

GUIDE TO THE AQUATIC HETEROPTERA OF SINGAPORE AND PENINSULAR MALAYSIA. XI. INFRAORDER NEPOMORPHA—FAMILIES NAUCORIDAE AND APHELOCHEIRIDAE

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ABSTRACT. — This is the eleventh part in a series of papers constituting a Guide to the Aquatic Heteroptera of Singapore and Peninsular Malaysia, and treats the families Naucoridae and Aphelocheiridae in the infraorder Nepomorpha. Keys are provided to the subfamilies and genera of Naucoridae occurring in the region, and to the regional species in the genera *Naucoris*, *Ctenipocoris*, *Heleocoris*, and *Aphelocheirus*; new distributional records are also provided for many of these species. In the naucorid subfamily Naucorinae, the new species *Naucoris minutus* is described from Singapore, and *Naucoris rhizomatus* J. Polhemus is placed in synonymy under *Naucoris scutellaris* Stål. In the naucorid subfamily Laccocorinae, new distributional records are provided for *Ctenipocoris asiaticus*; the new species *Heleocoris malayensis* is described from Peninsular Malaysia; and *Laccocoris nervicus* and *Heleocoris ovatus* are found to have been incorrectly recorded from Peninsular Malaysia in previous publications. Colour habitus photos are provided for the two new species described, and line drawings of male and female genitalic structures are provided for all species in these two families known to occur in Singapore and Peninsular Malaysia.

KEYWORDS. — Naucoridae, Aphelocheiridae, *Naucoris*, *Ctenipocoris*, *Heleocoris*, *Aphelocheirus*, Singapore, Peninsular Malaysia, keys, new species

INTRODUCTION

This contribution is the eleventh in a series of papers constituting a Guide to the Aquatic Heteroptera of Singapore and Peninsular Malaysia (Cheng et al., 2001a; Cheng et al., 2001b; Andersen et al., 2002; Nieser, 2002, 2004; Yang & Zettel, 2005; Yang & Murphy, 2011; Zettel et al., 2011; D. Polhemus & J. Polhemus, 2012; J. Polhemus & D. Polhemus, 2012; D. Polhemus & J. Polhemus, 2013), and treats the families Naucoridae and Aphelocheiridae. The Aphelocheiridae have been treated as a separate family for the purposes of this part following the classification of Štys & Jansson (1988), but have been considered by some authors to be a specialised subfamily of the Naucoridae, and treated as the Aphelocheirinae in the literature prior to 1990 (D. Polhemus & J. Polhemus, 1989 and references therein). The relationship between these two families is equivocal: the phylogenetic analysis of Rieger (1976) placed the Naucoridae as the sister group to the Neotropical Potamocoridae, with Aphelocheiridae as part of a sister clade that also included

Notonectidae, Helotrephidae, and Pleidae, whereas the phylogenetic analysis of Mahner (1993) resolved a clade containing Naucoridae and Aphelocheiridae as sister groups, with the placement of the Potamocoridae uncertain. Whether or not the two families actually constitute a monophyletic group, both still share similar benthic ecologies and predaceous habits, and the consequent development of dorsoventrally flattened bodies and other morphological specialisations for subaquatic predation.

MATERIAL AND METHODS

Keys are provided to the subfamilies and genera of Naucoridae occurring in the region, and to the regional species in the genera *Naucoris*, *Heleocoris*, *Ctenipocoris*, and *Aphelocheirus*. The geographic scope of this work includes the island of Singapore, and the Malay Peninsula south of the Isthmus of Kra. Because certain species previously known only from Sumatra or Indochina have proven to be present

[†]Deceased

in the southern Malay Peninsula, widespread extralimital species with geographically proximal ranges are also included in order to allow recognition of these taxa should they be encountered in future collections from the region.

New and clarified distributional records from Singapore and Peninsular Malaysia are provided under the individual treatments for each species. In some cases new extralimital records are also included in order to establish broader distributional context, and to document populations examined by the authors in interpreting species concepts. Most of the material listed is housed in the Zoological Reference Collection of the National University of Singapore (ZRC), with additional records from the J. T. Polhemus Collection in Englewood, Colorado (JTPC); the National Museum of Natural History, Smithsonian Institution, Washington, DC, USA (USNM); the Bernice P. Bishop Museum, Honolulu, Hawaii, USA (BPBM); the Indonesian Institute of Sciences, Bogor, Indonesia (LIPI); and the Natural History Museum, London, UK (BMNH).

In the Material Examined sections local conventions have been used in regard to geographic names without translation to English, so that the Malay “Sungai Gombak” is retained, rather than translating this locality to “Gombak River”. In certain cases additional notations have been added in brackets to provide clarity in cases where label data was insufficiently detailed. For material in JTPC, the CL numbers following collection localities refer to a numbering scheme allowing cross-referencing of photographs and other metadata to specific collecting localities.

All measurements are given in millimeters. Synonymies provided under species are nomenclatural only.

Family NAUCORIDAE Leach, 1815

Discussion. — The family Naucoridae, also known as creeping water bugs, has a worldwide distribution in tropical and temperate zones, with its greatest species richness in the Neotropical and Oriental regions (J. Polhemus & D. Polhemus, 2008). Members of this family are moderate sized, with generally ovate body forms and a modest to pronounced degree of dorsoventral flattening. Character states within the family include 4-segmented antennae; a short, stout labium; enlarged, raptorial fore femora; the fore tarsal segments fused with the fore tibia and generally non-articulating; the absence of venation on the forewing; the male genital capsule inverted and folded forward within the body when at rest, with the proctiger and parameres lying anterior the the phallosome base; and the abdominal spiracles lacking rosettes, but with the adjacent paratergites often bearing a variety of pressure receptors.

Five subfamilies are currently recognised within the Naucoridae (Štys & Jansson, 1988), of which three, the Naucorinae, Laccacorinae, and Cheirochelinae, occur in the region under study.

KEY TO THE SUBFAMILIES OF NAUCORIDAE

occurring in Singapore and Peninsular Malaysia

1. Apex of head folded under and backward, such that the rostrum arises at a point posterior to the anterior margin of the head when viewed laterally or ventrally.....2
 - Apex of head not folded under and backward, rostrum arising at anterior margin of head when viewed laterally..... Naucorinae
2. Rostrum recessed into a cavity on the underside of the head..
 - Rostrum not recessed into a cavity, pointing backward but flush with the underside of the head..... Laccacorinae

Subfamily NAUCORINAE Leach, 1815

Genus NAUCORIS Geoffroy, 1762

Discussion. — The genus *Naucoris* presently contains 23 species, with nine in Africa, six in Asia, five in Australia, and three in the Palearctic region. The genus is absent from New Guinea as far as is known, and is functionally replaced in the Neotropical region by the morphologically similar naucorine genus *Pelocoris* (J. Polhemus & D. Polhemus, 2008a). The genus *Thurselinus* Distant, although treated as valid by Zettel & Lane (2011), is considered herein to be a synonym of *Naucoris* following Bergroth (1911).

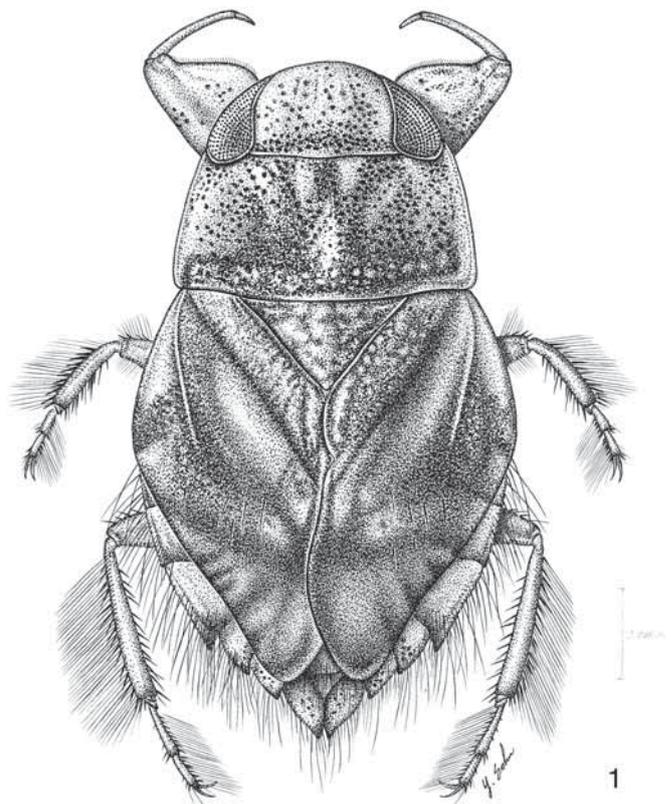
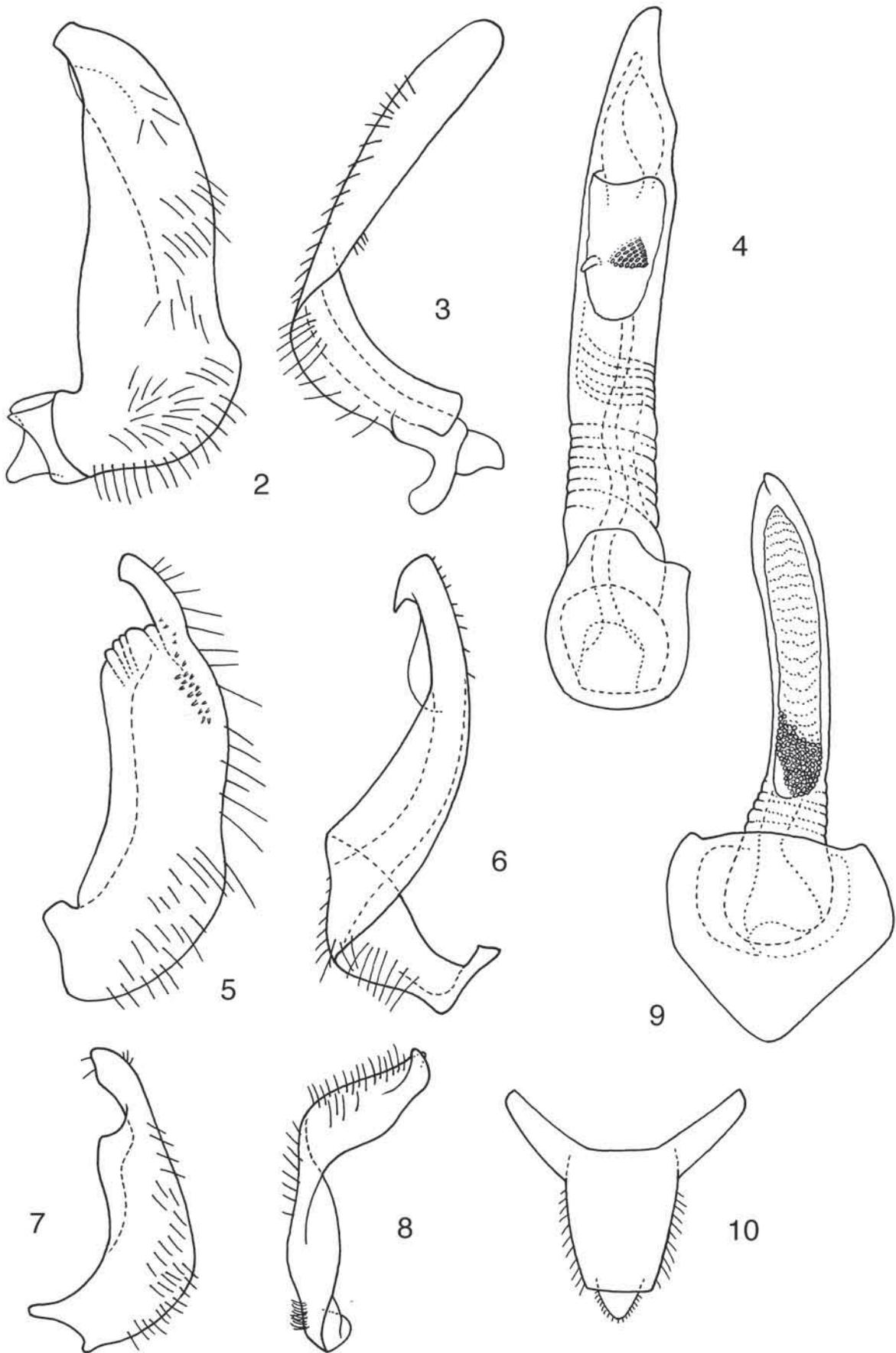


Fig. 1. *Naucoris sigaloeis* La Rivers, male, dorsal habitus, specimen from Vietnam, Đông Nai Prov., Nam Cát Tiên (Young Sohn illustration).



