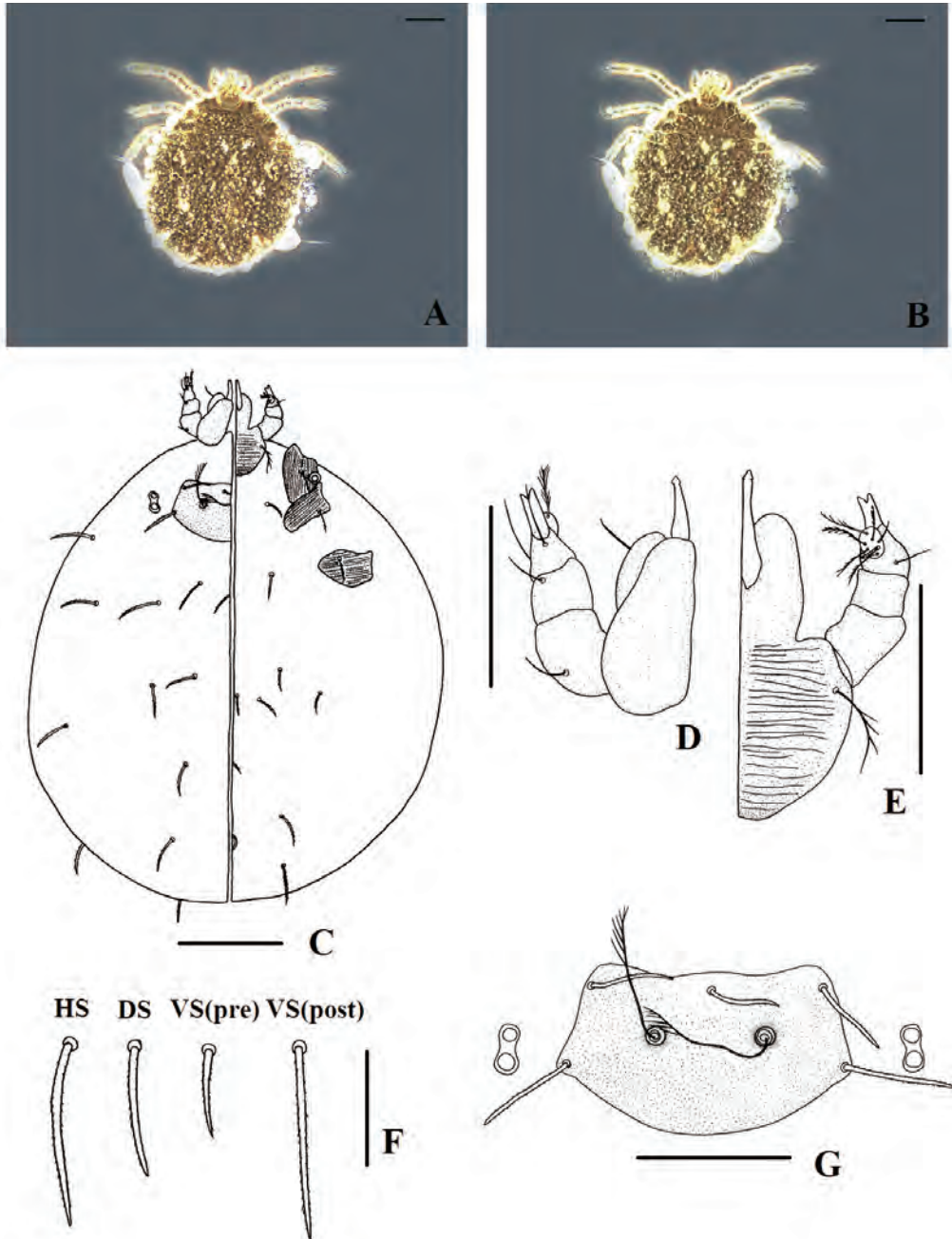


Fig. 7. *Eutrombicula ablephara* (Womersley, 1952) larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.

Eutrombicula wichmanni (Oudemans, 1905)

威氏真恙蟎

(Fig. 8; Table 6)

References.

- Trombicula wichmanni* Oudemans, 1905: 217; Gunther, 1952: 12; Radford, 1954: 258.
- Trombicula (Trombicula) wichmanni* Womersley, 1952: 87.
- Trombicula (Eutrombicula) wichmanni* Wharton & Fuller, 1952: 50; Sasa, 1956: 138, f. 38.
- Eutrombicula wichmanni* Fuller, 1952: 117; Vercammen-Grandjean, 1968: 65; Wen, 1984e: 315; Li, Wang & Chen, 1997: 285, f. 2-11-6.
- Eutrombicula (Eutrombicula) wichmanni* Audy, 1956b: 59, 73; Audy, 1956c: 94; Audy, 1957: 243; Maa & Kuo, 1966: 391.

Diagnosis of Larva. Scutum large, rectangular and covered with conspicuous punctations; posterior margin of scutum circular-arcuated outward; $PL > AL > AM$; SN flagelliform, with 7–9 branches on distal half. $fPp = B/N/NNB/4Bs$. $fD = 2H, 6, 6, 2, 4$; DS 20 in number (including HS); VS 12 in number, with 10 preanal setae; $NDV = 32$.

Description of Larva. ($n = 5$) Larva oval, red in color (Li et. al., 1997); size large; measurements of body length and width are as follows (in μm). Semi-engorged body length 463–500, width 408–423; engorged body length 574–611, width 505–589. Eyes 2+2, distinct and located by scutum, anterior pair larger.

Gnathosoma. Gnathosomal base with distinct transverse striations and evenly punctuate; punctations arranged orderly into transverse lines; bearing a pair of pectinate setae. Cheliceral base pear-shaped, evenly punctate; cheliceral blade long and straight, with tricuspid cap. Galeal setae nude; $fPp = B/N/NNB/4Bs$; palpotarsus with blunt solenidion; palpal claw 2-pronged.

Scutum. Shape rectangular, with indistinct anterolateral shoulders; anterior margin concave; lateral margins slightly curved inward; posterior margin circular-arcuated outward; scutum with conspicuous punctations except around base of AM. $PW/AP = 3.18-3.46$; SB/PL ; SN long flagelliform, with 7–9 branches on distal half. $PL > AL > AM$; AM, ALs and PLs covered with fine setules, shafts tapering to apex. Standard measurements of scutum are presented in Table 6.

Idiosomal Setae. One pair of HS and 18 DS, arranged in 2, 6, 6, 2, 4; HS and DS

similar to PLs, with fine setules and tapering to apex; HS the longest, DS slightly curved. ST 2-2, slender and branched. VS slightly curved and branched, 12 in number; preanal setae 10; postanal setae 2. NDV = 32. Measurements of idiosomal setae are as follows (in μm). HS 55–59; medial setae of first post-humeral row 48–51; VS (pre) 40–44; VS (post) 49–52.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, with conspicuous punctations and transverse striations. Ip 936–1005 μm . All segments with various numbers of branched setae (B).

Leg I. 322–347 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 5B, 3 genualae and 1 microgenuala; tibia 8B, 2 tibialae; tarsus 21B, with 1 central tarsala, 1 microtarsala anterior to it, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 292–315 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala posterior to it, and 1 pretarsala.

Leg III. 322–348 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 2B; genu 3B, with 1 genuala; tibia 6B, with 1 tibiala; tarsus 14B, with 1 nude and flagelliform mastitarsala.

SIF = 4Bs-N-2-3111.1000

Table 6. Standard measurements (in μm) of *Eutrombicula wichmanni* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 5 specimens	90	108	45	31	32	63	34	44	48	57	58	33
Observed range												
Min.	86	104	43	30	30	61	32	40	45	55	54	32
Max.	93	112	47	34	33	65	35	46	50	58	62	34

Specimens Examined. TAITUNG COUNTY: 1 larva (8537-38-2-1), Lanyu, Tungching (台東縣蘭嶼鄉東清村), 6 Sept. 2006, ex *Rattus losea*, female; 4 larvae (8555-56-2-1, 8555-56-4-1, 8555-56-5-1~2), Lanyu, Langtao (台東縣蘭嶼鄉朗島村), 7 Sept. 2006, ex *Rattus losea*, female.

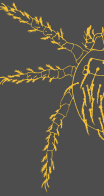
Distribution. China, Indonesia, Japan, Malaysia, Papua New Guinea, Philippine, and Taiwan (Audy, 1957; Maa & Kuo, 1966; Suzuki, 1980; Brown, 1992; Li et al., 1997).

Remarks. *Eutrombicula wichmanni* most closely resembles *E. ablephara* (Womersley, 1952), and it can be distinguished from the latter by the following features (*E. ablephara* in parentheses): Ip 936–1005 μm (Ip 739–790 μm); fPp = B/

N/NNB/4Bs (N/N/NNN/6Bs), anterior margin of scutum concave (biconcave); DS 20 in number (22).

Biology. *Eutrombicula wichmanni* is a large mite commonly found in the wild of Southeast and East Asia. A wide variety of hosts are recorded, including rodents (*Rattus flavipectus*, *R. losea*, *R. norvegicus*, *R. tanezumi*), birds (*Centropus bentalensis lignator*, *Gallus gallus domesticus*), carnivores (*Canis familiaris*, *Felis domesticus*), reptile (*Mabuya multifasciata*) and human (Audy, 1957; Wen, 1984e; Li et al., 1997).

Medical Importance. *Eutrombicula wichmanni* has been reported as an etiological agent of scrub itch in human (Womersley, 1952).



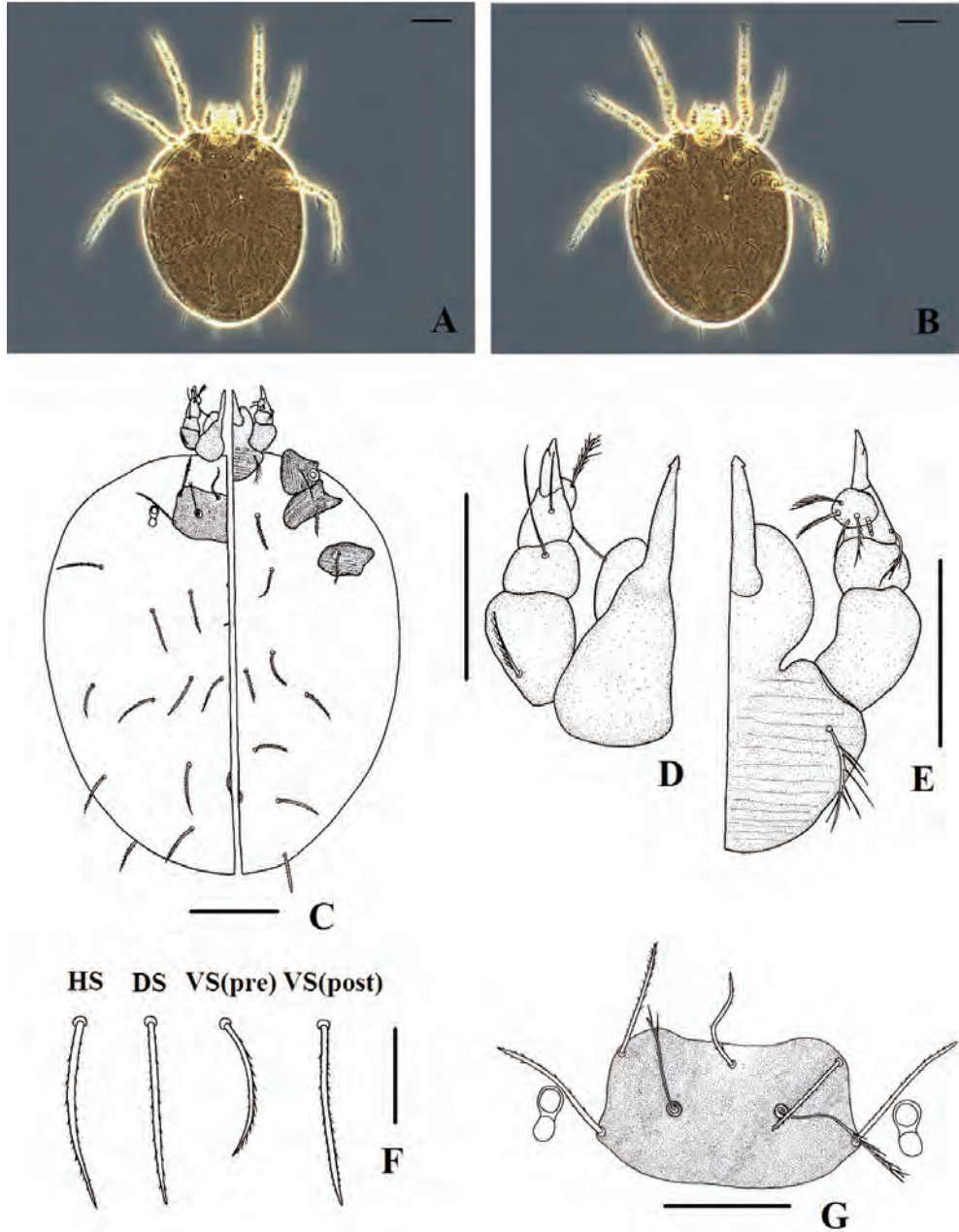


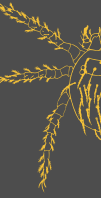
Fig. 8. *Eutrombicula wichmanni* (Oudemans, 1905) larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.

Genus *Helenicula* Audy, 1954

合輪恙蟎屬

Type species. *Neoschöngastia lanius* Radford, 1946.

Diagnosis. Small-to-medium mite; the gap between bases of SN less than the diameter of either base; scutum rectangular or trapezoidal; SN globose with small spikes on surface; usually $AL > PL > AM$. Tarsala I usually inserted close to subterminala, either proximal or distal to it.



Helenicula kohlsi (Philip and Woodward, 1946a)

柯氏合輪恙蟎

(Fig. 9; Table 7)

References.

- Neoschöngastia kohlsi* Philip & Woodward, 1946a: 159, pls. I-B, D; Radford, 1954: 263.
- Ascoschöngastia kohlsi* Philip & Woodward, 1946b: 509.
- Schöngastia (Ascoschöngastia) kohlsi* Womersley, 1952: 176.
- Euschöngastia kohlsi* Wharton & Fuller, 1952: 78.
- Euschöngastia (Helenicula) kohlsi* Audy, 1954: 152.
- Helenicula hongkongensis* Audy, 1957: 265.
- Helenicula kohlsi* Audy, 1957: 265; Mitchell, Hoogstraal, Schaller & Spillett, 1966: 120; Vercammen-Grandjean, 1968: 101; Nadchatram & Traub, 1971: 573, fs. 32–39; Wen, 1984e: 319; Li, Wang & Chen, 1997: 320, f. 2-22-8.

Diagnosis of Larva. Scutum rectangular. The gap between bases of SN less than the diameter of either base; SN globose with small spikes on surface. $AL > PL > AM$; setae of scutum strongly branched, AM and PLs even feathery. $fPp = B/B/BBB/4B$. $fD = 2H, 12 (13), 14 (15), 11, 13, 11 (12), 8 (9)...$; DS 80–84 in number (including HS); VS 54–58 in number; NDV = 134–142.

Description of Larva. ($n = 2$) Larva oval, red in color (Li et. al., 1997); size medium; measurements of body length and width are as follows (in μm). Semi-engorged body length 372–386, width 266–267. Eyes 2+2, distinct and located by scutum, anterior pair larger.

Gnathosoma. Gnathosomal base sparsely punctuate, bearing a pair of pectinate setae. Cheliceral base lightly punctate; cheliceral blade long and straight, with tricuspid cap. Galeal setae branched; $fPp = B/B/BBB/4B$; palpotarsus with blunt solenidion; palpal claw 2-pronged.

Scutum. Shape rectangular or trapezoidal; anterior margin slightly concave; lateral margins curved inward; posterior margin slightly convex; scutum with sparse punctations. $PW/AP = 3.25-3.38$; PL/SB ; the gap between bases of SN significantly smaller than the diameter of either base; SN globose, with tiny spikes on surface. $AL > PL > AM$; AM, ALs and PLs strongly branched, AM and PLs even feathery. Standard measurements of scutum are presented in Table 7.

Idiosomal Setae. One pair of HS and 78–82 DS; anterior half of dorsal setae



arranged orderly into rows, but the numbers in rows may differ among individuals; fD = 2H, 12 (13), 14 (15), 11, 13, 11 (12), 8 (9)...; HS and DS similar to scutal setae, stout and strongly branched; the closer to the side of body the curvier. ST 2-2, slender and branched. VS 54–58 in number; preanal setae 33–34, similar to ST but shorter; postanal setae 21–24, thicker and longer than preanal setae, similar to DS. NDV = 134–142. Measurements of idiosomal setae are as follows (in μm). HS 33–34; medial setae of first post-humeral row 27; VS (pre) 21–24; VS (post) 26–27.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, all evenly punctate. Ip 667–702 μm . All segments with various strongly branched setae (B).

Leg I. 223–254 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 4B, 1 genuala and 1 microgenuala; tibia 8B, 2 tibialae at distal fourth and 1 microgenuala; tarsus 20B, with 1 tarsala distal to nude subterminala and parasubterminala, 1 pretarsala.

Leg II. 204–205 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 14B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 240–243 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, with 1 genuala; tibia 7B, with 1 tibiala; tarsus 14B.

SIF = 4B-B-2-1111.0000.

Table 7. Standard measurements (in μm) of *Helenicula kohlsi* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 2 specimens	53	66	11	25	10	35	20	26*	49	34	28	30
Observed range												
Min.	52	64	10	25	9	34	20	N/A	48	32	26	27
Max.	54	69	12	25	10	35	20	N/A	50	36	29	33

*data from 1 specimen.

Specimens Examined. KINMEN COUNTY: 2 larvae (7157-1-1, 7157-3-1), Kinning, Lake Hou (金門縣金寧鄉后湖), 4 Nov. 1999, ex *Rattus tanezumi*, female.

Distribution. Australia, Burma, China, India, Iran, Nepal, Pakistan, Philippine,

South Vietnam, Taiwan (new record), and Thailand (Philip & Woodward, 1946a; Audy, 1957; Nadchatram & Traub, 1971; Wen 1984e; Li et al., 1997).

Remarks. *Helenicula kohlsi* most closely resembles *H. comata* (Womersley, 1952) in Southeast Asia, but it can be distinguished from the latter by the number of DS (*H. comata* in parenthesis): less than 90 (over 110) (Li et al., 1997).

Biology. *Helenicula kohlsi* is a widespread species across Asia. Rodents are the common hosts of *H. kohlsi*, such as *Rattus flavipectus*, *R. norvegicus*, *R. rattus*, *R. tanezumi* and *Apodemus chevrieri*. Birds and human are also recorded as hosts of *H. kohlsi* (Wen, 1984e).

Medical Importance. Unknown.

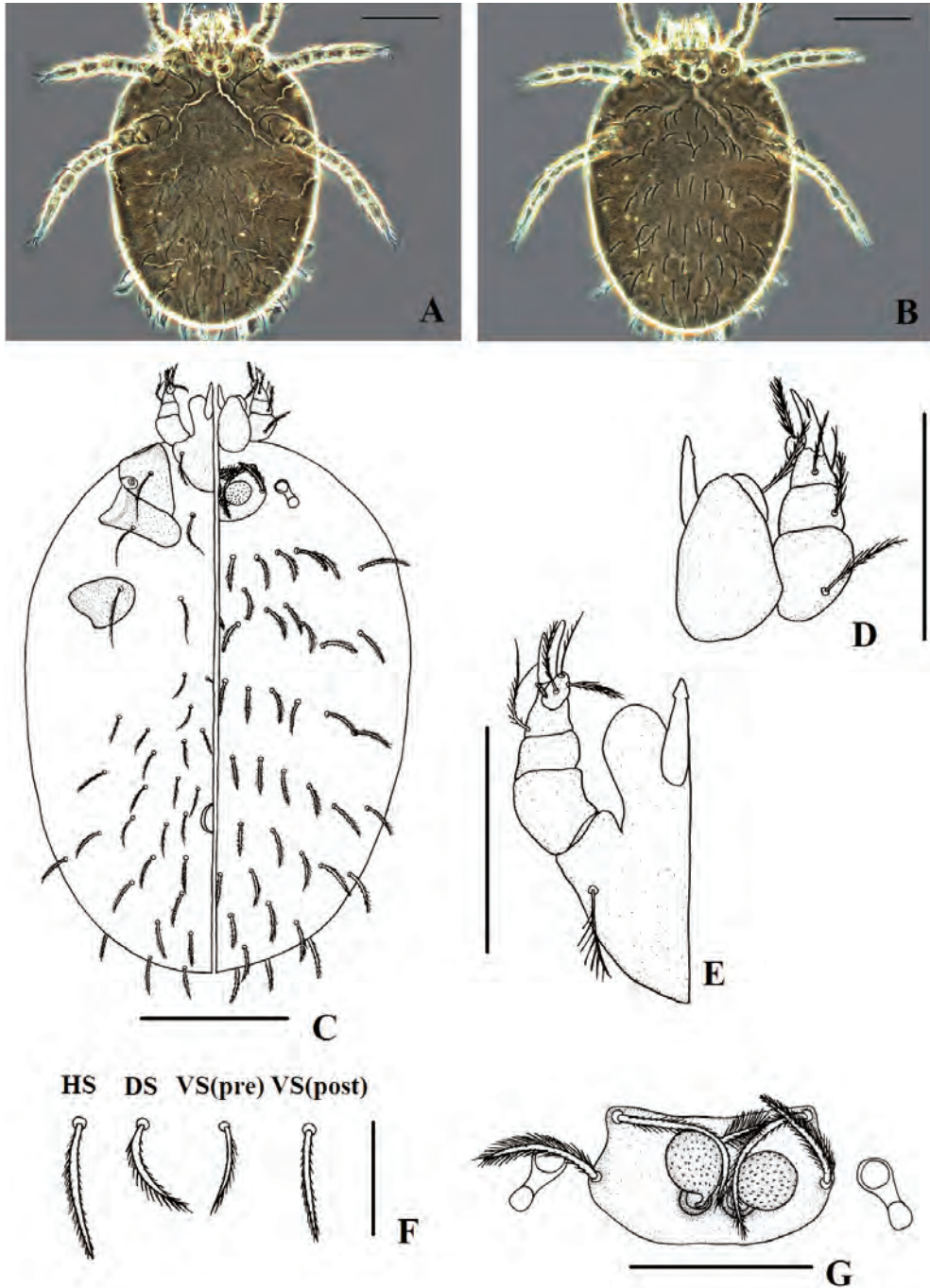
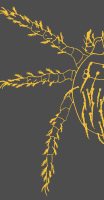


Fig. 9. *Helenicula kohlsi* (Philip and Woodward, 1946a) larva. A. phase contrast image of the ventral view; B. phase contrast image of the dorsal view; C. ventral and dorsal view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μm ; D, E, G = 50 μm ; F = 25 μm .



Genus *Herpetacarus* Vercammen-Grandjean, 1960

爬蟲恙蟎屬

Subgenus *Herpetacarus* Vercammen-Grandjean, 1960

爬蟲恙蟎亞屬

Type species. *Ascoschöngastia causicola* Jadin and Vercammen-Grandjean, 1952.

Diagnosis. Size medium to large; scutum rectangular or close to square, posterior rim usually curved outward; lack of anterolateral shoulders; SN clavate, globose or long fusiform; palpotarsus 7Bs; leg III without mastitarsala.

Herpetacarus (Herpetacarus) *longdongensis* (Mo, Li, Chen and Hsu, 1990)

龍洞爬蟲恙蟎

(Fig. 10; Table 8)

References.

Dongyangsha longdongensis Mo, Li, Chen & Hsu, 1990: 495, fs. 1–4.

Herpetacarus (H.) longdongensis Li, Wang & Chen, 1997: 406, f. 2-31-10.

Diagnosis of Larva. Scutum close to square, posterior margin protruded arc-shaped; scutum without anterolateral shoulders; SN clavate, both distal surface and pedicels with tiny spikes. fPp = B/B/NBB/7Bs. DS 52–64 in number (including HS), usually arranged disorderly; fD = 2H, 8 (9–10), 11, 12, 7, 6, 2, 2, 2; VS 50–62 in number; NDV = 104–126 (Mo et al., 1990).

Description of Larva. (n = 1) Larva long-oval; size large; lateral body slightly concave posterior to leg III; measurements of body length and width are as follows (in μm). Semi-engorged body length 604, width 391. Eyes 2+2, distinct and located by scutum.

Gnathosoma. Gnathosomal base evenly punctate, bearing a pair of pectinate setae. Cheliceral base punctate; cheliceral blade long and straight, with tricuspid cap. Galeal setae nude; fPp = B/B/NBB/7Bs; setae branched in palpofemur, palpogenu and ventral palpotibia, serrated in lateral tibia; palpotarsus with blunt solenidion; palpal claw 3-pronged.

Scutum. Shape close to square; anterior and lateral margins nearly straight; posterior margin protruded arc-shaped; without anterolateral shoulders; scutum evenly punctate. PW/AP = 1.85; SB/PL. SN clavate, both distal surface and pedicels with tiny spikes. PL > AM > AL, covered with fine setules and tapering to apex. Standard measurements of scutum are presented in Table 8.

Idiosomal Setae. One pair of HS and 50 DS; fD = 2H, 8, 11, 12, 7, 6, 2, 2, 2; HS and DS slightly curved, similar to setae of scutum. ST 2-2 branched. VS 54 in number; preanal setae 38, more slender, shorter and less branched than ST; postanal setae 16, similar to DS. NDV = 106. Measurements of idiosomal setae are as follows (in μm). HS 59; medial setae of first post-humeral row 50; VS (pre) 27; VS (post) 45.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, evenly punctate. Ip 975 μm . All segments with various branched setae (B). *Leg I.* 319 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 4B, 3

genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microgenuala; tarsus 21B, with 1 central tarsala, 1 nude subterminala, parasubterminala and pretarsala.

Leg II. 297 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, with 1 genuala; tibia 5B, with 2 tibialae; tarsus 14B, with 1 central tarsala and 1 pretarsala.

Leg III. 359 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, with 1 genuala; tibia 6B, with 1 tibiala; tarsus 14B.

SIF = 7Bs-N-3-3111.0000.

AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
70	87	26	41	31	72	47	50	48	57	38	32

Specimens Examined. HUALIEN COUNTY: 1 larva (8008-2-1), Juisui, Hokang (花蓮縣瑞穗鄉鶴岡村), 5 Mar. 2001, ex *Rattus losea*, female.

Distribution. China and Taiwan (new record) (Mo et al., 1990; Li et al., 1997)

Remarks. *Herpetacarus (H.) longdongensis* most closely resembles *H. (H.) limon* (Wen and Xiang, 1984b) in China, but it can be distinguished from the latter by the following features (*H. (H.) limon* in parentheses): PL > AL > AM, less than 60 μm (AL > PL > AM, longer than 60 μm); SN clavate, pedicels with tiny spikes (lemon shaped, pedicels without spikes); fPp = B/B/NBB/7Bs (B/B/BBB/7Bs); galeal setae nude (branched); VS 54 in number (76 in number) (Wen & Xiang, 1984b).

Biology. *Herpetacarus (H.) longdongensis* is collected from *Rattus flavipectus* and *R. losea* in China and Taiwan.

Medical Importance. Unknown.

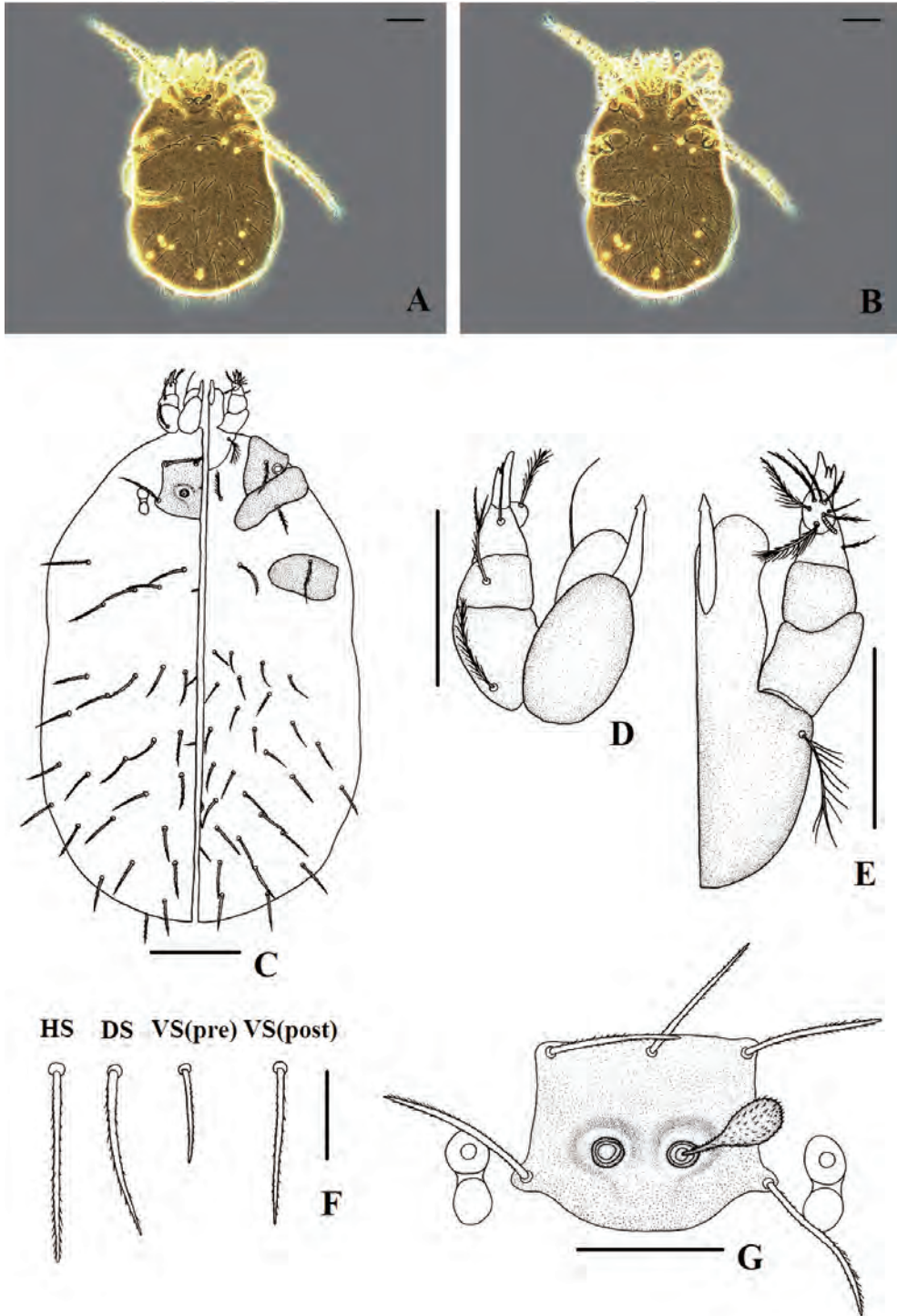
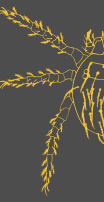


Fig. 10. *Herpetacarus (Herpetacarus) longdongensis* (Mo, Li, Chen and Hsu, 1990) larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.



Genus *Leptotrombidium* Nagayo, Miyagawa,
Mitamura and Imamura, 1916

織恙蟎屬

Subgenus *Leptotrombidium* Nagayo, Miyagawa,
Mitamura and Imamura, 1916

織恙蟎亞屬

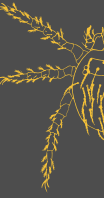
Type species. *Trombidium akamushi* Brumpt, 1910.

Diagnosis. Small-to-large mite; scutum rectangular, wider than long, with 1 AM, 2 ALs and 2 PLs. SN flagelliform, with or without branches on distal half. Palpotarsus 7B. Palpal claw 2 or 3-pronged. Leg I usually with 2 genualae, some rarely with 1 genuala.

**Key to the species of the subgenus *Leptotrombidium*
in Taiwan**

1. Scutum SB/PL or SB-PL 2
Scutum PL/SB..... 9
2. NDV \leq 60 3
NDV $>$ 60 5
3. DS 27–30 in number, usually arranged more stable; VS 20–23 in number; NDV = 47–52, where 52 = 30 DSs + 22 VSs or 29 DSs + 23 VSs4
DS 28–33 in number, arranged less ordered; VS 23–29 in number; NDV = 52–60, where 52 = 28 DSs + 24 VSs *L. (L.) imphalum* 英帕織恙蟎
4. Mostly SB \geq AP; if AP $>$ SB, no more than 5 μ m *L. (L.) deliense* 地里織恙蟎
AP $>$ SB, at least 5 μ m *L. (L.) rubellum* 微紅織恙蟎 (new record)
5. DS \leq 35 in number 6
DS $>$ 35 in number 7
6. Mostly SB/PL, seldom SB-PL; DS arranged less orderly; fD = 2H, 8 (9), 6 (7–8), 8 (6–7, 10)...; preanal setae of VS less than 20 in number *L. (L.) akamushi* 紅織恙蟎
SB-PL; DS arranged more orderly; fD = 2H, 8, 6, 6...; preanal setae of VS more than 20 in number *L. (L.) kawamurai* 川村織恙蟎
7. DS 38–42 in number; fD = 2H, 10 (8–9), 8 (6–7)...; VS 27–31 in number; NDV

- = 68 *L. (L.) fujianense* 福建纖恙蟎 (new record)
 DS > 45 in number; VS \geq 35 in number; NDV > 80 8
8. SB-PL or SB/PL; DS 45–55 in number; anterior half of DS usually stable in number; fD = 2H, 10, 10, 2, 8, 8...; VS 35–44 in number; NDV = 81–96; scutal and idiosomal setae moderately branched *L. (L.) scutellare* 小板纖恙蟎
 SB-PL; DS 48–54 in number; fD = 2H, 11 (13), 10, 10, 8 (6, 9)...; VS 47–52 in number; NDV = 94–106; scutal and idiosomal setae densely branched
 *L. (L.) xianglinense* 香林纖恙蟎 (new record)
9. DS 27–29 in number; VS 27–31 in number
 *L. (L.) cangjiangense* 滄江纖恙蟎 (new record)
 DS > 30; VS > 35 in number 10
10. DS 32–37 in number; VS 36–51 in number; NDV = 69–84
 *L. (L.) yui* 于氏纖恙蟎
 DS > 40 in number 11
11. DS 41–43 in number; fD = 2H, 8, 8, 2, 7, 6...; VS 37–43 in number; NDV = 80–83 *L. (L.) apodemi* 姬鼠纖恙蟎 (new record)
 DS 47–53 in number; fD = 2H, 12, 10, 10, 8...; VS 44–56 in number; NDV = 93–105; scutal and idiosomal setae strongly branched
 *L. (L.) pallidum* 粗毛纖恙蟎 (new record)



Leptotrombidium (Leptotrombidium) *akamushi* (Brumpt, 1910)

紅纖恙蟎

(Fig. 11; Table 9)

References.

Trombidium akamushi Brumpt, 1910: 506, f. 335.

Trombicula (L.) akamushi Fuller, 1952: 23; Wharton & Fuller, 1952: 51; Womersley, 1952: 67; Traub & Audy, 1954: 74; Audy, 1956b: 58, 72; 1956c: 93; 1957: 227.

Leptotrombidium (L.) akamushi Radford, 1954: 260; Sasa, 1956: 95, f. 1; Vercammen-Grandjean & Langston, 1975: 261, pls. 17, 18; Wen, 1984e: 304; Li, Wang & Chen, 1997: 107, f. 2-1-2.

Leptotrombidium akamushi Stekolnikov, 2013: 65.

Diagnosis of Larva. Scutum rectangular; fPp = N/N/BNN/7B. PL \geq AM > AL; mostly SB/PL. SN flagelliform, with 10–12 branches on distal half. DS 31–35 in number (including HS), arranged in 2H, 8 (9), 6 (7–8), 8 (6–7, 10), 6 (4–5, 8), 4 (2–3), (1–2); VS 29–31 in number. NDV = 61–65.

Description of Larva. (n = 12) Live larva oval, red (Li et al., 1997). Size medium. Measurements of body length and width are as follows (in μ m). Unengorged body length 295, width 210; semi-engorged body length 339–433, width 267–401; engorged body length 488–530, width 443–495. Eyes 2+2, located by scutum; anterior pair slightly larger.

Gnathosoma. Gnathosomal base evenly punctate, with a pair of pectinate setae; cheliceral base lightly punctate; cheliceral blade with tricuspid cap. Galeal setae branched; fPp = N/N/BNN/7B; palpotarsus with blunt solenidion; palpal claw 3-pronged.

Scutum. Close to rectangular; anterior margin slightly concave; lateral margins curved inward; posterior margin biconvex, concave in middle; scutum evenly punctate except around bases of AM and ALs. PW/AP = 2.42–3.44; PW/SD = 1.77–2.12. SB/PL in most specimens, seldom with SB-PL. SN long flagelliform, with 10–12 branches on distal half; pedicels with paired tiny spikes. PL \geq AM > AL; AM, ALs and PLs covered with fine setules, shafts tapering to apex; ALs with longer branches. Standard measurements of scutum are presented in Table 9.

Idiosomal Setae. DS 31–35 (including HS) in number; fD = 2H, 8 (9), 6 (7–8), 8 (6–7, 10), 6 (4–5, 8), 4 (2–3), (1–2), usually arranged disorderly near caudal. HS



and DS slightly curved and similar to PLs, covered with long setules and tapering to apex. ST 2-2 finely branched. VS 29–31 in number; preanal setae 16–19, similar to ST but shorter; postanal setae 11–13, similar to posterior pairs of DS. NDV = 61–65. Measurements of idiosomal setae are as follows (in μm). HS 50–58; medial setae of first post-humeral row 42–52; VS (pre) 26–33; VS (post) 40–48.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, evenly punctate. Ip 651–829 μm . All segments with various numbers of branched setae (B).

Leg I. 215–277 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microtibiala; tarsus 22B, with 1 central tarsala, 1 microtarsala next to it, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 196–250 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala next to it, and 1 pretarsala.

Leg III. 240–302 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, with 1 genuala; tibia 6B, with 1 tibiala; tarsus 15B.

SIF = 7B-B-3-2111.0000.

Table 9. Standard measurements (in μm) of *Leptotrombidium* (*Leptotrombidium*) *akamushi* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 12 specimens	68	79	31	27	14	41	28	54	41	58	66	24
Observed range												
Min.	59	71	27	25	13	39	25	48	38	49	61	22
Max.	76	86	33	29	15	43	31	62	45	64	74	27

Specimens Examined. HUALIEN COUNTY: 1 larva (7842-4-1), Juisui, Hokang (花蓮縣瑞穗鄉鶴岡村), 21 Dec. 2000, ex *Bandicota indica*, female; 4 larvae (7952-4-1, 7952-5-1, 7954-2-1~2), same locality, 1 Mar. 2001, ex *Rattus losea*, female; 1 larva (8007-5-1), same locality, 3 May 2001, ex *Rattus losea*, female; 3 larvae (9159-60-9-5, 9165-66-7-1~2), Fenglin (花蓮縣鳳林鎮), 28 Apr. 2009, ex *Rattus losea*, female; 3 larvae (9169-70-8-1, 9173-76-2-1, 9177-80-1-1), same locality and date, ex *Apodemus agrarius*, male.

Distribution. China, Indonesia, Japan, Malaysia, Papua New Guinea, Philippines, and Taiwan (Sasa, 1956; Audy, 1957; Wen, 1984e; Li et al., 1997).

Remarks. Among its congeners, *L. (L.) akamushi* most closely resembles *L. (L.) imphalum* Vercammen-Grandjean and Langston, 1975, but it can be distinguished from the latter by the following features (*L. (L.) imphalum* in parentheses): DS 31–35 in number, arranged in 2H, 8 (9), 6 (7–8), 8 (6–7, 10), 6 (4–5, 8), 4... (DS 28–33 in number, mostly arranged in 2H, 8, 6, 6, 4...); 2PSB \geq ASB (2PSB < ASB); VS = 29–31 (23–29); NDV = 61–65 (52–60).

Biology. *Leptotrombidium (L.) akamushi* is a widespread species in East Asia, and the larvae appear mainly in summer, starting in June and reaching peak in mid-July in Japan (Sasa, 1956). Diverse hosts are recorded: rodents (*Apodemus agrarius*, *A. semotus*, *Bandicota indica*, *Mus musculus*, *Rattus losea*, *R. norvegicus*, *R. rattus*), shrew (*Suncus murinus*), carnivores (*Canis familiaris*, *Felis domesticus*), domestic cow (*Bos taurus domestica*), water buffalo (*Bubalus bubalis*), bird (*Gallus gallus domesticus*), and reptile (*Mabuya multifasciata*) (Audy, 1957; Wen, 1984e).

Medical Importance. *Leptotrombidium (L.) akamushi* has been proven to be a vector of scrub typhus in Japan. The larvae can be naturally infected with *Orientia tsutsugamushi*, and transmit through egg and metamorphosis. Seasonal changes of the number of larvae stay accordance with the number of cases of scrub typhus in Japan, suggesting *L. (L.) akamushi* as a disease-highly-related vector (Sasa, 1956; Kitaoka et al., 1974; Li et al., 1997).