Figs. 2–10. *Naucoris* species, structural details of male genitalia. 2–4. *N. sigaloeis* La Rivers, specimen from NE Thailand. 2. Left paramere. 3. Right paramere. 4. Phallosome. 5, 6. *N. scutellaris* Stål, specimen from Singapore, Lower Fort Peirce Forest. 5. Left paramere. 6. Right paramere. 7–10. *N. minutus*, new species, specimen from Singapore, Chestnut Drive. 7. Left paramere. 8. Right paramere. 9. Phallosome. 10. Proctiger.

KEY TO SPECIES OF NAUCORIS
occurring in Singapore, Peninsular Malaysia,
and Indochina

1. Body shiny; hemelytral commissure arcuate; brachypterous forms predominant, with forewing membranes reduced, apices pointed; male right paramere with apex rounded, not hooked (Fig. 3); Thailand and Vietnam.....*N. sigaloeis* La Rivers
- Body dull; hemelytral commissure straight; macropterous forms predominant, forewing membranes usually fully developed, apices rounded (Fig. 15); male right paramere with apex hooked to some extent (Figs. 6, 8).....2
2. Very small species, body length less than 5 mm; apex of male right paramere with a small, blunt, upward-pointing hook (Fig. 8); Singapore.....*N. minutus*, new species
- Body length exceeding 6 mm.....3
3. Apex of male right paramere with a sharp, downward-pointing hook (Fig. 6); female subgenital hook elongate (Fig. 13); widespread from Southeast Asia to Australia.....*N. scutellaris* Stål
- Female subgenital short and truncate (Fig. 14); male unknown; Sumatra (?).....*N. sumatrensis* Fieber

***Naucoris minutus*, new species**
(Figs. 7–11, 15)

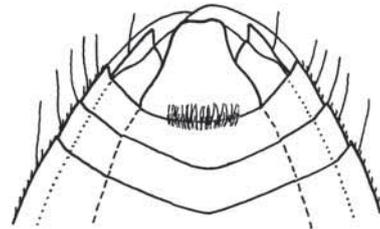
Material examined. — Holotype, male, SINGAPORE, Chestnut Drive [Selatar Reservoir area], 10 May 1994, Nature Reserves Survey, NS130B (ZRC). Paratypes: SINGAPORE: 2 males, 3 females, same data as holotype (ZRC, BPBM); 1 female, Chestnut Drive, stagnant pool, 10 May 1994, NS130B (ZRC).

Description. — **Macropterous form:** Of small size for genus, general body form ovate, widest across basal abdomen, basic colouration pale brown, with scutellum, hemelytra and wing membrane dark brown (Fig. 15). Male length 4.40 mm; maximum width (across abdomen) 2.40 mm; female length 4.80 mm, maximum width 2.90 mm.

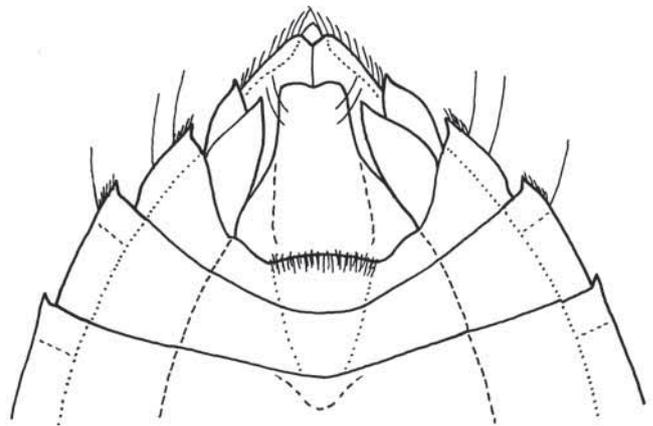
Head tan, with scattered dark brown dots centrally on vertex, these dots coagulating to form a large, irregular brown patch adjacent to posterior margin of vertex, width across eyes/length = 1.45/0.90; eyes dark red, shining, roughly teardrop-shaped when viewed from above with weakly developed lateral flange, tapering anteriorly, width/length = 0.40/0.60, inner margins straight and slightly convergent anteriorly, lateral margins broadly curving, separated from vertex by shallow furrows, anterior/posterior interocular width = 0.80/0.95; posterior margin of vertex broadly and gently curved, slightly produced behind eyes; anteclypeus broadly rounded, projecting slightly ahead of eyes, anterior margin not projecting beyond rostrum, lacking pits or other sensory structures; labrum golden, semicircular, ventral margin broadly rounded, apex blunt; rostrum evenly tapering to apex, all segments golden brown; antennae with all segments relatively slender, not extending to lateral margin of head, segments II–IV subequal in length.

Pronotum tan, irregularly dotted and mottled with dark brown, lateral margins each with a single more prominent

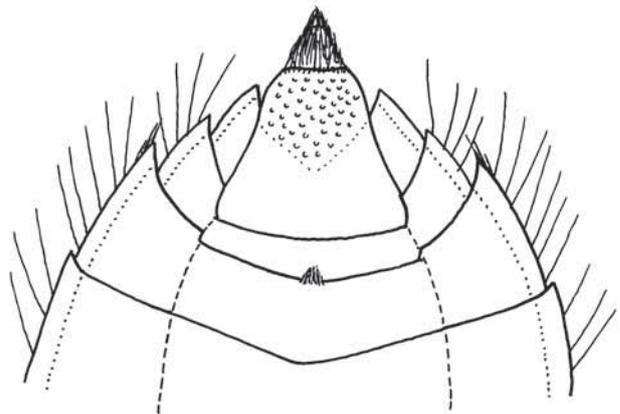
brown spot on anterior third, posterior margin broadly grayish brown; lateral margins nearly parallel, very weakly explanate, humeri slightly raised posterolaterally, dorsal surface broadly and evenly domed, not depressed medially behind vertex, width/length (midline) = 2.30/1.00, posterolateral



11



12



13



14

Figs. 11–14. *Naucoris* species, female terminal abdomens showing shapes of subgenital plates. 11. *N. minutus*, new species, specimen from Singapore, Chestnut Drive. 12. *N. scutellaris* Stål, specimen from Malaysia, Perak, S. of Grik, CL 2077. 13. *N. sigaloeis* La Rivers, specimen from Vietnam, Đông Nai Prov., Nam Cát Tiên National Park. 14. *N. sumatrensis* Fieber, holotype from Sumatra (after Zettel, 2011).

angles blunt, rounded. **Scutellum** medium brown, rugulose, anterior margin narrowly transversely depressed, width/length (midline) = 1.20/0.70, basal and lateral margins very broadly and weakly sinuate. **Hemelytra** dark blackish-brown, rugulose, basal half of embolium translucent golden yellow, posterior margin of this pale area forming a straight line perpendicular to embolar margin; clavus and corium well defined, membrane completely developed; tips of hemelytra broadly rounded, extending nearly to apex of genital segment; embolium demarcated by broadly arcuate furrow along inner margin, lateral margin lacking setae or spinules.

Abdomen with lateral portions of segments II–IV very slightly exposed beyond lateral wing margins when viewed dorsally, all visible paratergites pale golden yellow, dark brown on posterior thirds, posterolateral angles symmetrical, not produced, lateral margins bearing short golden setae.

Ventral surface pale brown, bearing very fine, appressed golden setae, long golden setae present on central sections of mesosternum and abdominal ventrites I–VII; propleura not reflexed posteriorly, barely covering basolateral portions of mesosternal plate, anterolateral angles lacking hydrostatic sense organs; mesosternal plate with anteromedial section raised into a roughly conical tumescence, this anterior tumescence separated by a low sulcus from the broadly tumescent posteromedial section of plate; metasternal plate small, medially carinate. Abdominal sternites and parasternites delineated by distinct sutures; all parasternites dull brown, each with 2 ovate glabrous patches.

Legs pale yellow; fore coxa and trochanter lacking hair pads; anterior femur greatly expanded, concave anteroventrally, pale yellow marked with scattered light brown spots posteroventrally, bearing a thick fringe of short, dense gold setae along anterior margin, posterior margin lacking setae; anterior tibia broadly curving, tapering distally, ventral margin lacking setal pads; anterior tarsi one segmented, bearing one tiny claw, ventral tarsal surfaces lacking hair pads; middle and hind femora each bearing a longitudinal row of tightly packed, tiny reddish spinules along posterior margins; middle and hind tibiae bearing numerous short, stout reddish-brown spines, posterior margin of hind tibia with fringe of long gold swimming hairs.

Male genitalia with parameres asymmetrical (Figs. 7, 8); phallosome slender, elongate, asymmetrical, apex acute (Fig. 9); proctiger elongate (Fig. 10). **Female subgenital plate** roughly trapezoidal, distal section elongate and parallel sided, posterior margin broadly rounded (Fig. 11).

Brachypterous form: Unknown.

Distribution. — Currently known only from Singapore.

Discussion. — *Naucoris minutus* is the smallest species of *Naucoris* so far known from Southeast Asia. The shapes of the parameres are distinctive (Figs. 7, 8), and in combination with the shape of the female's subgenital plate (Fig. 11) and small body size easily separate this species from other Southeast Asian congeners.

Naucoris scutellaris Stål, 1860

(Figs. 5, 6, 12)

Naucoris scutellaris Stål, 1860: 266

Thurselinus greeni Distant, 1904: 33; syn. by Lundblad, 1933: 65
Naucoris rhizomatus J. Polhemus, 1984: 157. **New synonymy.**

Material examined. — SINGAPORE: 1 male, 1 female, Lower Fort Peirce Forest, standing pool in stream, 13 Jul.1990 (ZRC); 2 females, Bukit Batok Nature Reserve Park, 7 Nov.1990, coll. K. L. Yeo, YKL0704 (ZRC); 1 female, Chestnut Drive, Selatar Reservoir, "F" Stream, 16 May 1994, coll. T. B. Lim et al., NS133B (ZRC). MALAYSIA, **Perlis:** 1 female, Sintok–Padang, Senai Road, 13 Feb.1997, coll. H. K. Lua, LHK0330 (ZRC). **Pahang:** 2 females, Lake Chini, on shore near chalet, 14 Apr.1997, coll. K. L. Yeo, YKL901P (ZRC); 1 female, 71 km to Kuantan, 15 May 1995, coll. B. Tan and G. Sumita, TG01 (ZRC). **Johor:** 1 female, Sungai Selangi, 28 Apr.1943, coll. C. M. Yang et al., Y827 (ZRC); 1 male, swamp forest stream 15 km W. of Sedili Besar, 20 m., 16 Oct.1986, CL 2218, coll. D. A. & J. T. Polhemus (JTTC); 2 males, swamp forest stream 12 km N. of Labis, nr. Ayer Panas, 22 Aug.1985, CL 2087, coll. J. T. & D. A. Polhemus (JTTC). **Malacca:** 1 male, south of Malacca, polluted ditch, 29 Oct.1963 (ZRC); 1 female, Jasin–Kesang Tua road, Station 1, 5 Nov.1966 (ZRC). **Trengganu:** 1 male, Kuala Arang, 16 May 1995, coll. B. Tan & G. Sumita, TG05 (ZRC). **Perak:** 1 male, 4 females, stream 58 km S. of Grik, 19 Aug.1985, CL 2077, coll. J. T. & D. A. Polhemus (JTTC); 2 males, 2 females, Kerunai River, 9 km N. of Grik, 19 Aug.1985, CL 2078, coll. J. T. & D. A. Polhemus (JTTC).



Fig. 15. *Naucoris minutus*, new species, male, colour photo of dorsal habitus. Specimen from Singapore, Chestnut Drive.

Extralimital material examined. — INDONESIA, **Bengkulu Prov.:** 3 males, 3 females, 1 immature, Sumatra, Hutabarna River and trib. at Tabarenah, 7 km W. of Curup, 600 m, 7 Sep.1991, CL 2582, coll. D. A. & J. T. Polhemus (JTPC). THAILAND, **Chiang Mai Prov.:** 1 male, 1 immature, stream 10 km NW of Mae Rim, 19 Nov.1985, CL 2204, coll. D. A. & J. T. Polhemus (JTPC); 2 males, 2 females, Fang Dist., ponds at Fang Horticultural Station, 500 m, 15 Nov.1985, CL 2201, coll. J. T. & D. A. Polhemus (JTPC). **Nakhon Ratchasima Prov.:** 8 males, 10 females, Sakaerat Exp. Station, 60 km S. of Nakhon Ratchasima, 300–600 m., 14°30'N, 101°55'E, 2–4 Mar.1971, coll. P. & P. Spangler (USNM); 3 females, 1 km. S. of Phi Mai, 15°14'N, 102°31'E, 10 Mar.1971, coll. P. & P. Spangler (USNM). VIETNAM, **Nghe An Prov.:** 1 male, Pu Mat Nature Reserve, Bac Stream, 2 Apr.2000, CL 4388, coll. P. Nguyen & J. T. Polhemus (JTPC); 1 male, Pu Mat Nature Reserve, Kem Waterfall, 400 m, 1 Apr.2000, CL 4385, coll. P. Nguyen & J. T. Polhemus (JTPC). **Kontum Prov.:** 15 males, 15 females, Ialing Rapids, 64 km SW of Kontum, 4 km W. of Ialy, 500 m, 14°12'02"N, 107°48'42"E, water temp. 24°C, 8 Mar.2001, CL 4285, coll. J. T. Polhemus & P. Nguyen (JTPC). **Gia Lai Prov.:** 2 females, Voi River, 2.5 km N. of An Khe on Kanat road, 430 m, 13°59'15"N, 108°40'54"E, water temp. 24°C, 14 Mar.2001, CL 4295, coll. J. T. Polhemus and P. Nguyen (JTPC). LAOS, **Khamouane Prov.:** 1 male, Phon Tiou, 11 Jun.1965, coll. N. Wilson (BPBM). BURMA, **Sagaing Division:** 1 female, Kanbalu Township, Chatthin Wildlife Sanctuary, pools along Chaung Mito stream at Line Three Camp, 165 m, 23°32.446'N, 95°36.794'E, water temp. 28°C, 9 Oct.1998, CL 4007, coll. D. A. & J. T. Polhemus (JTPC); 1 male, Kanbalu Township, Chatthin Wildlife Sanctuary, forest pond 1.5 km W. of San Myaung Camp, 230 m, water temp. 28°C, 9 Oct.1998, CL 4008, coll. D. A. & J. T. Polhemus (JTPC). **Mandalay Division:** 1 male, Maymyo Township, Gelaung River at Pwe Kauk Falls, 8 km E. of Maymyo, 1005 m, 22°03.523'N, 96°31.956'E, water temp. 24.5°C, 19 Oct.1998, CL 4008, coll. D. A. & J. T. Polhemus (JTPC).

Diagnosis. — Length 6.5–7.2 mm, maximum width (across abdomen) 4.1–4.5 mm. Head and pronotum dull yellowish-brown variably maculated with scattered darker brown markings, anterior pronotal margin with two small dark spots medially, lateral pronotal margins explanate, each with a pair (1+1) of widely separated, small dark patches; hemelytra brown, with basal half of embolium broadly dark yellow, wing membrane black; abdominal laterotergites dark yellow on anterior halves, dark brown on posterior halves, creating a striped appearance. This species may be recognised by its moderate size, dull head and pronotum, explanate lateral pronotal margins, the fully developed wing membrane of the hemelytra, the shape of the female subgenital plate (Fig. 12), and the distinctive male parameres (Figs. 5, 6).

Distribution. — Originally described from Java, with subsequent records from Ceylon, India, Thailand, Peninsular Malaysia (Johor), Java, Sulawesi, the Philippines (Fernando & Cheng, 1974; Zettel et al., 1999) and Australia (J. Polhemus, 1984, as *N. rhizomatus*). The records below are the first published for Singapore and the Peninsular Malaysian states of Perlis, Perak, Pahang, and Malacca.

Discussion. — *Naucoris scutellaris* is a widespread species in both lotic and lentic habitats throughout the lowlands of Southeast Asia, where it can be found along the margins of ponds and slow moving stream pools; for further discussion see Zettel et al. (1999). Within a given series from a single

locality there can often be significant inter- and intrasexual variations in body size and wing development, but the distinctively broad body shape of this species, which is widest across the base of the abdomen and then tapers to an angular point at the posterior terminus of the abdomen, allows quick recognition of this taxon in the field.

The distinctive structures of the male genitalia were figured by Lundblad (1933, Figs. 19F–H), and again by Zettel et al. (1999, Figs. 22–24), and a dorsal habitus figure was provided by Chen et al. (2005, Fig. 119). We have dissected paratypes of *N. rhizomatus* J. Polhemus, and determined that the male parameres are identical to those of *N. scutellaris*; we therefore place the former species in synonymy.

Naucoris sigaloeis La Rivers, 1974

(Figs. 1–4, 13)

Naucoris sigaloeis La Rivers, 1974: 4

Extralimital material examined. — THAILAND, **Nakhon Sawan Prov.:** 2 males, 1 female, Bung Borapet, Sep.1971, coll. J. K (paratypes, JTPC). **Nakhon Ratchasima Prov.:** 5 male, 5 females, Sakaerat Exp. Station, 60 km S. of Nakhon Ratchasima, 300–600 m, 14°30'N, 101°55'E, 2–4 Mar.1971, coll. P. & P. Spangler (USNM). **Khon Kaen Prov.:** 1 female, Ubolratana Dam, 20 km W. of Mae Nam Pong, 16°46'30"N, 102°36'30"E, 10 Mar.1971, coll. P. & P. Spangler (USNM). **Prov. uncertain:** 1 male, NE Thailand, 10 Jan.1953, FN 537, coll. M. E. Griffith (JTPC). VIETNAM, **Dông Nai Prov.:** 4 males, 3 females, Nam Cát Tiên National Park, Crocodile Lake, ~ 100 m, 11°27'25"N, 107°20'58"E, 5 May 1998, CL 3071, coll. J. T. Polhemus (JTPC).

Diagnosis. — Length 7.0–8.2 mm, maximum width (across abdomen) 4.2–4.5 mm (Fig. 1). Head and pronotum shiny, yellowish brown with numerous scattered, small, medium brown spots, these spots aggregated in posteriomedial section of pronotum to form larger medium brown maculations to either side of longitudinal midline, anterior pronotal margin with a small brown spots medially, lateral margins of pronotum not explanate, lacking darker markings; scutellum and hemelytra yellowish brown, heavily flecked with medium brown with basal half of embolium broadly dark yellow, wing membrane attenuated, dark brown; abdominal laterotergites dark yellow on anterior two-thirds, dark brown on posterior one-third, creating a striped appearance. Male genitalia with left paramere stout, apex blunt (Fig. 2), right paramere slender, twisted, apex rounded, phallosome as in Fig. 4; female subgenital plate elongate, roughly trapezoidal, apex truncate (Fig. 13).

Distribution. — Originally described from Bung Borapet, Thailand, and newly recorded from Vietnam herein.

Discussion. — This species may be recognised by its relatively large size for the genus, shiny head and pronotum, absence of explanate lateral margins on the pronotum (Fig. 1), the reduced wing membrane of the hemelytra, the shape of the female subgenital plate (Fig. 13), and the distinctive male genitalic structures (Figs. 2–4). This shiny, chestnut brown

species is known from Thailand and Vietnam, and may also possibly occur in the extreme northern portion of Peninsular Malaysia. It has been collected from both lotic and lentic habitats, including slow stream pools and shallow, standing waters along the margins of lakes, including the Crocodile Lake in southern Vietnam and Bung Borapet in Thailand.

***Naucoris sumatranus* Fieber, 1851**
(Fig. 14)

Naucoris sumatrana Fieber, 1851: 17
Naucoris sumatranus: Lundblad, 1933: 63

Diagnosis. — Length 8.0 mm, maximum width (across abdomen) 4.9 mm. Head and pronotum dull yellowish-brown variably maculated with scattered darker brown markings, but lacking medial spots, lateral pronotal margins not explanate, lacking dark patches; scutellum predominantly dark brown, with mesoscutum bearing transverse yellowish brown patches to either side of midline; hemelytra medium brown, with basal half of embolium broadly dark yellow, wing membrane black; abdominal laterotergites uniformly yellowish-brown, without darker markings; female subgenital plate only moderately long, posteriorly truncate, posterior margin slightly concave medially (Fig. 14); male unknown.

Distribution. — Originally described from Sumatra according to Fieber (1851), and so far known only from that island. Zettel (2011) examined the holotype and noted that a Montandon label on the specimen indicates some skepticism as to whether the holotype specimen originated in Sumatra, but offers no alternative geographic origin. Assuming that the original type locality of Sumatra is correct, this species could potentially occur in Singapore or southern Peninsular Malaysia.