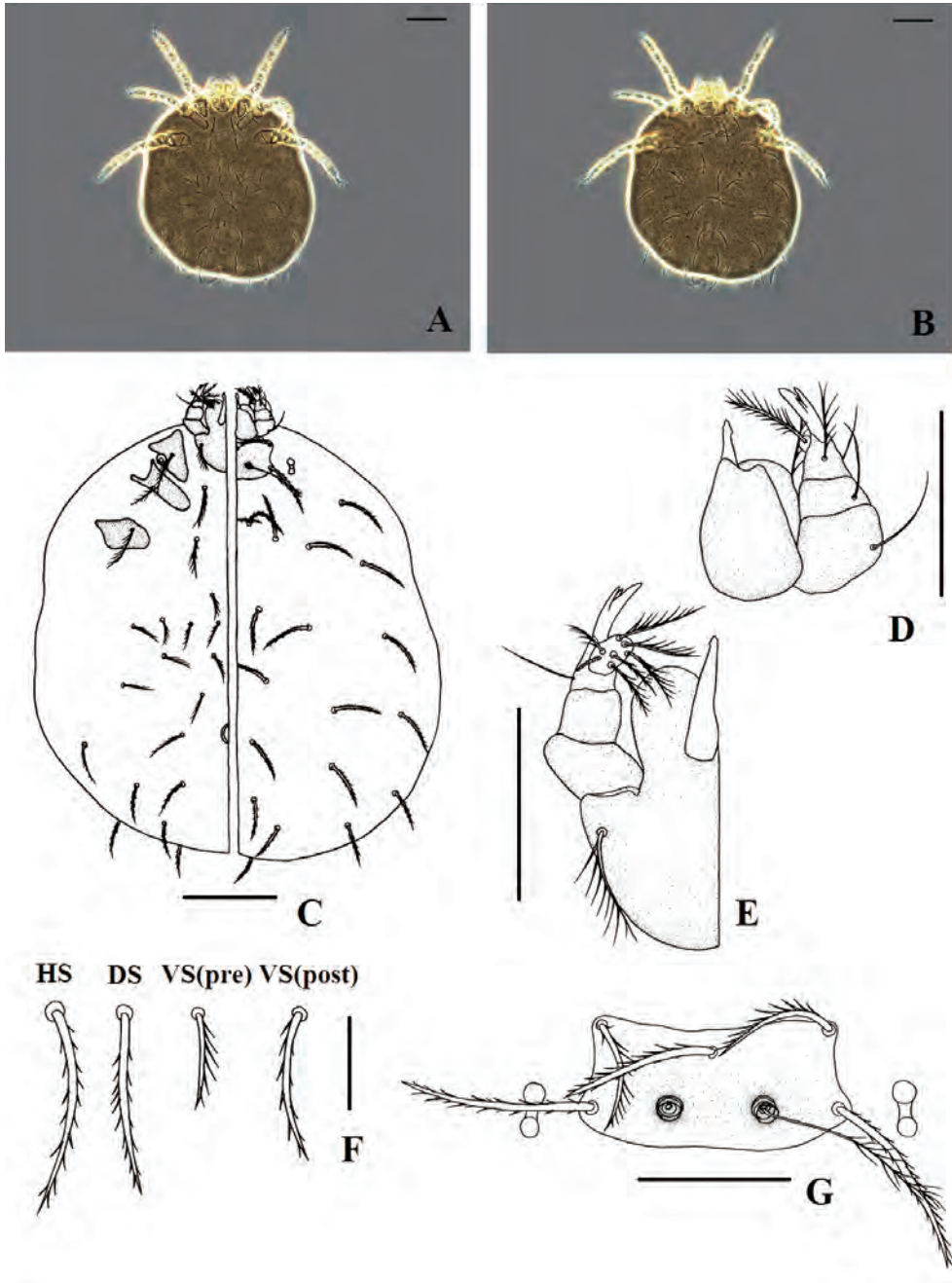


Fig. 11. *Leptotrombidium (Leptotrombidium) akamushi* (Brumpt, 1910) larva. A. phase contrast image of the ventral view; B. phase contrast image of the dorsal view; C. ventral and dorsal view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.



Leptotrombidium (Leptotrombidium) *apodemi* Wen and Sun, 1984

姬鼠纖恙蟎

(Fig. 12; Table 10)

References.

Leptotrombidium (L.) apodemi Wen & Sun, 1984: 59, f. II-10; Li, Wang & Chen, 1997: 109, f. 2-1-5.

Leptotrombidium apodemi Stekolnikov, 2013: 84.

Diagnosis of Larva. Scutum trapezoidal, with posterior margin curved backward and concave in the middle; fPp = N/N/BNN/7B. PL/SB. SN flagelliform, with 10–14 branches on distal half. Idiosomal setae plumose and branched; DS 41–43 in number (including HS), arranged in 2H, 8, 8, 2, 7, 6, 4, 2, 2...; VS 37–43 in number. NDV = 80–84.

Description of Larva. (n = 2) Live larva oval, color unknown. Size medium to large. Measurements of body length and width are as follows (in μm). Engorged body length 735–777, width 589–668. Eyes 2+2, located by scutum; anterior pair slightly larger.

Gnathosoma. Gnathosomal base evenly punctate, with a pair of pectinate setae; cheliceral base sparsely punctate; cheliceral blade with tricuspid cap. Galeal setae branched; fPp = N/N/BNN/7B; palpotarsus with blunt solenidion; palpal claw 3-pronged.

Scutum. Trapezoidal; anterior margin nearly straight; lateral margins curved inward; posterior margin curved backward and concave in the middle; scutum punctate in the middle. PW/AP = 3.01–3.15; PW/SD = 1.75. PL/SB. SN long flagelliform, with 10–14 branches on distal half. PL > AM > AL; AM, ALs and PLs densely branched, shafts tapering to apex. Standard measurements of scutum are presented in Table 10.

Idiosomal Setae. DS 41–43 (including HS) in number; fD = 2H, 8, 8, 2, 7, 6..., posterior less ordered. HS and DS similar to PLs, covered with long setules and tapering to apex; posterior setae of DS shorter. ST 2-2, plumose and finely branched. VS 37–43 in number; preanal setae 31, similar to ST but shorter; postanal setae 12, similar to posterior pairs of DS (data based on one specimen). NDV = 80–84. Measurements of idiosomal setae are as follows (in μm). HS 52–58; medial setae of first post-humeral row 51–59; VS (pre) 34–35; VS (post) 39–41.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, finely punctate. Ip 827–837 μm . All segments with various numbers of



branched setae (B).

Leg I. 270 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microtibiala; tarsus 22B, with 1 central tarsala, 1 microtarsala next to it, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 262–265 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala, and 1 pretarsala.

Leg III. 295–302 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 3B; genu 3B, with 1 genuala; tibia 6B, with 1 tibiala; tarsus 15B.

SIF = 7B-B-3-2111.0000.

Table 10. Standard measurements (in μm) of *Leptotrombidium (Leptotrombidium) apodemi* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 2 specimens	62	75	29	30*	12*	42*	25	48	42	59	53	24
Observed range												
Min.	59	74	27	N/A	N/A	N/A	25	48	40	56	47	23
Max.	65	77	32	N/A	N/A	N/A	25	50	44	61	59	25

*data from 1 specimen.

Specimens Examined. YILAN COUNTY: 2 larvae (IW0053-7-2, IW0053-10-2), Tatung, Szuyuan Wukou (宜蘭縣大同鄉思源埡口), 13 Aug. 2008, ex *Niviventer coninga*, male.

Distribution. China (Liaoning Province) and Taiwan (new record) (Wen & Sun, 1984).

Remarks. *Leptotrombidium (L.) apodemi* most closely resembles *L. (L.) intermedium* (Nagayo, Mitamura and Tamiya, 1920), and it can be distinguished from the latter by the following feature (*L. (L.) intermedium* in parenthesis): second row of DS 8 in number (usually 10) (Li et al., 1997).

Biology. Holotype and paratype of *L. (L.) apodemi* were collected from the conchal fossa of *Apodemus agrarius* in Liaoning Province of China (Wen & Sun, 1984), and here we report *Niviventer coninga* as its newly recorded host.

Medical Importance. Unknown.

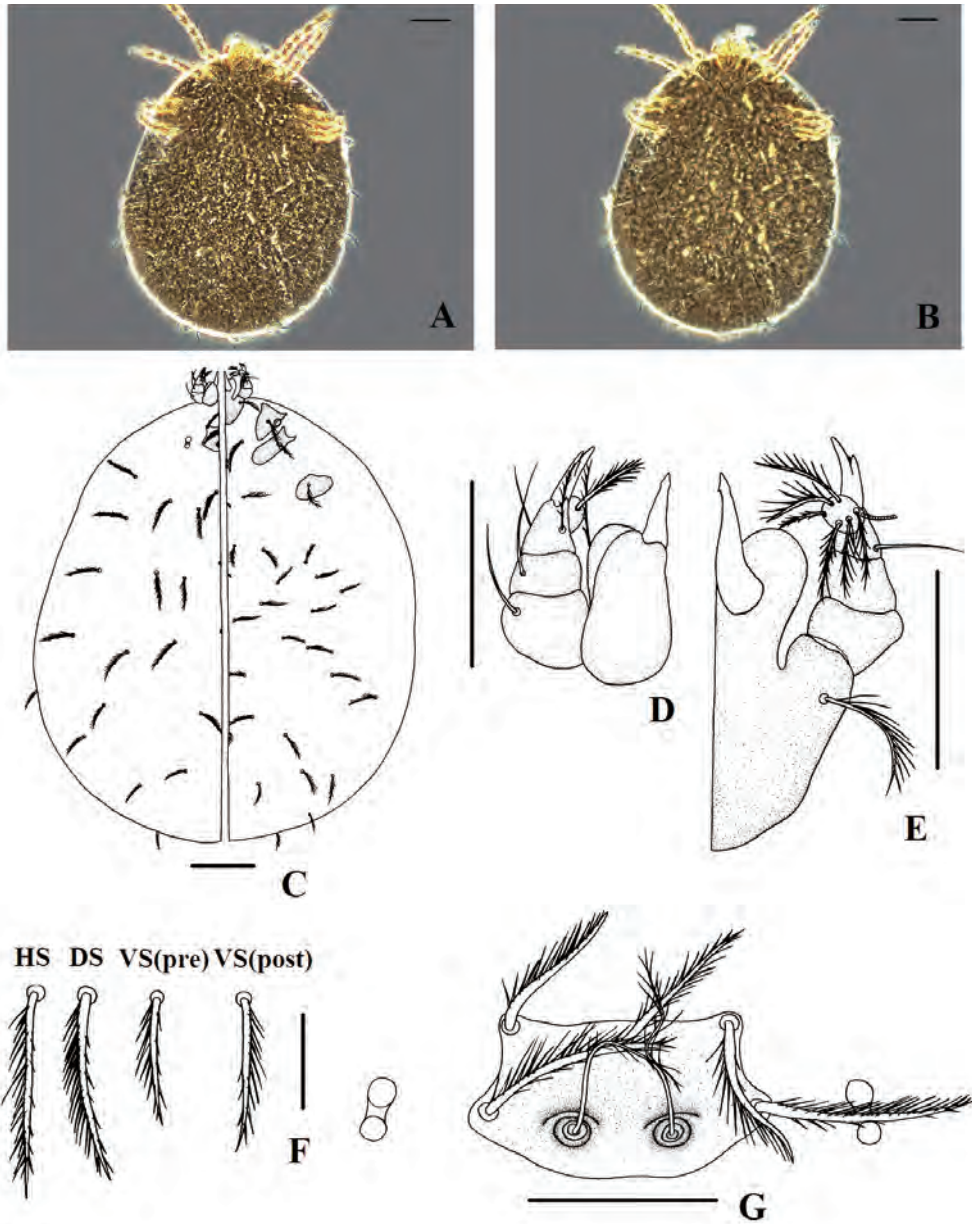


Fig. 12. *Leptotrombidium (Leptotrombidium) apodemi* Wen and Sun, 1984 larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.

Leptotrombidium (Leptotrombidium) *cangjiangense* Yu, Yang and Gong, 1981

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(Fig. 13; Table 11)

References.

Leptotrombidium (L.) cangjiangense Yu, Yang & Gong, 1981: 177, f. 2; Li, Wang & Chen, 1997: 117, f. 2-1-17.

Leptotrombidium cangjiangense Stekolnikov, 2013: 39.

Diagnosis of Larva. Scutum small, flat rectangular; fPp = N/N/BNN/7B. PL/SB; SB > AP. SN flagelliform, with 10–14 branches on distal half. DS 27–29 in number (including HS), arranged in 2H, 8, 6, 6 (5), 4, 2 (3); VS 27–31 in number. NDV = 55–59.

Description of Larva. (n = 3) Live larva oval, white (Li et al., 1997). Size medium. Measurements of body length and width are as follows (in μm). Unengorged body length 299, width 151; engorged body length 521–639, width 382–527. Eyes 2+2, located by scutum; anterior pair larger.

Gnathosoma. Gnathosomal base evenly punctate, with a pair of pectinate setae; cheliceral base lightly punctate; cheliceral blade with tricuspid cap. Galeal setae branched; fPp = N/N/BNN/7B; palpotarsus with blunt solenidion; palpal claw 3-pronged.

Scutum. Flat rectangular; bases of ALs and PLs project laterally; anterior margin concave; lateral margins curved inward; posterior margin biconvex; scutum punctate in the middle. PW/AP = 3.45–3.61; PW/SD = 1.90–1.96. PL/SB. SN long flagelliform, with 10–14 branches on distal half. PL > AM > AL; AM, ALs and PLs branched, shafts tapering to apex. Standard measurements of scutum are presented in Table 11.

Idiosomal Setae. DS 27–29 (including HS) in number; fD = 2H, 8, 6, 6 (5), 4, 2 (3). HS and DS similar to PLs, branched and tapering to apex. ST 2-2 finely branched. VS 27–31 in number; preanal setae 22–23, similar to ST but shorter; postanal setae 5–9, similar to posterior pairs of DS. NDV = 55–59. Measurements of idiosomal setae are as follows (in μm). HS 45–46; medial setae of first post-humeral row 48–53; VS (pre) 26–30; VS (post) 40–42.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, finely punctate. Ip 681–688 μm . All segments with various numbers of branched setae (B).

Leg I. 224–235 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microtibiala; tarsus 22B, with 1 central tarsala, 1 microtarsala, pretarsala, nude subterminala and parasubterminala.

Leg II. 203–218 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 243–246 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, with 1 genuala; tibia 6B, with 1 tibiala; tarsus 15B.

SIF = 7B-B-3-2111.0000.

Table 11. Standard measurements (in μm) of *Leptotrombidium (Leptotrombidium) cangjiangense* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 3 specimens	56	63	24	24	9	33	18	33	30	45	45	20
Observed range												
Min.	54	61	24	23	8	32	17	31	30	44	42	19
Max.	58	65	25	25	9	33	19	35	31	47	50	21

Specimens Examined. YILAN COUNTY: 3 larvae (IW0048-1-1, IW0048-11-4~5), Tatung, Szuyuan Wukou (宜蘭縣大同鄉思源埡口), 12 Aug. 2008, ex *Niviventer coninga*, female.

Distribution. China (Yunnan Province) and Taiwan (new record) (Yu et al., 1981).

Remarks. *Leptotrombidium (L.) cangjiangense* most closely resembles *L. (L.) longchuanense* Yu, Yang and Gong, 1981 in China, and it can be distinguished from the latter by the following features (*L. (L.) longchuanense* in parentheses): scutum smaller: PW 61–65 μm , SB 24–25 μm , ASB 23–25 μm , AP 17–19 μm (scutum larger: PW 68–78 μm , SB 31–35 μm , ASB 28–29 μm , AP 20–22 μm); scutal setae shorter: AM 31–35 μm , AL 30–31 μm , PL 44–47 μm (scutal setae longer: AM 43–49 μm , AL 38–40 μm , PL 48–51 μm) (Yu et al., 1981).

Biology. *Leptotrombidium (L.) cangjiangense* was reported from Yunnan Province of China, and newly recorded from Taiwan (Yilan County). *Rattus rattus* and *Niviventer coninga* are its known hosts (Yu et al., 1981).

Medical Importance. Unknown.

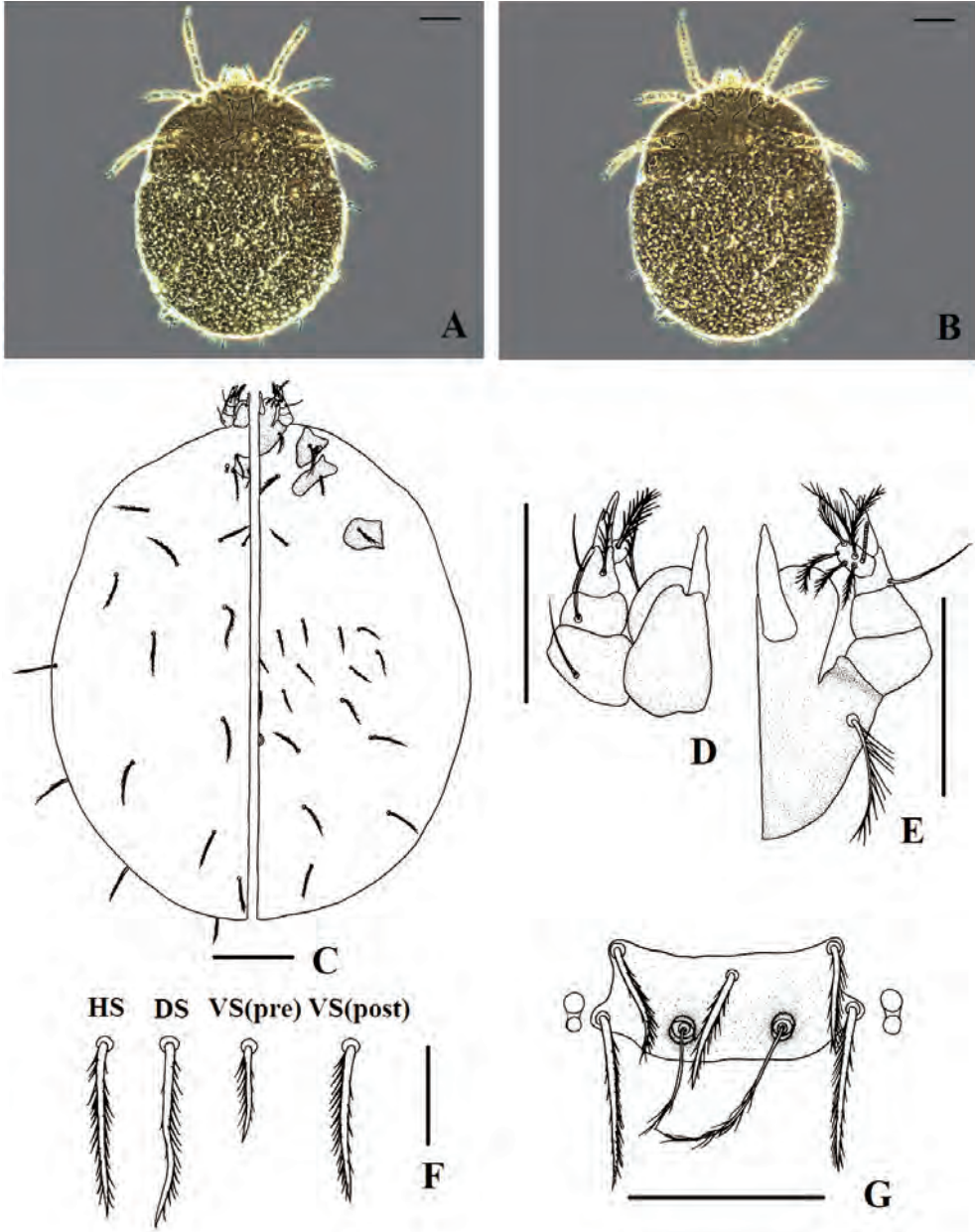
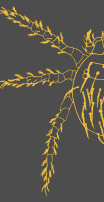


Fig. 13. *Leptotrombidium (Leptotrombidium) cangjiangense* Yu, Yang and Gong, 1981 larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.



Leptotrombidium (Leptotrombidium) *deliense* (Walch, 1922)

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(Fig. 14; Table 12)

References.

Trombicula deliensis Walch, 1922: 543, fs. 6–9.

Trombicula (L.) deliensis Audy, 1952: 133; Womersley, 1952: 62; Wharton & Fuller, 1952: 52; Audy, 1954: 142; Audy & Harrison, 1954: 17; Audy, 1956b: 58; 1957: 228; Maa & Kuo, 1966: 389.

Leptotrombidium deliensis Radford, 1954: 260.

Leptotrombidium (L.) deliense Vercammen-Grandjean, 1968: 74; Vercammen-Grandjean & Langston, 1975: 239, pls. 1–4, 6, 18; Wen, 1984e: 305; Li, Wang & Chen, 1997: 120, f. 2-1-22.

Leptotrombidium deliense Stekolnikov, 2013: 64.

Diagnosis of Larva. Larva oval; fPp = N/N/BNN/7B; scutum rectangular; PL > AM > AL; mostly SB/PL, some specimens with SB-PL; SN flagelliform, with 10–12 branches on distal half. Numbers of idiosomal setae relatively stable; DS 28–30 in number (including HS); 27 in a few individuals; fD = 2H, 8 (7, 9–10), 6 (7), 6 (5), 4 (5), 2 (3); VS 20–22 in number, a few with 23; preanal setae 14–17; postanal setae 4–8; NDV = 47–52.

Description of Larva. (n = 74) Live larva oval, pale red (engorged) or reddish orange (unengorged) (Li et al., 1997). Size medium. Measurements of body length and width are as follows (in μm). Unengorged body length 245–317, width 179–250; semi-engorged body length 329–494, width 260–411; engorged body length 446–535, width 418–465. Eyes 2+2, located by scutum; anterior pair slightly larger.

Gnathosoma. Gnathosomal base lightly punctate, with a pair of pectinate setae; cheliceral base round and lightly punctate; cheliceral blade with tricuspid cap. Galeal setae branched; fPp = N/N/BNN/7B; palpotarsus with blunt solenidium; palpal claw 3-pronged.

Scutum. Rectangular; anterior margin nearly straight; lateral margins slightly curved inward; posterior margin convex; angles between lateral and posterior margins extended laterally; scutum evenly punctate except around bases of AM and ALs. PW/AP = 2.40–3.16; PW/SD = 1.66–2.07. Mostly SB/PL; some specimens with SB-PL; SN long flagelliform, with 10–12 branches on distal half; pedicels with paired tiny spikes. PL > AM > AL; AM, ALs and PLs covered with fine setules, shafts tapering to apex; AM and ALs with longer branches. Standard measurements



of scutum are presented in Table 12.

Idiosomal Setae. Numbers of idiosomal setae relatively stable: DS mostly 27–30 (including HS), arranged in 2H, 8 (7, 9–10), 6 (7), 6 (5), 4 (5), 2 (3); HS and DS similar to PLs and slightly curved in posterior half, covered with long setules and tapering to apex. ST 2-2, significantly branched. VS mostly 20–22 in number, 23 in a few specimens; preanal setae 14–17, similar to ST but slightly shorter; postanal setae 4–8, similar to posterior pairs of DS. NDV = 47–52. Measurements of idiosomal setae are as follows (in μm). HS 41–57; medial setae of first post-humeral row 36–50; VS (pre) 24–31; VS (post) 33–48.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, evenly punctate. Ip 606–733 μm . All segments with various numbers of branched setae (B).

Leg I. 203–252 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 4B, 2 genualae and 1 microgenuala; tibia 9B, 2 tibialae and 1 microtibiala; tarsus 22B, with 1 central tarsala, 1 microtarsala next to it, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 178–228 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala next to it, and 1 pretarsala.

Leg III. 222–257 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 3B; genu 3B, with 1 genuala; tibia 6B, with 1 tibiala; tarsus 15B.

SIF = 7B-B-3-2111.0000.

Table 12. Standard measurements (in μm) of *Leptotrombidium (Leptotrombidium) deliense* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 74 specimens	60	72	29	25	13	38	27	45	39	50	51	22
Observed range												
Min.	54	66	26	22	10	35	23	38	32	42	45	19
Max.	66	78	32	28	17	42	31	53	47	61	58	25

Specimens Examined. NANTOU COUNTY: 1 larva (8081-1-1), Kuohsing, Peikang (南投縣國姓鄉北港村), 16 Oct. 2001, ex *Bandicota indica*, male; 1 larva (8205-1-1), Jenai, Pingho (南投縣仁愛鄉平和村), 28 June 2002, ex *Rattus losea*,

male. TAINAN CITY: 3 larvae (IW0013-4-1~2, IW0013-6-1), Kuantien (台南市官田區), 17 June 2007, ex *Rattus losea*, female; 1 larva (IW0015-1-1), Shanshang (台南市山上區), 18 June 2007, ex *Rattus losea*, male. YILAN COUNTY: 2 larvae (9106-7-1-1~2), Suao, Wuwei Port (宜蘭縣蘇澳鎮無尾港), 17 Mar. 2009, ex *Rattus losea*, male; 1 larva (9145-1-1), same locality, 19 Mar. 2009, ex *Rattus losea*, female; 1 larva (9345-6-2-1), same locality, 13 Aug. 2009, ex *Rattus losea*, male; 4 larvae (9317-8-3-1~2, 9325-3-1~2), Chuangwei, Tungkang (宜蘭縣壯圍鄉東港), 12 Aug. 2009, ex *Rattus losea*, female. HUALIEN COUNTY: 2 larvae (7783-4-1~2), Yuli, Kauliao (花蓮縣玉里鎮高寮里), 16 Aug. 2000, ex *Bandicota indica*, male; 1 larva (8038-5-1), same locality, 13 June 2001, ex *Bandicota indica*, male; 2 larvae (8055-3-1~2), same locality and date, ex *Rattus losea*, female; 2 larvae (7813-3-1~2), Juisui, Hokang (花蓮縣瑞穗鄉鶴岡村), 19 Oct. 2000, ex *Bandicota indica*, male; 2 larvae (7815-3-1~2), same locality and date, ex *Rattus losea*, male; 2 larvae (7944-2-1, 7944-3-1), same locality, 1 Mar. 2001, ex *Rattus losea*, female; 2 larvae (8012-3-1~2), same locality, 5 Mar. 2001, ex *Rattus losea*, male; 1 larva (8069-2-1), same locality, 14 June 2001, ex *Rattus losea*, male; 1 larva (7929-4-1), Fuli, Tungli (花蓮縣富里鄉東里村), 28 Feb. 2001, ex *Rattus losea*, female; 2 larvae (8018-1-1~2), same locality, 12 June 2001, ex *Bandicota indica*, male; 3 larvae (9159-60-8-1~2, 9159-60-9-1), Fenglin (花蓮縣鳳林鎮), 28 Apr. 2009, ex *Rattus losea*, female; 1 larva (9190-91-3-1), Shoufeng (花蓮縣壽豐鄉), 29 Apr. 2009, ex *Rattus losea*, male; 1 larva (9192-96-3-1), same locality and date, ex *Rattus exulans*, female. TAITUNG COUNTY: 1 larva (8558-2-1), Lanyu, Langtao (台東縣蘭嶼鄉朗島村), 7 Sept. 2006, ex *Rattus losea*, male; 7 larvae (9289-3-1, 9289-3-2, 9289-5-1~3, 9290-4-1, 9290-4-2), Peinan, Pinlang (台東縣卑南鄉賓朗村), 11 June 2009, ex *Rattus losea*, female; 1 larva (9360-1-1), Lutao, Chungliiao (台東縣綠島鄉中寮村), 29 Sept. 2009, ex *Rattus losea*, male; 2 larvae (9389-1-1~2), Lutao, Kungkuan (台東縣綠島鄉公館村), 30 Sept. 2009, ex *Rattus losea*, male; 2 larvae (9391-1-1~2), Lutao, Nantzuh (台東縣綠島鄉楠仔湖), 30 Sept. 2009, ex *Rattus losea*, male; 1 larva (9414-5-1), Lutao, Shihlang (台東縣綠島鄉石朗), 1 Oct. 2009, ex *Suncus murinus*, male; 1 larva (9417-2-1), Lutao, Nanliao (台東縣綠島鄉南寮村), 1 Oct. 2009, ex *Suncus murinus*, male. PENGHU COUNTY: 1 larva (8690-2-1), Huhsi, Huhsi (澎湖縣湖西鄉湖西村), 8 May 2007, ex *Suncus murinus*, female; 1 larva (8701-1-1), Huhsi, Nanliao (澎湖縣湖西鄉南寮村), 8 May 2007, ex *Rattus losea*, male; 1 larva (8725-2-1), Hsiyu, Chihtung (澎湖縣西嶼鄉池東村), 10 May 2007, ex *Rattus losea*, male; 1 larva (8732-1-1), Hsiyu, Tachih (澎湖縣西嶼鄉大池村), 10 May 2007, ex *Rattus losea*, male; 1 larva (8817-1-1), same locality, 11 Sept. 2007, ex *Rattus losea*, female; 2 larvae (8860-1-1~2), Makung, Chienliao (澎湖縣馬公市前寮里), 12 Sept. 2007,



ex *Rattus losea*, female. KINMEN COUNTY: 1 larva (6916-1-1), Kinning, Lake Hou (金門縣金寧鎮后湖), 16 Aug. 1999, ex *Rattus tanezumi*, female; 1 larva (6942-2-1), same locality and date, ex *Rattus losea*, female; 1 larva (6974-6-1), Kinsha, Tayang (金門縣金沙鎮大洋村), 18 Aug. 1999, ex *Rattus losea*, female; 1 larva (7211-1-1), same locality, 6 Nov. 1999, ex *Rattus losea*, male; 1 larva (7726-1-1), same locality, 15 June 2000, ex *Rattus losea*, male; 1 larva (7034-2-1), Kincheng, Hsiaokukang (金門縣金城鎮小古崗), 19 Aug. 1999, ex *Rattus losea*, female; 1 larva (7115-6-1), same locality, 3 Nov. 1999, ex *Rattus tanezumi*, male; 1 larva (7641-4-1), same locality, 12 June 2000, ex *Rattus tanezumi*, male; 1 larva (7654-2-1), same locality and date, ex *Rattus losea*, female; 1 larva (8499-1-1), Kinhu, Hsiaoching (金門縣金湖鎮小徑), 22 June 2006, ex *Rattus losea*, female. LIENCHIANG COUNTY: 1 larva (8761-1-1), Nankan, Chulo (連江縣南竿鄉珠螺村), 25 July 2007, ex *Suncus murinus*, female; 2 larvae (8674-3-1~2), same locality and date, ex *Rattus losea*, female; 2 larvae (8781-1-1~2), Nankan, Chinsha (連江縣南竿鄉津沙村), 26 July 2007, ex *Suncus murinus*, female; 1 larva (8785-1-1), same locality and date, ex *Rattus losea*, male.

Distribution. Australia, Burma, China, India, Japan, Malaysia, Pakistan, Papua New Guinea, Philippine, Taiwan, Thailand, and Vietnam (Audy, 1957; Maa & Kuo, 1966; Suzuki, 1980; Li et al., 1997).

Remarks. *Leptotrombidium* (*L.*) *deliense* most closely resembles *L.* (*L.*) *rubellum* Wang and Liao, 1984 in China in having similar numbers of DS and VS. The only feature that distinguishes *L.* (*L.*) *deliense* from *L.* (*L.*) *rubellum* is the comparison between AP and SB (the latter in parenthesis): mostly $SB \geq AP$; if $AP > SB$, no more than $5 \mu\text{m}$ ($AP > SB$, at least $5 \mu\text{m}$).

Biology. *Leptotrombidium* (*L.*) *deliense* is a dominant trombiculid species in Taiwan and many other places prevalent of scrub typhus. Based on the specimens collected and identified, *L.* (*L.*) *deliense* comprises almost 60% of the total numbers of trombiculid mites in Taiwan we collected, and can be found in plains, low mountains and hills. In spite of its high density among the population of trombiculid mites, the hosts of *L.* (*L.*) *deliense* are very diverse, including rodents (*Apodemus agrarius*, *Bandicota indica*, *Mus caroli*, *M. musculus*, *Rattus exulans*, *R. losea*, *R. norvegicus*, *R. rattus*, *R. tanezumi*), shrews (*Crocidura attenuate*, *Suncus murinus*), bat (*Pipistrellus pipistrellus*), birds (*Centropus bengalensis lignator*, *Gallus gallus domesticus*, *Phasianus colchicus formosanus*, *Turnix sylvatica*), carnivores (*Canis familiaris*, *Felis domesticus*), rabbit (*Oryctolagus cuniculus*) and human (Wen, 1984e).

Medical Importance. *Leptotrombidium (L.) deliense* has been proven to be a carrier of *Orientia tsutsugamushi* in many countries, including Australia, Burma, China, India, Malaysia, Philippine, Taiwan and Thailand, and can be naturally infected and transmit *O. tsutsugamushi* through life cycle for at least two generations. Wang et al. (2004) successfully detected several serotypes of *O. tsutsugamushi* from *L. (L.) deliense* in Kinmen County, and concluded *L. (L.) deliense* as the main vector for scrub typhus in summer in Kinmen County (Li et al., 1997; Wang et al., 2004).

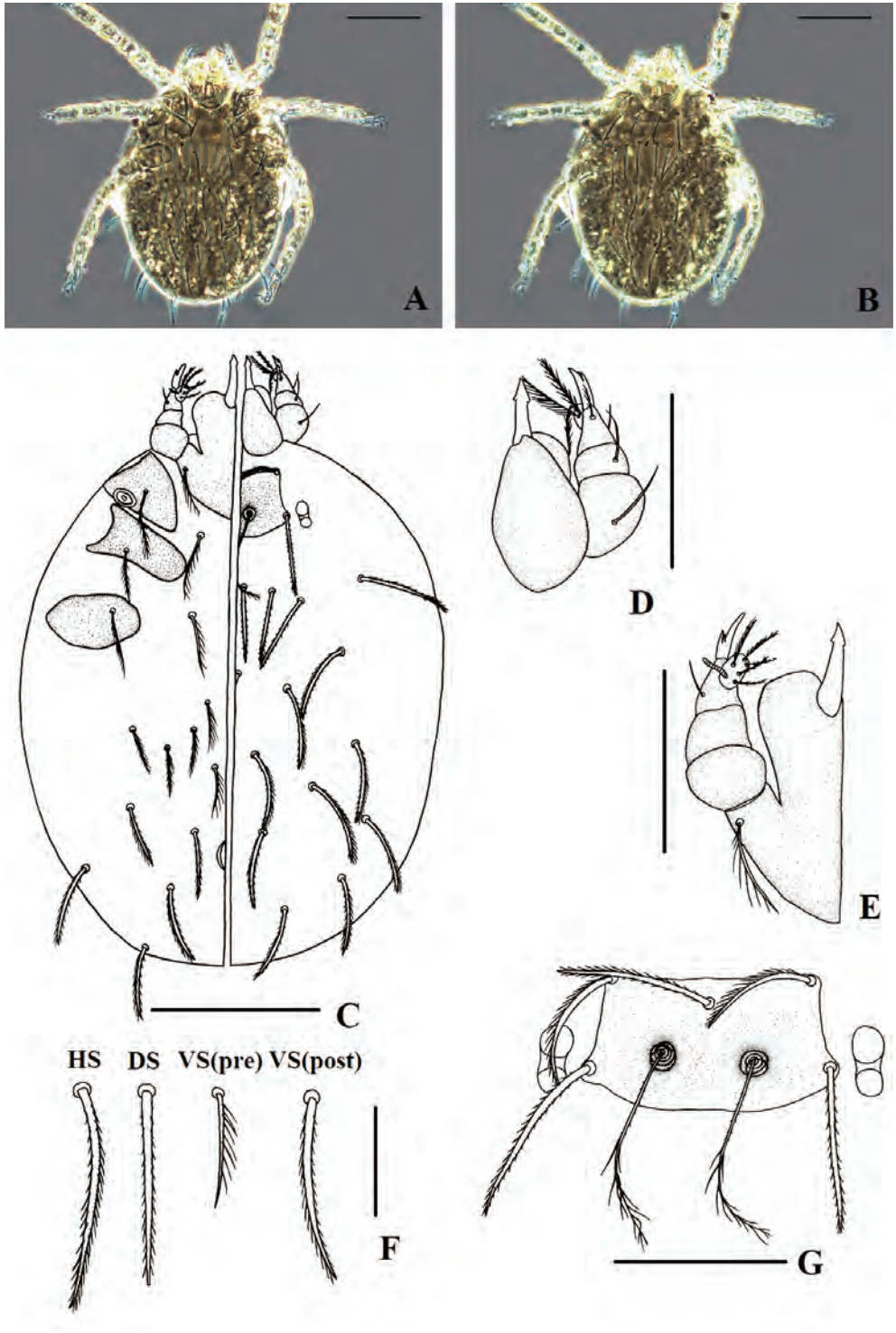


Fig. 14. *Leptotrombidium (Leptotrombidium) deliense* (Walch, 1922) larva. A. phase contrast image of the ventral view; B. phase contrast image of the dorsal view; C. ventral and dorsal view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.



Leptotrombidium (Leptotrombidium) fujianense Liao and Wang, 1983

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(Fig. 15; Table 13)

References.

Leptotrombidium (L.) fujianensis Liao & Wang, 1983: 177, fs. 1–4

Leptotrombidium (L.) fujianense Li, Wang & Chen, 1997: 128, f. 2-1-33.

Leptotrombidium fujianense Stekolnikov, 2013: 94.

Diagnosis of Larva. Larva oval; fPp = N/N/BNN/7B; scutum rectangular; PL \approx AM > AL; SB-PL, some specimens with SB/PL; SN flagelliform, with 12–14 branches on distal half. DS 38–42 in number (including HS); fD = 2H, 10 (8–9), 8 (6–7), (2), 8 (6), 6 (7), 4 (5), 2; VS 26–32 in number (26 in the specimen observed, with 15 preanal setae and 11 postanal setae) (Liao & Wang, 1983); NDV = 68.

Description of Larva. (n = 1) Live larva oval, pale pink (Liao & Wang, 1983). Size medium. Measurements of body length and width are as follows (in μ m). Semi-engorged body length 463, width 369. Eyes 2+2, located by scutum; anterior pair larger.

Gnathosoma. Gnathosomal base evenly punctate, with a pair of pectinate setae; cheliceral base round and lightly punctate; cheliceral blade with tricuspid cap. Galeal setae branched; fPp = N/N/BNN/7B; palpotarsus with blunt solenidion; palpal claw 3-pronged.

Scutum. Rectangular; anterior margin slightly concave; lateral margins curved inward; posterior margin biconvex; scutum evenly punctate. PW/AP = 2.58; PW/SD = 1.58. Mostly SB-PL; SN long flagelliform, with 12–14 branches on distal half. PL \approx AM > AL; AM, ALs and PLs branched, shafts tapering to apex. Standard measurements of scutum are presented in Table 13.

Idiosomal Setae. DS 42 in number (including HS); fD = 2H, 10, 8, 2, 8, 6, 4, 2, slightly curved, similar to PL. ST 2-2, branched. VS 26 in number, with 15 preanal setae, similar to ST but shorter, and 11 postanal setae similar to DS. NDV = 68. Measurements of idiosomal setae are as follows (in μ m). HS 54; medial setae of first post-humeral row 47; VS (pre) 32; VS (post) 44.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, evenly punctate. Ip 767 μ m. All segments with various numbers of branched setae (B).

Leg I. 265 μ m; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B,



2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microtibiala; tarsus 22B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 233 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 270 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 1 tibiala; tarsus 15B.

SIF = 7B-B-3-2111.0000.

Table 13. Standard measurements (in μm) of *Leptotrombidium* (*Leptotrombidium*) *fujianense* larval scutum.

AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
69	79	31	37	13	50	31	60	46	58	83	24

Specimens Examined. KAOHSIUNG CITY: 1 larva (20150127C03-4), Liukuei, Shanping (高雄市六龜區扇平), 27 Jan. 2015, ex *Herpestes urva*, gender unknown.

Distribution. China (Fuchien Province) and Taiwan (new record) (Liao and Wang, 1983).

Remarks. *Leptotrombidium* (*L.*) *fujianense* most closely resembles *L. (L.) scutellare* (Nagayo, Miyagawa, Mitamura, Tamiya and Tenjin, 1921), and it can be distinguish from the latter by the following features (*L. (L.) scutellare* in parentheses): DS 38–42, with the number of second row of DS more variable, starting with fD = 2H, 10 (8–9), 8 (6–7)...(DS 45–55, with second row more stable in number: 2H, mostly 10, 10 (11)...); VS 26–32 (35–44); posterior margin of scutum biconvex or nearly straight (curved and extended outward) (Liao & Wang, 1983).

Biology. *Leptotrombidium* (*L.*) *fujianense* was collected from *Rattus fulvescens* from Fuchien Province of China, and successfully raised to adult and reproduced to the next generation in the laboratory (Liao & Wang, 1983). In Taiwan, we discover *Herpestes urva* as a newly-recorded host.

Medical Importance. Unknown.

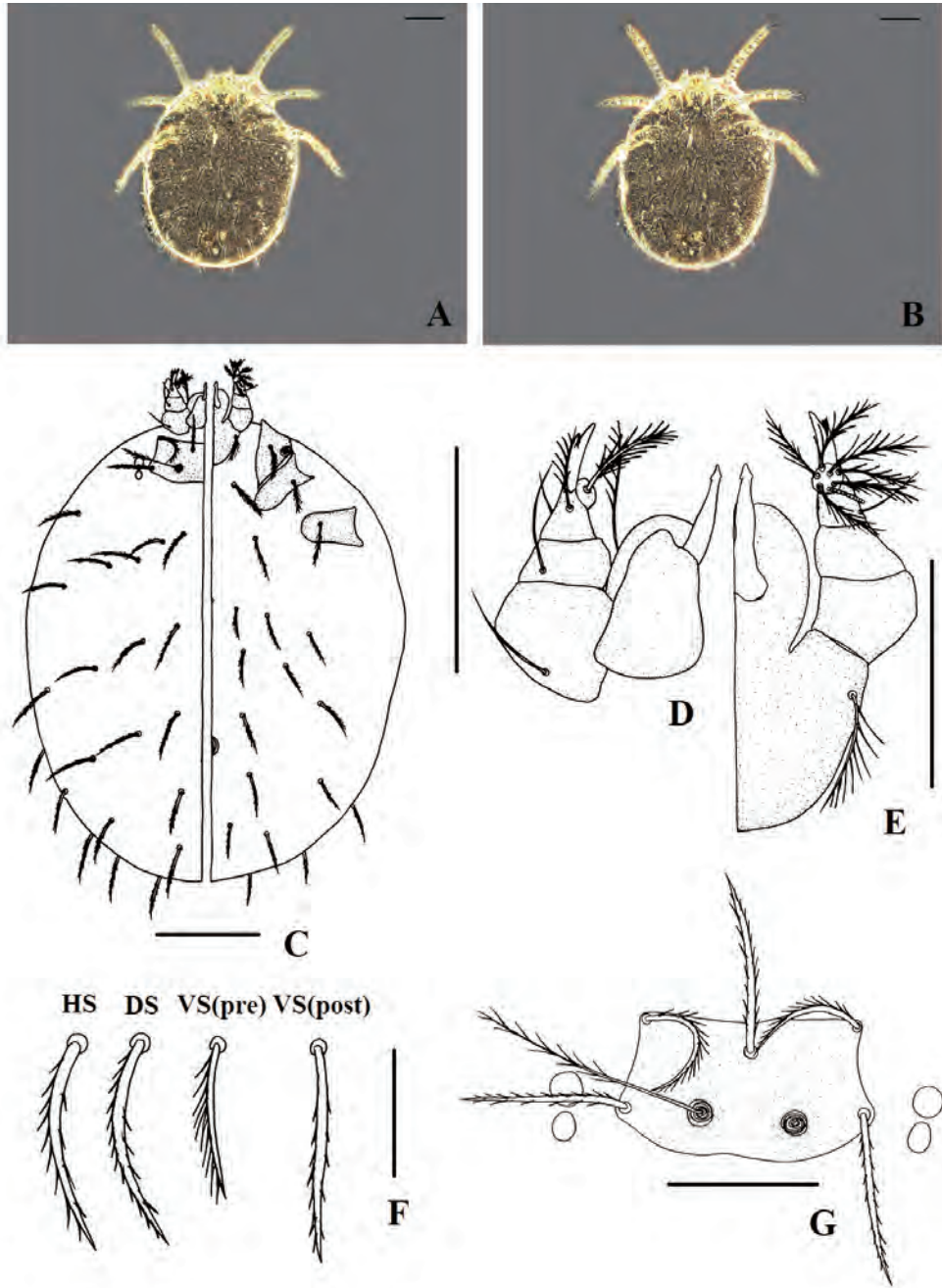


Fig. 15. *Leptotrombidium (Leptotrombidium) fujianense* Liao and Wang, 1983 larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.