Discussion. — Fieber's original description of this species is brief and deals only with details of colouration. This species was also listed by Lundblad (1933) in his work on the aquatic Heteroptera of Java, Sumatra and Bali, but not discussed or illustrated. Zettel (2011) located the female holotype in the Vienna Museum and provided a useful and detailed redescription. Based on this and the figures provided, *N. sumatranus* may be recognised by its dull head and pronotum, lack of explanate lateral pronotal margins, dark scutellum, uniformly pale brown abdominal laterotergites, and truncate female subgenital plate (for illustrations of these structures see Zettel, 2011).

Subfamily LACCOCORINAE Stål, 1876

Discussion. — The subfamily Laccocorinae may be recognised by its distinctive head morphology, with the labrum displaced posteriorly beneath the folded anterior margin, and occurs in all tropical regions of the world except Australia, New Guinea, and the Pacific Islands. As currently interpreted, the subfamily contains 10 genera, with two of these endemic to Africa and Madagascar (*Temnocoris*,

Aneurocoris), three endemic to Asia (*Diaphorocoris*, *Namtokocoris*, *Pogonocaudina*), two endemic to the Western Hemisphere (*Decarlea*, *Interocoris*), two shared between Africa and Asia (*Laccocoris*, *Heleocoris*), and one (*Ctenipocoris*) occurring in Africa, Asia, and South America (J. Polhemus & D. Polhemus, 2008a).

Most descriptions of the Southeast Asian *Heleocoris* and *Laccocoris* species date from the 1890–1910 period, and the types are widely scattered in many different European museums, which has hindered revisionary work. A regional treatment of *Heleocoris* for Thailand was provided by Sites & Vitheepadit (2011), including the description of a new species, but the last complete key to *Heleocoris* was that of Montandon (1897b). The species of *Laccocoris* have never been keyed. The other two genera in the region, *Ctenipocoris* and *Namtokocoris*, each have fewer species and have been the subject of recent taxonomic work, with a key to species available for the latter genus (Sites & Vitheepadit, 2007), and a key to Asian *Ctenipocoris* species provided herein.

KEY TO GENERA OF LACCOCORINAE
occurring in Singapore, Peninsular Malaysia, and
immediately adjacent areas

1. Fore tarsi in both sexes two-segmented, bearing two large apical claws (Fig. 16); male phallosome symmetrical (Fig. 18).....
..... *Ctenipocoris*

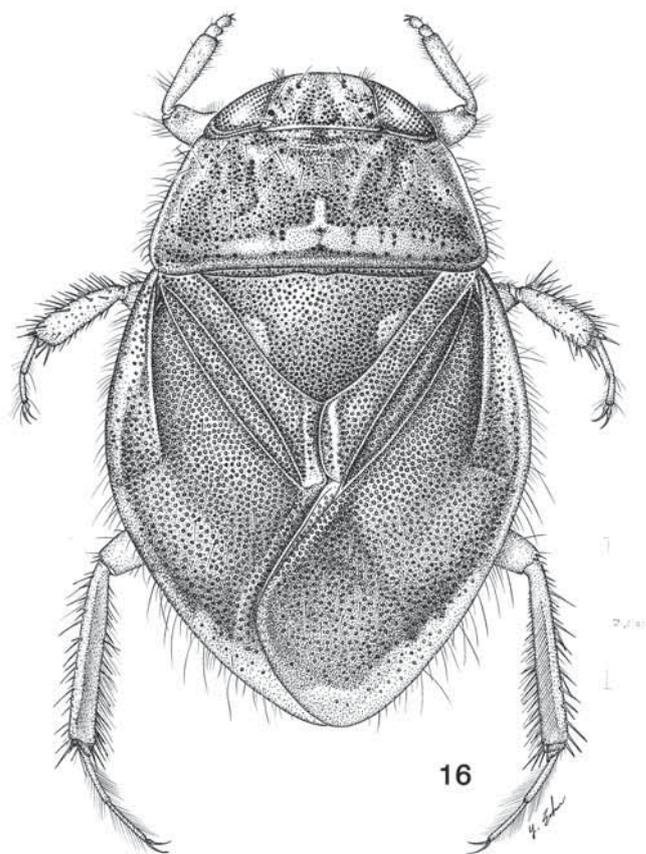


Fig. 16. *Ctenipocoris asiaticus* Montandon, female, dorsal habitus, specimen from Vietnam, Lam Dong Prov., nr. Lan Hanh, CL 3094 (Young Sohn illustration).

- Fore tarsi either one- segmented in both sexes, or two-segmented in males only; male phallosome asymmetrical.....2
- 2. Fore tarsi in both sexes one-segmented, bearing only a single apical claw (Fig. 22).....*Namtocoris*
- Fore tarsi two-segmented in males, one-segmented in females, bearing two small apical claws in both sexes (Fig. 23).....*Heleocoris*

Genus CTENIPOCORIS Montandon, 1897

Discussion. — This distinctive genus may be recognised by the strong anterior convergence of the eyes, with the minimum interocular distance being reached ventrally, beneath the apex of the head (Figs. 16, 17); the short legs set with stout, stubby spines (Fig. 16); the narrow, spine-like metaxyphus; and the maxillary plates with tufts of long setae arising from their margins and cradling the rostrum. The body is less strongly dorsoventrally flattened than in other members of the Laccocorinae, and the eyes as viewed from above are nearly triangular in shape (Fig. 16). The fore femur is small and stubby in relation to the tibia, being only weakly incrassate, and the apex of the foreleg bears two tarsal segments in both sexes, with two large apical claws. The male phallosome is symmetrical (Fig. 18), unlike the asymmetrical character state exhibited in *Heleocoris* and *Laccocoris*, and the parameres are elongate and unmodified (Figs. 18, 20).

Ctenipocoris was formerly considered to be an exclusively Paleotropical genus, but various Neotropical species previously held in *Heleocoris* have now been re-assigned to it (D. Polhemus, 1987; López Ruf, 2004; J. Polhemus & D. Polhemus, 2008). In Asia the genus is represented by a widespread species, *C. asiaticus*, which occurs in Singapore and Peninsular Malaysia. A second species, *C. sinicus*, was recently described from China based on a single female specimen (Zettel, 2012).

KEY TO SPECIES OF CTENIPOCORIS

occurring in Southeast Asia

(based on characters presented in Zettel, 2012)

- 1. Smaller species, body length 7.9–8.4 mm, width of pronotum 3.9–4.2 mm; sides of pronotum curving weakly downward, ventral pronotal surface nearly flat *C. asiaticus* Montandon
- Larger species, body length 9.4 mm, width of pronotum 4.7 mm; sides of pronotum curving strongly downward, ventral pronotal surface distinctly concave..... *C. sinicus* Zettel

***Ctenipocoris asiaticus* Montandon, 1897**

(Figs. 16–20)

Ctenipocoris asiaticus Montandon, 1897a: 374

Material examined. — SINGAPORE: 1 immature, Lower Peirce Forest, stream ‘E’, pool under bamboo, coll. D. H. Murphy, 31 Oct. 1991 (ZRC); 1 male, Bukit Timah Nature Reserve, 6 Dec. 1995, coll. H. K. Lua, NS 204 (ZRC); 1 immature, McRitchie Reservoir, SICC, nr. Plot #4, 28 May 1993, NS104 (ZRC); 1 male, Sime Road, 24 Apr. 1996 (ZRC); 1 male, Nee Soon swamp forest and drain,

13 Oct. 1986, CL 2214, coll. D. A. & J. T. Polhemus (USNM). MALAYSIA, **Pahang:** 1 male, Kuala Lipis, small streamlet leading to Sungai Jelai, 11 Apr. 1997, coll. K. L. Yeo, YKL901E (ZRC). **Selangor:** 1 female, 5 immatures, Ulu Gombak [upper Gombak River], 15 Nov. 1995, coll. C. M. Yang, YCM78 (ZRC). **Johor:** 1 male, Gunung Pulai, 4 Mar. 1992, coll. C. M. Yang & K. L. Yeo, Y781A (ZRC); 1 female, Mawai–Sedili, 6 km, 29 Apr. 1961, coll. Fernando (JTPC).

Extralimital material examined. — INDONESIA, Java, **Jawa Barat Prov.:** 1 male, Bandoeng [Bandung], 700 m., 28 Jun. 1940, coll. J. Olthof (LIPI); 1 female, same locality but 750 m., 10 Jul. 1938, coll. F. C. Drescher (LIPI). MALAYSIA, Borneo, **Sabah:** 1 female, Mt. Trus Madi, 1800 ft., 18–28 Aug. 1977, coll. M. E. Bacchus (BMNH). VIETNAM, **Lam Dong Prov.:** 2 females, Lam Dong Prov., small stream nr. Lan Hanh, 31 km E. of Di Linh, 825 m., 11°36'15"N, 108°19'17"E, water temp. 24°C, 27 Mar. 2001, CL 3094, coll. J. T. Polhemus (USNM). **Kontum Prov.:** 1 male, 1 female, stream in dry forest hills 29 km NE of Kontum on Hwy. 24, 565 m., 14°27'01"N, 108°09'12"E, water temp. 20.5°C, 19 Mar. 2001, CL 4284, coll. D. A. Polhemus, J. T. Polhemus & P. Nguyen (JTPC); 1 male, stream in laterite hills 70 km NE of Kontum on Hwy. 24, 1100 m, 14°36'48"N, 108°20'24"E, water temp. 27°C, 20 Mar. 2001, CL 4306 coll. D. A. Polhemus, J. T. Polhemus & P. Nguyen (JTPC). **Gia Lai Prov.:** 1 male, Canh Stream, small trib. to Ngoe Ba River, 12 km S. of An Khe, 455 m., 13°53'24"N, 108°35'00"E water temp. 27°C, 11 Mar. 2001, CL 4289, coll. J. T. Polhemus & P. Nguyen (JTPC). **Bac Kan Prov.:** 1 female, Ba Be Nat. Park, riverside spring nr. Ba Be Falls, 170 m, 22°25'N, 105°38'E, water temp. 20.5°C, 20 Mar. 2000, CL 4364, coll. J. T. Polhemus & P. Nguyen (JTPC). THAILAND, **Chiang Mai Prov.:** 1 male, stream 10 km NW of Mae Rim, 19 Nov. 1985, CL 2204, coll. D. A. & J. T. Polhemus (JTPC). LAOS, **Vientiane Prov.:** 1 male, Ban Van Eue, 30 Nov. 1965, coll. native collector (BPBM).

Diagnosis. — Male length 7.8–8.7 mm, maximum width (across abdomen) 4.5–5.1 mm; female length 8.2–8.3 mm, maximum width (across abdomen) 4.7–5.0 mm. Body form ovate (Fig. 16); head and pronotum shining yellowish brown; eyes triangular when viewed from above, reaching greatest degree of anterior convergence ventrally (Fig. 17); pronotum with lateral margins narrowly explanate; scutellum shining reddish brown, lateral margins dark yellow, entire scutellar surface bearing numerous tiny pale punctures; hemelytra dull dark brown, bearing numerous tiny pale punctures, outer portion of embolium translucent pale brown, wing membrane poorly defined, venation not evident, hemelytral corium and wing membrane bearing scattered fine, pale, recumbent setae, these setae more numerous on wing membrane; abdominal laterotergites medium brown, bearing long, fine, golden setae, lacking spines; legs short, stubby, bearing short, stout spines. Male phallosome symmetrical (Fig. 18); male parameres symmetrical, elongate (Figs. 18, 20).