Leptotrombidium (Leptotrombidium) *imphalum* Vercammen-Grandjean and Langston, 1975

英帕纖恙蟎

(Fig. 16; Table 14)

References.

Leptotrombidium (L.) imphalum Vercammen-Grandjean & Langston, 1975: 255, pl. 11; Wen, 1984e: 306; Li, Wang & Chen, 1997: 136, f. 2-1-45; Tanskul & Linthicum, 1999: 89, fs. 1-9.

Leptotrombidium imphalum Stekolnikov, 2013: 66.

Diagnosis of Larva. fPp = N/N/BNN/7B; scutum rectangular; PL > AM > AL; mostly SB/PL, SB-PL in a few specimens; SN flagelliform, with 10-16 branches on distal half. DS 28-33 in number (including HS); numbers stable in anterior half, variable in posterior half; fD = 2H, 8, 6 (7), 6 (7), 4 (5-7), 2 (3-4), (1-2); VS 23-29 in number. NDV = 52-60.

Description of Larva. (n = 33) Live larva oval, light orange (Li et al., 1997). Size medium. Measurements of body length and width are as follows (in μm). Unengorged body length 260-322, width 210-245; semi-engorged body length 321-443, width 256-371; engorged body length 384-542, width 381-520. Eyes 2+2, located by scutum; anterior pair slightly larger.

Gnathosoma. Gnathosomal base lightly punctate, with a pair of pectinate setae; cheliceral base round and lightly punctate; cheliceral blade with tricuspid cap. Galeal setae branched; fPp = N/N/BNN/7B; palpotarsus with blunt solenidion; palpal claw 3-pronged.

Scutum. Rectangular; anterior margin slightly biconcave or nearly straight; lateral margins slightly curved inward; posterior margin convex or biconvex; angles between lateral and posterior margins extended laterally; scutum punctate except around bases of AM and ALs. PW/AP = 2.37-3.35; PW/SD = 1.60-2.07. Mostly SB/PL, SB-PL in a few specimens; SN long flagelliform, with 10-16 branches on distal half; pedicels with paired tiny spikes. PL > AM > AL; AM, ALs and PLs covered with fine setules, shafts tapering to apex; ALs with longer branches. Standard measurements of scutum are presented in Table 14.

Idiosomal Setae. DS 28-33 (including HS); numbers stable in anterior half, variable in posterior half; fD = 2H, 8, 6 (7), 6 (7), 4 (5-7), 2 (3-4), (1-2); HS and DS slightly curved and similar to PLs, covered with long setules and tapering to apex. ST 2-2, significantly branched. VS 23-29 in number; preanal setae 13-19, similar to ST but shorter; postanal setae 6-12, similar to posterior pairs of DS. NDV =

52–60. Measurements of idiosomal setae are as follows (in μm). HS 46–64; medial setae of first post-humeral row 42–61; VS (pre) 25–37; VS (post) 42–53.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, evenly punctate. Ip 651–780 μm . All segments with various numbers of branched setae (B).

Leg I. 220–260 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microtibiala; tarsus 22B, with 1 central tarsala, 1 microtarsala next to it, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 198–238 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala next to it, and 1 pretarsala.

Leg III. 230–282 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 3B, with 1 genuala; tibia 5B, with 1 tibiala; tarsus 15B.

SIF = 7B-B-3-2111.0000.

Table 14. Standard measurements (in μm) of *Leptotrombidium (Leptotrombidium) imphalum* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 33 specimens	65	75	30	27	13	40	27	50	40	57	60	23
Observed range												
Min.	57	64	25	25	11	37	25	45	35	47	50	21
Max.	73	85	35	29	15	42	31	62	48	69	72	26
No.7853-3-1 (specimen with 4 PLs)	73	78	32	27	11	38	27	51	42	61	64	25

Specimens Examined. HUALIEN COUNTY: 1 larva (7772-4-1), Fuli, Tungli (花蓮縣富里鄉東里村), 15 Aug. 2000, ex *Bandicota indica*, male; 1 larva (7800-1-1), Yuli, Kaoliao (花蓮縣玉里鎮高寮里), 18 Oct. 2000, ex *Rattus losea*, male; 1 larva (7803-6-1), same locality and date, ex *Rattus losea*, female; 2 larvae (7808-3-1~2), same locality and date, ex *Bandicota indica*, female; 2 larvae (7848-1-1~2), Juisui, Hokang (花蓮縣瑞穗鄉鶴岡村), 21 Dec. 2000, ex *Bandicota indica*, female; 8 larvae (7852-3-1~3, 7852-6-1~2, 7853-1-1~2, 7853-3-1), same locality and date, ex *Rattus losea*, male; 4 larvae (8057-3-1~4), same locality, 14 June 2001, ex *Bandicota indica*, male; 1 larva (8069-2-2), same locality and date, ex *Rattus losea*, male; 7 larvae (9159-60-8-3~5, 9159-60-9-2~4, 9159-60-9-6), Fenglin (花蓮縣鳳林鎮), 28 Apr. 2009, ex *Rattus losea*, female; 4 larvae (9190-91-3-2, 9190-91-6-1~3), Shoufeng (花蓮縣壽豐鄉), 29 Apr. 2009, ex *Rattus losea*, male; 1 larva (9197-99-1-1), same locality and date, ex *Mus caroli*, male. KINMEN COUNTY: 1

larva (7213-4-1), Kinsha, Tayang (金門縣金沙鎮大洋村), 6 Nov. 1999, ex *Rattus losea*, female.

Distribution. Burma, China, India, Malaysia, Pakistan, Taiwan, and Thailand (Vercammen-Grandjean & Langston, 1975; Li et al., 1997; Tanskul & Linthicum, 1999; Wang et al., 2004).

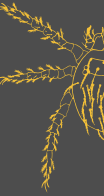
Remarks. *Leptotrombidium (L.) imphalum* most closely resembles *L. (L.) deliense* (Walch, 1922) occurring across East Asia, and it can be distinguished from the latter by the numbers of idiosomal setae (*L. (L.) deliense* in parentheses): numbers more variable, DS = 28–33, posterior half usually more in number (numbers stable, DS = 28–30); VS = 23–29 (VS = 20–23); NVD = 52–60, where 52 = 28 DSs + 24 VSs (NDV = 47–52, where 52 = 30 DSs + 22 VSs or 29 DSs + 23 VSs).

Leptotrombidium (L.) imphalum also resembles *L. (L.) akamushi* (Brumpt, 1910), and it differs from the latter in the following features (*L. (L.) akamushi* in parentheses): DS 28–33 in number, mostly arranged in 2H, 8, 6, 6, 4... (DS 31–35 in number, mostly arranged in 2H, 8 (9), 6 (7–8), 8 (6–7, 10), 6 (4–5, 8), 4...); 2PSB < ASB (2PSB ≥ ASB); VS = 23–29 (VS = 29–31); NDV = 52–60 (NDV = 61–65).

An anomaly with two pairs of PLs (7853-3-1) is found from Hualien County of Taiwan (Fig. 16-H). Wang et al. (1989) reported a new genus *Hsuella*, which was characterized with scutum with two pairs of PLs instead of PPLs; the shape of scutum similar to that of the genus *Leptotrombidium*. Among the three specimens the authors examined, no similarity on the standard measurements and chaetotaxy between the samples with two pairs of PLs and other *Leptotrombidium* species. Therefore, the authors considered the specimens as a new species of a new genus.

The specimen in hand (7853-3-1) appears similar to *L. (L.) imphalum* in general configuration and chaetotaxy: rectangular scutum; SB-PL; fPp = NNBNN/7B; galeal setae branched; DS 29 in number (2H, 8, 7, 6, 4, 2); VS 27 in number (17 preanal + 10 postanal setae). The variations on standard measurements are also insignificant (Table 14). Among the four PLs, two on the left side of scutum remain very close to each other, with bases slightly fused; the other two on the right side separate clearly. The unclear separation of the left PLs and overall observation of specimen indicate that this larva might still be *L. (L.) imphalum*, but only in certain phase of variation.

Biology. *Leptotrombidium (L.) imphalum* has been collected from various species



of rodents, including *Rattus losea*, *R. norvegicus*, *R. rattus* and *Mus caroli* (Wen, 1984e).

Medical Importance. It has been proven that *L. (L.) imphalum* can be naturally infected with *Orientia tsutsugamushi* (Tanskul & Linthicum, 1999). Isolation of *O. tsutsugamushi* from *L. (L.) imphalum* also has been performed, suggesting *L. (L.) imphalum* as a significant vector of scrub typhus in Asia (Li et al., 1997).

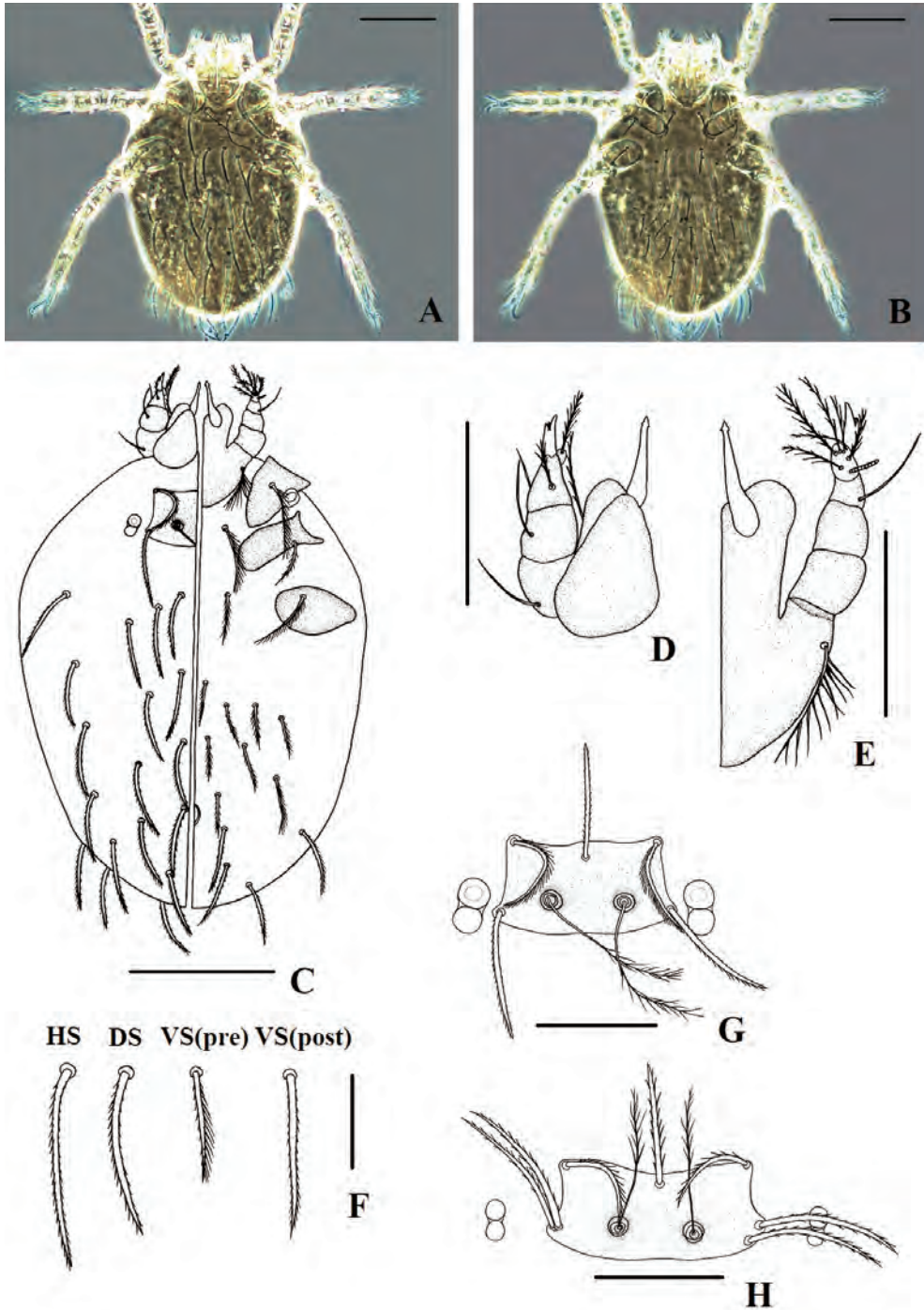


Fig. 16. *Leptotrombidium (Leptotrombidium) imphalum* Vercammen-Grandjean and Langston, 1975 larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum; H. scutum of specimen No. 7853-3-1. Scale: A, B, C = 100 μ m; D, E, G, H = 50 μ m; F = 25 μ m.



Leptotrombidium (*Leptotrombidium*) *kawamurai* (Fukuzumi and Obata, 1953)

川村織恙蟎

(Fig. 17; Table 15)

References.

- Trombicula* (*L.*) *kawamurai* Fukuzumi & Obata, 1953: 2; Sasa, 1956: 104, f. 8.
Leptotrombidium (*L.*) *kawamurai* Vercammen-Grandjean, 1968: 74; Vercammen-Grandjean & Langston, 1975: 403, pl. 172; Wen, 1984e: 307; Li, Wang & Chen, 1997: 141, f. 2-1-51.
Leptotrombidium kawamurai Stekolnikov, 2013: 55.

Diagnosis of Larva. fPp = N/N/BNN/7B; SB-PL; PL > AM > AL; scutum nearly rectangular, angles between lateral and posterior margins blunt; posterior margin of scutum biconvex; SN flagelliform, with 10–12 branches on distal half. DS 28–35 in number (including HS); anterior half of DS usually arranged in 2H, 8, 6, 6..., less ordered near caudal; VS 30–36 in number, with 21–26 preanal setae and 8–11 postanal setae. NDV = 61–69.

Description of Larva. (n = 19) Live larva oval, pale beige (Li et al., 1997). Size medium. Measurements of body length and width are as follows (in μm). Unengorged body length 276–342, width 207–250; semi-engorged body length 334–443, width 265–384. Eyes 2+2, located by scutum; anterior pair slightly larger.

Gnathosoma. Gnathosomal base evenly punctate, with a pair of pectinate setae; cheliceral base close to triangle and evenly punctate; cheliceral blade with tricuspid cap. Galeal setae branched; fPp = N/N/BNN/7B; palpotarsus with blunt solenidion; palpal claw 3-pronged.

Scutum. Close to rectangle; angles between lateral and posterior margins blunt; anterior margin concave; lateral margins slightly curved inward; posterior margin biconvex; scutum punctate significantly except around AM. PW/AP = 2.63–3.54; PW/SD = 1.88–2.08. SB-PL; SN long flagelliform, with 10–12 branches on distal half. PL > AM > AL; AM, ALs and PLs covered with fine setules, shafts tapering to apex. Standard measurements of scutum are presented in Table 15.

Idiosomal Setae. DS 28–35 (including HS); anterior half usually arranged in 2H, 8, 6, 6..., less ordered near caudal; HS and DS slender and straight, slightly curved near body sides, covered with long setules and tapering to apex. ST 2-2, slender and branched. VS 30–36 in number; preanal setae 21–26, similar to ST but shorter; postanal setae 8–11, similar to posterior pairs of DS. NDV = 61–69. Measurements



of idiosomal setae are as follows (in μm). HS 53–62; medial setae of first post-humeral row 45–54; VS (pre) 24–29; VS (post) 36–43.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, evenly punctate. Ip 671–724 μm . All segments with various numbers of branched setae (B).

Leg I. 222–240 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microtibiala; tarsus 22B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 203–228 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 245–260 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 3B; genu 3B, with 1 genuala; tibia 6B, with 1 tibiala; tarsus 15B.

SIF = 7B-B-3-2111.0000.

Table 15. Standard measurements (in μm) of *Leptotrombidium* (*Leptotrombidium*) *kawamurai* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 19 specimens	68	78	33	27	13	40	26	56	42	61	61	23
Observed range												
Min.	64	76	31	26	12	39	22	52	40	57	58	22
Max.	74	83	35	30	15	42	30	61	47	66	67	25

Specimens Examined. LIENCHIANG COUNTY: 2 larvae (8756-1-1, 8756-2-1), Nankan, Szuwei (連江縣南竿鄉四維村), 25 July 2007, ex *Suncus murinus*, male; 4 larvae (8761-1-2~3, 8761-3-1~2), Nankan, Chulo (連江縣南竿鄉珠螺村), 25 July 2007, ex *Suncus murinus*, female; 11 larvae (8771-2-1, 8772-1-1~5, 8772-2-1~2, 8772-3-1~3), Nankan, Jenai (連江縣南竿鄉仁愛村), 26 July 2007, ex *Suncus murinus*, female; 2 larvae (8781-1-3, 8781-2-1), Nankan, Chinsha (連江縣南竿鄉津沙村), 26 July 2007, ex *Suncus murinus*, female.

Distribution. China, Japan, and Taiwan (Sasa, 1956; Vercammen-Grandjean & Langston, 1975; Hasegawa et al., 1990; Li et al., 1997).

Remarks. Among its congeners, *L. (L.) kawamurai* most closely resembles *L. (L.) hupeicum* (Ma and Hsu, 1965) in China, and it can be distinguished from the latter by the following features (*L. (L.) hupeicum* in parentheses): scutum larger, AW 68 μm , PW 78 μm , SB 33 μm , SD 40 μm in average (scutum smaller; AW 62 μm , PW 67 μm , SB 26 μm , SD 36 μm); SB-PL (PL/SB); eyes 2+2 (eyes absent) (Li et al., 1997).

Biology. Various rodents (*Rattus losea*, *R. norvegicus*, *R. rattus*) and shrew (*Suncus murinus*) have been recorded as hosts of *L. (L.) kawamurai* (Wen, 1984e; Li et al., 1997).

Medical Importance. *Leptotrombidium (L.) kawamurai* occurs widely in Japan, and has long been suspected to be a vector of scrub typhus in Japan (Kitaoka et al., 1973).

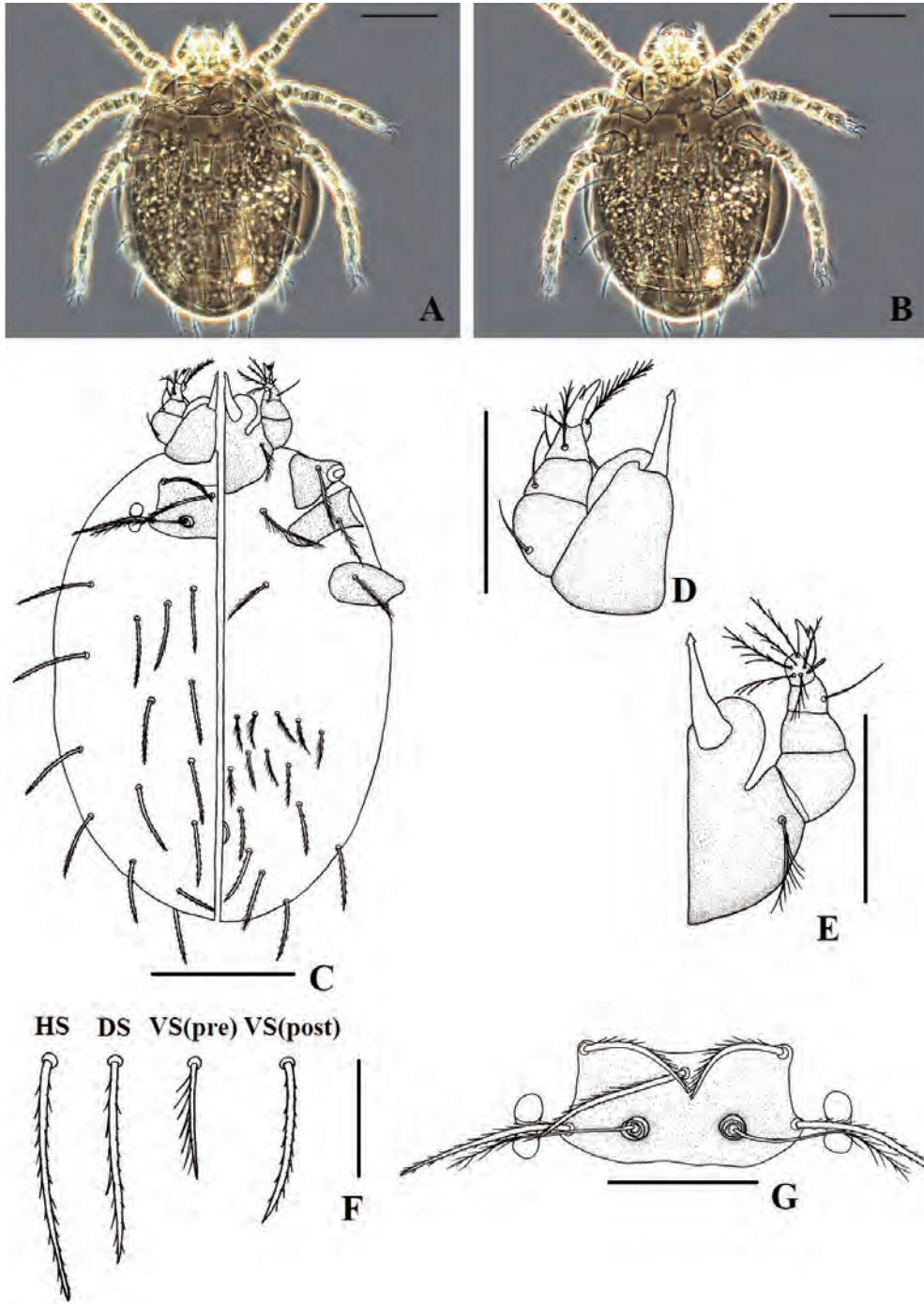
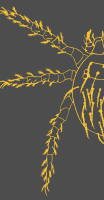


Fig. 17. *Leptotrombidium (Leptotrombidium) kawamurae* (Fukuzumi and Obata, 1953) larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.



Leptotrombidium (Leptotrombidium) *pallidum* (Nagayo, Miyagawa, Mitamura and Tamiya, 1919) 粗毛織恙蟎

(Fig. 18; Table 16)

References.

- Trombicula pallidum* Nagayo, Miyagawa, Mitamura & Tamiya, 1919: 107.
Trombicula (L.) pallida Jameson Jr. & Toshioka, 1954: 17; Sasa, 1956: 111, f. 15.
Leptotrombidium pallida Radford, 1954: 260.
Leptotrombidium (L.) pallidum Vercammen-Grandjean, 1968: 75; Vercammen-Grandjean & Langston, 1975: 524, pl. 139; Wen, 1984e: 308; Li, Wang & Chen, 1997: 156, f. 2-1-73.
Leptotrombidium pallidum Stekolnikov, 2013: 82.

Diagnosis of Larva. Scutum close to rectangle, with round angles between lateral and posterior margins; PL/SB; PLs situate in the middle of SD. $PL > AM > AL$, all strongly branched. SN flagelliform, with 10–14 branches on distal half; pedicels with conspicuous tiny spikes. $fPp = N/N/BNN/7B$. DS 47–53 in number (including HS), with long and strong branches along shafts; DS usually arranged in 2H, 12 (13–14), 10 (11), 10 (9, 11), 8 (7, 9), 6 (4–5), 4 (2–3); VS 44–56 in number, with 31–39 preanal setae and 12–20 postanal setae. NDV = 93–105.

Description of Larva. ($n = 16$) Live larva yellowish orange (Li et al., 1997), oval in shape, and long-oval in unengorged larvae. Size small to medium. Measurements of body length and width are as follows (in μm). Unengorged body length 297, width 191; semi-engorged body length 349–579, width 223–411; engorged body length 574–601, width 478–501. Eyes 2+2, located by scutum; anterior pair larger.

Gnathosoma. Gnathosomal base evenly punctate, with a pair of pectinate setae; cheliceral base close to triangle, barely punctate; cheliceral blade with tricuspid cap. Galeal setae branched; $fPp = N/N/BNN/7B$; palpotarsus with blunt solenidion; palpal claw 3-pronged.

Scutum. Close to rectangle, with round angles between lateral and posterior margins; anterior margin slightly biconcave; lateral margins curved inward; posterior margin nearly straight or biconvex; punctate sparsely. $PW/AP = 3.25\text{--}4.14$; $PW/SD = 1.53\text{--}1.82$. PL/SB; PLs situate in the middle of SD. $PL > AM > AL$, all strongly branched. SN long flagelliform, with 10–14 branches on distal half; pedicels with conspicuous tiny spikes. Standard measurements of scutum are presented in Table 16.



Idiosomal Setae. DS 47–53 in number (including HS), usually arranged in 2H, 12 (13–14), 10 (11), 10 (9, 11), 8 (7, 9), 6 (4–5), 4 (2–3); DS with long and strong branches along shafts, especially on anterior half. ST 2-2 finely branched. VS 44–56 in number, with 31–39 preanal setae similar to ST but shorter, and 12–20 postanal setae. NDV = 93–105. Measurements of idiosomal setae are as follows (in μm). HS 46–54; medial setae of first post-humeral row 40–45; VS (pre) 26–32; VS (post) 33–39.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, evenly punctate. Ip 636–743 μm . All segments with various numbers of branched setae (B).

Leg I. 213–250 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microtibiala; tarsus 22B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 198–225 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 223–267 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, with 1 genuala; tibia 6B, with 1 tibiala; tarsus 15B.

SIF = 7B-B-3-2111.0000.

Table 16. Standard measurements (in μm) of *Leptotrombidium* (*Leptotrombidium*) *pallidum* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 16 specimens	60	67	29	27	13	40	18	44	34	51	51	19
Observed range												
Min.	56	63	27	24	11	37	16	40	32	47	47	17
Max.	63	72	33	30	15	42	20	46	38	55	56	21

Specimens Examined. LIENCHIANG COUNTY: 3 larvae (8633-2-1, 8634-2-1~2), Peikan, Tangchi (連江縣北竿鄉塘岐村), 6 Mar. 2007, ex *Rattus losea*, male; 1 larva (8654-3-1), Nankan, Szuwei (連江縣南竿鄉四維村), 7 Mar. 2007, ex *Rattus losea*, female; 1 larva (8658-2-1), Nankan, Chulo (連江縣南竿鄉珠螺村), 7 Mar. 2007, ex *Rattus losea*, female; 4 larvae (8663-2-1, 8664-1-1, 8664-2-

1~2), same locality and date, ex *Rattus losea*, male; 2 larvae (8673-1-1, 8673-2-1), Nankan, Jenai (連江縣南竿鄉仁愛村), 8 Mar. 2007, ex *Rattus losea*, male; 1 larva (8679-2-1), Nankan, Chinsha (連江縣南竿鄉津沙村), 8 Mar. 2007, ex *Rattus losea*, female; 4 larvae (8682-1-1~2, 8682-2-1~2), same locality and date, ex *Rattus losea*, male.

Distribution. China, Japan, Korea, and Taiwan (Lienchiang County) (new record) (Jameson Jr. & Toshioka, 1954; Sasa, 1956; Vercammen-Grandjean & Langston, 1975; Suzuki, 1980; Wen, 1984e; Li et al., 1997).

Remarks. *Leptotrombidium (L.) pallidum* most closely resembles *L. (L.) asetulum* (Chen and Hsu, 1965), and it can only be distinguished from the latter by the presence of tiny spikes on basal SN: *L. (L.) pallidum* with spikes on basal SN; *L. (L.) asetulum* without spikes (Li et al., 1997).

Biology. In the wild, the larvae of *L. (L.) pallidum* occur mainly in winter and spring (Li et al., 1997). In Taiwan, it is only found in Lienchiang County (E119°53', N26°12'), and recorded from *Rattus losea*. Other hosts are recorded: *R. edwardsi*, *R. nitidus*, *R. norvegicus*, *R. rattus* and bird (species uncertain) (Wen, 1984e; Li et al., 1997).

Medical Importance. *Leptotrombidium (L.) pallidum* has been proven to be a carrier of *Orientia tsutsugamushi* in Japan and Korea (Pham et al., 2001; Lee et al., 2009).

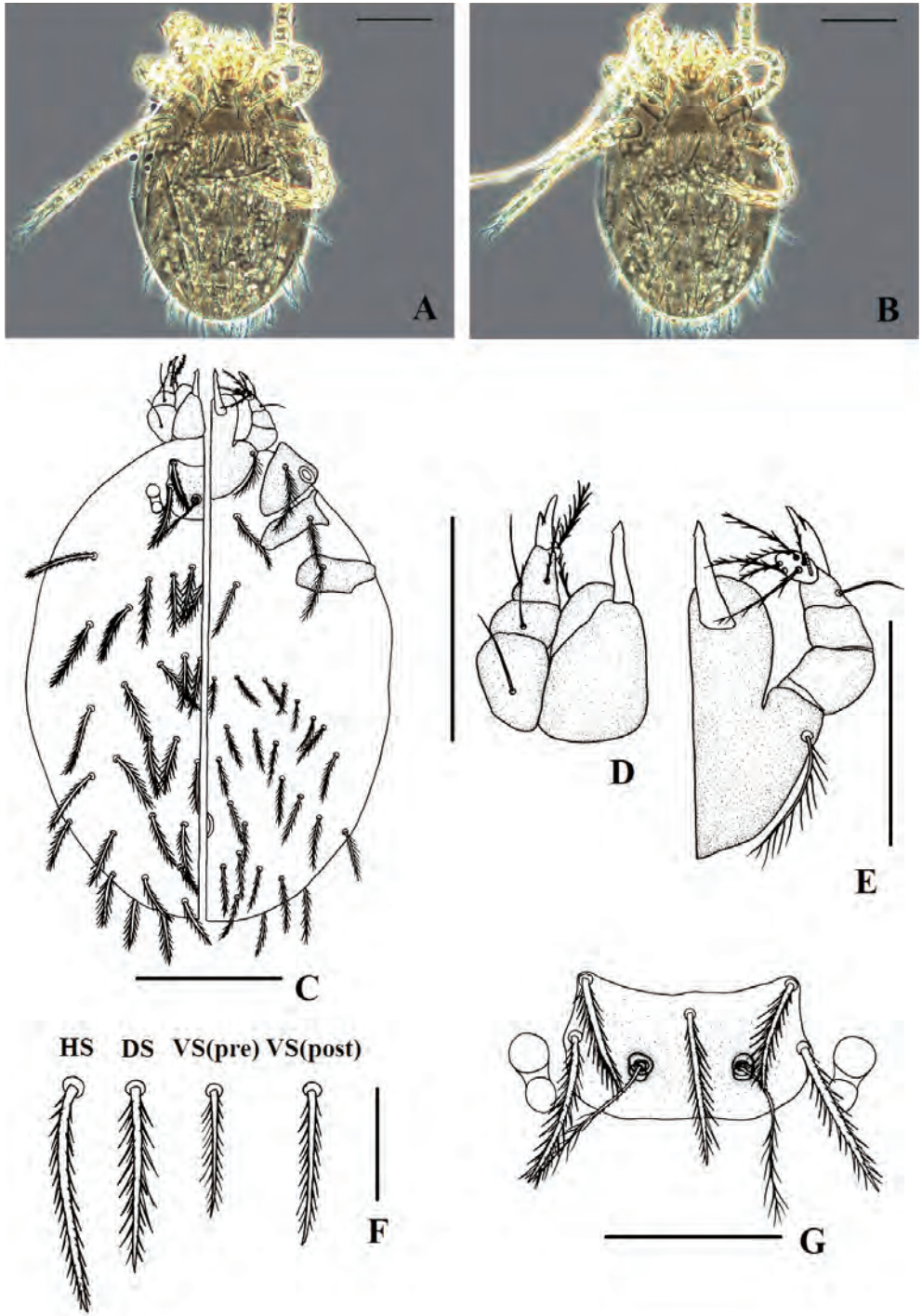


Fig. 18. *Leptotrombidium (Leptotrombidium) pallidum* (Nagayo, Miyagawa, Mitamura and Tamiya, 1919) larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.



Leptotrombidium (Leptotrombidium) rubellum Wang and Liao, 1984

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(Fig. 19; Table 17)

References.

Leptotrombidium (L.) rubellum Wang & Liao, 1984: 233, fs. 1–4; Li, Wang & Chen, 1997: 165, f. 2-1-84.

Leptotrombidium rubellum Stekolnikov, 2013: 56.

Diagnosis of Larva. Larva oval; fPp = N/N/BNN/7B; scutum close to trapezoid; PL > AM > AL; SB/PL; SB < AP (at least 5 μm). SN flagelliform, with 12–14 branches on distal half. DS 28–29 in number (including HS); fD = 2H, 8, 6, 6, 4 (5), 2; VS 20–22 in number (Wang & Liao, 1984); preanal setae 14–16; postanal setae 6; NDV = 48–50.

Description of Larva. (n = 2) Live larva oval, dark reddish orange (Li et al., 1997). Size small to medium. Measurements of body length and width are as follows (in μm). Unengorged body length 260–307, width 203–213. Eyes 2+2, located by scutum; posterior larger than anterior.

Gnathosoma. Gnathosomal base evenly punctate, with a pair of pectinate setae; cheliceral base round and lightly punctate; cheliceral blade with tricuspid cap. Galeal setae branched; fPp = N/N/BNN/7B; palpotarsus with blunt solenidion; palpal claw 3-pronged.

Scutum. Close to trapezoid; anterior margin slightly biconvex; lateral margins curved inward; posterior margin convex; scutum evenly punctate except around AM and ALs. PW/AP = 2.14; PW/SD = 1.60–1.61. SB/PL; SB < AP (at least 5 μm). SN flagelliform, with 12–14 branches on distal half; pedicels without tiny spikes. PL > AM > AL; AM, ALs and PLs covered with fine setules, shafts tapering to apex; AM and ALs with longer branches. Standard measurements of scutum are given in Table 17.

Idiosomal Setae. DS 28–29 in number (including HS), arranged in 2H, 8, 6, 6, 4 (5), 2; HS and DS similar to PLs, slightly curved, finely setuled and tapering to apex. ST 2-2 finely branched. VS 21–22 in number; preanal setae 15–16, similar to ST but shorter; postanal setae 6, similar to posterior setae of DS; NDV = 48–50. Measurements of idiosomal setae are as follows (in μm). HS 51–55; medial setae of first post-humeral row 46–47; VS (pre) 30–31; VS (post) 45–46.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III



unisetose, evenly punctate. Ip 735–751 μm . All segments with various numbers of branched setae (B).

Leg I. 250–251 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microtibiala; tarsus 22B, with 1 central tarsala, 1 microtarsala next to it, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 222–226 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, with 1 genuala; tibia 5B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala next to it, and 1 pretarsala.

Leg III. 264–273 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 3B, with 1 genuala; tibia 5B, with 1 tibiala; tarsus 15B.

SIF = 7B-B-3-2111.0000.

Table 17. Standard measurements (in μm) of *Leptotrombidium (Leptotrombidium) rubellum* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 2 specimens	58	66	25	27	15	41	31	45	40	52	58	21
Observed range												
Min.	56	66	25	26	15	41	31	45	40	49	54	21
Max.	59	67	25	27	15	42	31	46	41	56	61	22

Specimens Examined. HUALIEN COUNTY: 2 larvae (9155-56-4-1, 9165-66-9-1), Fenglin (花蓮縣鳳林鎮), 28 Apr. 2009, ex *Rattus losea*, female.

Distribution. China (Fuchien Province) and Taiwan (new record) (Wang & Liao, 1984).

Remarks. *Leptotrombidium (L.) rubellum* most closely resembles *L. (L.) deliense* (Walch, 1922), and it can be distinguished from the latter by the comparison between AP and SB (*L. (L.) deliense* in parenthesis): AP > SB, at least 5 μm (mostly SB \geq AP; if AP > SB, no more than 5 μm).

Biology. *Leptotrombidium (L.) rubellum* is limited-distributed in coastal areas of Fuchien Province in China and newly recorded from Taiwan. Rodents are its main hosts, including *Bandicota indica* and *Rattus losea*. Spring and summer are its mating season (Li et al., 1997).

Medical Importance. *Leptotrombidium (L.) rubellum* is regarded as the second most important vector of scrub typhus in certain epidemic areas in China, and isolation of *Orientia tsutsugamushi* from different stages of *L. (L.) rubellum* has been proven. *Orientia tsutsugamushi* can also be transmitted through eggs of *L. (L.) rubellum*, and studies indicated that the transmission can last for four generations, carrying the rickettsia into healthy hosts (Wang & Liao, 1984; Li et al., 1997).

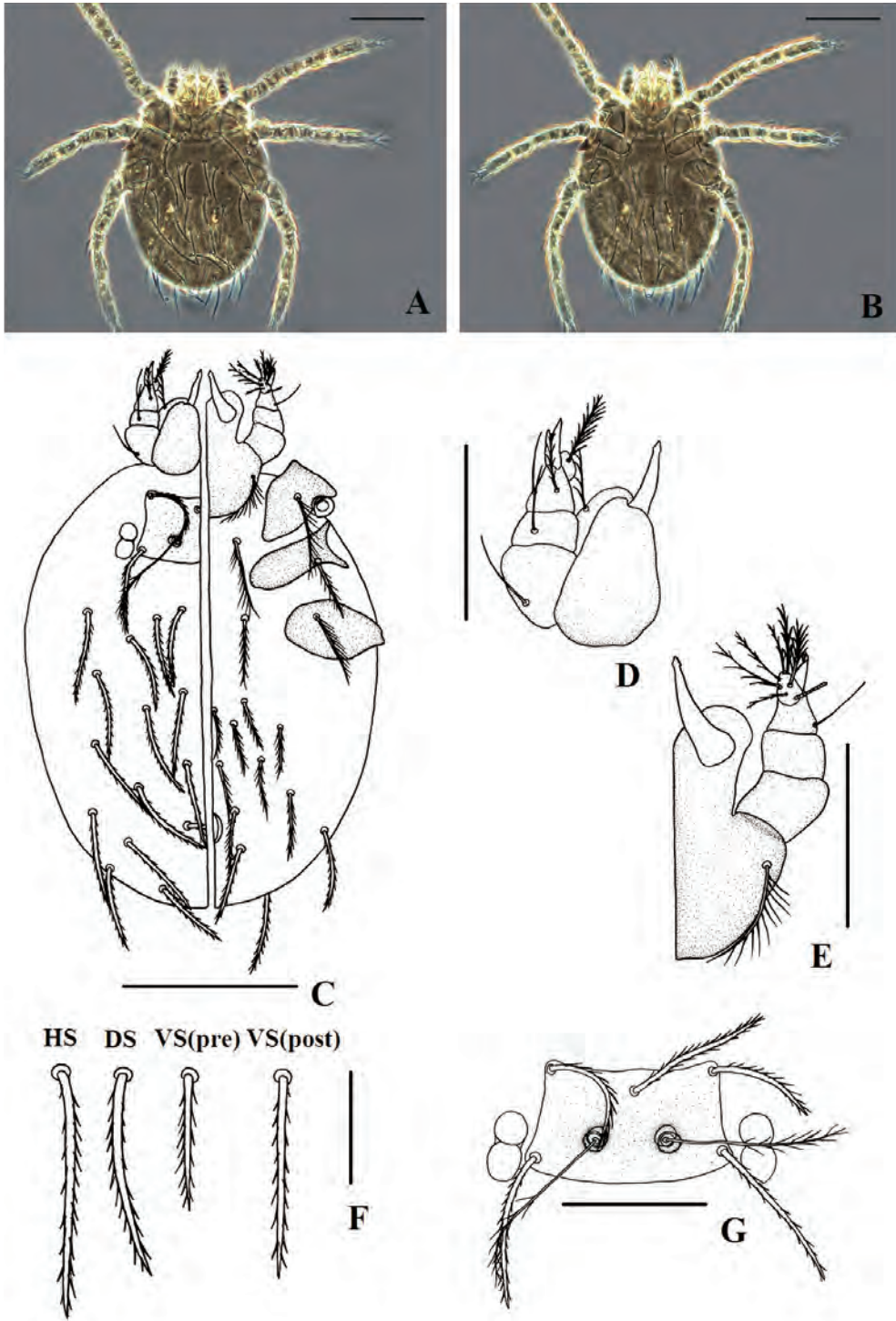
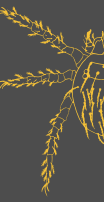


Fig. 19. *Leptotrombidium (Leptotrombidium) rubellum* Wang and Liao, 1984 larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.



Leptotrombidium (Leptotrombidium) scutellare (Nagayo, Miyagawa, Mitamura, Tamiya and Tenjin, 1921)

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(Fig. 20; Table 18)

References.

- Trombicula scutellaris* Nagayo, Miyagawa, Mitamura, Tamiya & Tenjin, 1921: 575.
Trombicula (L.) scutellaris Sasa, 1956: 97, f. 2.
Leptotrombidium scutellaris Radford, 1954: 260.
Leptotrombidium (L.) scutellare Vercammen-Grandjean, 1968: 75; Vercammen-Grandjean & Langston, 1975: 315, pl. 47; Wen, 1984e: 309; Li, Wang & Chen, 1997: 169, f. 2-1-89.
Leptotrombidium scutellare Stekolnikov, 2013: 126.