Distribution. — *Ctenipocoris asiaticus* was originally described by Montandon (1897) from a single specimen taken in Burma by Fea in 1888. Based on Fea’s notes in the Genoa Museum, the type locality of Carin, “Asciui Chebà” lay at 1200–1300 m. in the modern Karen state of Burma, somewhere in the vicinity of Leito. A number of Fea’s localities, including “Asciui Chebà”, refer the territories occupied by tribal divisions of the Karen people, rather than to specific towns or localities. Therefore “Chebà” pertains to this tribe of the Karen, also known as the Biapo. Montandon’s

type specimen was subsequently figured by Distant (1906) in the *Fauna of British India*; the specimen is deposited in the Genoa Museum, is in good condition, and has been examined by the authors.

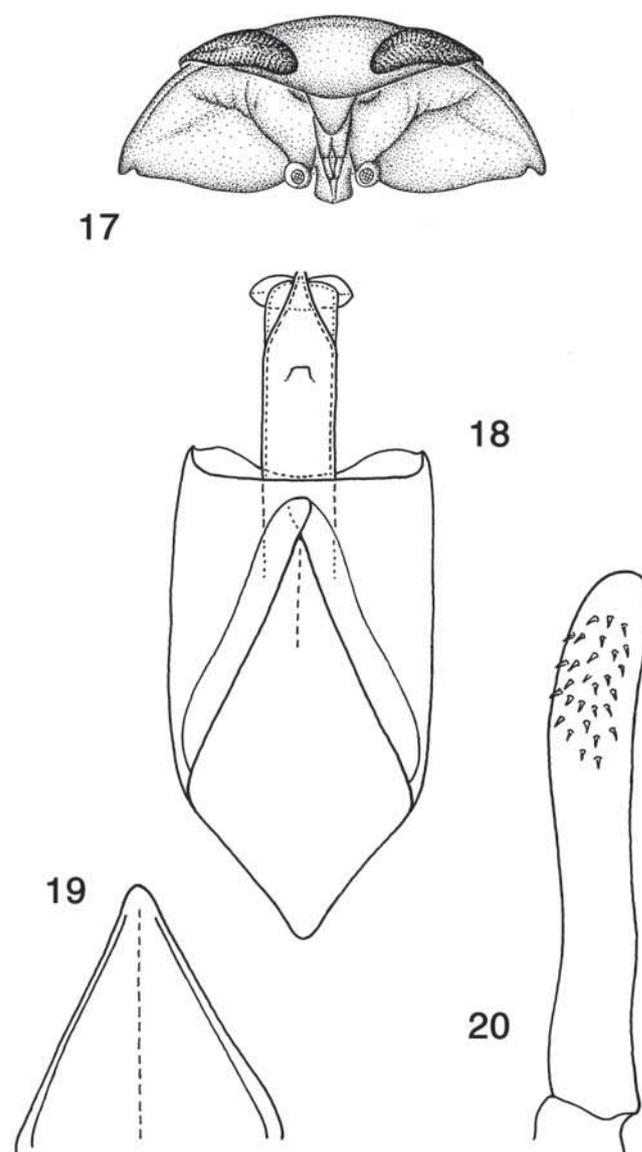
Based on our current concept of this species, it is widespread in Southeast Asia, from Burma through Indochina and the Malay Peninsula to the Greater Sunda Islands. Fernando & Cheng (1974) recorded this species from Peninsular Malaysian state of Johor. We provide new records for Singapore and the Peninsular Malaysian states of Pahang and Selangor, as well as additional records from Thailand and Vietnam. Based on our experience, *C. asiaticus* is an uncommonly encountered species, and most of the material we have seen consists of singletons or pairs taken from widely scattered localities.

Discussion. — This species may recognised by its distinctive head morphology, with eyes that are triangular when viewed from above and reach their greatest degree of inner convergence on the ventral side of the head (Figs. 16, 17), the distinctive male genitalic structures, particularly the symmetrical phallosome (Figs. 18–20), and the short, posteriorly truncate female subgenital plate (Fig. 21).

Ctenipocoris asiaticus is a relatively small, ovate naucorid, typically found along the margins of swamp forest streams and other slow water lotic habitats. It is easily separated from the superficially similar *Heleocoris montandoni*, with which it sometimes co-occurs, by the unusual structure of the eyes (see previous discussion); the very stout reddish spines on the middle and hind tibiae; the rather stubby forelegs which bear two apical claws in both sexes; the symmetrical male phallosome (compare Figs. 18 and 25); the well-developed male parameres; and the shape of the female subgenital plate (compare Figs. 21 and 31).

Genus *NAMTOKOCORIS* Sites, 2007

Discussion. — The genus *Namtokocoris* is endemic to Indochina, being represented by five species (Sites & Vithepradit, 2007). Members of the genus inhabit seeping rheocrenes, often in proximity to waterfalls, and are easily recognised by the character states of the foreleg, the apex of which bears only a single tarsal segment in both sexes with only a single apical claw present (Fig. 22); by the anteriorly divergent interocular space (Fig. 22); and by the prominent scutellar tubercles. Although currently unknown south of the Isthmus of Kra, *Namtokocoris* does occur in the southern peninsula of Thailand, therefore one or more species of could conceivably occur in the mountains of the northern Peninsular Malaysia, where they should be searched for on vertical or sloping wet bedrock faces. Previous records of the Indian and Ceylonese genus *Diaphorocoris* from Indochina, based on a single female unidentified as to species (Chen et al., 2005), are in fact referable to *Namtokocoris* (Sites & Zettel, 2011).



Figs. 17–20. *Ctenipocoris asiaticus* Montandon, structural details, specimen from Vietnam, Lam Dong Prov., nr. Lan Hanh, CL 3094. 17. Head, ventral view. 18. Male phallosome. 19. Medial process of male phallosome. 20. Male left paramere.

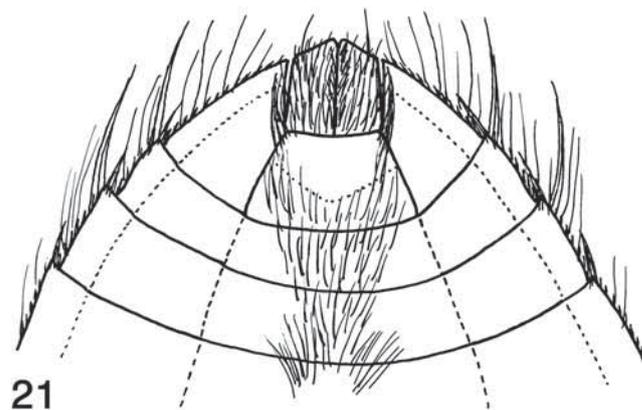


Fig. 21. *Ctenipocoris asiaticus* Montandon, female terminal abdomen showing shape of subgenital plate, specimen from Malaysia, Johor, Mawai-Sedili.

Genus HELEOCORIS Stål, 1876

Discussion. — The type-species of *Heleocoris* is *H. obliquatus* Spinola, described from Bombay, and designated by Stål (1876) as the genotype. The genus contains 29 species, of which 14 occur in southern and southeastern Asia, 11 in India, and 3 in Madagascar (J. Polhemus & D. Polhemus, 2008a). The one Neotropical species still held in this genus, *Heleocoris plaumanni* De Carlo, is assigned here on a provisional basis pending examination of further material, with all other Neotropical taxa formerly placed in *Heleocoris* having been transferred to *Ctenipocoris* (J. Polhemus & D. Polhemus, 2008b). Of the 14 Southeast Asian taxa, four are known from continental Southeast Asia, nine from the Sunda Islands, and one from the Philippines. The generic limits of *Heleocoris* in relation to the closely related genus *Laccocoris* are poorly constrained, and certain Asian species currently held in the latter genus may eventually prove to be more properly assigned to *Heleocoris*.

The apex of the foreleg in *Heleocoris* bears two tarsal segments in males and only a single segment in females, with two small apical claws present in both sexes. The male phallosome is asymmetrical, and its shape is useful for species separation (Figs. 24–28). The male proctiger is relatively large, roughly triangular, and lies over the top of the phallosome in the intact genital capsule; its shape may also be useful for species discrimination (Figs. 29, 30), and care should be taken not to damage it during dissection. The male parameres are highly reduced and often inconspicuous (Figs.

24–28), but their shapes are also interspecifically distinctive. In certain species, male left paratergite VI may also bear a distinctive lateral process (Figs. 34, 35). The female subgenital plate is roughly trapezoidal, and its shape is once again useful for species separation (Figs. 31, 32), although this structure is often thickly covered with long gold hairs which may create difficulty in ascertaining its precise details.

KEY TO MALES OF HELEOCORIS SPECIES

occurring in Singapore, Peninsular Malaysia, and adjacent Indochina

1. Small species, body length 8 mm or less *H. montandoni* Lundblad
 - Larger species, body length exceeding 9 mm 2
2. Embolium strongly produced laterally, posterolateral margin cut sharply inward, projecting markedly beyond remaining hemelytral margin (Fig. 23); apex of male phallosome bluntly rounded, lacking prominent lobes (Fig. 28) *H. strabus* Montandon
 - Embolium not strongly produced laterally, posterolateral margin merging smoothly and evenly with remaining hemelytral margin; apex of male phallosome either acute, or bearing prominent projecting lobes (Figs. 24, 26, 27) 3
3. Male left paratergite VI bearing a hooked process laterally (Fig. 34); male phallosome with elongate distal lobe (Fig. 24); Peninsular Malaysia *H. malayensis*, new species
 - Male left paratergite VI bearing a blunt process laterally (Fig. 35); distal lobe of male phallosome shorter (Fig. 27); Indochina *H. ovatus* Montandon

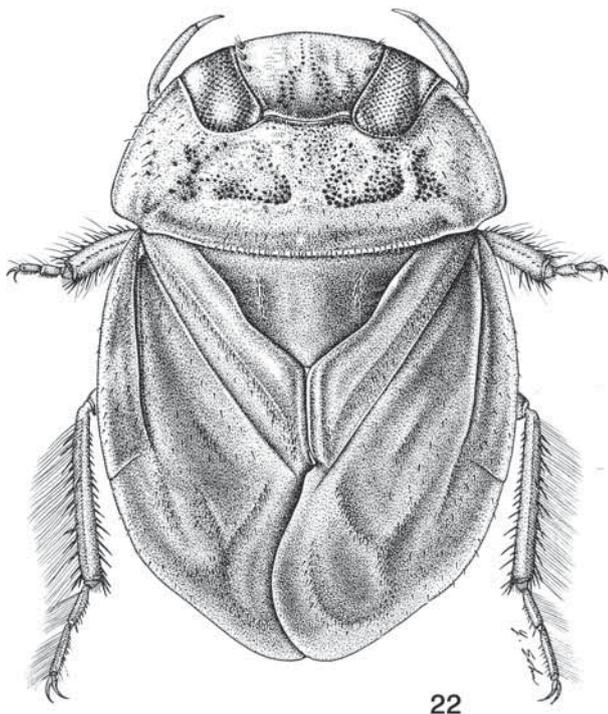


Fig. 22. *Namtokocoris kem* Sites & Vitheepadit, male, dorsal habitus, specimen from Vietnam, Quang Ngai Prov., Via Lac Pass (Young Sohn illustration).

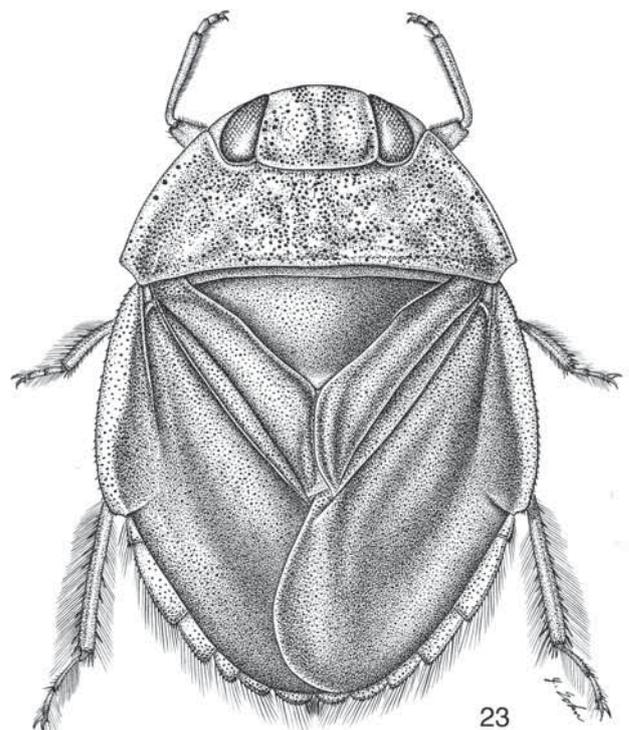


Fig. 23. *Heleocoris strabus*, male, dorsal habitus, specimen from Burma, Kachin Dist, S. of Putao (Young Sohn illustration).

***Heleocoris montandoni* Lundblad, 1933**

(Figs. 25, 31)

Heleocoris bengalensis montandoni Lundblad, 1933: 70*Heleocoris montandoni*: Chen et al., 2005: 418

Material examined. — SINGAPORE: 1 male, 1 female, Nee Soon Swamp Forest, 18 Jun.1994, coll. H. K. Lua et al., NS162A (ZRC); 1 male, Bukit Timah Nature Reserve, Taban Valley, 26 Oct.2001, coll. M. S. Choy, CMS0104 (ZRC); 1 male, Pulau Tekong, fresh water stream, 27 Nov.2001, YCM273 (ZRC); 3 females, Nee Soon Swamp Forest, 3 May 1994, NS 1279 (ZRC); 1 male, Selatar Reservoir Park, stream, 10 May 1991, coll. C. M. Yang et al., YKL0753 (ZRC). MALAYSIA, **Penang**: 1 male, Sungai Relau (upper reaches), Kampung Darat, 9 Jun.1993, coll. H. H. Tan & S. H. Tan, Y848 (ZRC). **Johor**: 1 male, Gunung Pulai, 20 May

1993, Y833 (ZRC). **Perak**: 2 females, stream 58 km S. of Grik, 19 Aug.1985, CL 2077, coll. D. A. & J. T. Polhemus (JTPC).

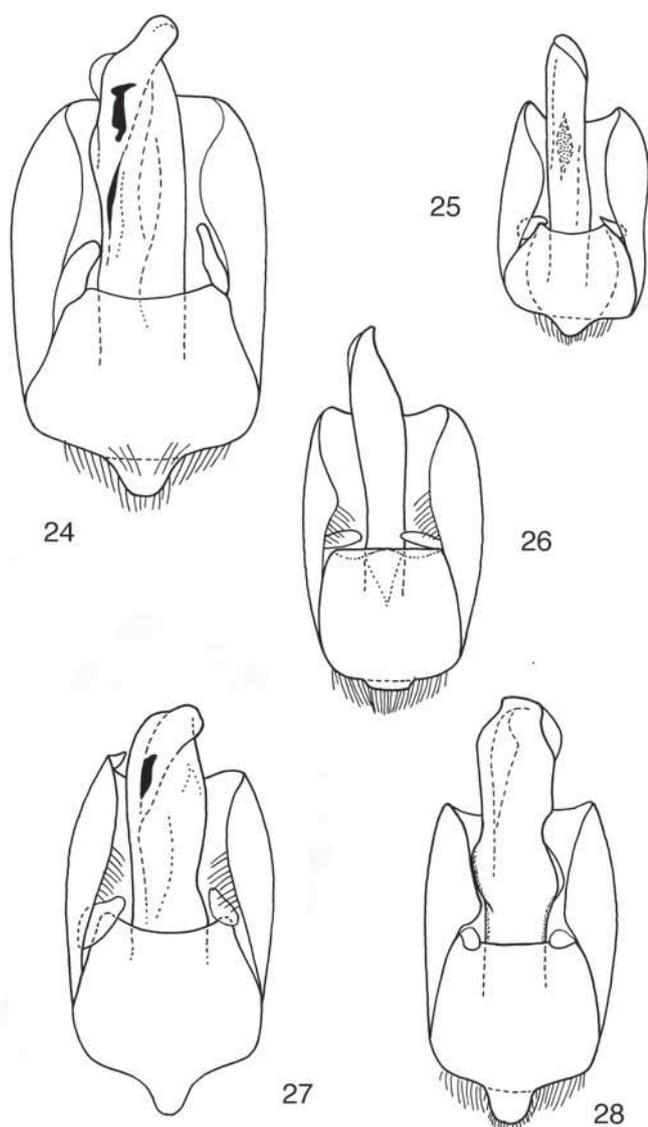
Extralimital material examined. — INDONESIA, **Jambi Prov.**: 2 males, Sumatra, Jambi, stream crossing road 40 km towards Bajubang from Jambi, 1°47'47"S, 103°25'23"E, 24 Jul.1997, THH9741, coll. H. H. Tan (ZRC). **Riau Islands Prov.**: 1 male, Pulau Bintan, TT3 (ZRC); 1 female, Pulau Bintan, TT2 (ZRC). **Kalimantan Barat Prov.**: 1 male, Anambas Is. [Natuna Archipelago], S. Pulau Bajau, 19 Mar.2002, EA_DW14, coll. D. Wowor (ZRC). VIETNAM, **Lam Dong Prov.**: 1 female, small stream nr. Lan Hanh, 31 km E. of Di Linh, 825 m., 11°36'15"N, 108°19'17"E, water temp. 24°C, 27 Mar.2001, coll. D. A. Polhemus, J. T. Polhemus & P. Nguyen (JTPC).

Diagnosis. — Length 7.6–9.5 mm, maximum width (across abdomen) 4.8–5.9 mm, general body form ovate. Head and pronotum dull yellowish brown, spotted and maculated with dark brown or black; scutellum uniformly dark brown; hemelytra finely rugulose, dark reddish brown, except anterolateral half of embolium translucent yellow, wing membrane black, poorly defined, venation obscure; abdominal laterotergites translucent yellow on anterior three-quarters of each, dark brown on posterior one-quarter of each, creating a striped appearance. This species may be recognised by its small size for the genus (body length less than 10 mm), the predominantly dark hemelytra which lack yellow markings except on the outer section of the embolium, the distinctive male genitalic structures (Fig. 25), and the shape of the female subgenital plate (Fig. 31).

Distribution. — Originally described from Sumatra and Java (Lundblad, 1933). Sites & Vithepradit (2011) recorded this taxon (as *H. bengalensis montandoni*) from Thailand, Laos, Vietnam, Malaysia (Johor, Penang, Kedah), Singapore, Java, Sumatra, and Anambas Island. As noted below, there are morphological variations in the male genitalia that suggest multiple species may exist across this geographic range.

Discussion. — This is a small *Heleocoris* species that is widespread in Singapore and Peninsular Malaysia, occurring amid leaf packs along small streams. It is occasionally syntopic with the superficially similar *Ctenipocoris asiaticus*, but may be easily separated by the characters given in the key to genera of Laccocorinae, and discussed further under *C. asiaticus*. In particular, the asymmetrical male phallosome (Fig. 25) of *H. bengalensis* is quite unlike the symmetrical male phallosome of *C. asiaticus* (Fig. 18). The eyes of both species are triangular when viewed from above, but in *H. montandoni* they do not fold under the head and reach their greatest point of convergence ventrally, as is the case in *C. asiaticus* (Figs. 16, 17).

Heleocoris bengalensis was described by Montandon (1910) from specimens taken in India from the Manbhum district of what is now West Bengal, immediately west of Calcutta. The populations conforming to the broad concept of *Heleocoris bengalensis* are widely distributed from India (Distant, 1910; Montandon, 1910) eastward through Southeast Asia to the Greater Sunda Islands (Lundblad, 1933; Sites & Vithepradit, 2011). There are subtle localised variations in



Figs. 24–28. *Heleocoris* species, male phallosome. 24. *Heleocoris malayensis*, new species, specimen from Malaysia, Terengganu, Sungai Brang. 25. *Heleocoris montandoni* Lundblad, specimen from Singapore, Nee Soon swamp forest. 26. *Heleocoris nebulosus* Montandon, specimen from Indonesia, Bali, Melangit River. 27. *Heleocoris ovatus* Montandon, specimen from Vietnam, Lam Dong Prov., Pongour Falls, CL 3091. 28. *Heleocoris strabus* Montandon, specimen from Thailand, Chiang Mai Prov., Huay Hia Creek, CL 2198.

male genitalic morphology throughout this range, making precise delineation of species concepts challenging. Lundblad (1933) considered the populations occurring on Sumatra and Java to be sufficiently distinct from those in India and Ceylon to warrant separate designation as a variant under the name *H. bengalensis montandoni*. We concur with this assessment of regional differentiation, and treat this taxon as a full species herein, following the lead of Chen et al. (2005, pg. 418), although Zettel (in litt.) has questioned whether *montandoni* is an available name in the sense of Art. 45.6.4 ICZN. For the present we have assigned here all the specimens so far seen from the Greater Sunda Islands, Vietnam, Singapore, and Peninsular Malaysia. Even within this regional assemblage there is, however, a certain amount of variability in the male genitalic structure. Our examination of specimens from Singapore, Anambas Island, and Sumatra reveals small but potentially significant differences in the structure of the parameres and phallosome, with the shape of the latter structure being most similar in the specimens from the two former areas, while that of the Sumatra specimen is less elongate. The proctigers of the three populations cannot be compared, because they are missing from the vials containing the dissected genitalia of the available Anambas and Sumatra specimens. The shape of this structure is in fact extremely useful in species separation (Figs. 29, 30), and it should always be retained for subsequent examination. Overall, the status of species concepts in the *H. bengalensis* complex is a problem which requires further detailed study that is beyond the scope of the present work, and it should be anticipated that the taxonomy may be further revised in the future as additional character systems are analysed.