Diagnosis of Larva. Scutum nearly rectangular, with posterior margin curved outward; SB-PL in most specimens, some with SB/PL. $PL > AM > AL$. SN flagelliform, with 12–16 branches on distal half; pedicels without spikes. fPp = N/N/BNN/7B. DS 45–55 in number (including HS). Anterior half of DS usually arranged orderly, posterior half more variably: 2H, 10 (9, 11–12), 10 (11), 2, 8 (7, 9–10), 8 (7, 9–10), 4 (3, 5), 4 (2–3), (1–3); VS 35–44 in number, with 20–27 preanal setae and 9–20 postanal setae. NDV = 81–96.

Description of Larva. (n = 32) Unengorged live larva reddish orange, engorged live larva evenly pink (Li et al., 1997). Oval in shape, size medium to large. Measurements of body length and width are as follows (in μm). Unengorged body length 292–304, width 218; semi-engorged body length 332–506, width 240–418; engorged body length 507–723, width 446–646. Eyes 2+2, located by scutum; anterior pair larger.

Gnathosoma. Gnathosomal base lightly punctate, with a pair of pectinate setae; cheliceral base evenly punctate; cheliceral blade with tricuspid cap. Galeal setae branched; fPp = N/N/BNN/7B; palpotarsus with blunt solenidion; palpal claw 3-pronged.

Scutum. Close to rectangle; anterior margin nearly straight; lateral margins curved inward; posterior margin curved and extended outward; scutum punctate evenly except around AM and ALs. $PW/AP = 2.40\text{--}3.55$; $PW/SD = 1.64\text{--}2.38$. Mostly SB-PL, some with SB/PL. $PL > AM > AL$, finely branched and tapering to apex. SN long flagelliform, with 12–16 branches on distal half; pedicels without spikes. Standard measurements of scutum are presented in Table 18.



Idiosomal Setae. DS 45–55 in number (including HS). Anterior half of DS usually arranged orderly, posterior half more variably: 2H, 10 (9, 11–12), 10 (11), 2, 8 (7, 9–10), 8 (7, 9–10), 4 (3, 5), 4 (2–3), (1–3); DS similar to PL, finely setuled, tapering to apex. ST 2-2, finely branched; VS 35–44 in number, with 20–27 preanal setae similar to ST but shorter, and 9–20 postanal setae similar to DS. NDV = 81–96. Measurements of idiosomal setae are as follows (in μm). HS 48–64; medial setae of first post-humeral row 37–48; VS (pre) 26–34; VS (post) 37–47.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, evenly punctate. Ip 772–860 μm . All segments with various numbers of branched setae (B).

Leg I. 255–297 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae; tarsus 22B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 238–261 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 3B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, and 1 pretarsala.

Leg III. 272–314 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 3B; genu 3B, with 1 genuala; tibia 5B, with 1 tibiala; tarsus 15B.

SIF = 7B-B-3-2111.0000.

Table 18. Standard measurements (in μm) of *Leptotrombidium (Leptotrombidium) scutellare* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 32 specimens	72	83	31	31	15	45	29	53	47	55	73	26
Observed range												
Min.	63	74	27	25	13	39	26	44	41	47	64	24
Max.	77	99	36	34	19	52	33	58	52	61	83	31

Specimens Examined. KINMEN COUNTY: 5 larvae (7240-1-1~2, 7240-4-1~2, 7240-5-1), Kinning, Lake Hou (金門縣金寧鄉后湖), 20 Dec. 1999, ex *Rattus losea*, female; 6 larvae (7245-5-1, 7253-1-1, 7253-2-1~2, 7259-3-1, 7263-4-1), same locality and date, ex *Rattus losea*, male; 2 larvae (8613-2-1, 8613-5-1), Kinning, Hsishan (金門縣金寧鄉西山), 18 Jan. 2007, ex *Rattus losea*, female; 3 larvae (7272-2-1, 7278-1-1, 7278-2-1), Kincheng, Hsiaokukang (金門縣金城鎮小

古崗), 21 Dec. 1999, ex *Rattus losea*, male; 1 larva (7289-2-1), same locality and date, ex *Rattus losea*, female; 2 larvae (8606-1-1, 8606-3-1), Kinhu, Hsiaoching (金門縣金湖鎮小徑), 17 Jan. 2007, ex *Rattus losea*, male; 1 larva (7296-4-1) Liehyu, Chingchi (金門縣列嶼鄉青岐), 22 Dec. 1999, ex *Suncus murinus*, male; 2 larvae (7298-2-1, 7308-1-1), same locality and date, ex *Rattus losea*, female; 1 larva (7314-2-1), Kinhu, Chengyi (金門縣金湖鎮正義村), 23 Dec. 1999, ex *Rattus losea*, female; 3 larvae (7324-3-1, 7325-1-1, 7326-3-1), same locality and date, ex *Rattus losea*, male; 2 larvae (7340-2-1~2), Kinsha, Tayang (金門縣金沙鎮大洋村), 24 Dec. 1999, ex *Rattus losea*, female. LIENCHIANG COUNTY: 3 larvae (8663-2-2, 8664-1-2, 8664-3-1), Nankan, Chulo (連江縣南竿鄉珠螺村), 7 Mar. 2007, ex *Rattus losea*, male; 1 larva (8682-2-3), Nankan, Chinsha (連江縣南竿鄉津沙村), 3 Mar. 2007, ex *Rattus losea*, male.

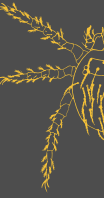
Distribution. China, Japan, Korea, Malaysia, Taiwan (Kinmen and Lienchiang Counties), and Thailand (Sasa, 1956; Vercammen-Grandjean & Langston, 1975; Wen, 1984e; Li et al., 1997; Wang et al., 2004; Lee et al., 2012).

Remarks. Among its congeners, *L. (L.) scutellare* most closely resembles *L. (L.) fujianense* Liao and Wang, 1983 and *L. (L.) xianglinense* Wen, 1984c: *L. (L.) scutellare* differs from *L. (L.) fujianensis* in the following features (*L. (L.) fujianense* in parentheses): DS 45–55, with second row more stable in number: 2H, mostly 10, 10 (11)... (DS 38–42, with the number of second row of DS more variable, starting with fD = 2H, 10 (8–9), 8 (6–7)...); VS 35–44 (26–32); posterior margin of scutum curved and extended outward (biconvex or nearly straight) (Liao & Wang, 1983).

L. (L.) scutellare can be distinguished from *L. (L.) xianglinense* by the following features (*L. (L.) xianglinense* in parentheses): scutal and idiosomal setae normally branched (setae more densely branched); SB-PL or SB/PL (SB-PL or PL slightly above SB); VS = 35–44, with 20–27 preanal setae (VS = 47–52, with 31–37 preanal setae).

Biology. *Leptotrombidium (L.) scutellare* is widespread in China, Japan and Southeast Asia, and also found in Kinmen and Lienchiang Counties of Taiwan. Larvae of *L. (L.) scutellare* occur mainly in winter and spring (Li et al., 1997). Wang et al. (2004) reported that the larvae of *L. (L.) scutellare* in Kinmen County of Taiwan occurred only from November to April as dominant species of chigger mites in winter and spring. Various hosts are recorded, including rodents (*Rattus losea*, *R. norvegicus*, *Bandicota indica*), shrew (*Suncus murinus*), carnivores (*Canis familiaris*, *Felis domesticus*), and human (Wen, 1984e; Li et al., 1997).

Medical Importance. In Japan and China, isolation of *Orientia tsutsugamushi* from *L. (L.) scutellare* has been performed successfully, indicating *L. (L.) scutellare* as a vector for scrub typhus in winter (Li et al., 1997; Pham et al., 2001). Wang et al. (2004) also reported *L. (L.) scutellare* as a carrier of *O. tsutsugamushi* in Kinmen County of Taiwan.



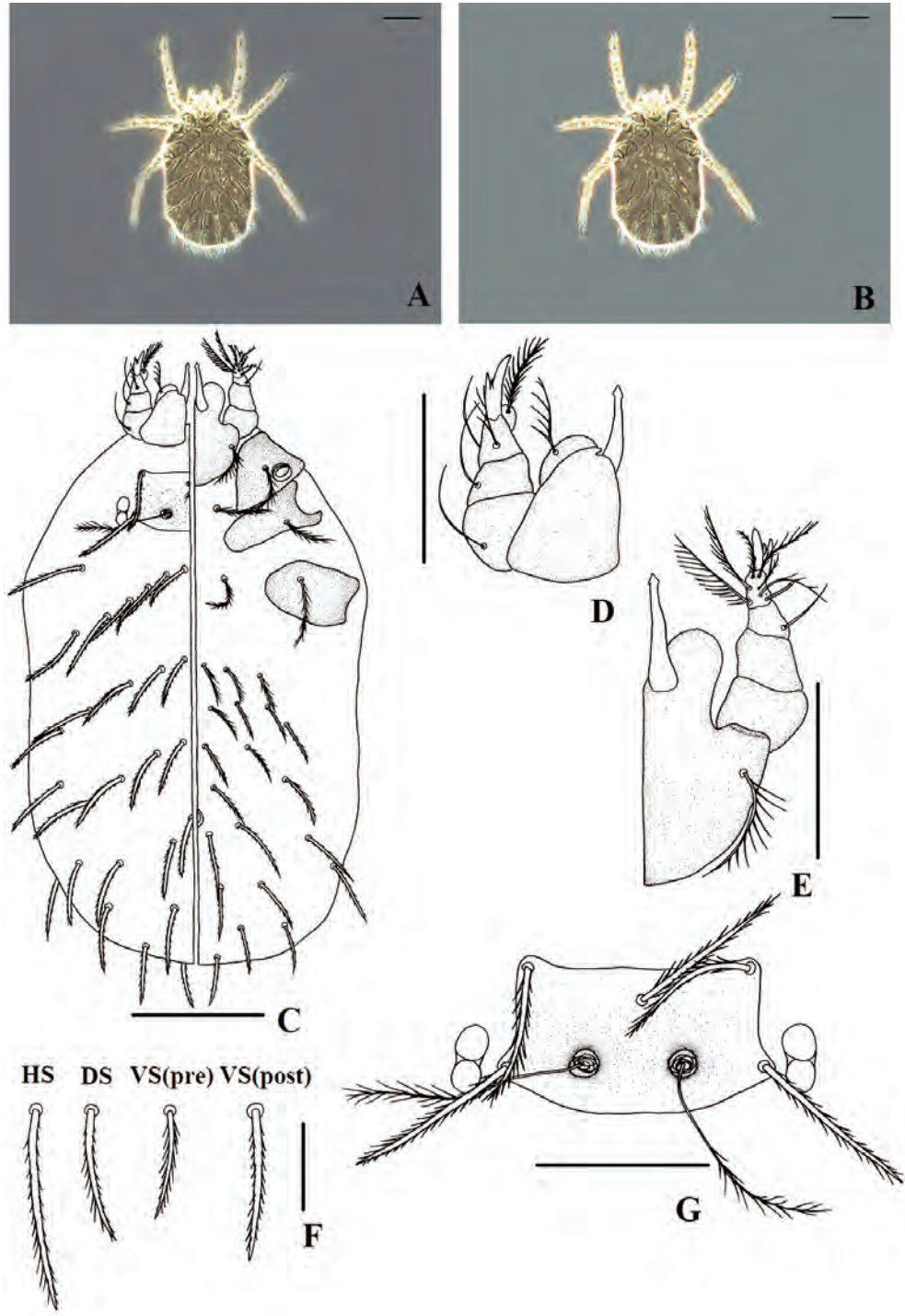


Fig. 20. *Leptotrombidium (Leptotrombidium) scutellare* (Nagayo, Miyagawa, Mitamura, Tamiya and Tenjin, 1921) larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.

Leptotrombidium (Leptotrombidium) *xianglinense* Wen, 1984c

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(Fig. 21; Table 19)

References.

Leptotrombidium (L.) xianglinense Wen, 1984c: 82: f. II-22.

Leptotrombidium xianglinense Stekolnikov, 2013: 122.

Diagnosis of Larva. Scutum rectangular; SB-PL or PL slightly above SB. fPp = N/N/BNN/7B. PL > AM > AL. SN flagelliform, with 12–14 branches on distal half; pedicels without spikes. Scutal and idiosomal setae densely branched; DS 45–54 in number (including HS), arranged in 2H, 11 (10, 13), 10 (11), 10 (11), 8 (6, 9), 4 (5–6), 2 (3–4), (2); VS 47–52 in number. NDV = 94–106.

Description of Larva. (n = 7) Live larva oval, color unknown. Size medium to large. Measurements of body length and width are as follows (in μm). Semi-engorged body length 401–540, width 290–389; engorged body length 611–663, width 490–517. Eyes 2+2, located by scutum; anterior pair slightly larger.

Gnathosoma. Gnathosomal base evenly punctate, with a pair of pectinate setae; cheliceral base lightly punctate; cheliceral blade with tricuspid cap. Galeal setae branched; fPp = N/N/BNN/7B; palpotarsus with blunt solenidion; palpal claw 3-pronged.

Scutum. Rectangular; anterior margin slightly biconcave; lateral margins curved inward; posterior margin biconvex; scutum punctate in the middle. PW/AP = 2.31–3.25; PW/SD = 1.43–1.88. SB-PL or PL slightly above SB. SN long flagelliform, with 12–14 branches on distal half; pedicels without tiny spikes. PL > AM > AL; AM, ALs and PLs all densely covered with fine setules, shafts tapering to apex. Standard measurements of scutum are presented in Table 19.

Idiosomal Setae. DS 45–54 (including HS) in number; fD = 11 (10, 13), 10 (11), 10 (11), 8 (6, 9), 4 (5–6), 2 (3–4), (2); similar to PLs, densely covered with setules and tapering to apex. ST 2-2 finely branched. VS 47–52 in number; preanal setae 31–37, similar to ST but shorter; postanal setae 14–18, longer than preanal setae but less branched. NDV = 94–106. Measurements of idiosomal setae are as follows (in μm). HS 58–64; medial setae of first post-humeral row 44–51; VS (pre) 32–36; VS (post) 42–50.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, evenly punctate. Ip 817–853 μm . All segments with various numbers of

branched setae (B).

Leg I. 267–290 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microtibiala; tarsus 22B, with 1 central tarsala in the middle, 1 microtarsala, pretarsala, nude subterminala and parasubterminala.

Leg II. 248–265 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala next to it, and 1 pretarsala.

Leg III. 295–314 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, with 1 genuala; tibia 6B, with 1 tibiala; tarsus 15B.

SIF = 7B-B-3-2111.0000.

Table 19. Standard measurements (in μm) of *Leptotrombidium (Leptotrombidium) xianglinense* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 7 specimens	69	81	32	33	15	48	29	58	47	59	70	25
Observed range												
Min.	66	74	29	30	14	45	26	56	42	57	67	22
Max.	74	86	35	36	17	52	32	60	52	61	73	28

Specimens Examined. LIENCHIANG COUNTY: 4 larvae (8645-1-1~4), Peikan, Panli (連江縣北竿鄉坂里村), 6 Mar. 2007, ex *Rattus losea*, male; 3 larvae (8648-1-1~2, 8648-2-1), same locality and date, ex *Rattus losea*, female.

Distribution. China (Fuchien Province) and Taiwan (new record) (Wen, 1984c).

Remarks. *Leptotrombidium (L.) xianglinense* most closely resembles *L. (L.) scutellare* (Nagayo, Miyagawa, Mitamura, Tamiya and Tenjin, 1921), but it can be distinguished from the latter by the following features (*L. (L.) scutellare* in parentheses): scutal and idiosomal setae more densely branched (less branched compared to the former); SB-PL or PL slightly above SB (SB-PL or SB/PL); VS = 47–52, with 31–37 preanal setae (VS = 35–44, with 20–27 preanal setae).

Biology. *Leptotrombidium (L.) xianglinense* was collected from the conchal fossa of squirrel (*Tamias* sp.) in Fuchien County, and a new host, *Rattus losea*, is recorded in Taiwan (Wen, 1984c).

Medical Importance. Unknown.

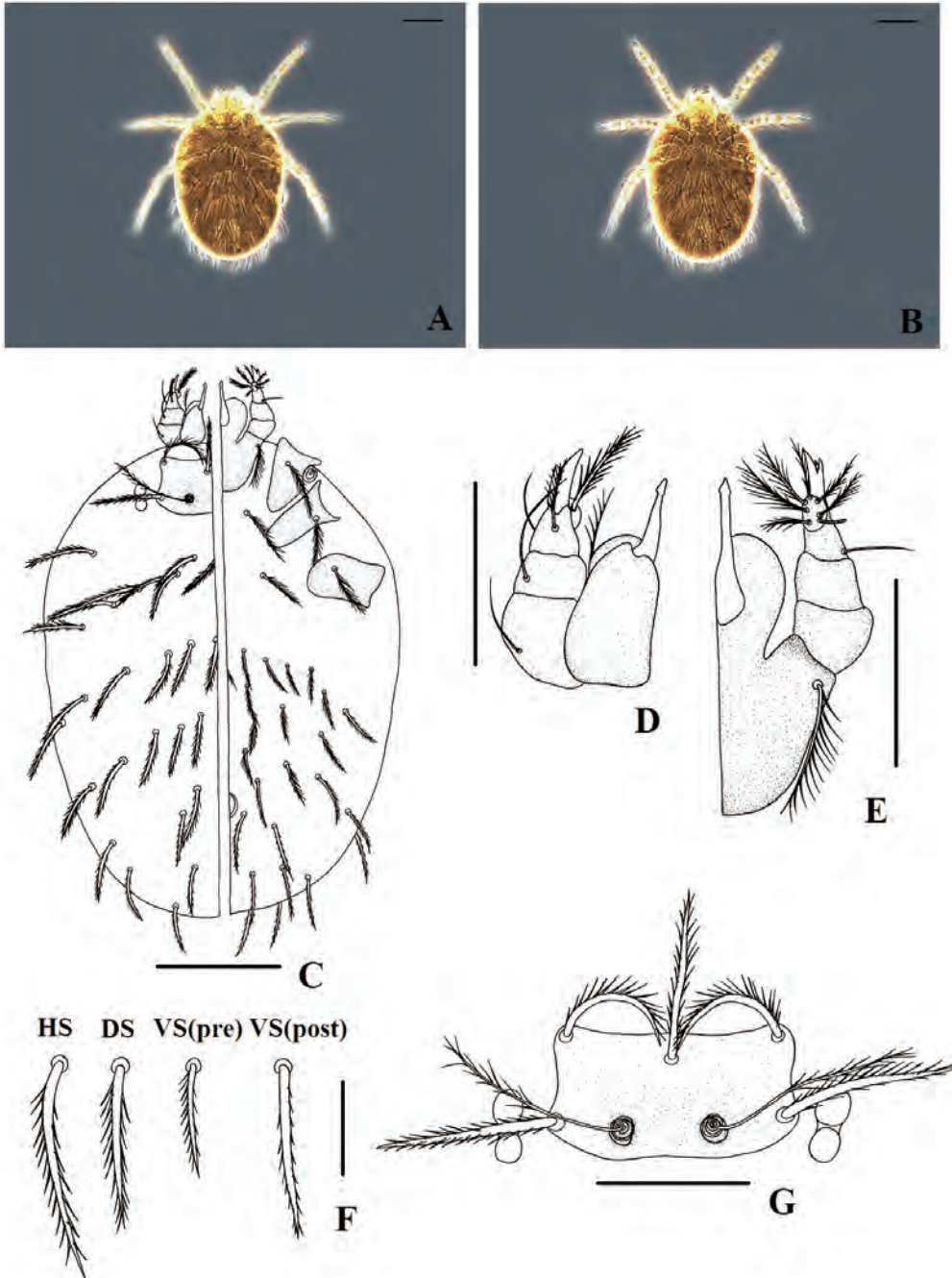
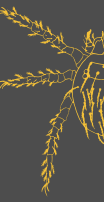


Fig. 21. *Leptotrombidium (Leptotrombidium) xianglinense* Wen, 1984c larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.



Leptotrombidium (Leptotrombidium) yui (Chen and Hsu, 1955)

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(Fig. 22; Table 20)

References.

Trombicula (L.) yui Chen & Hsu, 1955: 119, fs. 28–33.

Leptotrombidium (L.) yui Vercammen-Grandjean, 1968: 76; Vercammen-Grandjean & Langston, 1975: 450, pl. 174; Wen, 1984e: 311; Li, Wang & Chen, 1997: 189, f. 2-1-118.

Leptotrombidium yui Stekolnikov, 2013: 36.

Diagnosis of Larva. Scutum close to flat rectangle, with posterior margin biconvex or nearly straight; PW slightly longer than AW. PL/SB. $PL > AM > AL$, all with thick branches. SN flagelliform, with 14–16 branches near two thirds from the distal; pedicels with tiny spikes. fPp = N/N/BNN/7B. DS 32–37 in number (including HS), arranged in 2H, 8, 6, 6, 6 (4–5, 7), 4 (3, 5), 2 (1, 4), (1, 3); VS 36–51 in number, with 24–33 preanal setae and 10–20 postanal setae. NDV = 69–84.

Description of Larva. (n = 16) Live larva milky white (Li et al., 1997). Oval in shape; size medium. Measurements of body length and width are as follows (in μm). Unengorged body length 276–309, width 188–218; semi-engorged body length 332–475, width 244–349; engorged body length 470–532, width 406–485. Eyes 2+2, located by scutum; anterior pair larger.

Gnathosoma. Gnathosomal base evenly punctate, with a pair of pectinate setae; cheliceral base sparsely punctate; cheliceral blade with tricuspid cap. Galeal setae branched; fPp = N/N/BNN/7B; palpotarsus with blunt solenidion; palpal claw 3-pronged.

Scutum. Close to flat rectangle; PW slightly longer than AW; anterior margin concave, with corners of ALs pointed; lateral margins slightly curved inward; posterior margin usually biconvex or nearly straight; scutum lightly punctate between bases of SNs. $PW/AP = 3.16\text{--}4.09$; $PW/SD = 1.63\text{--}1.95$. PL/SB. $PL > AM > AL$, with thick and long branches and tapering to apex. SN long flagelliform, with 14–16 branches near two thirds from the distal; pedicels with tiny spikes. Standard measurements of scutum are presented in Table 20.

Idiosomal Setae. DS 32–37 in number (including HS). Anterior half of DS more ordered: 2H, 8, 6, 6, 6 (4–5, 7), 4 (3, 5), 2 (1, 4), (1, 3); DS similar to PL, thickly branched, tapering to apex. ST 2-2, finely branched; VS 36–51 in number, with



24–33 preanal setae and 10–20 postanal setae; the former similar to ST but shorter, and the latter much closer to posterior half of DS. NDV = 69–84. Measurements of idiosomal setae are as follows (in μm). HS 43–57; medial setae of first post-humeral row 40–57; VS (pre) 20–30; VS (post) 33–42.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae I-III unisetose, finely punctate. Ip 616–691 μm . All segments with various numbers of branched setae (B).

Leg I. 208–233 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microgenuala; tarsus 22B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 191–215 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 218–245 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 3B; genu 3B, with 1 genuala; tibia 6B, with 1 tibiala; tarsus 15B.

SIF = 7B-B-3-2111.0000.

Table 20. Standard measurements (in μm) of *Leptotrombidium (Leptotrombidium) yui* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 16 specimens	57	64	26	24	12	36	18	40	32	53	53	20
Observed range												
Min.	53	58	22	22	10	33	16	38	30	49	45	17
Max.	63	70	30	25	15	40	20	42	36	59	58	22

Specimens Examined. NANTOU COUNTY: 4 larvae (8075-1-1~2, 8075-2-1~2), Kuohsing, Peikang (南投縣國姓鄉北港村), 29 Aug. 2001, ex *Rattus losea*, female. YILAN COUNTY: 1 larva (9130-31-1-1), Suao, Wuwei Port (宜蘭縣蘇澳鎮無尾港), 18 Mar. 2009, ex *Rattus losea*, female. HUALIEN COUNTY: 1 larva (8057-3-5), Juisui, Hokang (花蓮縣瑞穗鄉鶴岡村), 14 June 2001, ex *Bandicota indica*, male. KINMEN COUNTY: 2 larvae (7120-3-1, 7120-5-1), Kincheng, Hsiaokukang (金門縣金城鎮小古崗), 3 Nov. 1999, ex *Rattus norvegicus*, male; 1 larva (7503-1-1), same locality, 17 Apr. 2000, ex *Rattus losea*, female; 1 larva

(7508-2-1), same locality and date, ex *Rattus losea*, male; 2 larvae (7162-2-1, 7162-7-1), Kinning, Lake Hou (金門縣金寧鄉后湖), 4 Nov. 1999, ex *Rattus norvegicus*, male; 1 larva (7554-1-1), same locality, 18 Apr. 2000, ex *Rattus losea*, female. LIENCHIANG COUNTY: 3 larvae (8647-1-1, 8647-3-1, 8647-4-1), Peikan, Panli (連江縣北竿鄉坂里村), 6 Mar. 2007, ex *Rattus losea*, male.

Distribution. China and Taiwan (Vercammen-Grandjean & Langston, 1975; Wen, 1984e; Li et al., 1997; Wang et al., 2004).

Remarks. *Leptotrombidium* (*L.*) *yui* most closely resembles *L. (L.) fuji* (Kuwata, Berge and Philip, 1950) in Japan and China, and these two species share numerous similarities, with only few feature that distinguishes the former from the latter (*L. (L.) fuji* in parenthesis): distance between seta of coxa III and anterior margin of coxa III usually lies between 9–15 μm (5–7 μm) (Wang & Yu, 1992).

Biology. *Leptotrombidium* (*L.*) *yui* is widespread across China, and can be found whole year around, more frequently in spring and autumn (Li et al., 1997). Rodents are the major hosts of *L. (L.) yui*, and various species have been recorded: *Bandicota indica*, *Rattus losea*, *R. norvegicus*, *Eothenomys melanogaster* and *Suncus murinus* (shrew) (Wen, 1984e).

Medical Importance. Natural infection of *O. tsutsugamushi* in *L. (L.) yui* was discovered in Fuchien Province, China (Li et al., 1997).

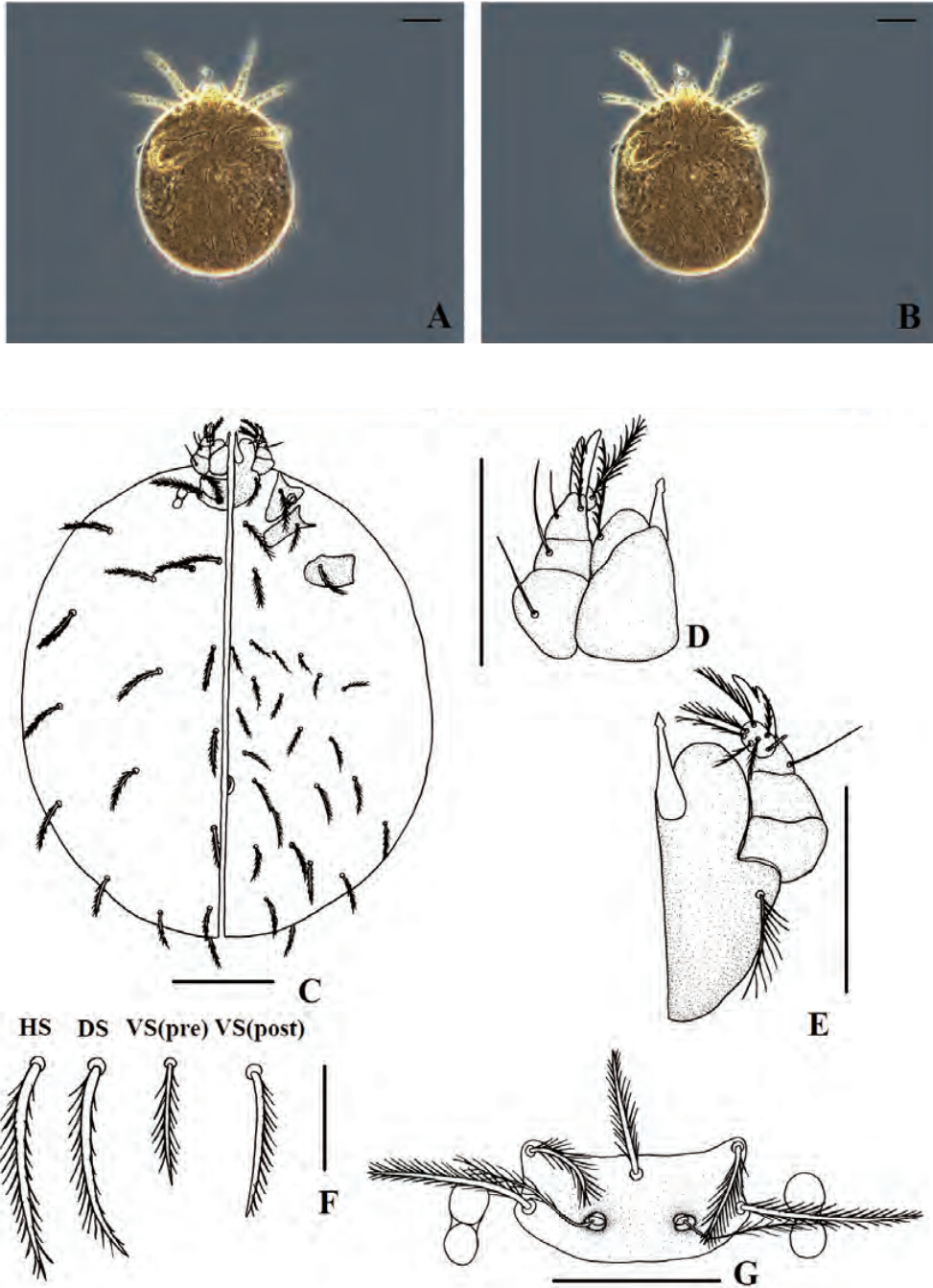
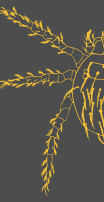


Fig. 22. *Leptotrombidium (Leptotrombidium) yui* (Chen and Hsu, 1955) larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.



Genus *Neoschöngastia* Ewing, 1929

新棒恙蟎屬

Type species. *Schöngastia americana* Hirst, 1921.

Diagnosis. Size medium to large; scutum usually trapezoidal, posterior half covered with cuticular striations. AL > AM; SN globose or clavate. Palpotarsus 7Bs. Parasubterminala of leg I plumose; leg III with 1 mastitarsala. Mostly parasitize in birds.

Neoschöngastia posekanyi Wharton and Hardcastle, 1946

波氏新棒恙蟎

(Fig. 23; Table 21)

References.

Neoschöngastia posekanyi Wharton & Hardcastle, 1946: 302; Radford, 1954: 263, f. 81; Sasa, 1956: 149, f. 49; Wen, 1984e: 321; Li, Wang & Chen, 1997: 323, f. 2-26-6.

Diagnosis of Larva. Scutum close to trapezoid, posterior half covered with cuticular striations. Anterolateral shoulders distinct. SN globose, surface with thin setae. SB/PL; PSB > ASB; AL > PL > AM. fPp = B/B/NBB/7Bs. Galeal setae nude. DS 32–36 in number (including HS), arranged in 2H, 8 (9), 6 (5), 6 (5), 4, 4 (5), 2 (3–4), (1–3), all shortly branched. VS 25–32 in number, with 18–24 preanal setae and 6–9 postanal setae. NDV = 58–68. Parasubterminala of leg I plumose; leg III with 1 mastitarsala. Larvae parasitize in birds.

Description of Larva. (n = 12) Oval in shape, red in color (Li et al., 1997); size large. Measurements of body length and width are as follows (in μm). Semi-engorged body length 564–728, width 455–530; engorged body length 703–767, width 582–634. Eyes 2+2, anterior pair significantly larger.

Gnathosoma. Gnathosomal base evenly punctate, with a pair of pectinate setae; cheliceral base punctate; cheliceral blade with tricuspid cap. Galeal setae nude; fPp = B/B/NBB/7Bs; palpotarsus with blunt solenidium; palpal claw 3-pronged.

Scutum. Trapezoidal; anterior margin biconcave; lateral margins curved inward; posterior margin biconvex; anterolateral shoulders distinct; scutum punctate in the middle. Cuticular striations overlapped with posterior half of scutum. PW/AP = 2.15–2.81; PW/SD = 1.26–1.68. SB/PL; PSB > ASB. AM long-feather shaped; ALs and PLs shortly branched. AL > PL > AM. SN globose, with thin setae on surface. Standard measurements of scutum are presented in Table 21.

Idiosomal Setae. DS 32–36 in number (including HS), arranged in 2H, 8 (9), 6 (5), 6 (5), 4, 4 (5), 2 (3–4), (1–3), all slender and shortly branched. ST 2-2 slenderly branched; VS 25–32 in number, with 18–24 preanal setae and 6–9 postanal setae; similar to ST but shorter. NDV = 58–68. Measurements of idiosomal setae are as follows (in μm). HS 54–68; medial setae of first post-humeral row 43–49; VS (pre) 28–33; VS (post) 40–48.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae

unisetose, evenly punctate. Ip 1017–1125 μm . All segments with various numbers of branched setae (B).

Leg I. 349–390 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 4B, 3 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microgenuala; tarsus 22B, with 1 central tarsala, 1 microtarsala, 1 pretarsala and 1 nude subterminala; parasubterminala plumose.

Leg II. 312–347 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 349–389 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, with 1 genuala; tibia 5B, with 1 tibiala; tarsus 15B, 1 flagelliform mastitarsala. SIF = 7Bs-N-3-3111.1000.

Table 21. Standard measurements (in μm) of *Neoschöngastia posekanyi* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 12 specimens	80	88	47	26	34	61	35	47	79	51	36	29
Observed range												
Min.	75	82	45	20	32	54	31	42	72	47	33	27
Max.	83	94	49	32	37	67	41	50	83	53	38	33

Specimens Examined. NANTOU COUNTY: 1 larva (990864-1), Jenai (南投縣仁愛鄉), 26 Aug. 2010, ex *Otus lettia*; 11 larvae (990910-1~11), same locality, 9 Sept. 2010, ex *Otus lettia*.

Distribution. China, Japan, and Taiwan (Sasa, 1956; Lien et al., 1967; Wen, 1984e; Li et al., 1997).

Remarks. *Neoschöngastia posekanyi* most closely resembles *N. gallinarum* (Hatori, 1920), a widespread species in China and Southeast Asia, but it can be distinguished from the latter by the following features (*N. gallinarum* in parentheses): fPp = BBNBB (BBBBB); DS 32–36 in number (46); VS 25–32 in number (VS 40); Ip 1017–1125 μm (667 μm) (Li et al., 1997).

Biology. *Neoschöngastia posekanyi* is found on birds, including *Gallus gallus domesticus*, *Meleagris gallopavo*, woodpecker in China (*Blythipicus pyrrhotis hainanus*), *Lanius schach* and *Otus lettia* (Wen, 1984e).

Medical Importance. Unknown.

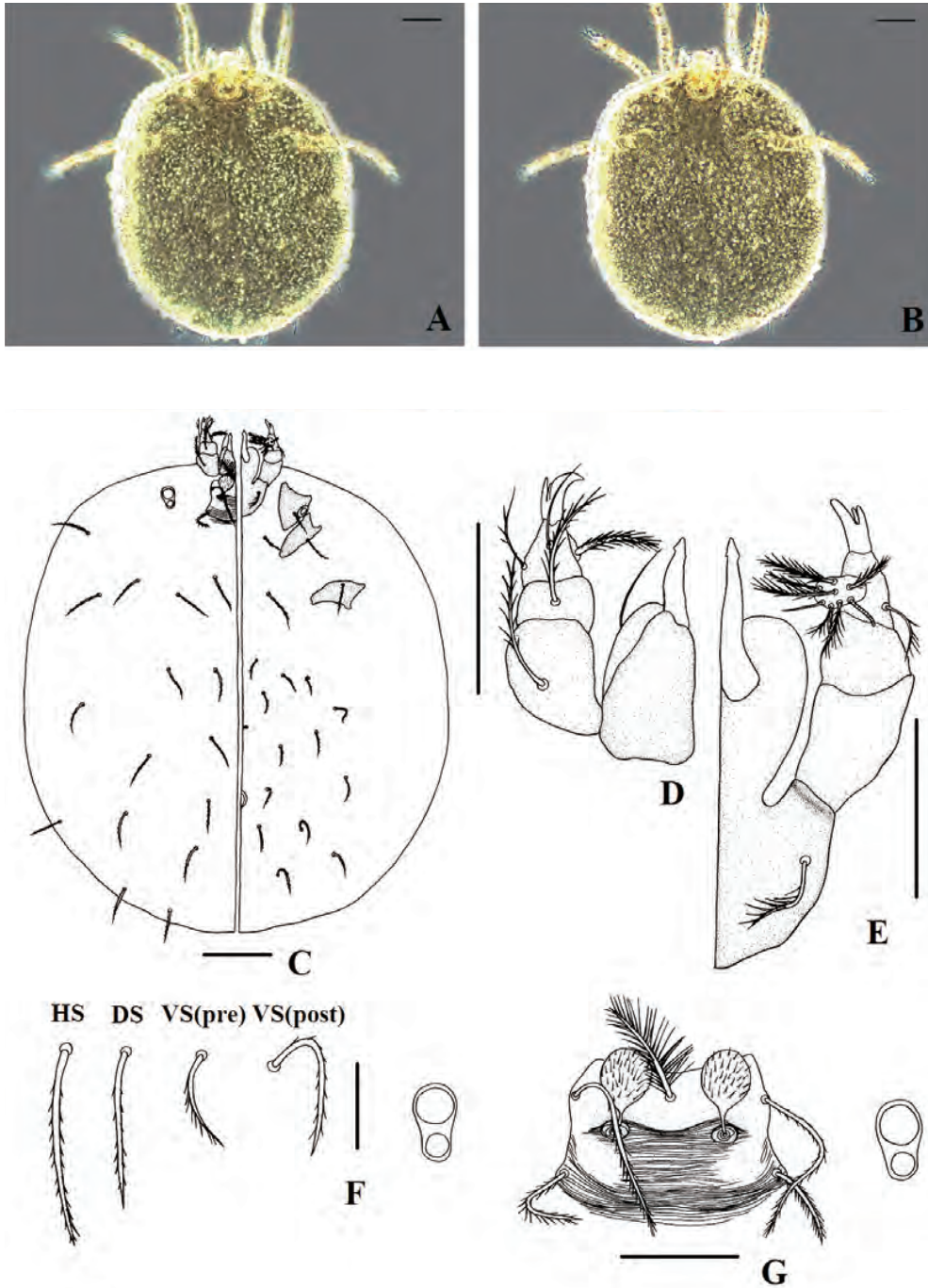


Fig. 23. *Neoschöngastia posekanyi* Wharton and Hardcastle, 1946 larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.



Genus *Toritrombicula* Sasa, 1954

鳥恙蟎屬

Type species. *Trombicula (Toritrombicula) hasegawai* Sasa, Hayashi and Kawashima, 1953.

Diagnosis. Size usually large; anterior eyes strongly sclerotized or lens-like, significantly larger than posterior pair (at least two times larger); scutum rectangular; SN long flagelliform. Parasubterminala of leg I plumose. Mostly parasitize in birds.

Toritrombicula densipiliata (Walch, 1923)

密毛鳥恙蟎

(Fig. 24; Table 22)

References.

Trombicula densipiliata Walch, 1923: 79; Womersley, 1952: 126; Radford, 1954: 250.

Trombicula (Vorcana) densipiliata Audy, 1956b: 52; Audy, 1957: 236.

Toritrombicula densipiliata Nadchatram, 1967: 404, fs. 1–8; Takahashi, Mitsumi & Takahashi, 2012: 63.

Diagnosis of Larva. Size large; eyes 2+2, anterior pair conspicuously larger and strongly sclerotized. Scutum flat rectangular. SB/PL; SN long flagelliform, with branches on distal half. fPp = B/B/NNN/7B. Galeal setae nude. HS 2-paired; DS 65–73 in number (including HS), arranged irregularly: 4H, 20 (16–18), 14 (15–16), 12 (11, 15), 8 (9), 9 (6–8), 4 (2), (2), slender and shortly branched; the first post-humeral row usually consists of two to three rows of disordered setae. VS 42–51 in number, with 27–34 preanal setae and 14–18 postanal setae. NDV = 108–122. Parasubterminala of leg I plumose. Larvae parasitize in birds.

Description of Larva. (n = 5) Oval, color light orange to brown (Nadchatram, 1967); size large. Measurements of body length and width are as follows (in μm). Engorged body length 906–1054, width 703–881. Eyes 2+2, anterior pair significantly larger and strongly sclerotized.

Gnathosoma. Gnathosomal base lightly punctate, with a pair of pectinate setae; cheliceral base sparsely punctate; cheliceral blade with tricuspid cap. Galeal setae nude; fPp = B/B/NNN/7B; palpotarsus with blunt solenidion; palpal claw 3-pronged.

Scutum. Flat rectangular; anterior and posterior margins nearly straight, some slightly concave in the middle; lateral margins curved inward; scutum evenly punctate. PW/AP = 2.42–2.66; PW/SD = 1.84–1.98. SB/PL; PL > AL > AM, all shortly branched and tapering to apex. SN long flagelliform, with 12–14 branches on distal half. Standard measurements of scutum are presented in Table 22.

Idiosomal Setae. HS 2-paired; DS 65–73 in number (including HS), arranged irregularly: 4H, 20 (16–18), 14 (15–16), 12 (11, 15), 8 (9), 9 (6–8), 4 (2), (2), slender and shortly branched; the first post-humeral row usually consists of two to three rows of disordered setae. ST 2-2, slender and shortly branched. VS 42–51 in

number, with 27–34 preanal setae and 14–18 postanal setae; similar to ST. NDV = 108–122. Measurements of idiosomal setae are as follows (in μm). HS 66–73; medial setae of first post-humeral row 55–61; VS (pre) 33–37; VS (post) 52–58.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae unisetose, evenly punctate. Ip 1111–1210 μm . All segments with various numbers of branched setae (B).

Leg I. 371–421 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microgenuala; tarsus 22B, with 1 central tarsala, 1 microtarsala, 1 pretarsala and 1 nude subterminala; paraterminala plumose.

Leg II. 339–369 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 15B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 399–426 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, with 1 genuala; tibia 5B, with 1 tibiala; tarsus 15B.