***Heleocoris malayensis*, new species**

(Figs. 24, 30, 32, 33, 34)

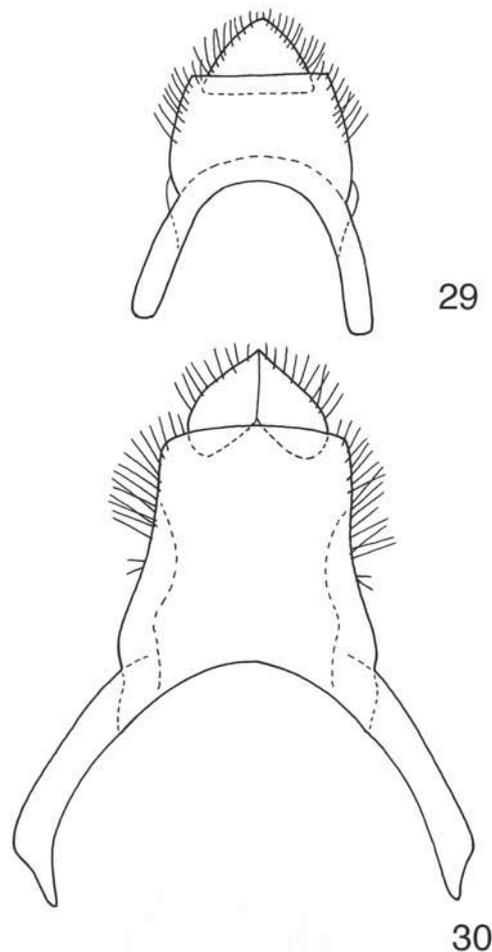
Material examined. — Holotype, male, MALAYSIA, **Pahang**, Sungai Cheroh, 6 km E. of Tapah, 18 Aug. 1985, CL 2072, coll. D. A. & J. T. Polhemus (JTPC). Paratypes: MALAYSIA, **Pahang**: 17 males, 18 females, same data as holotype (JTPC, ZRC); 1 female, Taman Negara, coll. L. C. Fong (ZRC); 1 female, Raub, Sungai Kila, 11 Nov. 1992, coll. J. Cramphorn (ZRC). **Perak**: 19 males, 16 females, Sungai Kerunai, 9 km N. of Grik, 19 Aug. 1985, CL 2078, coll. D. A. & J. T. Polhemus (JTPC); 1 female, Sungai Kenderong at Gerik, 17 Feb. 1997, coll. H. K. Lua, LHK0324 (ZRC); 1 male, Sungai Korbu at Jalong, 16 Feb. 1997, coll. H. K. Lua, LHK0321 (ZRC); **Trengganu**: 1 male, Sungai Trengganu tributary, Sekayu, 16 May 1995, coll. B. Tan & G. Sumita, TG06 (ZRC); 1 male, tributary of Sungai Trengganu downriver of Sekayu Waterfall Park, 18 Mar. 1992, LHK179c (ZRC); 8 males, 5 females, Sekayu, Sungai Brang, 21 Oct. 1998, coll. H. K. Lua, LHK0401 (ZRC).

Description. — **Macropterous form:** Of moderate size for genus, general body form ovate, widest across embolium of hemelytra (Fig. 33), basic colouration pale yellowish brown, with scutellum, hemelytra and wing membrane dark brown. Male length 11.00 mm; maximum width (across embolia) 7.40 mm; female length 10.90 mm, maximum width 7.35 mm.

Head pale yellowish brown, with scattered dark brown dots medially and 3 ovate, evenly spaced dark patches along lateral margins of vertex adjacent to each inner eye margin;

posterior margin broadly dark, width across eyes/length = 4.20/1.40; eyes dark red, shining, roughly teardrop-shaped when viewed from above with well developed lateral flange, tapering anteriorly, width/length = 0.70/1.20, inner margins straight and slightly convergent anteriorly, lateral margins broadly curving, separated from vertex by shallow furrows, anterior/posterior interocular width = 1.70/2.20; posterior margin of vertex nearly straight, not produced behind eyes; anteclypeus broadly rounded, not projecting ahead of eyes, anterior margin projecting beyond rostrum for 0.42 length of rostrum, bearing a pair (1+1) of transversely ovate dark brown pits widely spaced to either side of longitudinal midline, these pits bearing short, pale setae; labrum golden, roughly triangular, broadly rounded, apex blunt; rostrum evenly tapering to apex, dark yellow, terminal segment dark brown; antennae with all segments thickened, not extending to lateral margin of head, segment III longest.

Pronotum yellowish brown, irregularly dotted with numerous small, dark brown spots, lateral margins translucent golden, posterior margin broadly grayish brown; dorsal surface broadly and evenly domed, not depressed medially behind vertex, width/length (midline) = 6.15/3.60, lateral margins not explanate, posterolateral angles truncate, rounded.



Figs. 29, 30. *Heleocoris* species, male proctigers. 29. *Heleocoris montandoni* Lundblad, specimen from Singapore, Nee Soon swamp forest. 30. *Heleocoris malayensis* new species, specimen from Malaysia, Terengganu, Sungai Brang.

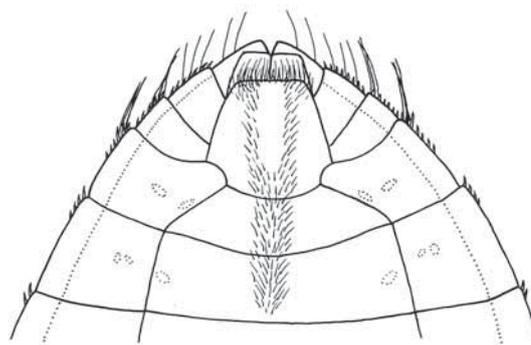
Scutellum mottled medium to dark brown, set with numerous tiny pale asperities, extreme apex pale yellow, width/length (midline) = 4.00/1.92, basal margin broadly posteriorly concave, lateral margins broadly sinuate.

Hemelytra dark blackish-brown set with numerous tiny pale asperities, outer half of embolium translucent golden yellow, inner margin of this pale area forming a straight line angling from inner anterior base of embolium backward and outward to outer posterior terminus; clavus and corium well defined, membrane highly reduced, obscure; tips of hemelytra broadly rounded, extending to apex of genital segment; embolium demarcated by broadly arcuate furrow along inner margin, furrow marking posterior margin obscure, basal half of lateral margin bearing very short, posteriorly angling reddish-brown spinules.

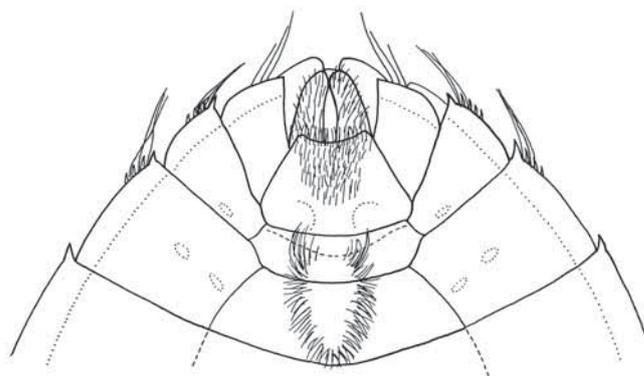
Abdomen with lateral portions of segments II–IV exposed when viewed dorsally, all visible paratergites pale golden yellow, dark brown at extreme posterolateral angles, these posterolateral angles symmetrical, produced into short, curving spinose projections on paratergites II–V, lateral margins immediately ahead of each projection inwardly notched, these notches each bearing 3 short, stout spines plus acuminate tufts of very long golden setae, remaining lateral margins of paratergites set with very short reddish posteriorly angling brown spinules; lateral margin of left paratergite VI bearing a hooked process (Fig. 34).

Ventral surface pale brown, generally lacking setae, with posterolateral sections of propleuron and central sections of abdominal ventrites I–VII covered with thick recumbent gold hydrofuge pile; propleura not reflexed posteriorly, barely covering basolateral portions of mesosternal plate, anterolateral angles bearing depressed, brown, ovate hydrostatic sense organs present below lateral eye margins; mesosternal plate broadly tumescent centrally, anterior margin of this tumescence transversely folded and raised, entire medial tumescence bearing long, scattered, fine golden setae; metasternal plate elongate, posterior section elongate and triangular with acute posterior apex, longitudinal midline raised into a sharp carina on basal half, this carina becoming widened and rounded on posterior half. Abdominal sternites and parasternites delineated by distinct sutures; all parasternites dull brown, each with 1–3 elongate glabrous patches.

Legs pale yellow; fore coxa unmodified; fore trochanter bearing roughly circular patch of very short, densely packed reddish brown setae centrally; anterior femur uniformly pale yellow, bearing a thick fringe of short, dense gold setae along anterior margin, posterior margin lacking setae; anterior tibia slender, straight, slightly expanded distally, broadly grooved along inner face, ventral margin bearing a distally expanding fringe of short, dense, reddish-brown setae along entire length; anterior tarsi two segmented, bearing two moderately large golden-brown claws, ventral tarsal surfaces bearing thick hair pads similar to that on anterior tibia; middle and hind coxae each bearing a single glabrous tubercle distally; middle and hind femora ventrally with a longitudinal row of tightly



31



32

Figs. 31, 32. *Heleocoris* species, female terminal abdomen, ventral view, showing shape of subgenital plate. 31. *Heleocoris montandoni* Lundblad, specimen from Vietnam, Lam Dong Prov., CL 3094. 32. *Heleocoris malayensis*, new species, specimen from Malaysia, Perak, Kerunai River, CL 2078.



33

Fig. 33. *Heleocoris malayensis*, new species, male, colour photo of dorsal habitus. Specimen from Malaysia, Terengganu, Sungai Brang.

packed, elongate, reddish spinules, additional spinules of this same type present ventrally on basal part of anterior margin, posterior margin of middle femur also bearing thick fringe of short, dense, reddish-golden setae; middle tibiae bearing numerous short, stout brown spines, ventral surface with thick pad of dark golden setae on distal four-fifths, tarsal segments of middle leg bearing similar hair pads ventrally; hind tibiae with scattered moderately long, stout dark brown spines, posterior margin with fringe of long gold swimming hairs.

Male genitalia with proctiger elongate, apex acute (Fig. 30); parameres highly reduced, elongate ovate (Fig. 24); male phallosome asymmetrical, with apex expanded into a rounded lobe (Fig. 24). **Female subgenital plate** roughly trapezoidal, posterior broadly concave (Fig. 32).

Brachypterous form: Unknown.

Distribution. — Peninsular Malaysia (below the Isthmus of Kra).

Discussion. — The larger of the two *Heleocoris* species currently known to occur in Peninsular Malaysia, *H. malayensis* may be recognised by its body size in excess of 11 mm; the generally dark hemelytra with the anterolateral half of the embolium broadly pale yellow (Fig. 33); the hooked process on the lateral margin of male abdominal left paratergite VI (Fig. 34), the shape of the male phallosome (Fig. 24); the elongate shape of the male proctiger (Fig. 30), and the shape of the female subgenital plate (Fig. 32).

Previous records of *Laccocoris nervicus* Montandon from the Peninsular Malaysian states of Perak and Selangor (Fernando & Cheng, 1974) are referable to this species, whereas *L. nervicus* is endemic to the mountains of Sumatra. Previous records of *H. ovatus* Montandon from Peninsular Malaysia are also represent this species (see below).