SIF = 7B-N-3-2111.0000.

Table 22. Standard measurements (in μm) of *Toritrombicula densipiliata* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 5 specimens	78	94	28	34	16	49	37	51	55	65	58	34
Observed range												
Min.	74	87	27	31	15	47	35	49	54	63	54	31
Max.	82	100	30	37	17	52	40	55	57	69	62	37

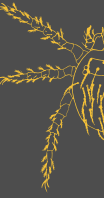
Specimens Examined. NANTOU COUNTY: 4 larvae (990864-2~5), Jenai (南投縣仁愛鄉), 26 Aug. 2010, ex *Otus lettia*; 1 larva (990910-12), same locality, 9 Sept. 2010, ex *Otus lettia*.

Distribution. Indonesia, Malaysia, Papua New Guinea, Philippine, Taiwan (new record), and Thailand (Nadchatram, 1967; Takahashi et al., 2012).

Remarks. *Toritrombicula densipiliata* resembles closely to *Tori. hasegawai* (Sasa et al., 1953) in Japan and China (Sasa, 1956; Li et al., 1997), and it can only be distinguished from the latter by the comparison in length of scutal setae (*Tori. hasegawai* in parenthesis): PL > AL > AM (PL > AM > AL) (Takahashi et al., 2012).

Biology. *Toritrombicula densipiliata* is widespread across Southeast Asia, and recorded from a wide variety of bird species, such as *Pitta sordida*, *Otus lettia*, *Zoothera citrine*, and *Centropus* sp. (pheasants) (Takahashi et al., 2012).

Medical Importance. Unknown.



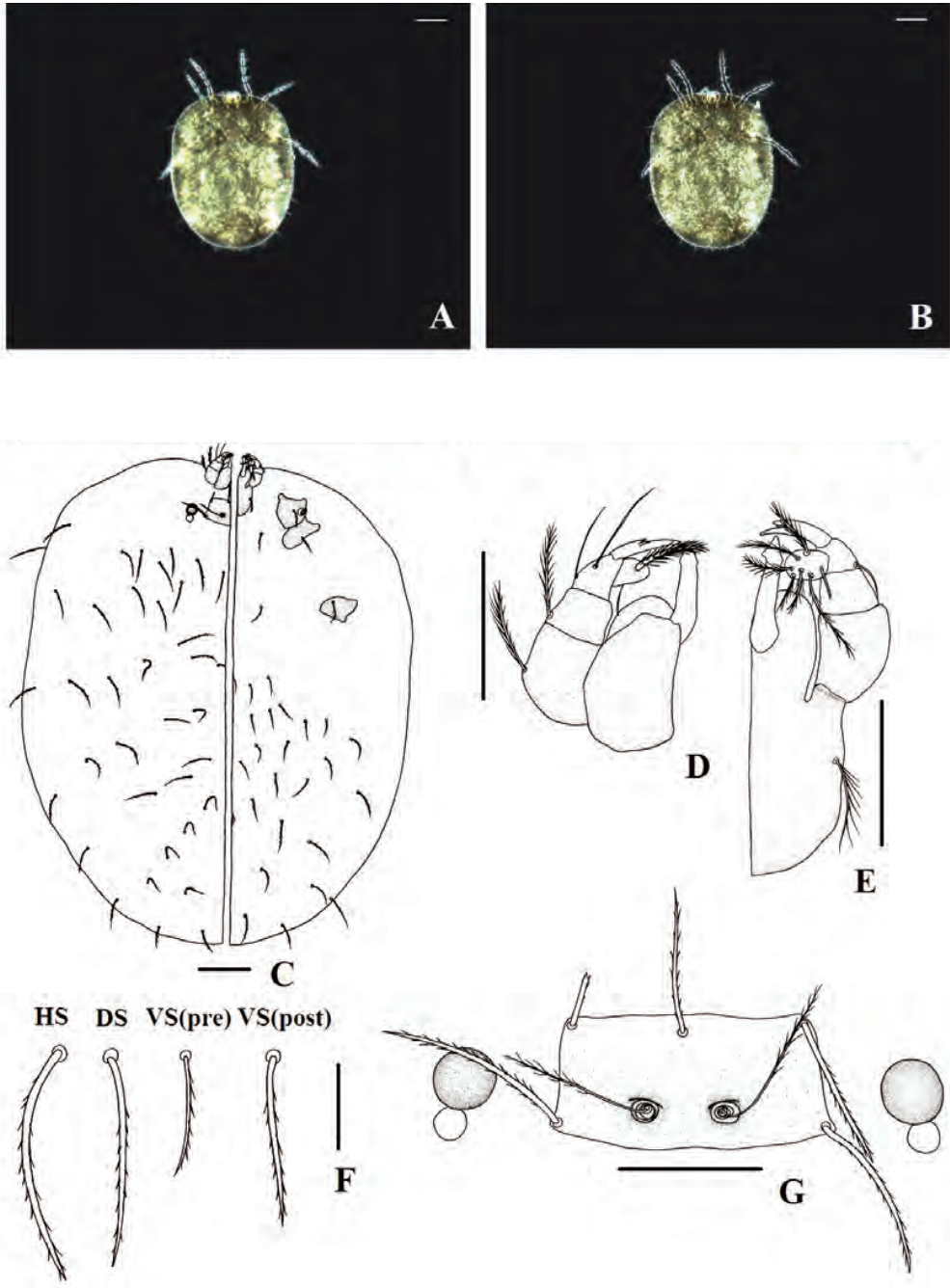


Fig. 24. *Toritrombicula densipiliata* (Walch, 1923) larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B = 200 μ m; C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.

Genus *Trombiculindus* Radford, 1948

葉片恙蟎屬

Subgenus *Trombiculindus* Radford, 1948

葉片恙蟎亞屬

Type species. *Trombiculindus squamosus* Radford, 1948.

Diagnosis. Size medium; scutum usually rectangular or trapezoidal. PL and DS significantly expanded or foliate, with lines of spikes on surface; ST and VS plumose or branched, but the VS near caudal usually slightly expanded. SN flagelliform. Palpotarsus 7B.

Key to the species of the subgenus *Trombiculindus* in Taiwan

1. fPp =N/N/BNB/7B; scutum larger (AW 79 μm ; PW 92 μm); PL 82 x 12 μm ; idiosomal setae longer (HS 77 μm ; DS 71 μm); DS 28–29; VS 33–38; NDV = 61–67; Ip 824–965 μm *T. (T.) hunanye* 湖南葉片恙蟎 (new record)
fPp = N/N/BNN/7B; scutum smaller (AW 69 μm ; PW 80 μm); PL 60 x 11 μm ; idiosomal setae shorter (HS 51 μm ; DS 46 μm); DS 28; VS 32; NDV = 60; Ip 728 μm *T. (T.) spinifoliatus* 刺葉葉片恙蟎 (new record)



Trombiculindus (Trombiculindus) *hunanye* (Wen, 1984b)

湖南葉片恙蟎

(Fig. 25; Table 23)

References.

- Leptotrombidium (Trombiculindus) hunanye* Wen, 1984b: 89, f. II-26.
Trombiculindus (T.) hunanye Li, Wang & Chen, 1997: 204, f. 2-2-9.

Diagnosis of Larva. Scutum close to flat rectangle; PL bamboo-leaf shaped, with five to six straight lines of spikes on surface, locating above the middle of SD. PL/SB. fPp = N/N/BNB/7B. SN flagelliform, with tiny spikes at basal, and 10–12 branches at distal. DS 28–29 in number (including HS), arranged in 2H, 8, 6, 6, 4, 2 (3), all similar to PL; VS 33–38 in number, with 22–29 preanal setae and 9–13 postanal setae; VS thin and finely branched, only the last four setae in caudal (CS) slightly expanded. NDV = 61–67.

Description of Larva. (n = 7) Oval in shape, color unknown; size medium. Measurements of body length and width are as follows (in μm). Unengorged body length 262–309, width 201–228; semi-engorged body length 394–443, width 280–314; engorged body length 562, width 446. Eyes 2+2, anterior pair larger.

Gnathosoma. Gnathosomal base lightly punctate, with a pair of pectinate setae; cheliceral base sparsely punctate; cheliceral blade with tricuspid cap. Galeal setae branched; fPp = N/N/BNB/7B; palpotarsus with blunt solenidion; palpal claw 3-pronged.

Scutum. Flat rectangular; anterior margin lightly convex; posterior margin concave; scutum evenly punctate. PW/AP = 4.43–5.15; PW/SD = 1.71–1.97. PL/SB. AM and ALs branched and tapering to apex; PLs bamboo-leaf shaped, with five to six straight lines of spikes on surface, locating above the middle of SD; length-to-width ratio of PL 5.90–8.15. PL > AM > AL. SN not available based on the specimen examined. However, according to the drawings of Wen (1984b), SN flagelliform, with 10–12 branches at distal, basal with tiny spikes. Standard measurements of scutum are presented in Table 23.

Idiosomal Setae. DS 28–29 in number (including HS), arranged in 2H, 8, 6, 6, 4, 2 (3); all similar to PL. ST 2-2, long and finely branched; VS 33–38 in number, with 22–29 preanal setae and 9–13 postanal setae; VS similar to ST, thin and finely branched except CS, which expanded mildly, with tiny spikes on surface. NDV = 61–67. Measurements of idiosomal setae are as follows (in μm). HS 68–85; medial



setae of first post-humeral row 63–75; VS (pre) 31–38; VS (post) 42–53.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae unisetose, evenly punctate. Ip 824–965 μm . All segments with various numbers of branched setae (B).

Leg I. 282–324 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microgenuala; tarsus 22B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 250–300 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 4B; genu 4B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala and 1 pretarsala.

Leg III. 292–342 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, with 1 genuala; tibia 5B, with 1 tibiala; tarsus 15B.

SIF = 7B-B-3-2111.0000.

Table 23. Standard measurements (in μm) of *Trombiculindus (Trombiculindus) hunanye* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 7 specimens	79	92	45	33	17	50	19	64	45	82 x 12	N/A	27
Observed range												
Min.	76	87	41	32	15	48	17	61	40	71 x 10	N/A	25
Max.	86	102	50	36	18	53	22	67	48	88 x 14	N/A	29

Specimens Examined. YILAN COUNTY: 2 larvae (IW0043-1-1~2), Tatung, Szuyuan Wukou (宜蘭縣大同鄉思源埡口), 12 Aug. 2008, ex *Apodemus semotus*, female; 4 larvae (IW0045-1-1, IW0047-1-1, IW0047-2-1~2), same locality and date, ex *Apodemus semotus*, male; 1 larva (IW0048-13-1), same locality and date, ex *Niviventer coninga*, female.

Distribution. China (Hunan Province) and Taiwan (new record) (Wen, 1984b; Li et al., 1997).

Remarks. *Trombiculindus (T.) hunanye* closely resembles another *Trombiculindus* species, *Trombiculindus (T.) spinifoliatus* (Wang, Li and Tien, 1985) in Taiwan, and can be distinguished from the latter by the following features (*T. (T.) spinifoliatus*

in parentheses): fPp = NNBNB (NNBNN); scutum larger: AW 79 μm ; PW 92 μm in average (69 and 80 μm , respectively); PL longer: 82 μm in average (60 μm); idiosomal setae longer: HS 77 μm ; DS 71 μm ; VS (pre) 36 μm ; VS (post) 48 μm in average (51, 46, 25, 36 μm , respectively); VS more branched (only shortly branched).

Biology. *Trombiculindus (T.) hunanye* was reported from Hunan Province in China. Rodents are recorded as hosts, including *Apodemus agrarius*, *A. semotus* and *Niviventer coninga* (Wen, 1984b).

Medical Importance. Unknown.

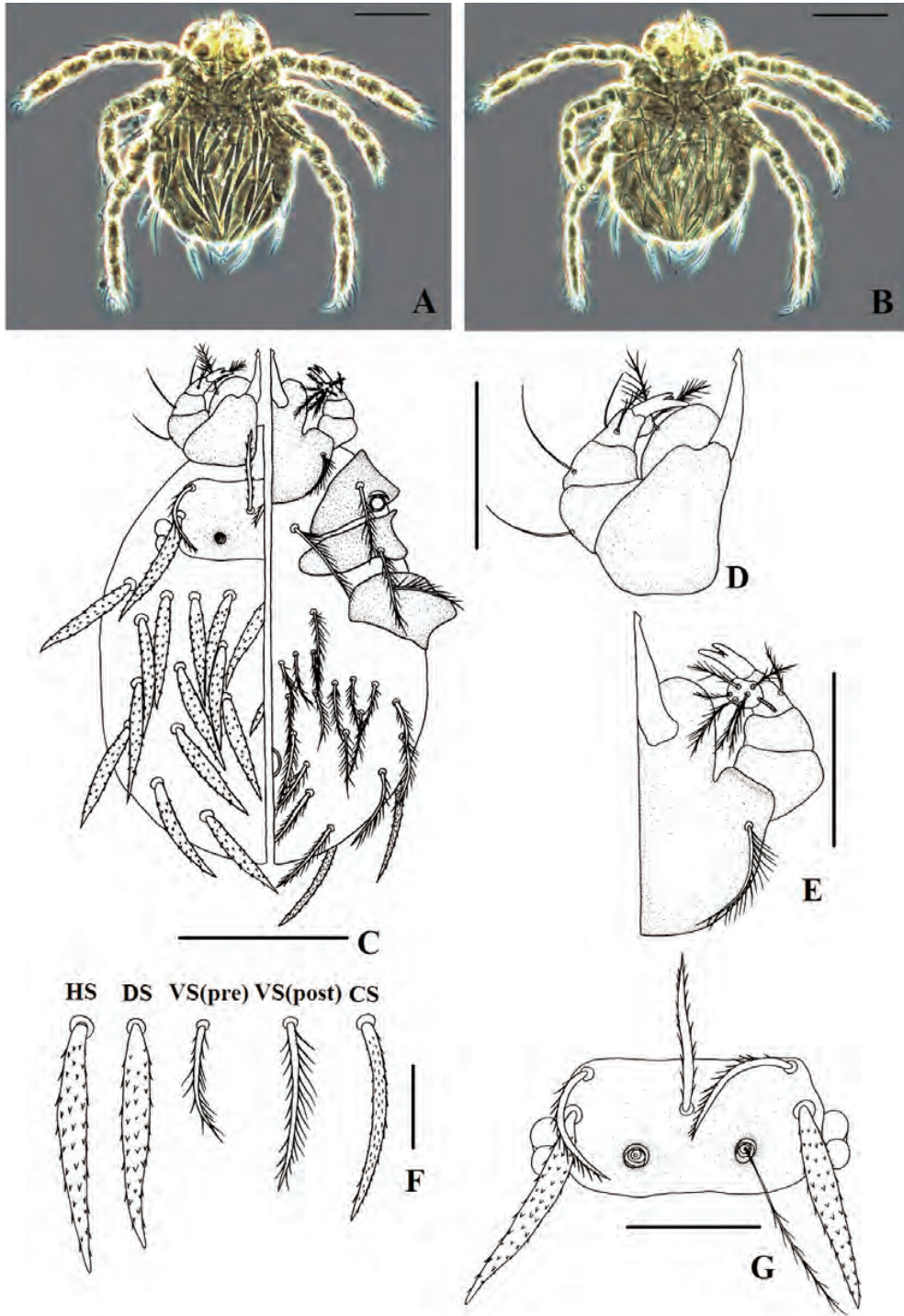


Fig. 25. *Trombiculindus (Trombiculindus) hunanye* (Wen, 1984b) larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.

Trombiculindus (Trombiculindus) spinifolius (Wang, Li and Tien, 1985)

刺葉葉片恙蟎

(Fig. 26; Table 24)

References.

Leptotrombidium (Trombiculindus) spinifolius Wang, Li & Tien, 1985: 153, fs. 5–8.

Trombiculindus (T.) spinifolius Li, Wang & Chen, 1997: 207, f. 2-2-13.

Diagnosis of Larva. Scutum close to flat rectangle; PL bamboo-leaf shaped, with four to five straight lines of spikes on surface. PL/SB. fPp = N/N/BNN/7B. DS 28 in number (including HS), arranged in 2H, 8, 6, 6, 4, 2, similar to PL but shorter; VS 32 in number (Li et al., 1997), with 24 preanal setae and 8 postanal setae; VS shortly branched, only the last four setae in caudal (CS) slightly expanded. NDV = 60.

Description of Larva. (n = 1) Oval in shape, color unknown; size medium. Measurements of body length and width are as follows (in μm). Engorged body length 495, width 421. Eyes 2+2, anterior pair larger.

Gnathosoma. Gnathosomal base sparsely punctate, with a pair of pectinate setae; cheliceral base also sparsely punctate; cheliceral blade with tricuspid cap. Galeal setae branched; fPp = N/N/BNN/7B; palpotarsus with blunt solenidion; palpal claw 3-pronged.

Scutum. Flat rectangular; angles of AL lightly protruded; anterior margin convex; lateral margins nearly straight; posterior margin concave; evenly punctate. PW/AP = 4.5; PW/SD = 1.83. PL/SB. AM lost in the specimen examined; ALs slightly branched and tapering to apex; PLs bamboo-leaf shaped, with four to five straight lines of spikes on surface; length-to-width ratio of PL 5.36. SN not available based on the specimen examined. Standard measurements of scutum are presented in Table 24.

Idiosomal Setae. DS 28 in number (including HS), arranged in 2H, 8, 6, 6, 4, 2; all similar to PL. ST 2-2, thin and shortly branched; VS 32 in number, with 24 preanal setae and 8 postanal setae; VS similar to ST but shorter except CS, which expanded mildly, with tiny spikes on surface. NDV = 60. Measurements of idiosomal setae are as follows (in μm). HS 51; medial setae of first post-humeral row 46; VS (pre) 25; VS (post) 36.

Legs. All 7-segmented, with a pair of claws and a slender empodium. Coxae unisetose, evenly punctate. Ip 728 μm . All segments with various numbers of



branched setae (B).

Leg I. 248 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microgenuala; tarsus 22B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 240 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 250 μm ; coxa 1B; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, with 1 genuala; tibia 6B, with 1 tibiala; tarsus 15B.

SIF = 7B-B-3-2111.0000.

Table 24. Standard measurements (in μm) of *Trombiculindus (Trombiculindus) spinifolius* larval scutum.

AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
69	80	40	27	17	44	18	N/A	35	60 x 11	N/A	22

Specimens Examined. NANTOU COUNTY: 1 larva (8090-1-1), Kuohsing, Peikang (南投縣國姓鄉北港村), 12 Dec. 2001, ex *Rattus losea*, male.

Distribution. China (Hunan Province) and Taiwan (new record) (Li et al., 1997).

Remarks. *Trombiculindus (T.) spinifolius* closely resembles another *Trombiculindus* species, *Trombiculindus (T.) hunanye* (Wen, 1984b) in Taiwan, and it can be distinguished from the latter by the following features (*T. (T.) hunanye* in parentheses): fPp = NNBN (NNBNB); scutum larger: AW 69 μm ; PW 80 μm in average (79 and 92 μm , respectively); PL shorter: 60 μm in average (82 μm); idiosomal setae shorter: HS 51 μm ; DS 46 μm ; VS (pre) 25 μm ; VS (post) 36 μm in average (77, 71, 36, 48 μm , respectively); VS only shortly branched (more branched).

Biology. *Trombiculindus (T.) spinifolius* is recorded mainly from rodents, including *Apodemus agrarius* and *Rattus losea* (Wang et al., 1985).

Medical Importance. Unknown.

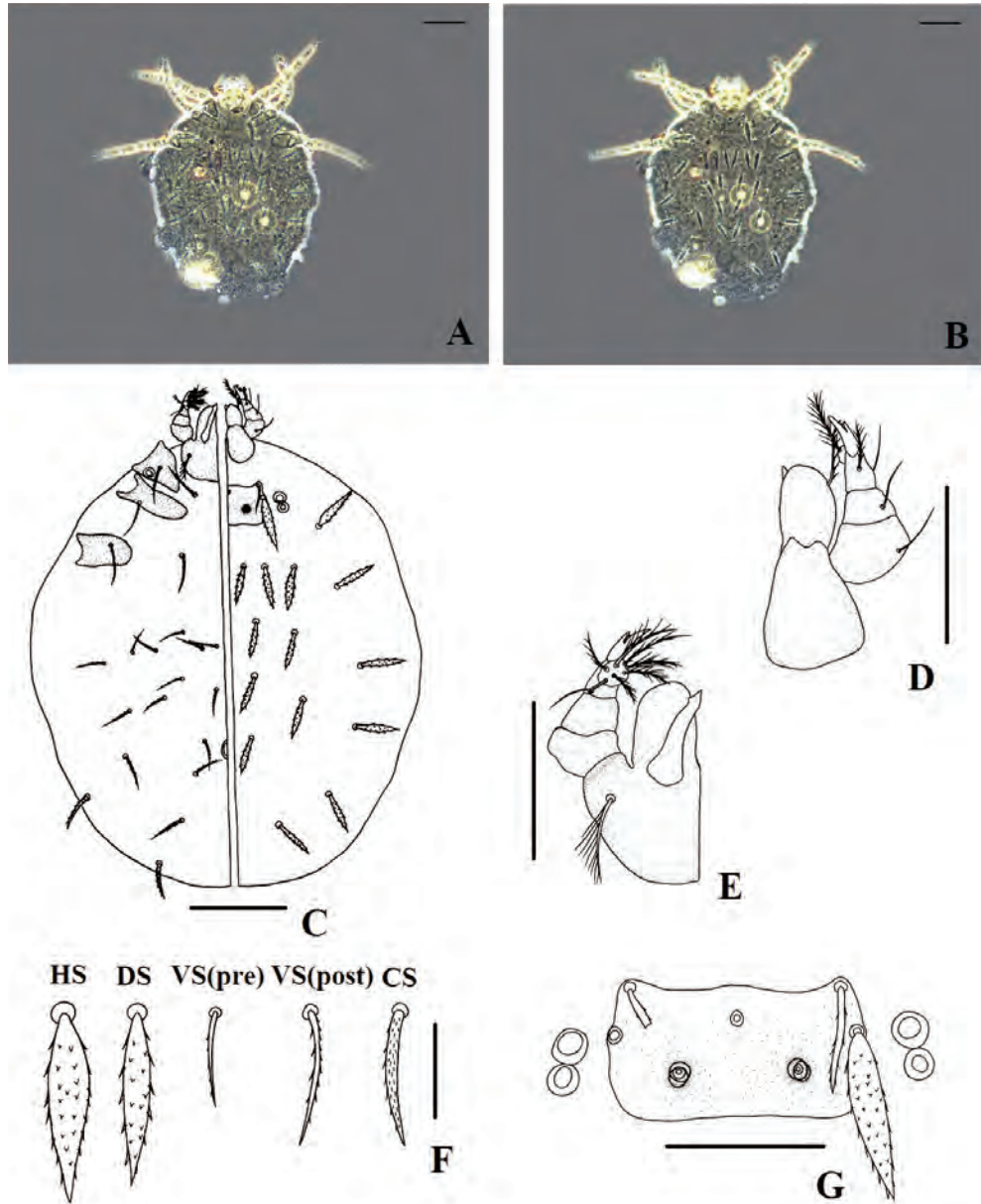


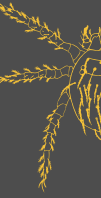
Fig. 26. *Trombiculindus (Trombiculindus) spinifolius* (Wang, Li and Tien, 1985) larva. A. phase contrast image of the ventral view; B. phase contrast image of the dorsal view; C. ventral and dorsal view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.

Genus *Walchiella* Fuller, 1952

毫前恙蟎屬

Type species. *Trombicula oudemansi* Walch, 1922.

Diagnosis. Medium-to-large mite. Scutum usually trapezoidal, significantly punctate, and lack of anterolateral shoulders. Mostly $AM \geq PL$. SN clavate or long-clavate. Palpotarsus 7Bs; galeal setae nude.



Walchiella wuyiensis Wang and Liao, 1981

武夷毫前恙蟎

(Fig. 27; Table 25)

References.

Walchiella wuyiensis Wang & Liao, 1981: 219, fs. 4–7; Li, Wang & Chen, 1997: 388, f. 2-28-4.

Diagnosis of Larva. Scutum trapezoidal, with posterior margin concave in the middle; posterolateral angles blunt. Scutum punctate significantly. $AM > AL > PL$. SN long-clavate, distal end needle-like, with spikes on surface. $fPp = B/B/BBB/7Bs$. DS 37–42 in number (including HS), arranged in 2H, 6, 6, 6 (2, 7), 8, 6 (7), 4, 2; VS 40–44 in number (Wang & Liao, 1981), with 33 preanal setae and 11 postanal setae based on the specimen in hand. Small circular plates lie beneath the bases of DS near central idiosoma. $NDV = 84$ based on the specimen observed. Legs 7-6-6 segmented.

Description of Larva. ($n = 1$) Oval, size small to medium. Live larva milky yellow (Wang & Liao, 1981). Measurements of body length and width are as follows (in μm). Semi-engorged body length 386, width 295. Eyes distinct, 2+2.

Gnathosoma. Gnathosomal base evenly punctate, with a pair of pectinate setae; cheliceral base lightly punctate; cheliceral blade with tricuspid cap. Galeal setae nude; $fPp = B/B/BBB/7Bs$, with one blunt solenidion; palpal claw 3-pronged.

Scutum. Trapezoidal; anterior margin slightly biconcave; posterior margin concave in the middle, with posterolateral angles blunt. Scutum significantly punctate. SB/PL . $PW/SD = 1.59$. Similar to other species of Trombiculinae, *Walchiella wuyiensis* bears 5 scutal setae: 1 AM, 2 ALs and 2 PLs; $AM > AL > PL$; PL slightly more slender than other scutal setae; all branched sparsely and tapering to apex. AM and SN not available on the specimen observed, but SN long-clavate, with needle-like distal end and spikes on surface in the original description (Wang & Liao, 1981). Standard measurements of scutum are presented in Table 25.

Idiosomal Setae. HS and DS similar to PL in shape; posterior DS shorter. DS 40 in number (including HS), arranged in 2H, 6, 6, 6, 8, 6, 4, 2; ST 2-2, slender and branched; VS 44 in number, with 33 preanal setae and 11 postanal setae. Small circular plates lie beneath the bases of DS near central idiosoma. $NDV = 84$ based on the specimen observed. Measurements of idiosomal setae are as follows (in μm). HS 39; medial setae of first post-humeral row 33; VS (pre) 19; VS (post) 21.



Legs. 7-6-6 segmented, with a pair of claws and a slender empodium. Coxae unisetose, evenly punctate. Ip 747 μm . All segments with various numbers of branched setae (B).

Leg I. 248 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 3 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microgenuala; tarsus 21B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 228 μm ; coxa 1B; trochanter 1B; femur 5B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 272 μm ; coxa 1B; trochanter 1B; femur 4B, with 1 nude ventral femorala; genu 3B, with 1 genuala; tibia 6B with 1 tibiala; tarsus 16B.

SIF = 7Bs-N-3-3111.0000.

Table 25. Standard measurements (in μm) of *Walchiella wuyiensis* larval scutum.

AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
66	86	36	27	27	54	37	N/A	31	25	N/A	27

Specimens Examined. KAOHSIUNG CITY: 1 larva (20150127C03-4), Liukuei, Shanping (高雄市六龜區扇平), 27 Jan. 2015, ex *Herpestes urva*, gender unknown.

Distribution. China (Fuchien Province) and Taiwan (new record) (Wang & Liao, 1981).

Remarks. *Walchiella wuyiensis* most closely resembles *Walchiella traubi* (Womersley, 1952) in Southeast Asia, but it can be distinguished from the latter by (*Walchiella traubi* in parentheses): scutum trapezoidal (rectangular); SN with needle-like distal end (blunt distal end); fPp = B/B/BBB/7Bs (N/N/NNN/7Bs) (Wang & Liao, 1981).

Biology. *Walchiella wuyiensis* was first collected from *Tamiops swinhoi* in Fuchien County; later more rodent hosts are recorded: *Berylmys bowersi*, *Niviventer confucianus* and *N. fulvescens*. In Taiwan, *Herpestes urva* is recorded as host of *Walchiella wuyiensis* for the first time (Wang & Liao, 1981).

Medical Importance. Unknown.

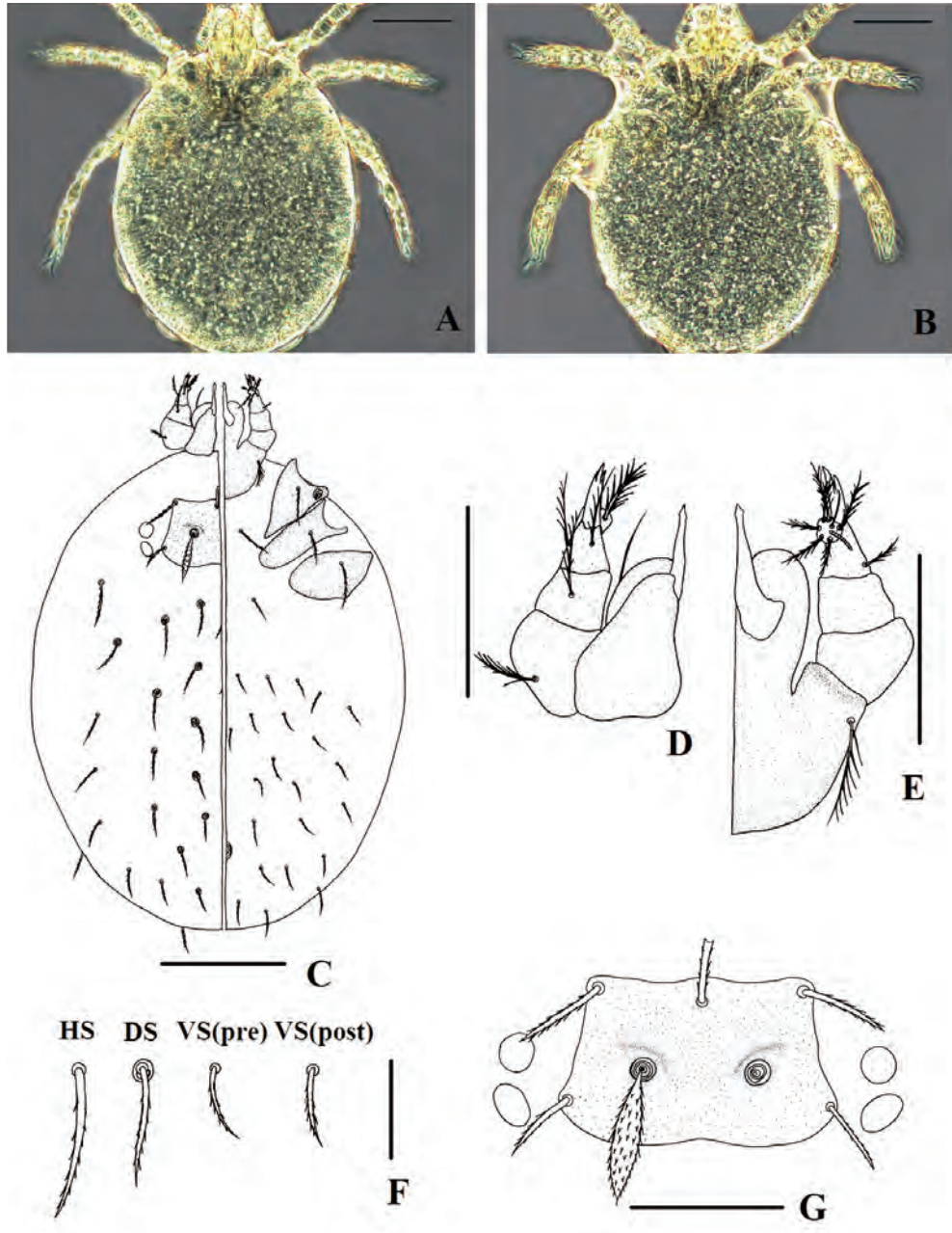


Fig. 27. *Walchiella wuyiensis* Wang and Liao, 1981 larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.

Subfamily Gahrlepiinae Womersley, 1952

背展恙蟎亞科

Diagnosis. Scutum without AM and anteromedian projection; with two ALs and two PLs; with or without PPLs; legs 7-6-6 segmented.

Genus *Gahrlepiea* Oudemans, 1912

背展恙蟎屬

Subgenus *Gateria* Ewing, 1938

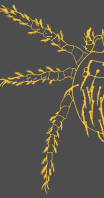
革脫恙蟎亞屬

Type species. *Typhlothrombidium nanus* Oudemans, 1910b.

Diagnosis. Medium-to-large mite; scutum hexagonal; lack of AM; with 2 ALs and 2 PLs, and multiple pairs of PPLs. SN usually clavate with tiny spikes on surface. Palpotarsus with 4B. Legs 7-6-6 segmented; leg III without tibiala.

Key to the species of the subgenus *Gateria* in Taiwan

1. Scutum significantly smaller than the other congeners (PW \leq 90 μ m; SD \leq 145 μ m; SW \leq 105 μ m); idiosomal setae shorter (HS $<$ 45 μ m; DS $<$ 40 μ m; VS (pre) \leq 25 μ m; VS (post) \leq 30 μ m); Ip \leq 720 μ m; NDV \leq 100
..... *G. (Gat.) minuta* 微小背展恙蟎
Scutum larger (PW $>$ 90 μ m; SD $>$ 145 μ m; SW $>$ 105 μ m); idiosomal setae longer (HS $>$ 45 μ m; DS $>$ 40 μ m; VS (pre) $>$ 25 μ m; VS (post) $>$ 30 μ m); Ip $>$ 720 μ m; NDV $>$ 1002
2. Scutal setae 25–28 in number; posterior margin of scutum curved outward; SD \leq 160 μ m; scutal and idiosomal setae significantly plumose
..... *G. (Gat.) linguipelta* 舌板背展恙蟎
Scutal setae $<$ 23 in number; posterior margin of scutum nearly straight; SD $>$ 160 μ m; scutal and idiosomal setae branched 3
3. DS 46–49 in number; NDV = 108–119
..... *G. (Gat.) longipedalis* 長足背展恙蟎 (new record)
DS $>$ 50 in number; NDV = 118–141 4
4. DS 50–53 in number; second row of DS consists of two sets of three setae that are



- closely aligned; ventral femorala of leg III branched
..... *G. (Gat.) yilanensis* 宜蘭背展恙蟎
DS 61–66 in number; second row of DS evenly situated; ventral femorala of leg
III nude *G. (Gat.) lienii* 連氏背展恙蟎

Gahrliepia (Gateria) lieni Chung, Wu, Kuo and Wang, 2015

連氏背展恙蟎

(Fig. 28; Table 26)

References.

Gahrliepia (Gateria) lieni Chung, Wu, Kuo & Wang, 2015: 1242, f. 1.

Diagnosis of Larva. fPp = B/B/NNN/4B; scutum long, hexagonal. Scutal setae 19–23 in number, with 2 ALs, 2 PLs and 15–19 PPLs; PPLs arranged in 4 (3, 5), 5 (4, 6), 4 (3, 5), 2 (1, 3), 2 (0). SN claviform with spikes on surface. Scutal and idiosomal setae branched and tapering to apex. DS 61–66 in number (including HS), arranged in 2 (3–4), 4 (5–6), 6 (7)...; posterior DS arranged disorderly. VS 67–77 in number. NDV = 128–141.

Description of Larva. (n = 10) Live larva oval. Measurements of body length and width are as follows (in μm). Semi-engorged body length 314–465, width 260–374; engorged body length 530–572, width 470–507. Eyes 2+2, located by scutum; anterior pair larger; posterior pair long, elliptical.

Gnathosoma. Gnathosomal base round, evenly punctate, with a pair of pectinate setae; cheliceral base evenly punctate; cheliceral blade with tricuspid cap. Galeal setae nude; fPp = B/B/NNN/4B, with a blunt solenidion; palpal claw 3-pronged.

Scutum. Long, hexagonal; anterior margin nearly straight; posterior margin slightly convex. Scutum evenly punctate. PW/AP = 2.06–2.45; PW/SD = 0.54–0.62. SB/PL. Scutal setae branched, 19–23 in number, with 2 ALs, 2 PLs and 15–19 PPLs that are more slender than the ALs and the PLs, and arranged in 4 (3, 5), 5 (4, 6), 4 (3, 5), 2 (1, 3), 2 (0). SN claviform with short spikes on surface. Standard measurements of scutum are presented in Table 26.

Idiosomal Setae. DS 61–66 in number, arranged in 2 (3–4), 4 (5–6), 6 (7)...; posterior DS arranged disorderly. HS and DS similar to PL, branched and tapering to apex. ST 2-2 and finely branched; posterior pair conspicuously farther apart than the first pair. VS 67–77 in number, with preanal setae 41–51 and postanal setae 24–29. NDV = 128–141. Measurements of idiosomal setae are as follows (in μm). HS 53–64; medial setae of first post-humeral row 50–56; VS (pre) 28–32; VS (post) 41–48.

Legs. fsp 7-6-6, all with a pair of claws and a slender empodium. Coxae I-III unisetose, evenly punctate. Ip 846–941 μm . All segments with various numbers of branched setae (B).

Leg I. 287–324 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae (the distal one is similar to the tarsala and thicker than the proximal one) and 1 microtibiala; tarsus 23B, 1 central tarsala, 1 microtarsala, pretarsala, nude subterminala and parasubterminala.

Leg II. 243–280 μm ; coxa 1B; trochanter 1B; femur 5B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae (the distal one is slightly thicker than the proximal one); tarsus 15B, with 1 central tarsala, 1 microtarsala and pretarsala.

Leg III. 304–337 μm ; coxa 1B; trochanter 1B; femur 4B, with 1 nude ventral femorala; genu 3B, with 1 genuala; tibia 6B; tarsus 16B.

SIF = 4B-N-3-2110.0000.

Specimen	AW	PW	SB	ASB	PSB	SD	SW	AP	AL	PL	SN	PS
Mean of 10 specimens	62	102	61	27	151	178	127	45	53	50	47 x 14	26
Observed range												
Min.	59	97	59	25	146	172	119	40	48	45	45 x 14	22
Max.	66	109	66	30	161	189	134	49	58	54	50 x 15	29

Specimens Examined. YILAN COUNTY: 3 larvae (IW0048-10-2, IW0048-14-2~3), Tatung, Szuyuan Wukou (宜蘭縣大同鄉思源埡口), 12 Aug. 2008, ex *Niviventer coninga*, female; 7 larvae (IW0047-2-3, IW0047-3-1~2, IW0047-4-1, IW0047-5-1~3), same locality and date, ex *Apodemus semotus*, male.

Distribution. Taiwan.

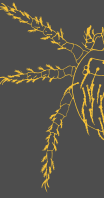
Remarks. Among its congeners, *G. (Gat.) lienі* most closely resembles *G. (Gat.) taiwanensis* (Wen, 2000) in Taiwan, but it can be distinguished from the latter by the following features (*G. (Gat.) taiwanensis* in parentheses): PPLs 15–19 in number (22); scutum without sharp posterolateral angles inserted by PPL (scutum with sharp posterolateral angles inserted by PPL); ventral femorala of leg III nude (branched) (Wen, 2000).

Gahrлиеpia (Gat.) lienі also closely resembles *G. (Gat.) yilanensis* Chung, Wu, Kuo and Wang, 2015, and can be distinguished from the latter by the following features (*G. (Gat.) yilanensis* in parentheses): DS 61–66 in number (DS 50–53); setae of second row of DS evenly spaced (second row of DS consists of two sets of three setae that are closely aligned); ventral femorala of leg III nude (branched).

Biology. *Gahrлиеpia (Gat.) lienі* is found in Szuyuan Wukou of Yilan County (close to 2000 m in elevation), and mainly collected from rodents (*Apodemus semotus*,

Niviventer coninga).

Medical Importance. Unknown.



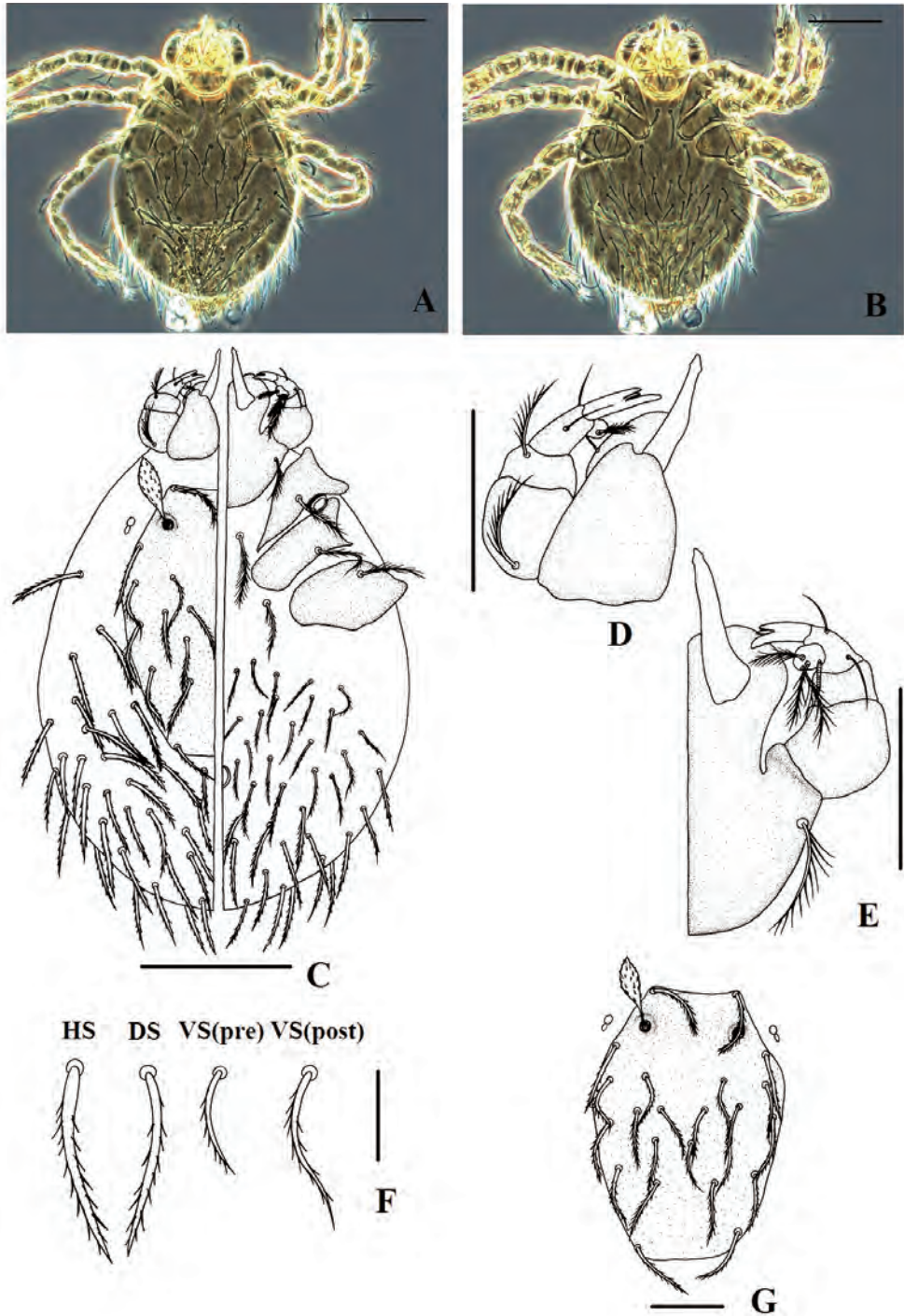


Fig. 28. *Gahrlepia (Gateria) lienii* Chung, Wu, Kuo and Wang, 2015 larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.

Gahrliepia (Gateria) linguipelta Jeu, Yu and Wan, 1983

舌板背展恙蟎

(Fig. 29; Table 27)

References.

Gahrliepia (Gateria) linguipelta Jeu, Yu & Wan, 1983: 103, fs. 6–10; Li, Wang & Chen, 1997: 495, f. 3-3-16.

Diagnosis of Larva. fPp = B/B/NNN/4B; scutum long, hexagonal, with lateral angles extruded and posterior margin curved outward; scutal setae 25–28 in number, with 2 ALs, 2 PLs and 21–24 PPLs. SN round claviform with spikes on surface. Scutal and idiosomal setae plumose. DS 45–48 in number (including HS), arranged in 2H, 8 (6), 6 (8)...; caudal DS usually arranged disorderly. VS 70–76 in number; preanal setae more than 50. NDV = 118–121.

Description of Larva. (n = 2) Live larva oval, pale yellow (Li et al., 1997). Measurements of body length and width are as follows (in μm). Unengorged body length 260–262, width 196–203. Eyes 2+2, located by scutum; anterior pair larger; posterior pair long, elliptical.

Gnathosoma. Gnathosomal base round, evenly punctate, with a pair of pectinate setae; cheliceral base close to triangle, sparsely punctate; cheliceral blade with tricuspid cap. Galeal setae nude; fPp = B/B/NNN/4B, with a blunt solenidion; palpal claw 3-pronged.

Scutum. Long, hexagonal; anterior margin nearly straight; lateral angles extruded; posterior margin curved outward. Scutum evenly punctate. PW/AP = 2.19; PW/SD = 0.61–0.62. SB/PL. Scutal setae plumose, 25–28 in number, with 2 ALs, 2 PLs and 21–24 PPLs. PPLs arranged in 9 (7), 7 (6), 4, 2, 2. SN broad claviform with short spikes on surface. Standard measurements of scutum are presented in Table 27.

Idiosomal Setae. DS 45–48 in number (including HS), arranged in 2H, 8 (6), 6 (8)...; posterior part of DS arranged disorderly. HS and DS plumose, slightly thicker than the scutal setae. ST 2-2, slender and finely branched. VS 70–76 in number, with preanal setae 51–52, similar to ST but shorter, and postanal setae 19–24, similar to posterior part of DS. NDV = 118–121. Measurements of idiosomal setae are as follows (in μm). HS 52–53; medial setae of first post-humeral row 45–49; VS (pre) 30–31; VS (post) 38–40.

Legs. fsp 7-6-6, all with a pair of claws and a slender empodium. Coxae I-III unisetose, evenly punctate. Ip 725–761 μm . All segments with various numbers of

branched setae (B).

Leg I. 250–256 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae (the distal one is similar to the tarsala and thicker than the proximal one) and 1 microtibiala; tarsus 23B, 1 central tarsala, 1 microtarsala, pretarsala, nude subterminala and parasubterminala.

Leg II. 210–230 μm ; coxa 1B; trochanter 1B; femur 4B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae (the distal one is slightly thicker than the proximal one); tarsus 15B, with 1 central tarsala, 1 microtarsala and pretarsala.

Leg III. 265–275 μm ; coxa 1B; trochanter 1B; femur 4B, with 1 branched ventral femorala; genu 3B, with 1 genuala; tibia 6B; tarsus 16B.

SIF = 4B-N-3-2110.0000.

Table 27. Standard measurements (in μm) of *Gahrliepia (Gateria) linguipelta* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	SW	AP	AL	PL	SN	PS
Mean of 2 specimens	54	94	56	26	127	153	114	43	49	46	37 x 14	24
Observed range												
Min.	54	91	53	25	121	148	106	42	48	45	37 x 14	22
Max.	54	97	58	27	134	158	121	44	50	47	37 x 14	26

Specimens Examined. YILAN COUNTY: 1 larva (IW0047-2-5), Tatung, Szuyuan Wukou (宜蘭縣大同鄉思源埡口), 12 Aug. 2008, ex *Apodemus semotus*, male; 1 larva (IW0054-1-1), same locality, 13 Aug. 2008, ex *Niviventer culturatus*, female.

Distribution. China (Yunnan Province) and Taiwan (new record) (Li et al., 1997).

Remarks. *Gahrliepia (Gat.) linguipelta* most closely resembles *G. (Gat.) madun* Wen and Xiang, 1984a in Yunnan Province of China, but it can be distinguished from the latter by the following features (*G. (Gat.) madun* in parentheses): fPp = B/B/NNN/4B (B/N/NNN/4B); posterior margin of scutum roundly extended backward (nearly straight); VS 70–76 in number (65) (Wen & Xiang, 1984a).

Biology. *Gahrliepia (Gat.) linguipelta* is collected from medium-to-high altituded locations, such as Chienchuan County of Yunnan Province and Szuyuan Wukou of Yilan County (close to 2000 m in elevation). Rodents are its main hosts, including *Apodemus semotus* and *Niviventer culturatus*.

Medical Importance. Unknown.

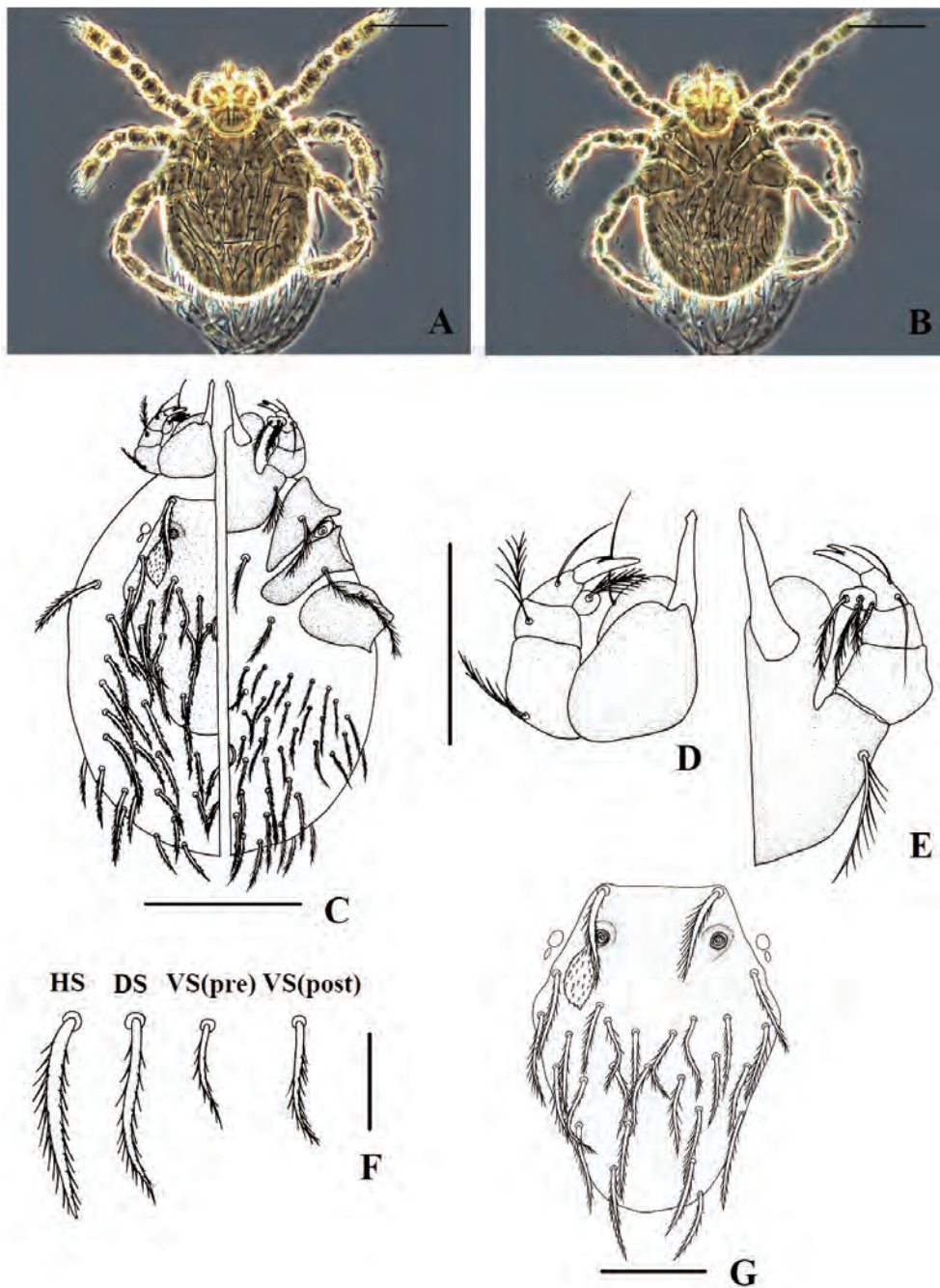


Fig. 29. *Gahrlipeia (Gateria) linguipelta* Jeu, Yu and Wan 1983 larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.



Gahrliepia (Gateria) longipedalis Yu and Yang, 1986

長足背展恙蟎

(Fig. 30; Table 28)

References.

Gahrliepia (Gateria) longipedalis Yu & Yang, 1986: 63, fs. 1–4; Li, Wang & Chen, 1997: 496, f. 3-3-17.

Diagnosis of Larva. fPp = B/B/NNN/4B; scutum long, hexagonal, anterior and posterior margins nearly straight; scutal setae 16–21 in number, with 2 ALs, 2 PLs and 12–17 PPLs. PPLs more slender than the other scutal setae. SN claviform with spikes on surface. DS 46–49 in number (including HS), arranged in 2H, 6 (5), 7 (6, 8)...; caudal DS arranged disorderly. VS 60–70 in number. NDV = 108–119.

Description of Larva. (n = 6) Live larva oval, milky white (Li et al., 1997). Measurements of body length and width are as follows (in μm). Unengorged body length 265–322, width 212–225; semi-engorged body length 349–394, width 267–297. Eyes 2+2, located by scutum; anterior pair larger; posterior pair long, elliptical.

Gnathosoma. Gnathosomal base round, evenly punctate, with a pair of pectinate setae; cheliceral base evenly punctate; cheliceral blade with tricuspid cap. Galeal setae nude; fPp = B/B/NNN/4B, with a blunt solenidion; palpal claw 3-pronged.

Scutum. Long, hexagonal; anterior and posterior margins nearly straight. Scutum evenly punctate. PW/AP = 2.05–2.51; PW/SD = 0.54–0.63. SB/PL. Scutal setae branched and tapering to apex, 16–21 in number, with 2 ALs, 2 PLs and 12–17 PPLs. PPLs more slender than the ALs and the PLs, and arranged in 5 (3–4), 4 (3, 5–6), 4 (2–3), 2 (1, 3), 2 (0). SN claviform with spikes on surface. Standard measurements of scutum are presented in Table 28.

Idiosomal Setae. DS 46–49 in number (including HS), arranged in 2H, 6 (5), 7 (6, 8)...; posterior part of DS arranged disorderly. HS and DS similar to PLs. ST 2-2, finely branched. VS 60–70 in number, with preanal setae 37–44, similar to ST but shorter, and postanal setae 20–27, similar to posterior part of DS. NDV = 108–119. Measurements of idiosomal setae are as follows (in μm). HS 54–66; medial setae of first post-humeral row 50–59; VS (pre) 27–32; VS (post) 44–48.

Legs. fsp 7-6-6, all with a pair of claws and a slender empodium. Coxae I-III unisetose, evenly punctate. Ip 861–938 μm . All segments with various numbers of branched setae (B).



Leg I. 302–327 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae (the distal one is similar to the tarsala, thicker than the proximal one) and 1 microtibiala; tarsus 23B, 1 central tarsala, 1 microtarsala, pretarsala, nude subterminala and parasubterminala.

Leg II. 253–277 μm ; coxa 1B; trochanter 1B; femur 5B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae (the distal one is slightly thicker than the proximal one); tarsus 15B, with 1 central tarsala, 1 microtarsala and pretarsala.

Leg III. 307–342 μm ; coxa 1B; trochanter 1B; femur 4B, with 1 branched ventral femorala; genu 3B, with 1 genuala; tibia 6B; tarsus 16B.

SIF = 4B-N-3-2110.0000.

Table 28. Standard measurements (in μm) of *Gahrlipeia (Gateria) longipedalis* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	SW	AP	AL	PL	SN	PS
Mean of 6 specimens	61	107	65	29	156	184	136	42	55	54	51 x 17*	25
Observed range												
Min.	57	100	61	27	149	176	124	44	52	50	N/A	24
Max.	62	114	69	32	163	191	150	50	59	56	N/A	29

*data from 1 specimen.

Specimens Examined. YILAN COUNTY: 5 larvae (IW0048-9-6, IW0048-10-1, IW0048-10-3, IW0048-12-1, IW0048-14-1), Tatung, Szuyuan Wukou (宜蘭縣大同鄉思源埡口), 12 Aug. 2008, ex *Niviventer coninga*, female; 1 larva (IW0054-2-3), same locality, 13 Aug. 2008, ex *Niviventer culturatus*, female.

Distribution. China (Yunnan Province) and Taiwan (new record) (Li et al., 1997).

Remarks. *Gahrlipeia (Gat.) longipedalis* most closely resembles *G. (Gat.) cidun* Wen and Xiang, 1984a in Yunnan Province of China, but it can be distinguished from the latter by the following features (*G. (Gat.) cidun* in parentheses): scutal setae 16–21 in number (15); DS 46–49 in number (60 in number); PSB 156 μm in average (167 μm in average) (Wen & Xiang, 1984a).

Biology. *Gahrlipeia (Gat.) longipedalis* can be found in medium-to-high altituded locations, such as Dali City of Yunnan Province and Szuyuan Wukou of Yilan County (close to 2000 m in elevation), and also in plains (Luku of Nantou County);

recorded hosts are rodents (*Niviventer coninga*, *N. culturatus*) and shrew (*Crocidura attenuata*).

Medical Importance. Unknown.

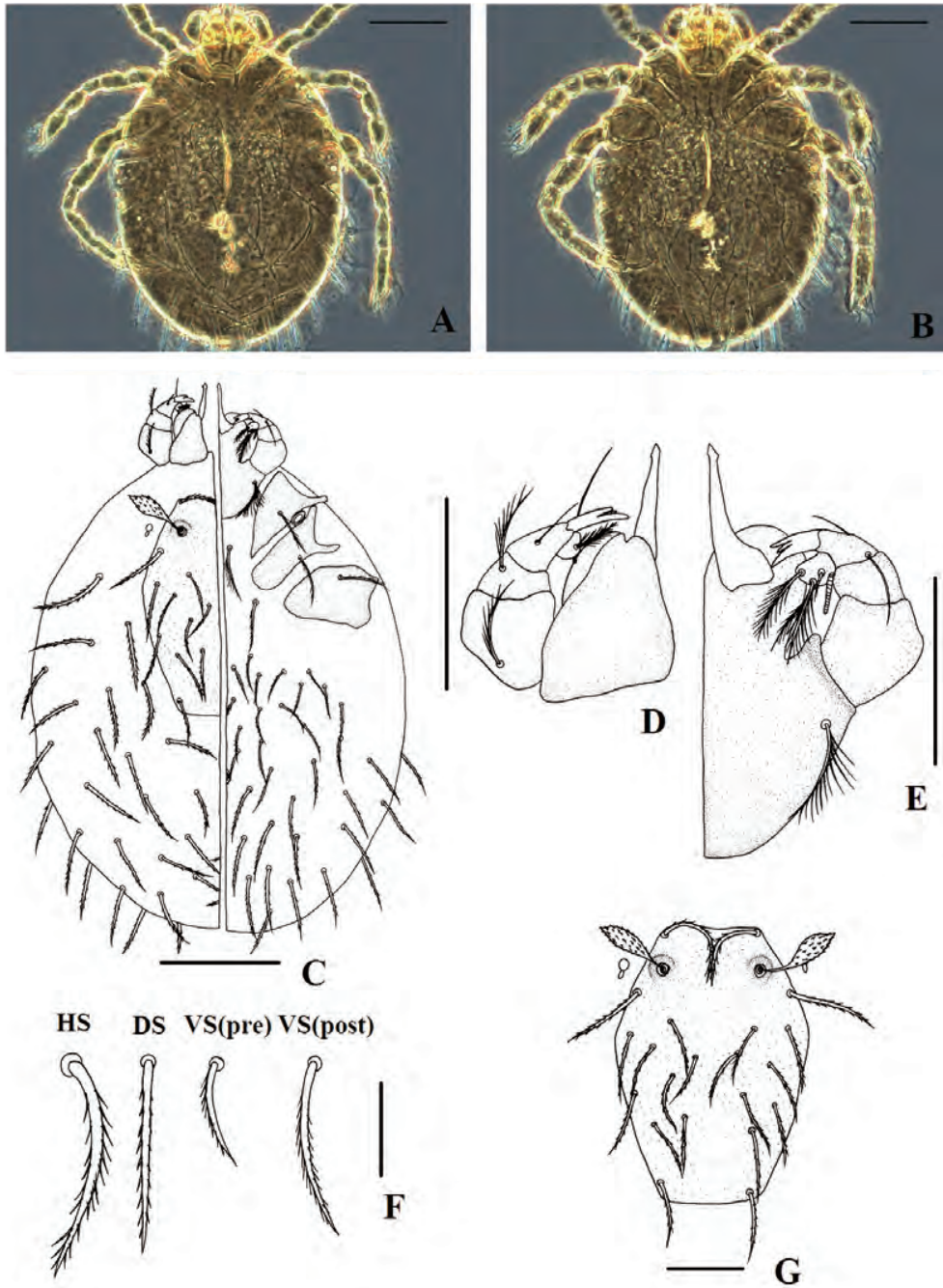
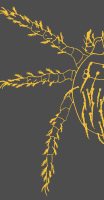


Fig. 30. *Gahrlepiea (Gateria) longipedalis* Yu and Yang 1986 larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.



Gahrliepia (Gateria) minuta Chung, Wu, Kuo and Wang, 2015

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(Fig. 31; Table 29)

References.

Gahrliepia (Gateria) minuta Chung, Wu, Kuo & Wang, 2015: 1244, f. 2.

Diagnosis of Larva. fPp = B/B/NNN/4B; scutum long, hexagonal. Scutal setae 16 in number, with 2 ALs, 2 PLs and 12 PPLs; PPLs arranged in 2, 4 (3), 2 (3), 2, 2. SN claviform with spikes on surface. Scutum conspicuously smaller than those of the other congeners in Taiwan. DS 42–43 in number (including HS), arranged in 2, 4, 6 (8), 9...; posterior DS arranged disorderly. VS 54–55 in number. NDV = 97.

Description of Larva. (n = 2) Live larva oval. Measurements of body length and width are as follows (in μm). Semi-engorged body length 342–460, width 219–374. Eyes 2+2, located by scutum; anterior pair larger; posterior pair long, elliptical.

Gnathosoma. Gnathosomal base round, evenly punctate, with a pair of pectinate setae; cheliceral base sparsely punctate; cheliceral blade with tricuspid cap. Galeal setae nude; fPp = B/B/NNN/4B, with a blunt solenidion; palpal claw 3-pronged.

Scutum. Long, hexagonal; conspicuously smaller than those of the other congeners in Taiwan. Anterior margin slightly concave; posterior margin gently convex. Scutum evenly punctate. PW/AP = 1.99–2.40; PW/SD = 0.60. SB/PL. Scutal setae branched, 16 in number, with 2 ALs, 2 PLs and 12 PPLs, which are more slender than the ALs and the PLs, and arranged in 2, 4 (3), 2 (3), 2, 2. SN claviform with spikes on surface. Standard measurements of scutum are presented in Table 29.

Idiosomal Setae. DS 42–43 in number, arranged in 2, 4, 6 (8), 9...; posterior DS arranged disorderly. HS and DS similar to PL, branched and tapering to apex. ST 2-2 and finely branched. VS 54–55 in number, with preanal setae 34–35 and postanal setae 19–21. NDV = 97. Idiosomal setae shorter than the other congeners in Taiwan. Measurements of idiosomal setae are as follows (in μm). HS 40–41; medial setae of first post-humeral row 31–35; VS (pre) 20–22; VS (post) 27–30.

Legs. fsp 7-6-6, all with a pair of claws and a slender empodium. Coxae I-III unisetose, evenly punctate. Ip 700–717 μm . All segments with various numbers of branched setae (B).

Leg I. 243–251 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae (the distal one is similar to the tarsala, thicker than the proximal one) and 1 microtibiala; tarsus 23B, 1 central



tarsala, 1 microtarsala, pretarsala, nude subterminala and parasubterminala.

Leg II. 210–215 μm ; coxa 1B; trochanter 1B; femur 5B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae (the distal one is slightly thicker than the proximal one); tarsus 15B, with 1 central tarsala, 1 microtarsala and pretarsala.

Leg III. 248–250 μm ; coxa 1B; trochanter 1B; femur 4B, with 1 nude ventral femorala; genu 3B, with 1 genuala; tibia 6B; tarsus 16B.

SIF = 4B-N-3-2110.0000.

Table 29. Standard measurements (in μm) of *Gahrlipeia (Gateria) minuta* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	SW	AP	AL	PL	SN	PS
Mean of 2 specimens	51	82	47	23	115	138	99	38	34	38	34 x 12*	22
Observed range												
Min.	51	79	47	22	109	132	96	36	32	35	N/A	22
Max.	51	86	48	23	121	144	101	40	37	41	N/A	22

*data from 1 specimen.

Specimens Examined. HUALIEN COUNTY: 1 larva (7955-2-1), Fuli, Tungli (花蓮縣富里鄉東里村), 1 May 2001, ex *Bandicota indica*, female; 1 larva (7919-1-1), same locality, 28 Feb. 2001, ex *Rattus losea*, male.

Distribution. Taiwan.

Remarks. Compared to the other congeners from Taiwan, *G. (Gat.) minuta* has a smaller scutum and shorter idiosomal setae. *G. (Gat.) minuta* most closely resembles *G. (Gat.) kiangsiensis* Hsu, Hsu and Wen, 1965 in China, but it can be distinguished from the latter by the following features (*G. (Gat.) kiangsiensis* in parentheses): scutal setae 16 in number (14 in number); DS 42–43 (28) (Hsu, Hsu & Wen, 1965).

Biology. *Gahrlipeia (Gat.) minuta* is collected from Hualien County of Taiwan, and rodents (*Bandicota indica*, *Rattus losea*) are its known hosts.

Medical Importance. Unknown.

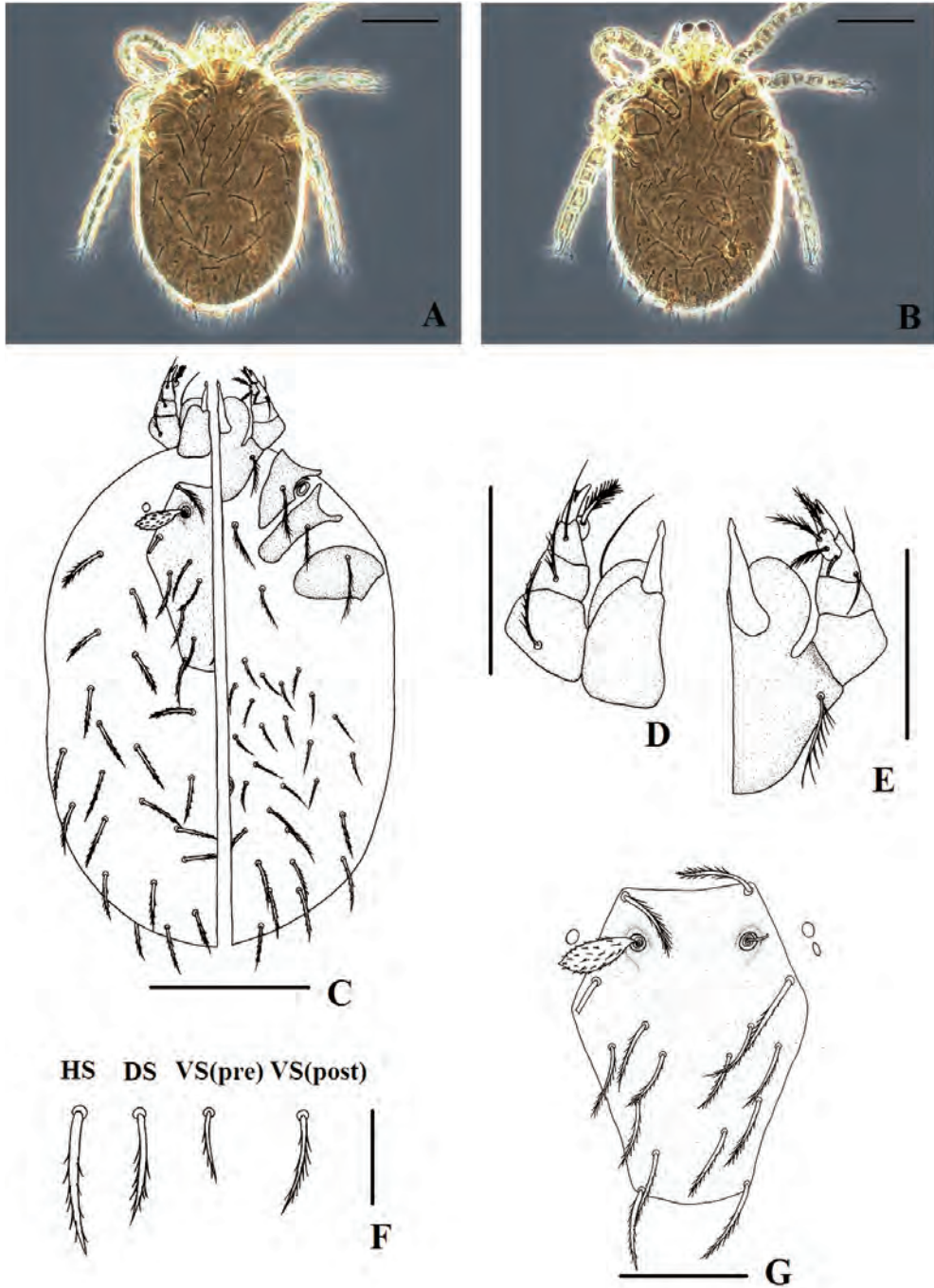


Fig. 31. *Gahlriepia (Gateria) minuta* Chung, Wu, Kuo and Wang, 2015 larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.

Gahrliepia (Gateria) yilanensis Chung, Wu, Kuo and Wang, 2015

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(Fig. 32; Table 30)

References.

Gahrliepia (Gateria) yilanensis Chung, Wu, Kuo & Wang, 2015: 1245, f. 3.

Diagnosis of Larva. fPp = B/B/NNN/4B; scutum long, hexagonal. Scutal setae 19–22 in number, with 2 ALs, 2 PLs and 15–18 PPLs; PPLs arranged in (1), 4 (5–6), 6 (4–5), 4 (3, 5), 2 (1, 3–4), 2 (0). SN claviform with spikes on surface. Second row of DS (medially separated by scutum) consists of two sets of setae, each includes three closely aligned setae (some specimens with four setae on one side). DS 50–53 in number (including HS), arranged in 2 (3), 6 (7), 7...; posterior DS arranged disorderly. VS 69–84 in number. NDV = 118–135.

Description of Larva. (n = 6) Live larva oval. Measurements of body length and width are as follows (in μm). Unengorged body length 250–295, width 183–230. Eyes 2+2, located by scutum; anterior pair larger.

Gnathosoma. Gnathosomal base round, evenly punctate, with a pair of pectinate setae; cheliceral base evenly punctate; cheliceral blade with tricuspid cap. Galeal setae nude; fPp = B/B/NNN/4B, with a blunt solenidion; palpal claw 3-pronged.

Scutum. Long, hexagonal; anterior margin slightly concave; posterior margin slightly convex. Scutum evenly punctate. PW/AP = 2.20–2.36; PW/SD = 0.58–0.62. SB/PL. Scutal setae branched, 19–22 in number, with 2 ALs, 2 PLs and 15–18 PPLs, which are more slender than the ALs and the PLs, and are arranged in (1), 4 (5–6), 6 (4–5), 4 (3, 5), 2 (1, 3–4), 2 (0). SN claviform with short spikes on surface. Standard measurements of scutum are given in Table 30.

Idiosomal Setae. DS 50–53 in number, arranged in 2 (3), 6 (7), 7...; posterior DS arranged disorderly. Second row of DS (medially separated by scutum) consists of two sets of setae, each set includes three setae that are closely aligned (some specimen with four setae on one side). HS and DS similar to PL, branched and tapering to apex. ST 2-2 and finely branched. VS 69–84 in number, with preanal setae 41–54 similar to ST but shorter, and postanal setae 21–32 similar to posterior DS. NDV = 118–135. Measurements of idiosomal setae are as follows (in μm). HS 54–61; medial setae of first post-humeral row 48–56; VS (pre) 28–32; VS (post) 42–44.

Legs. fsp 7-6-6, all with a pair of claws and a slender empodium. Coxae I-III

unisetose, evenly punctate. Ip 864–906 μm . All segments with various numbers of branched setae (B).

Leg I. 295–309 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae (the distal one is similar to the tarsala, thicker than the proximal one) and 1 microtibiala; tarsus 23B, 1 central tarsala, 1 microtarsala, pretarsala, nude subterminala and parasubterminala.

Leg II. 255–270 μm ; coxa 1B; trochanter 1B; femur 5B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae (the distal one is slightly thicker than the proximal one); tarsus 15B, with 1 central tarsala, 1 microtarsala and pretarsala.

Leg III. 309–327 μm ; coxa 1B; trochanter 1B; femur 4B, with 1 branched ventral femorala; genu 3B, with 1 genuala; tibia 6B; tarsus 16B.

SIF = 4B-N-3-2110.0000.

Table 30. Standard measurements (in μm) of <i>Gahrliepia (Gateria) yilanensis</i> larval scutum.												
Specimen	AW	PW	SB	ASB	PSB	SD	SW	AP	AL	PL	SN	PS
Mean of 6 specimens	59	105	65	27	147	174	128	46	56	50	47 x 15	25
Observed range												
Min.	56	101	63	26	139	166	124	45	53	45	45 x 14	22
Max.	62	110	68	29	152	181	134	48	59	52	50 x 15	27

Specimens Examined. YILAN COUNTY: 1 larva (IW0048-8-1), Tatung, Szuyuan Wukou (宜蘭縣大同鄉思源埡口), 12 Aug. 2008, ex *Niviventer coninga*, female; 1 larva (IW0047-2-4), same locality and date, ex *Apodemus semotus*, male; 4 larvae (IW0054-1-2~3, IW0054-2-1~2), same locality, 13 Aug. 2008, ex *Niviventer culturatus*, female.

Distribution. Taiwan.

Remarks. *Gahrliepia (Gat.) yilanensis* most closely resembles *G. (Gat.) lieni* Chung, Wu, Kuo and Wang, 2015, and can be distinguished from this species using the following features (*G. (Gat.) lieni* in parentheses): DS 50–53 in number (DS 61–66); second row of DS consists of 2 sets of 3 setae closely aligned (setae of second row of DS evenly arranged).

Biology. *Gahrliepia (Gat.) yilanensis* is found in Szuyuan Wukou of Yilan County (close to 2000 m in elevation), and mainly collected from rodents (*Apodemus semotus*, *Niviventer coninga*, *N. culturatus*).

Medical Importance. Unknown.

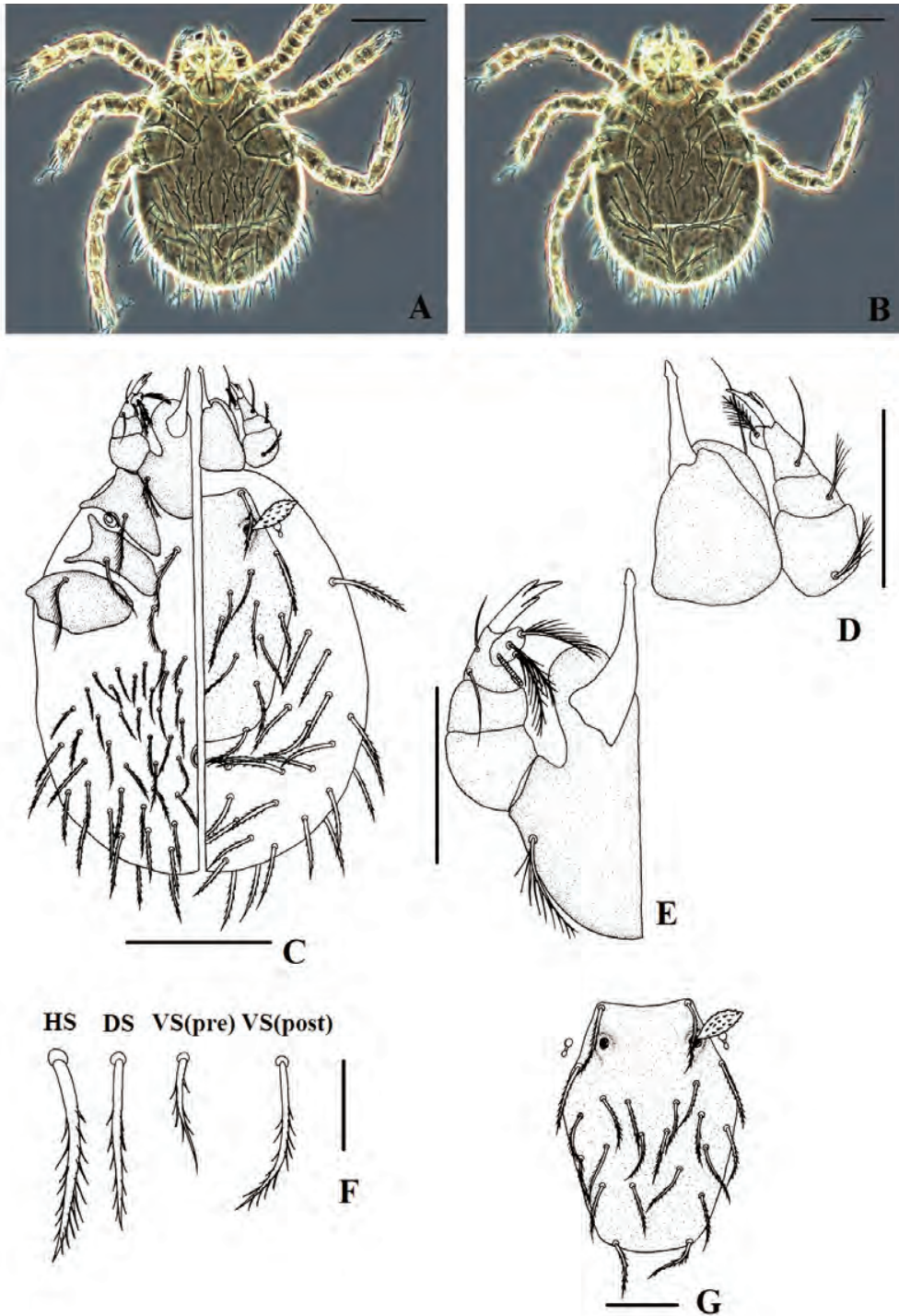


Fig. 32. *Gahrlipeia (Gateria) yilanensis* Chung, Wu, Kuo and Wang, 2015 larva. A. phase contrast image of the ventral view; B. phase contrast image of the dorsal view; C. ventral and dorsal view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.

Genus *Walchia* Ewing, 1931

無前恙蟎屬

Subgenus *Walchia* Ewing, 1931

無前恙蟎亞屬

Type species. *Trombidium glabrum* Walch, 1927.

Diagnosis. Small-to-medium mite; body line concave behind leg III. Scutum usually close to pentagon or a shield, with only 2 ALs and 2 PLs. SN globose or clavate with spikes on surface. Palpotarsus 4B. Leg III lacks of tibiala.

Key to the species of the subgenus *Walchia* in Taiwan

1. Coxae setae 1-1-1 2
Coxae setae 1-1-2 7
2. Venter with ventro-humeral setae 3
Venter without ventro-humeral setae 4
3. Lateral margins of scutum usually smooth; PL 39 μm ; dorsal setae significantly longer than the other congeners (HS 30–37 μm ; DS 32–36 μm)
..... *W. (W.) fragilis* 脆弱無前恙蟎 (new record)
Lateral margins of scutum wavy; PL 31 μm ; HS 25–31 μm ; DS 27–31 μm
..... *W. (W.) pacifica* 太平洋無前恙蟎 (new record)
4. SD > 90 μm ; SD/PW > 2.20 *W. (W.) acugastia* 尖棒無前恙蟎 (new record)
SD \leq 90 μm ; SD/PW \leq 2.20 5
5. Posterior angle of scutum papillary; scutal lateral margins smooth
..... *W. (W.) jiangxiensis* 江西無前恙蟎 (new record)
Posterior angle of scutum acute; scutal lateral margins nearly straight, forming an obtuse angle 6
6. AP < PP ; PSB 40–45 μm ; SD 57–62 μm ; DS usually started with 2H, 6, 6, 4.....
..... *W. (W.) kritochoeta* 瓣毛無前恙蟎 (new record)
AP > PP; PSB 46–59 μm ; SD 63–78 μm ; DS usually started with 2H, 6, 6, 2
..... *W. parapacifica* 似太平洋無前恙蟎 (new record)
7. PW \approx AW; PW 31 μm in average; eyes 2+2 *W. (W.) chinensis* 中華無前恙蟎
PW > AW; PW 40 μm in average; eyes 1+1
..... *W. (W.) xishaensis* 西沙無前恙蟎 (new record)

Walchia (Walchia) acugastia Wen, Yu and Yang, 1984

尖棒無前恙蟎

(Fig. 33; Table 31)

References.

Walchia (W.) *acugastia* Wen, Yu & Yang, 1984: 179, f. III-1; Li, Wang & Chen, 1997: 445, f. 3-1-2.

Diagnosis of Larva. Scutum similar to bird face, with 2 ALs and 2 PLs. PSB 70 μm in average (Li et al., 1997); SD longer than 90 μm ; SD/PW > 2.20. SN globose with pointed tip. fPp = N/N/NNN/4B. DS 36 in number (including HS), arranged in 2H, 6, 6, 2, 6, 6, 4, 2, 2; VS 47–53 in number, with 30–39 preanal setae and 14–17 postanal setae; NDV = 83–87 (Wen et al., 1984). Coxae setae 1-1-1; venter without ventro-humeral setae.

Description of Larva. (n = 1) Oval, body line concave behind leg III. Color pale yellow (Wen et al., 1984); size small to medium. Measurements of body length and width are as follows (in μm). Semi-engorged body length 364, width 282. Eyes 2+2, anterior pair larger.

Gnathosoma. Gnathosomal base round, lightly punctate, with a pair of pectinate setae; cheliceral base sparsely punctate; cheliceral blade with tricuspid cap. Galeal setae nude; fPp = N/N/NNN/4B, with one blunt solenidium; palpal claw 3-pronged.

Scutum. Bird-face shaped and lightly punctate, with long and pointed posterior angle and wave-like curved lateral margins. PSB 70 μm in average (Li et al., 1997); SD usually longer than 90 μm . SD/PW = 2.26. SB/PL. Lack of AM, but with 2 ALs and 2 PLs which are finely branched and tapering to apex. SN not available on the specimen examined, but globose, with pointed tip and spikes on surface in the original description (Wen et al., 1984). Standard measurements of scutum are presented in Table 31.

Idiosomal Setae. DS 36 in number (including HS), arranged in 2H, 6, 6, 2, 6, 6, 4, 2, 2; similar to PL. ST 2-2, finely branched; lack of ventro-humeral setae between coxae II and III; VS 47 in number, with 30 preanal setae similar to ST but shorter, and 17 postanal setae similar to DS. NDV = 83. Measurements of idiosomal setae are as follows (in μm). HS 27; medial setae of first post-humeral row 24; VS (pre) 13; VS (post) 22.

Legs. 7-6-6 segmented, with a pair of claws and a slender empodium. Coxae unisetose, lightly punctate. Ip 497 μm . All segments with various numbers of

branched setae (B).

Leg I. 176 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microgenuala; tarsus 23B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 144 μm ; coxa 1B; trochanter 1B; femur 5B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 178 μm ; coxa 1B; trochanter 1B; femur 4B, with 1 nude ventral femorala; genu 3B, with 1 genuala; tibia 6B; tarsus 16B.

SIF = 4B-N-3-2110.0000.

Table 31. Standard measurements (in μm) of *Walchia (Walchia) acugastia* larval scutum.

AW	PW	SB	ASB	PSB	SD	PP	AP	AL	PL	SN	PS
34	42	30	20	75	95	52	39	24	26	N/A	22

Specimens Examined. HUALIEN COUNTY: 1 larva (7810-3-4), Juisui, Hokang (花蓮縣瑞穗鄉鶴岡村), 19 Oct. 2000, ex *Bandicota indica*, male.

Distribution. China (Hunan Province) and Taiwan (new record) (Wen et al., 1984).

Remarks. *Walchia (W.) acugastia* most closely resembles *W. (W.) jiangxiensis* Wang and Song, 1981 and *W. (W.) neosinensis* (Hsu and Wen, 1956) in China, but it can be distinguished from the former by the following features (*W. (W.) jiangxiensis* in parenthesis): PSB 70 μm in average; SD longer than 90 μm (PSB 60 μm in average; SD 72–86 μm); *W. (W.) acugastia* can be distinguished from the latter by (*W. (W.) neosinensis* in parentheses): scutum with pointed posterior angle (blunt posterior angle); fPp = N/N/NNN/4B (N/N/NNB/4B); DS arranged in 2H, 6, 6, 2, 6, 6, 4, 2, 2 (6, 4, 8, 6, 6, 4, 2); PSB 70 μm in average; SD longer than 90 μm (PSB < 65 μm ; SD < 85 μm) (Li et al., 1997).

Biology. *Walchia (W.) acugastia* is mainly collected from rodents, including *Bandicota indica* and *Niviventer confucianus* (Wen et al., 1984).

Medical Importance. Unknown.

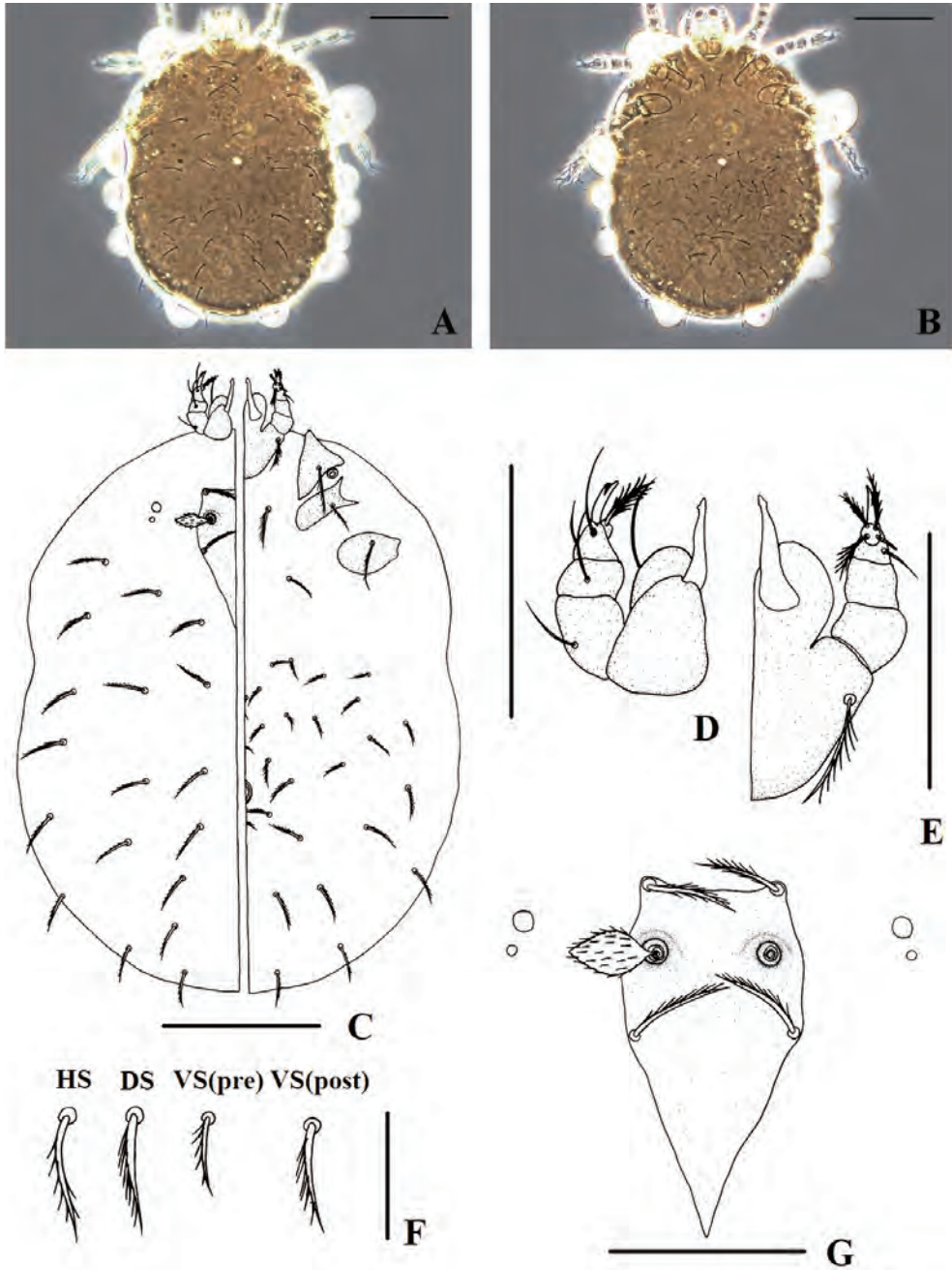
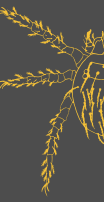


Fig. 33. *Walchia (Walchia) acugastia* Wen, Yu and Yang, 1984 larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μm ; D, E, G = 50 μm ; F = 25 μm .



Walchia (Walchia) chinensis (Chen and Hsu, 1955)

中華無前恙蟎

(Fig. 34; Table 32)

References.

Gahrlipeia (W.) chinensis Chen & Hsu, 1955: 114, fs. 11–16.

Walchia (W.) chinensis Wen, 1984e: 181; Li, Wang & Chen, 1997: 447, f. 3-1-4.

Diagnosis of Larva. Scutum pentagonal, with 2 ALs and 2 PLs. AP > PP; posterior angle close to 90 degrees. SN globose with spikes on surface. fPp = N/N/NNN/4B. DS 34–38 in number (including HS), arranged in 2H, 6, 6, 2 (3), 6 (7), 4 (5–6), 4 (3, 5), 2 (3), 2 (1, 3); VS 41–54 in number, with 22–32 preanal setae and 18–25 postanal setae; NDV = 77–92. Coxae setae 1-1-2; venter without ventro-humeral setae.

Description of Larva. (n = 22) Oval, body line concave behind leg III. Color milky white; eyes red, 2+2, anterior pair larger (Li et al., 1997); size small to medium. Measurements of body length and width are as follows (in μm). Unengorged body length 260, width 176–181; semi-engorged body length 285–413, width 200–302.

Gnathosoma. Gnathosomal base round, lightly punctate, with a pair of pectinate setae; cheliceral base sparsely punctate; cheliceral blade with tricuspid cap. Galeal setae nude; fPp = N/N/NNN/4B, with one blunt solenidion; palpal claw 3-pronged.

Scutum. Pentagonal and lightly punctate; anterior margin slightly concave; antero- and posterolateral margins nearly straight; posterior angle close to 90 degrees. AP > PP; SD/PW = 1.37–1.88. SB/PL. Lack of AM, but with 2 ALs and 2 PLs which are finely branched and tapering to apex. SN globose with spikes on surface. Standard measurements of scutum are presented in Table 32.

Idiosomal Setae. DS similar to PL; 34–38 in number (including HS), arranged in 2H, 6, 6, 2 (3), 6 (7), 4 (5–6), 4 (3, 5), 2 (3), 2 (1, 3). ST 2-2, finely branched; lack of ventro-humeral setae; VS 41–54 in number, with 22–32 preanal setae similar to ST but shorter, and 18–25 postanal setae similar to DS. NDV = 77–92. Measurements of idiosomal setae are as follows (in μm). HS 25–28; medial setae of first post-humeral row 23–28; VS (pre) 11–15; VS (post) 20–25.

Legs. 7-6-6 segmented, with a pair of claws and a slender empodium. Coxae setae 1-1-2; coxae lightly punctate. Ip 438–490 μm . All segments with various numbers of branched setae (B).

Leg I. 153–173 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu



4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microgenuala; tarsus 23B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 124–149 μm ; coxa 1B; trochanter 1B; femur 5B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 153–174 μm ; coxa 1B; trochanter 1B; femur 4B, with 1 nude ventral femorala; genu 3B, with 1 genuala; tibia 6B; tarsus 16B.

SIF = 4B-N-3-2110.0000.

Table 32. Standard measurements (in μm) of *Walchia* (*Walchia*) *chinensis* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	PP	AP	AL	PL	SN	PS
Mean of 22 specimens	25	31	22	17	33	50	17	32	20	23	21 x 12	17
Observed range												
Min.	22	27	19	16	30	47	15	29	18	21	19 x 11	15
Max.	28	34	24	19	38	55	20	34	22	25	23 x 13	19

Specimens Examined. KINMEN COUNTY: 5 larvae (6917-4-1~2, 6935-1-1, 6935-2-1, 6936-1-1), Kinning, Lake Hou (金門縣金寧鄉后湖), 16 Aug. 1999, ex *Rattus losea*, female; 1 larva (7162-3-1), same locality, 4 Nov. 1999, ex *Rattus norvegicus*, male; 1 larva (7693-1-1), same locality, 14 June 2000, ex *Rattus losea*, female; 3 larvae (7699-2-1~3), same locality and date, ex *Rattus losea*, male; 1 larva (6954-1-1), Liehyu, Shangchi (金門縣列嶼鄉上岐), 17 Aug. 1999, ex *Rattus losea*, female; 1 larva (6999-4-1), Kinsha, Tayang (金門縣金沙鎮大洋村), 18 Aug. 1999, ex *Rattus losea*, female; 2 larvae (7606-1-1~2), same locality, 21 Apr. 2000, ex *Rattus losea*, female; 2 larvae (7720-3-1~2), same locality, 15 June 2000, ex *Rattus losea*, male; 2 larvae (7010-3-1~2), Kincheng, Hsiaokukang (金門縣金城鎮小古崗), 19 Aug. 1999, ex *Rattus losea*, male; 1 larva (7653-2-1), same locality, 12 June 2000, ex *Rattus losea*, female; 3 larvae (7085-4-1~2, 7085-6-1), Kinhu, Chengyi (金門縣金湖鎮正義村), 20 Aug. 1999, ex *Rattus tanezumi*, female.

Distribution. China and Taiwan (Li et al., 1997; Wang et al., 2004).

Remarks. *Walchia* (*W.*) *chinensis* most closely resembles *W.* (*W.*) *xishaensis* Zhao,

Tang and Mo, 1986, but it can be distinguished from the latter by the following features (*W. (W.) xishaensis* in parentheses): $PW \approx AW$; $PW \approx 31 \mu\text{m}$ in average ($PW > AW$; $PW \approx 40 \mu\text{m}$ in average); eyes 2+2 (1+1).

Biology. *Walchia (W.) chinensis* is widespread across various provinces in China (Fuchien, Kuangtung, Kuanghsi, Chechiang, Hunan, Hupei, Yunnan...), and in Fuchien Province, *W. (W.) chinensis* occurs more frequently in coastal areas than in mountainous areas, and decreases as the altitude elevated; it is mainly collected in summer and autumn, fewer records in winter (Li et al., 1997). In Taiwan, *W. (W.) chinensis* is only found in Kinmen County, and can be collected in whole year, but more in summer and autumn, fewer in winter (Wang et al., 2004). *Walchia (W.) chinensis* is mainly collected from the concha of rodents, including *Apodemus agrarius*, *Bandicota indica*, *Niviventer confucianus*, *Rattus flavipectus*, *R. losea*, *R. norvegicus*, *R. rattus* and *R. tanezumi* (Wen, 1984e).

Medical Importance. In Fuchien and Kuangtung Provinces, it has been proven that *W. (W.) chinensis* is a carrier for *Orientia tsutsugamushi* (Li et al., 1997); Wang et al. (2004) also detected *O. tsutsugamushi* from *W. (W.) chinensis* in Kinmen County.

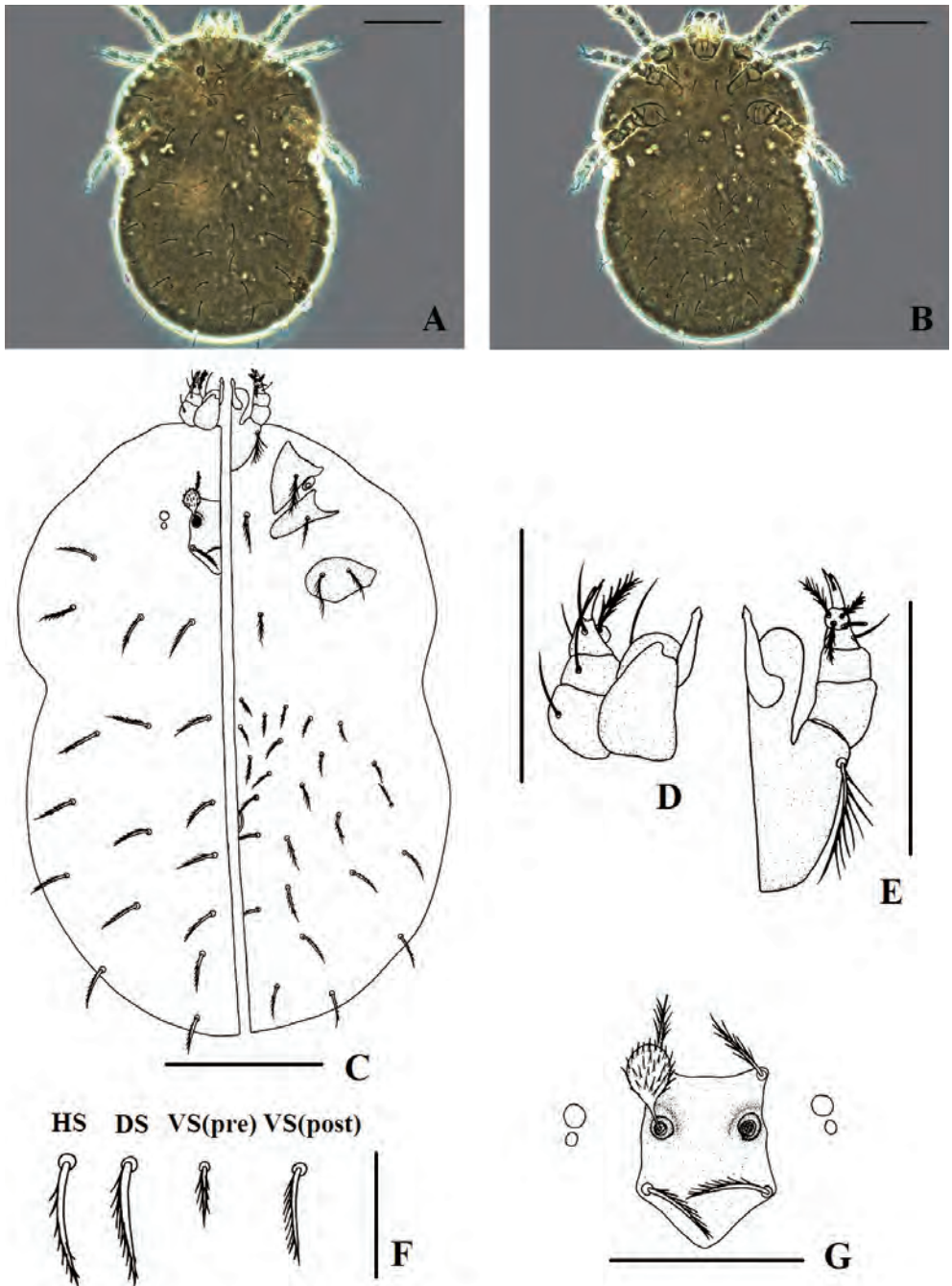


Fig. 34. *Walchia (Walchia) chinensis* (Chen and Hsu, 1955) larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μm ; D, E, G = 50 μm ; F = 25 μm .



Walchia (Walchia) fragilis Schluger, 1955

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(Fig. 35; Table 33)

References.

Walchia (W.) fragilis Schluger, 1955; Wen, 1984e: 68; Li, Wang & Chen, 1997: 451, f. 3-1-10.

Diagnosis of Larva. Scutum close to pentagon, shield-shaped, with 2 ALs and 2 PLs. AP > PP; lateral margins curved and smooth. SN clavate with spikes on surface. Eyes absent. fPp = N/N/NNN/4B. DS 41–43 in number (including HS), arranged disorderly: 4H (2H, 5H), 8 (6), 6 (7–9), 7 (8)...; VS 40–46 in number, with 24–27 preanal setae and 15–19 postanal setae; NDV = 82–89. PL, HS and DS are significantly longer than the other congeners. Coxae setae 1-1-1; venter with 3–6 ventro-humeral setae (right: 1–3; left: 2–3).

Description of Larva. (n = 8) Size medium; oval; body line concave behind leg III. Color milky white (Li et al., 1997); eyes absent. Measurements of body length and width are as follows (in μm). Unengorged body length 280–327, width 188–215; semi-engorged body length 376–463, width 252–302; engorged body length 540–619, width 413–473.

Gnathosoma. Gnathosomal base evenly punctate, with a pair of pectinate setae; cheliceral base sparsely punctate; cheliceral blade with tricuspid cap. Galeal setae nude; fPp = N/N/NNN/4B, with one blunt solenidion; palpal claw 3-pronged.

Scutum. Close to pentagon; shield-shaped; scutum evenly punctate. Anterior margin wavy; lateral margins smooth and curved. AP > PP. SD/PW = 1.66–2.01. SB/PL. Scutum lack of AM but with 2 ALs and 2 PLs which are branched and tapering to apex and distinctively longer than those of the other congeners in Taiwan. SN clavate with spikes on surface. Standard measurements of scutum are presented in Table 33.

Idiosomal Setae. HS and DS slightly branched and distinctively longer than those of the other congeners in Taiwan; 41–43 in number (including HS), arranged disorderly: 4H (2H, 5H), 8 (6), 6 (7–9), 7 (8)...; ST 2-2, finely branched; venter with 3–6 ventro-humeral setae (right: 1–3; left: 2–3); VS 40–46 in number, with 24–27 preanal setae similar to ST but shorter, and 15–19 postanal setae similar to DS. NDV = 82–89. Measurements of idiosomal setae are as follows (in μm). HS 30–37; medial setae of first post-humeral row 32–36; VS (pre) 13–19; VS (post) 24–31.

Legs. 7-6-6 segmented, with a pair of claws and a slender empodium. Coxae setae



1-1-1; coxae lightly punctate. Ip 554–646 μm . All segments with various numbers of branched setae (B).

Leg I. 188–223 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microgenuala; tarsus 23B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 168–193 μm ; coxa 1B; trochanter 1B; femur 5B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 198–230 μm ; coxa 1B; trochanter 1B; femur 4B, with 1 nude ventral femorala; genu 3B, with 1 genuala; tibia 6B; tarsus 16B.

SIF = 4B-N-3-2110.0000.

Table 33. Standard measurements (in μm) of *Walchia (Walchia) fragilis* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	PP	AP	AL	PL	SN	PS
Mean of 8 specimens	37	42	31	23	51	74	34	37	29	39	29 x 13	17
Observed range												
Min.	34	38	26	21	47	69	30	34	27	36	27 x 12	16
Max.	41	47	34	25	59	84	38	39	30	43	30 x 15	18

Specimens Examined. YILAN COUNTY: 1 larva (IW0048-14-4), Tatung, Szuyuan Wukou (宜蘭縣大同鄉思源埡口), 12 Aug. 2008, ex *Niviventer coninga*, female; 7 larvae (IW0053-7-3, IW0053-9-3~4, IW0053-11-1~2, IW0053-12-3~4), same locality, 13 Aug. 2008, ex *Niviventer coninga*, male.

Distribution. China, Korea, and Taiwan (new record) (Li et al., 1997; Lee et al., 2009).

Remarks. *Walchia (W.) fragilis* most closely resembles *W. (W.) huensis* Wen, 1984d and *W. (W.) pacifica* (Chen and Hsu, 1955), and it can be distinguished from the former by (*W. (W.) huensis* in parenthesis): scutum larger; ASB, PSB, SD, and PP = 23, 51, 74, 34 μm in average, respectively (scutum smaller; ASB, PSB, SD, and PP = 19, 43, 64, 25 μm in average) (Wen, 1984d); it can be distinguished from the latter by the following features (*W. (W.) pacifica* in parentheses): PL 39 μm in average (31 μm); HS 30–37 μm ; DS 32–36 μm (25–31 and 27–31 μm).

Biology. *Walchia (W.) fragilis* is mainly collected from rodents, including

Apodemus agrarius, *Niviventer coninga*, *Rattus norvegicus* and *Myodes regulus* in Korea (Wen, 1984e; Lee et al., 2009).

Medical Importance. Unknown.

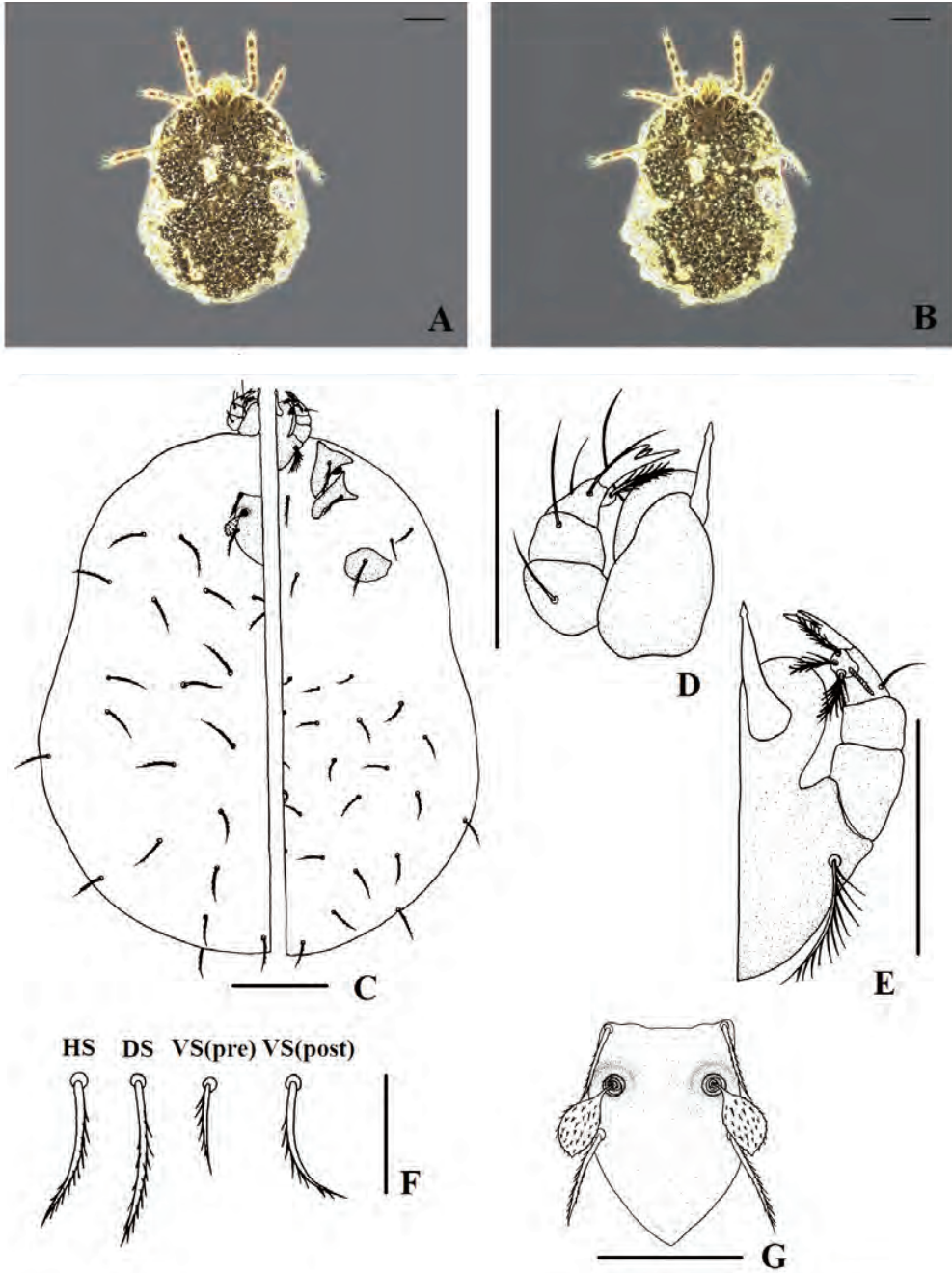
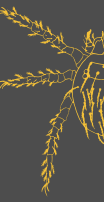


Fig. 35. *Walchia (Walchia) fragilis* Schluger, 1955 larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.



Walchia (Walchia) jiangxiensis Wang and Song, 1981

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(Fig. 36; Table 34)

References.

Walchia (W.) jiangxiensis Wang & Song, 1981: 159, fs. 1–5; Li, Wang & Chen, 1997: 453, f. 3-1-13.

Diagnosis of Larva. Scutum similar to bird face, with 2 ALs and 2 PLs; posterior angle of scutum papillary; SD 72–86 μm . SN globose with spikes on surface. fPp = N/N/NNN/4B. DS 34–37 in number (including HS), arranged in 2H, 6, 6, 2, 6, 6, 4 (5), 2 (3–4), 2 (0–1); VS 44–52 in number, with 28–31 preanal setae and 14–22 postanal setae; NDV = 80–86. Coxae setae 1-1-1; venter without ventro-humeral setae.

Description of Larva. (n = 14) Oval, body line concave behind leg III. Color pale yellow (Li et al., 1997); size small to medium. Measurements of body length and width are as follows (in μm). Unengorged body length 267–314, width 178–213; semi-engorged body length 322–389, width 250–309. Eyes 2+2, anterior pair larger.

Gnathosoma. Gnathosomal base round, lightly punctate, with a pair of pectinate setae; cheliceral base sparsely punctate; cheliceral blade with tricuspid cap. Galeal setae nude; fPp = N/N/NNN/4B, with one blunt solenidion; palpal claw 3-pronged.

Scutum. Bird-face shaped; lightly punctate; lateral margins smooth; posterior angle papillary. SD 72–86 μm ; SD/PW = 1.80–2.19. SB/PL. Lack of AM, but with 2 ALs and 2 PLs which are finely branched and tapering to apex. SN globose with spikes on surface. Standard measurements of scutum are presented in Table 34.

Idiosomal Setae. DS 34–37 in number (including HS), arranged in 2H, 6, 6, 2, 6, 6, 4 (5), 2 (3–4), 2 (0–1), similar to PL. ST 2-2, finely branched; lack of ventro-humeral setae between coxae II and III; VS 44–52 in number, with 28–31 preanal setae similar to ST but shorter, and 14–22 postanal setae similar to DS. NDV = 80–86. Measurements of idiosomal setae are as follows (in μm). HS 22–27; medial setae of first post-humeral row 22–25; VS (pre) 12–15; VS (post) 19–24.

Legs. 7-6-6 segmented, with a pair of claws and a slender empodium. Coxae unisetose, lightly punctate. Ip 483–509 μm . All segments with various numbers of branched setae (B).

Leg I. 171–181 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microgenuala; tarsus 23B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and



parasubterminala.

Leg II. 139–149 μm ; coxa 1B; trochanter 1B; femur 5B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 171–183 μm ; coxa 1B; trochanter 1B; femur 4B, with 1 nude ventral femorala; genu 3B, with 1 genuala; tibia 6B; tarsus 16B.

SIF = 4B-N-3-2110.0000.

Table 34. Standard measurements (in μm) of *Walchia (Walchia) jiangxiensis* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	PP	AP	AL	PL	SN	PS
Mean of 14 specimens	34	40	28	18	60	78	43	34	23	25	25 x 13	20
Observed range												
Min.	32	37	27	17	54	72	39	33	21	24	23 x 12	18
Max.	36	42	30	19	68	86	49	36	25	27	28 x 15	22

Specimens Examined. HUALIEN COUNTY: 6 larvae (7785-1-2~3, 7785-2-1~2, 7785-3-1~2), Juisui, Hokang (花蓮縣瑞穗鄉鶴岡村), 17 Aug. 2000, ex *Rattus losea*, male; 8 larvae (7810-1-1~3, 7810-2-1, 7810-3-1~3, 5), same locality, 19 Oct. 2000, ex *Bandicota indica*, male.

Distribution. China (Chianghsi Province) and Taiwan (new record).

Remarks. *Walchia (W.) jiangxiensis* most closely resembles *W. (W.) acugastia* Wen, Yu and Yang, 1984 and *W. (W.) neosinensis* (Hsu and Wen, 1956) in China, but it can be distinguished from the former by the following features (*W. (W.) acugastia* in parenthesis): PSB 60 μm in average; SD 72–86 μm (PSB 70 μm in average; SD longer than 90 μm), and distinguished from the latter by (*W. (W.) neosinensis* in parentheses): posterior angle of scutum papillary (blunt); fPp = N/N/NNN/4B (N/N/NNB/4B); DS arranged in 2H, 6, 6, 2, 6, 6, 4 (5), 2 (3–4), 2 (0–1) (6, 4, 8, 6, 6, 4, 2) (Li et al., 1997).

Biology. The recorded hosts of *W. (W.) jiangxiensis* include *Apodemus agrarius*, *Bandicota indica*, *Rattus flavipectus*, *R. losea* and *R. norvegicus* (Wen, 1984e).

Medical Importance. Unknown.

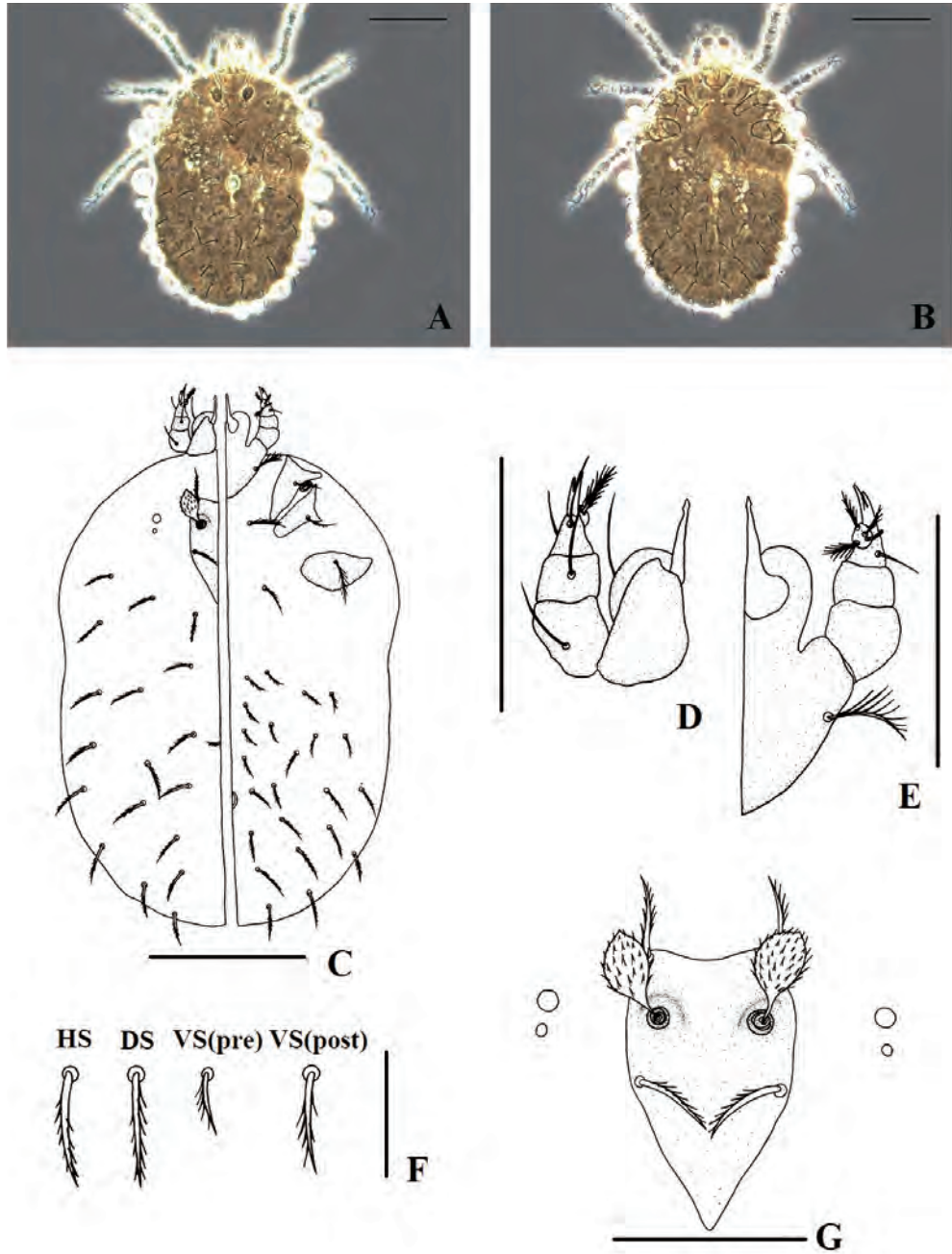


Fig. 36. *Walchia (Walchia) jiangxiensis* Wang and Song, 1981 larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.

Walchia (Walchia) kritochaeta (Traub and Evans, 1957)

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(Fig. 37; Table 35)

References.

Gahrlipeia (W.) kritochaeta Traub & Evans, 1957; Audy, 1957: 279.

Walchia (W.) kritochaeta Wen, 1984e: 70; Li, Wang & Chen, 1997: 455, f. 3-1-15.

Diagnosis of Larva. Scutum pentagonal, with 2 ALs and 2 PLs that are significantly branched; AP > PP; PSB 40–45 μm ; SD 57–62 μm . SN globose with spikes on surface. fPp = N/N/NNN/4B. DS 39–43 in number (including HS), arranged in 2H, 6 (7), 6, 4 (5), 6 (7), 6 (4–5), 4 (3), 4 (3, 5), 2 (1, 3), (2); VS 47–60 in number, with 28–38 preanal setae and 17–26 postanal setae; NDV = 89–103. Coxae setae 1-1-1; venter without ventro-humeral setae.

Description of Larva. (n = 12) Oval, body line slightly concave behind leg III. Color unknown, pale yellow in alcohol (Li et al., 1997); size small to medium. Measurements of body length and width are as follows (in μm). Unengorged body length 240–317, width 149–223; semi-engorged body length 408, width 302. Eyes 2+2, anterior pair larger.

Gnathosoma. Gnathosomal base lightly punctate, with a pair of pectinate setae; cheliceral base sparsely punctate; cheliceral blade with tricuspid cap. Galeal setae nude; fPp = N/N/NNN/4B, with one blunt solenidion; palpal claw 3-pronged.

Scutum. Pentagonal; sparsely punctate; lateral margins straight. AP > PP; PSB 40–45 μm ; SD 57–62 μm ; SD/PW = 1.41–1.65. SB/PL. Lack of AM, but with 2 ALs and 2 PLs which are significantly branched and tapering to apex. SN globose with spikes on surface. Standard measurements of scutum are presented in Table 35.

Idiosomal Setae. DS 39–43 in number (including HS), arranged in 2H, 6 (7), 6, 4 (5), 6 (7), 6 (4–5), 4 (3), 4 (3, 5), 2 (1, 3), (2), similar to PL in shape. ST 2-2, branched; lack of ventro-humeral setae between coxae II and III; VS 47–60 in number, with 28–38 preanal setae similar to ST but shorter, and 17–26 postanal setae similar to DS. NDV = 89–103. Measurements of idiosomal setae are as follows (in μm). HS 26–29; medial setae of first post-humeral row 25–28; VS (pre) 13–17; VS (post) 20–25.

Legs. 7-6-6 segmented, with a pair of claws and a slender empodium. Coxae unisetose, lightly punctate. Ip 505–537 μm . All segments with various numbers of branched setae (B).

Leg I. 176–191 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microgenuala; tarsus 23B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 149–161 μm ; coxa 1B; trochanter 1B; femur 5B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 176–191 μm ; coxa 1B; trochanter 1B; femur 4B, with 1 nude ventral femorala; genu 3B, with 1 genuala; tibia 6B; tarsus 16B.

SIF = 4B-N-3-2110.0000.

Table 35. Standard measurements (in μm) of *Walchia (Walchia) kritochaeta* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	PP	AP	AL	PL	SN	PS
Mean of 12 specimens	30	40	24	18	42	60	27	31	23	25	23 x 13	17
Observed range												
Min.	28	37	22	16	40	57	25	30	21	24	22 x 12	15
Max.	32	41	27	19	45	62	30	34	25	29	26 x 15	17

Specimens Examined. PINGTUNG COUNTY: 5 larvae (IW0035-1-1~2, IW0035-3-2, IW0035-4-1~2), Kaoshu, Kaomei Bridge (屏東縣高樹鄉高美大橋), 20 June, 2008, ex *Bandicota indica*, male. HUALIEN COUNTY: 1 larva (7778-6-1), Fuli, Tungli (花蓮縣富里鄉東里村), 15 Aug. 2000, ex *Niviventer coninga*, male; 1 larva (7779-4-1), Yuli, Kauliao (花蓮縣玉里鎮高寮里), 16 Aug. 2000, ex *Bandicota indica*, male; 1 larva (7804-2-1), same locality, 18 Oct. 2000, ex *Rattus losea*, female; 4 larvae (7807-1-1~2, 7807-3-1, 7807-5-1), same locality and date, ex *Bandicota indica*, male.

Distribution. China (Kuangtung Province), Taiwan (new record), and Thailand (Audy, 1957; Li et al., 1997).

Remarks. *Walchia (W.) kritochaeta* most closely resembles *W. (W.) parapacifica* (Chen, Hsu and Wang, 1956), but it can be distinguished from the latter by the following features (*W. (W.) parapacifica* in parentheses): PSB 40–45 μm ; SD 57–62 μm (PSB 46–59 μm ; SD 63–78 μm); AP > PP (AP < PP); DS usually arranged in 2H, 6, 6, 4... (2H, 6, 6, 2...).

Biology. *Walchia (W.) kritochaeta* is collected from *Bandicota indica*, *Niviventer coninga*, *Rattus losea* and *R. rattus* (Wen, 1984e).

Medical Importance. Unknown.

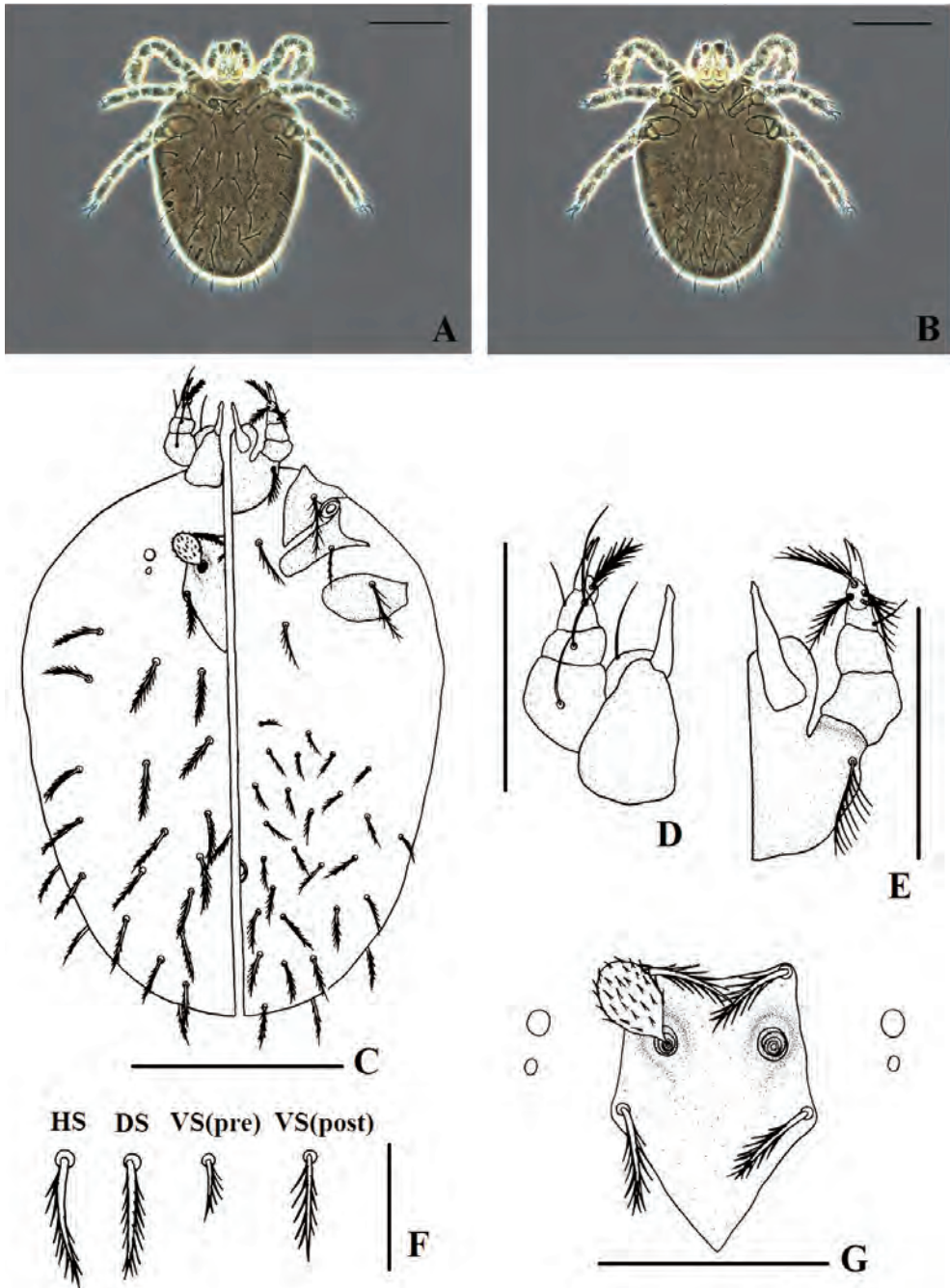
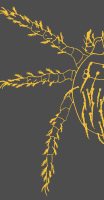


Fig. 37. *Walchia (Walchia) kritochaeta* (Traub and Evans, 1957) larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 µm; D, E, G = 50 µm; F = 25 µm.



Walchia (Walchia) pacifica (Chen and Hsu, 1955)

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(Fig. 38; Table 36)

References.

Gahrliepia (W.) pacifica Chen & Hsu, 1955: 112, fs. 5–10.

Walchia (W.) pacifica Wen, 1984e: 68; Li, Wang & Chen, 1997: 459, f. 3-1-21.

Diagnosis of Larva. Scutum similar to bird face, with 2 ALs and 2 PLs; lateral margins smooth; wavy in some specimens. SN globose with spikes on surface. Eyes absent among the specimens observed; Li et al. (1997) described the species with reddish oculi. fPp = N/N/NNN/4B. DS 35–43 in number (including HS), arranged in 4H, 8, 8 (7), 2 (6), 6 (5), 6 (4–5), 2 (3–4), (2), (2); VS 42–53 in number, with 27–33 preanal setae and 14–21 postanal setae; NDV = 82–93. Coxae setae 1-1-1; venter with 6–9 ventro-humeral setae (left: 3–5; right: 3–4).

Description of Larva. (n = 14) Size small to medium; oval, body line concave behind leg III. Color milky white (Li et al., 1997); eyes absent in specimens observed but were described reddish in Li et al. (1997). Measurements of body length and width are as follows (in μm). Semi-engorged body length 376–522, width 243–389.

Gnathosoma. Gnathosomal base evenly punctate, with a pair of pectinate setae; cheliceral base sparsely punctate; cheliceral blade with tricuspid cap. Galeal setae nude; fPp = N/N/NNN/4B, with one blunt solenidion; palpal claw 3-pronged.

Scutum. Similar to bird face in shape; evenly punctate. Lateral margins smooth; wavy in some specimens. SD/PW = 1.73–2.07. SB/PL. Scutum lack of AM but with 2 ALs and 2 PLs which are finely branched and tapering to apex. SN globose with spikes on surface. Standard measurements of scutum are given in Table 36.

Idiosomal Setae. HS and DS similar to PL, finely branched; DS 35–43 in number (including HS), arranged in 4H, 8, 8 (7), 2 (6), 6 (5), 6 (4–5), 2 (3–4), (2), (2); ST 2-2, finely branched; venter with 6–9 ventro-humeral setae (left: 3–5; right: 3–4); VS 42–53 in number, with 27–33 preanal setae similar to ST but shorter, and 14–21 postanal setae similar to DS. NDV = 82–93. Measurements of idiosomal setae are as follows (in μm). HS 25–31; medial setae of first post-humeral row 27–31; VS (pre) 15–18; VS (post) 23–27.

Legs. 7-6-6 segmented, with a pair of claws and a slender empodium. Coxae setae 1-1-1; coxae evenly punctate. Ip 525–606 μm . All segments with various numbers



of branched setae (B).

Leg I. 173–208 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microgenuala; tarsus 23B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 158–183 μm ; coxa 1B; trochanter 1B; femur 5B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 193–215 μm ; coxa 1B; trochanter 1B; femur 4B, with 1 nude ventral femorala; genu 3B, with 1 genuala; tibia 6B; tarsus 16B.

SIF = 4B-N-3-2110.0000.

Table 36. Standard measurements (in μm) of *Walchia (Walchia) pacifica* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	PP	AP	AL	PL	SN	PS
Mean of 14 specimens	36	39	29	21	53	73	37	36	26	31	26 x 13	18
Observed range												
Min.	34	36	27	19	49	68	34	34	23	28	25 x 12	16
Max.	40	44	31	23	56	78	40	38	29	34	28 x 15	19

Specimens Examined. HSINCHU COUNTY: 2 larvae (IW0038-3-1, IW0038-4-1), Chienshih, Chiale (新竹縣尖石鄉嘉樂村), 15 July 2008, ex *Bandicota indica*, male. NANTOU COUNTY: 1 larva (8078-1-1), Puli, Neipu (南投縣埔里鎮內埔里), 30 Aug. 2001, ex *Bandicota indica*, male; 2 larvae (8086-1-1, 8086-3-1), Puli, Chingshin (南投縣埔里鎮清新里), 17 Oct. 2001, ex *Bandicota indica*, female; 1 larva (8080-1-1), Kuohsing, Peikang (南投縣國姓鄉北港村), 30 Aug. 2001, ex *Bandicota indica*, male. TAINAN CITY: 4 larvae (IW0013-2-1, IW0013-3-1, IW0013-4-3, IW0013-6-2), Kuantien (台南市官田區), 17 June 2007, ex *Rattus losea*, female. HUALIEN COUNTY: 1 larva (7808-1-1), Yuli, Kaoliao (花蓮縣玉里鎮高寮里), 18 Oct. 2000, ex *Bandicota indica*, female; 1 larva (8038-2-1), same locality, 13 June 2001, ex *Bandicota indica*, male; 2 larvae (7955-3-1, 7955-5-1), Fuli, Tungli (花蓮縣富里鄉東里村), 5 Jan. 2001, ex *Bandicota indica*, female.

Distribution. China and Taiwan (new record) (Li et al., 1997).

Remarks. *Walchia (W.) pacifica* most closely resembles *W. (W.) fragilis* Schluger,

1955, and it can be distinguished from the latter mainly by the differences in length of idiosomal setae (*W. (W.) fragilis* in parenthesis): PL 31 μm in average; HS 25–31 μm ; DS 27–31 μm (PL 39 μm ; HS 30–37 μm ; DS 32–36 μm).

Biology. *Walchia (W.) pacifica* is recorded from many provinces in China (Fuchien, Kuangtung, Kuanghsi, Chianghsi, Chechiang, Hunan, Chiangsu, Shanghai, Yunnan...). In Fuchien Province, *W. (W.) pacifica* is collected more in mountains than in coastal areas, and occurring mostly in summer and autumn (Li et al., 1997). In Taiwan, *W. (W.) pacifica* can be collected from all parts of Taiwan (except northern Taiwan).

Walchia (W.) pacifica is mainly collected from rodents, including *Apodemus agrarius*, *Bandicota indica*, *Niviventer confucianus*, *Rattus losea*, *R. norvegicus* and *R. rattus* (Wen, 1984e).

Medical Importance. Isolation of *Orientia tsutsugamushi* from *Walchia (W.) pacifica* has been proven (Liu et al., 1999); natural infection in *W. (W.) pacifica* has also been confirmed (Yang et al., 2000).

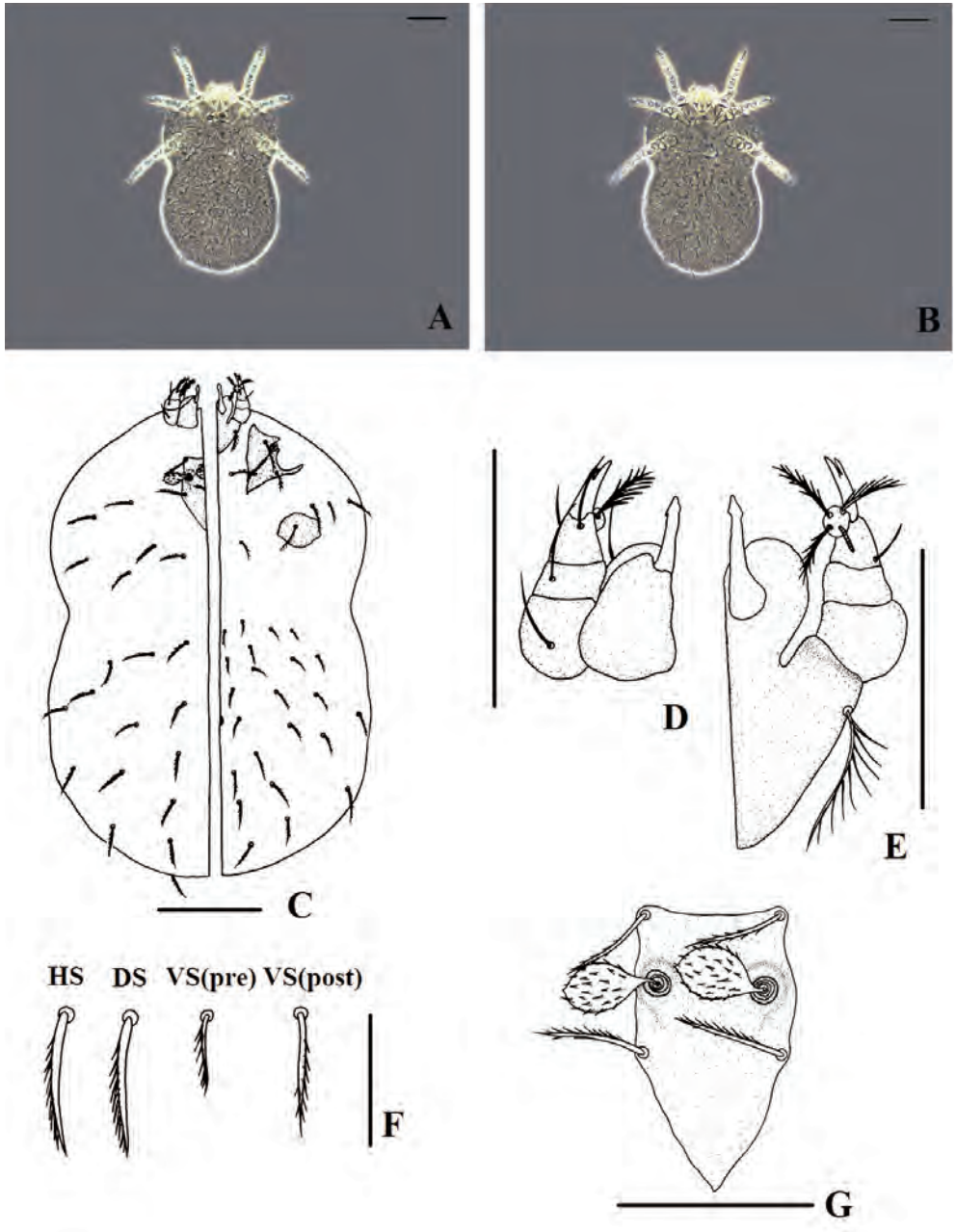


Fig. 38. *Walchia (Walchia) pacifica* (Chen and Hsu, 1955) larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 µm; D, E, G = 50 µm; F = 25 µm.



Walchia (Walchia) parapacifica (Chen, Hsu and Wang, 1956)

似太平洋無前恙蟎

(Fig. 39; Table 37)

References.

Gahrliepia (W.) parapacifica Chen, Hsu & Wang, 1956: 150, fs. 6–10.

Walchia (W.) parapacifica Wen, 1984e: 298; Li, Wang & Chen, 1997: 460, f. 3-1-22.

Diagnosis of Larva. Scutum pentagonal, with 2 ALs and 2 PLs; lateral margins nearly straight; AP < PP; PSB 46–59 μm ; SD 63–78 μm . SN globose with spikes on surface. fPp = N/N/NNN/4B. DS 36–42 in number (including HS), arranged in 2H, 6 (7), 6, 2 (3), 6 (5), 6 (4), 4 (3), 4 (2–3), 2, (2); VS 46–62 in number, with 28–38 preanal setae and 18–27 postanal setae; NDV = 85–102. Coxae setae 1-1-1; venter without ventro-humeral setae.

Description of Larva. (n = 16) Oval; size medium; body line concave behind leg III. Color milky white, with reddish eyes 2+2, anterior pair larger (Li et al., 1997). Measurements of body length and width are as follows (in μm). Unengorged body length 299, width 213; semi-engorged body length 324–460, width 225–335.

Gnathosoma. Gnathosomal base lightly punctate, with a pair of pectinate setae; cheliceral base sparsely punctate; cheliceral blade with tricuspid cap. Galeal setae nude; fPp = N/N/NNN/4B, with one blunt solenidion; palpal claw 3-pronged.

Scutum. Pentagonal; lightly punctate; lateral margins nearly straight. AP < PP; PSB 46–59 μm ; SD 63–78 μm ; SD/PW = 1.45–1.91. SB/PL. Lack of AM but with 2 ALs and 2 PLs that are branched and tapering to apex. SN globose with spikes on surface. Standard measurements of scutum are presented in Table 37.

Idiosomal Setae. DS 36–42 in number (including HS), arranged in 2H, 6 (7), 6, 2 (3), 6 (5), 6 (4), 4 (3), 4 (2–3), 2, (2); similar to PL in shape. ST 2-2, branched; lack of ventro-humeral setae between coxae II and III; VS 46–62 in number, with 28–38 preanal setae similar to ST but shorter, and 18–27 postanal setae similar to DS. NDV = 85–102. Measurements of idiosomal setae are as follows (in μm). HS 25–30; medial setae of first post-humeral row 26–29; VS (pre) 13–16; VS (post) 20–24.

Legs. 7-6-6 segmented, with a pair of claws and a slender empodium. Coxae unisetose, lightly punctate. Ip 512–547 μm . All segments with various numbers of branched setae (B).

Leg I. 181–193 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu



4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microgenuala; tarsus 23B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 153–166 μm ; coxa 1B; trochanter 1B; femur 5B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 176–193 μm ; coxa 1B; trochanter 1B; femur 4B, with 1 nude ventral femorala; genu 3B, with 1 genuala; tibia 6B; tarsus 16B.

SIF = 4B-N-3-2110.0000.

Table 37. Standard measurements (in μm) of *Walchia (Walchia) parapacifica* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	PP	AP	AL	PL	SN	PS
Mean of 16 specimens	31	41	25	18	52	70	37	33	22	25	25 x 13	18
Observed range												
Min.	29	37	23	16	46	63	32	30	20	23	23 x 12	15
Max.	33	45	27	20	59	78	44	37	25	28	28 x 13	19

Specimens Examined. PINGTUNG COUNTY: 4 larvae (IW0035-2-1, IW0035-3-1, IW0035-4-3, IW0035-6-1), Kaoshu, Kaomei Bridge (屏東縣高樹鄉高美大橋), 20 June, 2008, ex *Bandicota indica*, male. HUALIEN COUNTY: 2 larvae (7778-1-1, 7778-4-1), Fuli, Tungli (花蓮縣富里鄉東里村), 15 Aug. 2000, ex *Niviventer coninga*, male; 1 larva (7785-1-1), Juisui, Hokang (花蓮縣瑞穗鄉鶴岡村), 17 Aug. 2000, ex *Rattus losea*, male; 4 larvae (7804-1-1, 7804-3-1, 7804-4-1~2), same locality, 18 Oct. 2000, ex *Rattus losea*, female; 1 larva (7807-3-1), same locality and date, ex *Bandicota indica*, male; 1 larva (7854-1-1), same locality, 21 Dec. 2000, ex *Rattus losea*, male; 1 larva (7834-4-1), Yuli, Kauliao (花蓮縣玉里鎮高寮里), 20 Dec. 2000, ex *Rattus losea*, male; 2 larvae (7995-1-1, 7995-5-1), same locality, 2 May 2001, ex *Rattus losea*, female.

Distribution. China and Taiwan (new record) (Li et al., 1997).

Remarks. *Walchia (W.) parapacifica* most closely resembles *W. (W.) kritochaeta* (Traub and Evans, 1957), and it can be distinguished from the latter by the following features (*W. (W.) kritochaeta* in parentheses): PSB 46–59 μm ; SD 63–78 μm (PSB 40–45 μm ; SD 57–62 μm); AP < PP (AP > PP); DS usually arranged in

2H, 6, 6, 2... (2H, 6, 6, 4...).

Biology. Similar to *W. (W.) pacifica*, *W. (W.) parapacifica* is recorded from many provinces in China (Fuchien, Kuangtung, Kuanghsi, Chianghsi, Chechiang, Hunan, Yunnan...). In Fuchien Province, *W. (W.) pacifica* is collected more in mountains than in coastal areas; more in hills than in plains, and occurring mostly in summer and autumn (Li et al., 1997).

Walchia (W.) parapacifica is mainly collected from the conchal fossa of rodents, including *Apodemus agrarius*, *Bandicota indica*, *Niviventer coninga*, *Rattus flavipectus*, *R. losea*, *R. norvegicus* and *R. rattus* (Wen, 1984e).

Medical Importance. Unknown.

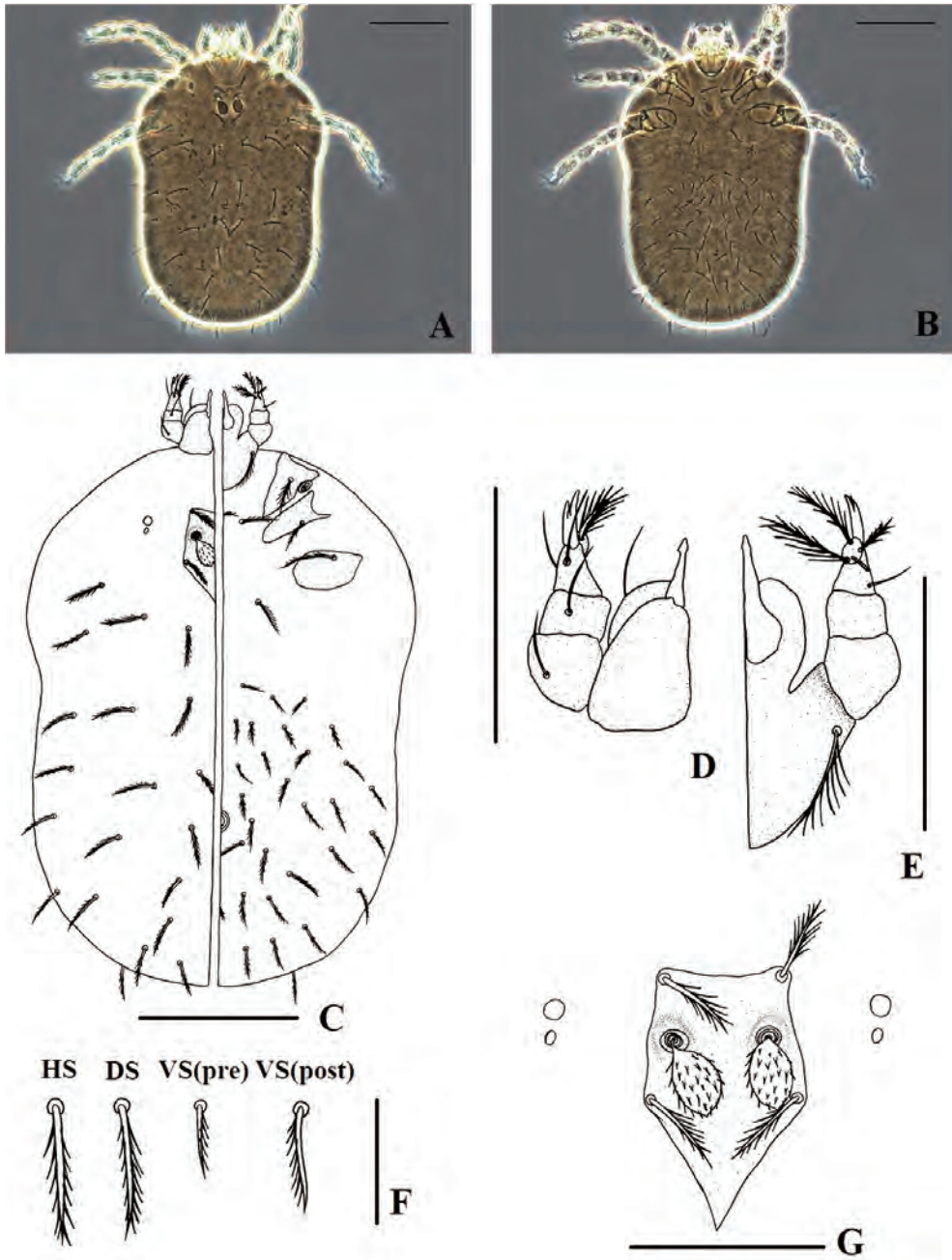


Fig. 39. *Walchia (Walchia) parapacifica* (Chen, Hsu and Wang, 1956) larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μm; D, E, G = 50 μm; F = 25 μm.

Walchia (Walchia) xishaensis Zhao, Tang and Mo, 1986

西沙無前恙蟎

(Fig. 40; Table 38)

References.

Walchia (W.) xishaensis Zhao, Tang & Mo, 1986: 96, fs. 1–6; Li, Wang & Chen, 1997: 466, f. 3-1-31.

Diagnosis of Larva. Scutum pentagonal, with 2 ALs and 2 PLs; $PW > AW$; $AP > PP$; PSB 32–40 μm ; SD 49–58 μm . SN globose with spikes on surface. fPp = N/N/NNN/4B. DS 32–40 in number (including HS), arranged in 2H, 6, 6, 2, 6 (5), 4 (5–6), 4 (5), 4 (2–3), (2–3), (1–2); VS 44–56 in number, with 24–30 preanal setae and 17–26 postanal setae; NDV = 77–90. Coxae setae 1-1-2; venter without ventro-humeral setae.

Description of Larva. (n = 14) Oval; size small to medium; body line concave behind leg III. Color white or pale yellow (Li et al., 1997); eyes 1+1. Measurements of body length and width are as follows (in μm). Unengorged body length 290, width 189; semi-engorged body length 376–436, width 260–322.

Gnathosoma. Gnathosomal base lightly punctate, with a pair of pectinate setae; cheliceral base sparsely punctate; cheliceral blade with tricuspid cap. Galeal setae nude; fPp = N/N/NNN/4B, with one blunt solenidion; palpal claw 3-pronged.

Scutum. Pentagonal; evenly punctate. PW significantly longer than AW; $AP > PP$; PSB 32–40 μm ; SD 49–58 μm ; $SD/PW = 1.18\text{--}1.47$. SB/PL. Lack of AM but with 2 ALs and 2 PLs that are branched and tapering to apex. SN globose with spikes on surface. Standard measurements of scutum are presented in Table 38.

Idiosomal Setae. DS 32–40 in number (including HS), arranged in 2H, 6, 6, 2, 6 (5), 4 (5–6), 4 (5), 4 (2–3), (2–3), (1–2); posterior half arranged more disordered. DS similar to PL in shape. ST 2-2, finely branched; lack of ventro-humeral setae between coxae II and III; VS 44–56 in number, with 24–30 preanal setae similar to ST but shorter, and 17–26 postanal setae similar to DS. NDV = 77–90. Measurements of idiosomal setae are as follows (in μm). HS 25–28; medial setae of first post-humeral row 24–28; VS (pre) 13–16; VS (post) 19–23.

Legs. 7-6-6 segmented, with a pair of claws and a slender empodium. Coxae unisetose, lightly punctate. Ip 458–512 μm . All segments with various numbers of branched setae (B).

Leg I. 161–181 μm ; coxa 1B; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 genualae and 1 microgenuala; tibia 8B, 2 tibialae and 1 microgenuala; tarsus



23B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 134–151 μm ; coxa 1B; trochanter 1B; femur 5B; genu 3B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala, 1 microtarsala and 1 pretarsala.

Leg III. 163–186 μm ; coxa 1B; trochanter 1B; femur 4B, with 1 nude ventral femorala; genu 3B, with 1 genuala; tibia 6B; tarsus 16B.

SIF = 4B-N-3-2110.0000.

Table 38. Standard measurements (in μm) of *Walchia (Walchia) xishanensis* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	PP	AP	AL	PL	SN	PS
Mean of 14 specimens	27	40	24	17	36	54	21	33	21	24	25 x 13	18
Observed range												
Min.	26	38	22	16	32	49	17	30	20	22	23 x 12	17
Max.	28	44	26	19	40	58	24	34	25	25	26 x 14	19

Specimens Examined. HUALIEN COUNTY: 1 larva (7776-2-1), Fuli, Tungli (花蓮縣富里鄉東里村), 15 Aug. 2000, ex *Rattus losea*, male; 5 larvae (7778-1-2, 7778-2-1, 7778-3-1, 7778-4-2, 7778-5-1), same locality and date, ex *Niviventer coninga*, male; 2 larvae (7784-1-1, 7784-2-1), Yuli, Kauliao (花蓮縣玉里鎮高寮里), 16 Aug. 2000, ex *Rattus losea*, male. TAITUNG COUNTY: 1 larva (8537-38-1-1), Lanyu, Tungching (台東縣蘭嶼鄉東清村), 6 Sept. 2006, ex *Rattus losea*, female; 4 larvae (9286-87-1-1, 9286-87-2-1, 9286-87-5-1~2), Peinan, Pinlang (台東縣卑南鄉賓朗村), 11 June 2009, ex *Rattus losea*, female; 1 larva (9292-2-1), same locality and date, ex *Rattus losea*, male.

Distribution. Paracel Islands and Taiwan (new record) (Li et al., 1997).

Remarks. *Walchia (W.) xishaensis* most closely resembles *W. (W.) chinensis* (Chen and Hsu, 1955), but it can be distinguished from the latter by the following features (*W. (W.) xishaensis* in parentheses): $\text{PW} > \text{AW}$; $\text{PW} 40 \mu\text{m}$ in average ($\text{PW} \approx \text{AW}$; $\text{PW} 31 \mu\text{m}$ in average); eyes 1+1 (2+2).

Biology. *Walchia (W.) xishaensis* is found in Paracel Islands and eastern parts of Taiwan, including Green Island, and is collected from the conchal fossa of rodents (*Niviventer coninga*, *Rattus exulans*, *R. losea*, *R. norvegicus*) (Li et al., 1997).

Medical Importance. Unknown.

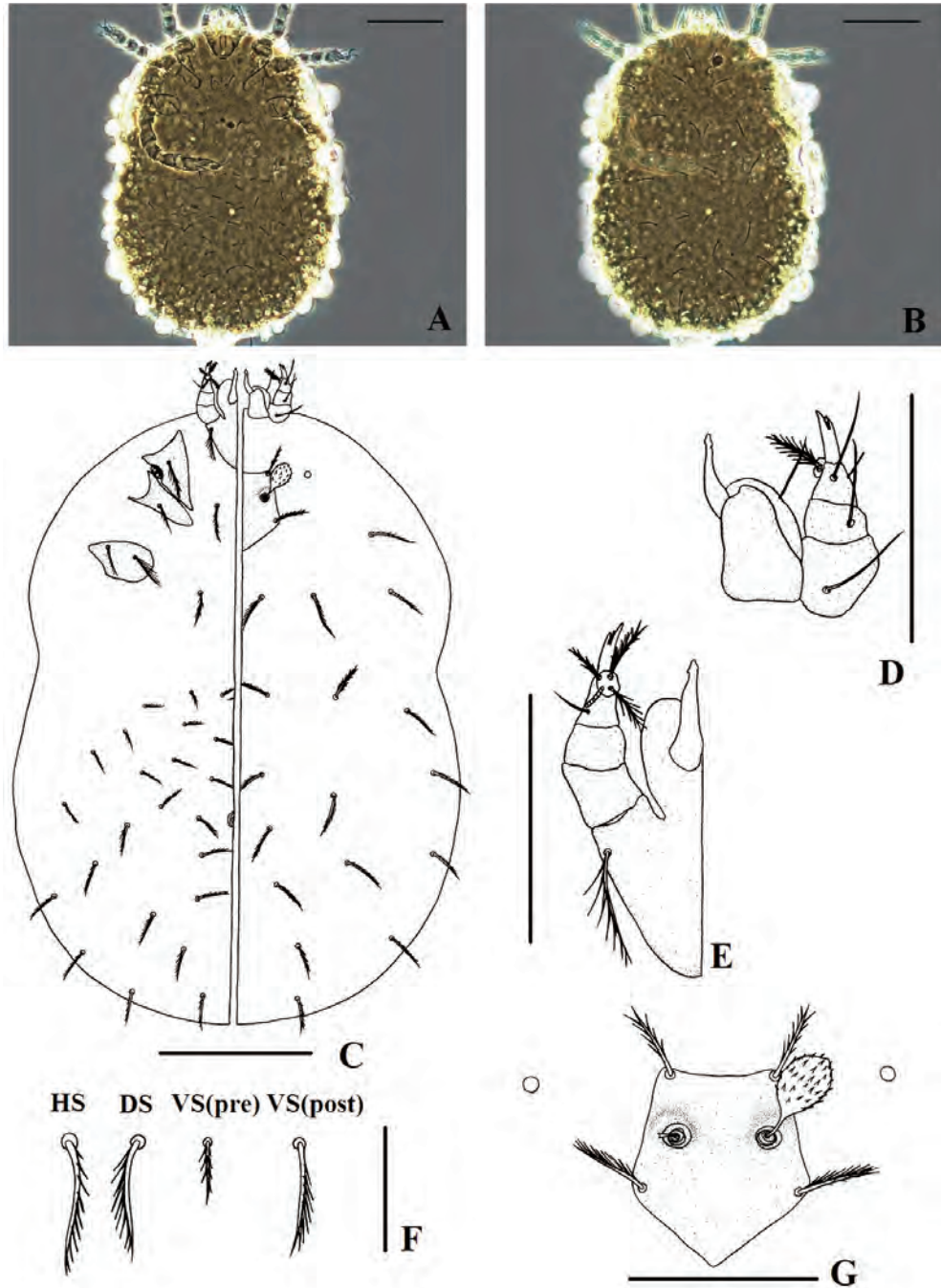


Fig. 40. *Walchia (Walchia) xishaensis* Zhao, Tang and Mo, 1986 larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.

Family *Leeuwenhōkiidae* Womersley, 1944

列恙蟎科

Subfamily *Leeuwenhōkiinae* Womersley, 1944

列恙蟎亞科

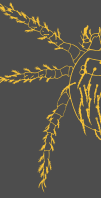
Diagnosis. Scutum with 2 AMs and/or an anteromedian projection; legs 6-6-6 segmented.

Genus *Odontacarus* Ewing, 1929

螯齒恙蟎屬

Type species. *Trombicula dentata* Ewing, 1925.

Diagnosis. Size medium to large; scutum with an anteromedian projection; AMs, ALs and PLs all in pairs. SN flagelliform, with or without branches. All legs 6-segmented; leg III usually with one tarsala.



Odontacarus majesticus (Chen and Hsu, 1955)

巨螯齒恙蟎

(Fig. 41; Table 39)

References.

- Acomatacarus majesticus* Chen & Hsu, 1955: 131, f. 70.
Odontacarus (Tarsalacarus) majesticus Vercammen-Grandjean, 1968: 121.
Odontacarus (Tarsalacarus) yosanoi majesticus Wen, 1984e: 324.
Odontacarus majesticus Li, Wang & Chen, 1997: 524, f. 4-1-4.

Diagnosis of Larva. Scutum close to pentagon, with an anteromedian projection and posterior margin curvedly extended. AM, AL and PL all in pairs. SB-PL. SN long flagelliform, without branches. fPp = B/B/BBB/7B. DS 82–92 in number (including HS); VS 73–87 in number, with 34–45 preanal setae and 39–45 postanal setae. NDV = 155–178. Leg III with one tarsala.

Description of Larva. (n = 9) Live larva white (Li et al., 1997). Long-oval in shape, body line slightly curved inward behind leg III; size large. Measurements of body length and width are as follows (in μm). Semi-engorged body length 401–562, width 243–319. Eyes 2+2, located on ocular platelets; anterior pair larger.

Gnathosoma. Gnathosomal base sparsely punctate, with a pair of short and brush-like setae; cheliceral base lightly punctate; cheliceral blade with tricuspid cap. Galeal setae branched; fPp = B/B/BBB/7B; palpotarsus with blunt solenidion; palpal claw 2-pronged.

Scutum. Close to pentagon, with an anteromedian projection; anterior margin convex; lateral margins slightly curved inward; posterior margin circularly extended outward; scutum lightly punctate. PW/AP = 2.81–3.24; PW/SD = 1.41–1.51. SB-PL. All AMs, ALs and PLs are in pairs. PL > AM \geq AL, and all are finely and shortly branched and tapering to apex. SN long and thin flagelliform, without any branches and tiny spikes. Standard measurements of scutum are presented in Table 39.

Idiosomal Setae. DS 82–92 in number (including HS), with indistinct HS; DS usually arranged disorderly: 12 (11, 14), 8 (9–10), 8 (6–7, 9–10)...; DS similar to PL: shortly branched and tapering to apex. ST one pair, finely branched; VS 73–87 in number, with 34–45 preanal setae, which are thin and short, and 39–45 postanal setae which are similar to posterior half of DS. NDV = 155–178. Measurements of idiosomal setae are as follows (in μm).



HS 61–81; medial setae of first post-humeral row 42–47; VS (pre) 30–35; VS (post) 39–46.

Legs. All 6-segmented, with a pair of claws and a slender empodium. Coxa I with 2 branched setae, others unisetose. Ip 928–980 μm . All segments with various numbers of branched setae (B).

Leg I. 319–347 μm ; coxa 2B; trochanter 1B; femur 6B; genu 4B, 2 genualae and 1 microgenuala; tibia 9B, 2 tibialae and 1 microgenuala; tarsus 23B, with 1 central tarsala, 1 microtarsala, 1 pretarsala, nude subterminala and parasubterminala.

Leg II. 285–303 μm ; coxa 1B; trochanter 1B; femur 6B; genu 4B, with 1 genuala; tibia 6B, with 2 tibialae; tarsus 16B, with 1 central tarsala and 1 pretarsala.

Leg III. 317–349 μm ; coxa 1B; trochanter 1B; femur 4B; genu 4B, with 1 genuala; tibia 6B, with 1 tibiala; tarsus 15B, 1 tarsala.

SIF = 7B-B-2-2111.0000.

Table 39. Standard measurements (in μm) of *Odontacarus majesticus* larval scutum.

Specimen	AW	PW	SB	ASB	PSB	SD	AP	AM	AL	PL	SN	PS
Mean of 9 specimens	71	83	26	36	21	57	28	52	52	75	77	29
Observed range												
Min.	68	81	25	32	19	54	26	50	49	72	72	27
Max.	73	87	27	37	23	60	29	55	56	79	88	30

Specimens Examined. KINMEN COUNTY: 1 larva (7386-3-1), Kincheng, Hsiaokukang (金門縣金城鎮小古崗), 14 Feb. 2000, ex *Rattus losea*, male; 3 larvae (7641-5-2~3, 7641-6-2), same locality, 12 June 2000, ex *Rattus tanezumi*, male; 5 larvae (7433-1-1~2, 7433-2-1~3), Kinning, Lake Hou (金門縣金寧鄉后湖), 16 Feb 2000, ex *Rattus losea*, male.

Distribution. China and Taiwan (Wen, 1984e; Li et al., 1997; Wang et al., 2004).

Remarks. *Odontacarus majesticus* most closely resembles *O. yosanoi* (Fukuzumi and Obata, 1953) in Japan and China, and it can be distinguished from the latter by the number of prongs on palpal claw (*O. yosanoi* in parenthesis): 2-pronged (4-pronged) (Fukuzumi & Obata, 1953).

Biology. *Odontacarus majesticus* is widespread across China, and various hosts are

recorded, including rodents (*Rattus losea*, *R. norvegicus*, *R. rattus*, *R. tanezumi*), shrew (*Suncus murinus*), domestic rabbit, carnivores (*Canis familiaris*, *Felis domesticus*), goat and pig (Wen, 1984e).

Medical Importance. Natural infection of *Orientia tsutsugamushi* in *Odontacarus majesticus* has been proven (Chen & Hsu, 1955).

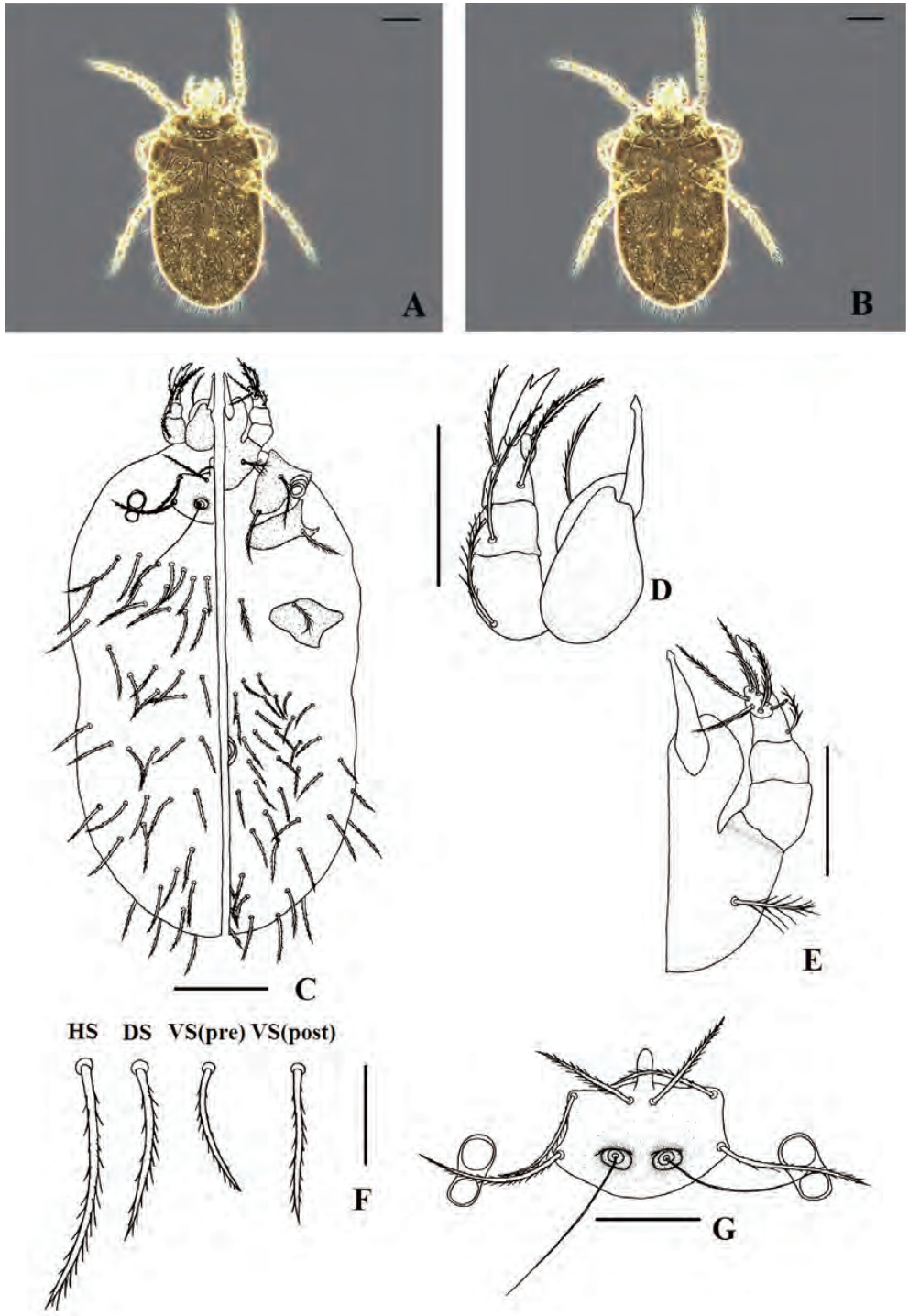


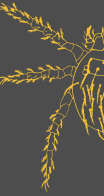
Fig. 41. *Odontacarus majesticus* (Chen and Hsu, 1955) larva. A. phase contrast image of the dorsal view; B. phase contrast image of the ventral view; C. dorsal and ventral view of the larva; D. dorsal view of the gnathosoma; E. ventral view of the gnathosoma; F. idiosomal setae; G. scutum. Scale: A, B, C = 100 μ m; D, E, G = 50 μ m; F = 25 μ m.



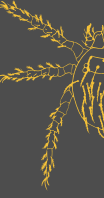
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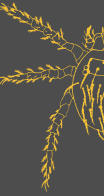
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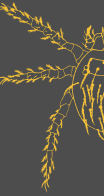
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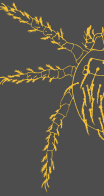
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Index

Bold page numbers refer to principal entries of genera/species.

- A**
ablephara 26, 29, 31
acugastia 10, **134**, 136, 146
akamushi 43, **45**, 48, 66
alfreddugesi 25
aliena 16
americana 93
apodemi 44, **49**, 51
Ascoschöngastia 11, **13**, 39
asetulum 75
audyi 19
- C**
cangjiangense 44, **52**, 54
causicola 39
chinensis 133, **137**, 140, 160
cidun 124
comata 37
- D**
deliense 43, **55**, 60, 66, 78
densipiliata **98**, 101
dentata 162
- E**
Eutrombicula 12, **25**
- F**
fragilis 133, **141**, 144, 152
fuji 91
fujianense 43, **61**, 63, 83
- G**
Gahrliepia 12, **114**
gallinarum 95
Gateria **114**
glabrum 133
- H**
hasegawai 97, 99
Helenicula 11, **34**
Herpetacarus 11, **39**
huensis 142
hunanye **103**, 106, 108
hupeicum 71
- I**
imphalum 43, 47, **64**, 68
indica **14**, 17
intermedium 50
- J**
jiangxiensis 133, 135, **145**, 147
- K**
kawamurai 43, **69**, 72
kiangsiensis 128
kohlsi **35**, 38
kritochoeta 133, **148**, 150, 156
- L**
lanius 34
latyshevi 22
Leptotrombidium 12, **43**
lieni 9, **116**, 119, 131
limon 41
linguipelta 114, **120**, 122
longchuanense 53



<i>longdongensis</i>	40, 42	<i>traubi</i>	112
<i>longipedalis</i>	10, 114, 123 , 126	<i>Trombicula</i>	97, 110, 162
•M		<i>Trombiculindus</i>	11, 102
<i>madun</i>	121	<i>Trombidium</i>	43, 133
<i>majesticus</i>	10, 163 , 166	<i>Typhlothrombidium</i>	114
<i>malayensis</i>	13	•W	
<i>Microtrombidium</i>	25	<i>Walchia</i>	12, 133
<i>minuta</i>	114, 127 , 129	<i>Walchiella</i>	11, 110
•N		<i>wichmanni</i>	9, 25, 30 , 33
<i>nanus</i>	114	<i>wuyiensis</i>	111 , 113
<i>Neoschöngastia</i>	11, 13, 34, 93	•X	
<i>neosinensis</i>	135, 146	<i>xianglinense</i>	44, 86 , 88
•O		<i>xishaensis</i>	133, 138, 159 , 161
<i>Odontacarus</i>	11, 162	•Y	
<i>oudemansi</i>	110	<i>yilanensis</i>	115, 117, 130 , 132
•P		<i>yosanoi</i>	164
<i>pacifica</i>	133, 142, 151 , 154	<i>yui</i>	44, 89 , 92
<i>paishaensis</i>	13, 18 , 20		
<i>pallidum</i>	10, 44, 73 , 76		
<i>parapacifica</i>	133, 149, 155 , 158		
<i>posekanyi</i>	94 , 96		
•R			
<i>rattinorvegici</i>	10, 13, 21 , 24		
<i>rubellum</i>	43, 58, 77 , 80		
•S			
<i>Schöngastia</i>	93		
<i>scutellare</i>	44, 62, 81 , 85, 87		
<i>spinifoliatus</i>	102, 107 , 109		
<i>squamosus</i>	102		
•T			
<i>taiwanensis</i>	117		
<i>Toritrombicula</i>	12, 97		

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