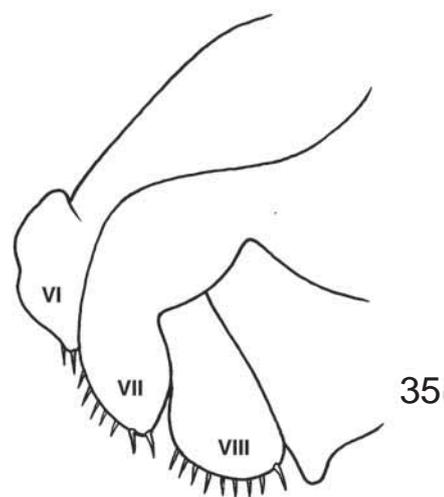
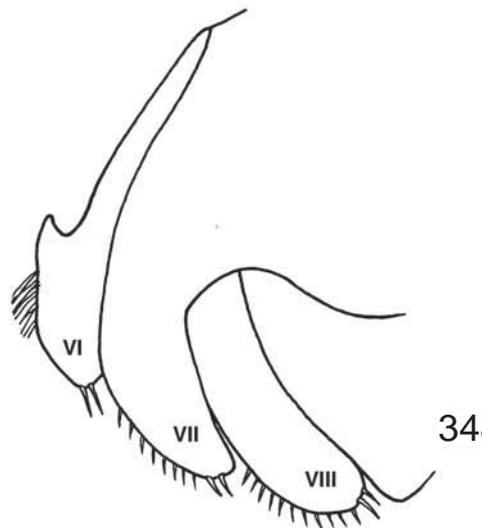
***Heleocoris ovatus* Montandon, 1897**
(Figs. 27, 35)

Heleocoris ovatus Montandon, 1897b: 451

Extralimital material examined. — VIETNAM, **Nghê An Prov.:** 6 males, 2 females, Pu Mat Nature Reserve, SW of Con Cuông, Khe Moi stream, 235 m, water temp. 22°C., 1 Apr.2000, CL 4382, coll. J. T. Polhemus & P. Nguyen (JTPC, BPBM). **Lam Dong Prov.:** 5 males, 3 females, Pongour Falls, 47 km SW of Dalat, 825 m, 11°41'19"N, 108°15'55"E, water temp. 25.5°C, 13 and 16 May 1998, CL 3091, coll. D. A. & J. T. Polhemus (JTPC, BPBM); 1 female, small stream nr. Lan Hanh, 31 km E. of Di Linh, 825 m, 11°36'15"N, 108°19'17"E, water temp. 24°C, 27 Mar.2001, CL 3094, coll. J. T. Polhemus (USNM). **Kontum Prov.:** 2 males, 2 females, laling Rapids, 64 km SW of Kontum, 4 km W. of laly, 500 m, 14°12'02"N, 107°48'42"E, water temp. 24°C, 8 Mar.2001, CL 4285, coll. J. T. Polhemus & P. Nguyen (USNM). **Quang Ngai Prov.,** 10 males, 10 females, Nuoc Xi stream, 123 km NE of Kontum on Hwy. 24, 120 m, 14°43'10"N, 108°35'48"E, water temp. 26°C, 18 Mar.2001, CL 4299, coll. D. A. Polhemus, J. T. Polhemus & P. Nguyen (USNM). **Binh Dinh Prov.,** 1 male, 1 female, spring fed stream on E. side of An Khe Pass, 15.5 km E. of An Khe on

Hwy. 19, 365 m., 13°57'53"N, 108°45'48"E, water temp. 22°C, 14 Mar.2001, CL 4293, coll. J. T. Polhemus & P. Nguyen (USNM). **THAILAND, Chiang Mai Prov.:** 11 males, 10 females, Fang Dist., Mae Mao River, S. of Fang Horticultural Station, 500 m, 16 Nov.1985, CL 2200, coll. D. A. & J. T. Polhemus (JTPC); 1 male, 1 female, stream 10 km NW of Mae Rim, 19 Nov.1985, CL 2204, coll. D. A. & J. T. Polhemus (USNM). **BURMA, Shan Division:** 10 males, 11 females, Magwe River at confluence with clear tributary in sandstone bed, 26 km NW of Kalaw along Kalaw to Thazi road, 520 m, 20°43.796'N, 96°29.477'E, water temp. 29°C (main river), 24 Oct.1998, CL 4023, coll. D. A. & J. T. Polhemus (USNM). **HONG KONG:** 1 male, 2 females, Lam Tsuen River, lower course, from trailing vegetation, coll. D. Dudgeon (JTPC).

Diagnosis. — Length 10.2–11.0 mm, maximum width (across abdomen) 7.0–7.4 mm, general body form ovate. Head and pronotum dull medium brown finely maculated with dark brown or black; scutellum blackish brown, extreme



Figs. 34, 35. *Heleocoris* species, male left abdominal paratergites. 34. *Heleocoris malayensis*, new species, specimen from Malaysia, Terengganu, Sungai Brang. 35. *Heleocoris ovatus* Montandon, specimen from Vietnam, Lam Dong Prov., Pongour Falls.

apex dark yellow; hemelytra dark blackish brown with tiny pale asperities, outer half of embolium dark yellow, wing membrane in submacropterous forms poorly defined, dark brown; abdominal laterotergites dark yellow, extreme posterior margins dark brown. This species may be recognised by its moderate size for the genus, the predominantly dark hemelytra which lack yellow markings except on the outer half of the corium, the projecting tab on the lateral margin of male abdominal left paratergite V (Fig. 35), and the distinctive male genitalic structures (Fig. 27).

Distribution. — Montandon (1897a) described *H. ovatus* from a single specimen taken in the vicinity of Lakhon, in northern Laos, by François Jules Harmand, a French doctor who from 1877–1878 made a traverse of the country lying between Lakhon, on the Mekong River, and Quang Tri, in modern Vietnam. Montandon did not indicate the sex of his Laotian holotype, and although this specimen was recently re-examined and discussed by Sites & Vithepradit (2011), these latter authors did not indicate the sex in their publication either. We have contacted Eric Guilbert of the Muséum National d'Histoire Naturelle in Paris, where the holotype is held, who has confirmed that this specimen is a female, and has provided useful notes on its morphology. As noted by Sites & Vithepradit (2011), *H. ovatus* is widespread in Indochina, with records provided by these authors for China (Hainan), Burma, Thailand, and Vietnam, to which we can now add a new record from Hong Kong as well. As explained below, records of *H. ovatus* for Malaysia (and perhaps elsewhere in Indochina) listed by these latter authors are misidentifications, and refer instead to the new species *H. malayensis* described herein.

Discussion. — Males of *H. ovatus* are easily recognised by the blunt, anteriorly projecting tab on the lateral margin of male left abdominal paratergite VI (Fig. 35), which is very different in form from the hooked projection on the left abdominal paratergite VI in males of *H. malayensis* (Fig. 34). No other species of *Heleocoris* so far known from Southeast Asia possess similar projections on male left paratergite VI. The male phallosome also differs in shape between the two species, with the tip being more produced and evenly rounded in *H. malayensis*, and the distal internal sclerite of a different shape (compare Figs. 24 and 27). Females are by contrast far more similar, with the posterior margin of the subgenital plate being broadly concave in *H. malayensis* (Fig. 32), rather than bearing a broad, V-shaped incision as in *H. ovatus*; the latter character state has been confirmed on the basis of an examination of the holotype female by Guilbert in relation to illustrations of the subgenital plates of both *H. ovatus* and *H. malayensis* provided by the authors.

Although Sites & Vithepradit (2011) provided records of *H. ovatus* from the Peninsular Malaysian states of Pahang, Terengganu, and Selangor, we have re-examined the Terengganu series and determined that it is in fact composed of specimens of *H. malayensis* (see paratype material listed under that species). Given that all other specimens of *Heleocoris* of appropriate size and colouration that we have examined from Peninsular Malaysia also represent *H.*

malayensis rather than *H. ovatus*, we have concluded that the Malaysian records of the latter species listed by Sites & Vithepradit (2011) are probably all misidentifications. In addition, because the above authors did not utilise male paratergite or genitalic characters in their taxonomic analysis, and therefore did not realise that two species were co-mingled under their concept of *H. ovatus*, we consider it probable that at least some of the specimens of “*H. ovatus*” that they list from southern peninsular Thailand may represent *H. malayensis* as well, since it appears that *H. malayensis* may occur as far north as Laos (Zettel, in litt.). As such, all of the extensive material listed as *H. ovatus* by Sites & Vithepradit (2011) will need to be critically re-examined on the basis of the characters discussed above in order to determine which of these two species was represented at any given locality, and the distribution map for this species given in their Fig. 9 will need to be revised for the southern half of the distribution in question, given that some of the symbols likely depict populations of *H. malayensis* rather than *H. ovatus*.

Heleocoris strabus Montandon, 1897

(Figs. 23, 28)

Heleocoris strabus Montandon, 1897a: 372

Extralimital material examined. — THAILAND, **Chiang Mai Prov.:** 5 females, Fang Dist., Nam Chai River above hydro intake, near Fang Horticultural Station, 500 m, 15 Nov.1985, CL 2197, coll. D. A. & J. T. Polhemus (JTTC); 1 male, 5 females, Fang Dist., Huay Hia Creek, Fang Horticultural Station, 500 m, 15 Nov.1985, CL 2198, coll. D. A. & J. T. Polhemus (JTTC). VIETNAM, **Lam Dong Prov.:** 1 male, small steeply dropping stream at Mother Mary Shrine, along Hwy. 20, 18 km W. of Bao Lac, 800 m, water temp. 76°F., 7 May 1998, CL 3076, coll. J. T. Polhemus (JTTC). **Ninh Thuận Prov.:** 2 males, 10 females, first small stream on E. side of Bellevue Pass (Ngoan Muc Pass), 66 km NW of Phan Rang, 900 m, pools and cascades, water temp. 76°F., 12 May 1998, CL 3087, coll. J. T. Polhemus (JTTC). **Vinh Phu Prov.:** 2 females, stream at Tam Dao, NW of Hanoi, 940 m, 21°28'00"N, 105°38'00"E, water temp. 17°C, 18 Mar.2000, CL 4359, coll. J. T. Polhemus & P. Nguyen (JTTC). **Nghê An Prov.:** 2 males, Bac stream, nr. Pu Mat Nature Reserve, 200 m, water temp. 24°C, 2 Apr.2000, CL 4388, coll. J. T. Polhemus & P. Nguyen (JTTC). LAOS, **Bokeo Prov.:** 2 males, Tonpheng [Ton Pheung Dist.], 16 Dec.1966, coll. native collector (BPBM). BURMA, **Kachin Division:** 1 male, 1 female, stream at Mularshidi village, 12 km S. of Putao, 500–550 m, 27°15.13'N, 97°24.95'E, 31 May 1999, coll. H. Schillhammer (USNM); 1 female, stream on E. slope of pass from Hopin to Indawgyi Lake, 380 m, 24°59.51'N, 96°24.31'E, 26 May 1999, coll. H. Schillhammer (USNM).

Diagnosis. — Length 11.5–12.5 mm, maximum width (across abdomen) 8.3–9.0 mm, general body form ovate. Head and pronotum dull yellowish brown extensively flecked with small dark brown spots; scutellum brown, basal angles and apex sparingly yellow; hemelytra dark blackish brown, outer half of embolium broadly yellow, wing membrane black; abdominal laterotergites uniformly yellow. This species may be recognised by its moderately large size, the distinctive shape of the embolium which is produced posterolaterally and then cut sharply inward (Fig. 23), and the distinctive male genitalic structures (Fig. 28).

Distribution. — Described from southern Burma (Tenasserim), and subsequently recorded from India (Meghalaya), China (Yunnan), Burma, Thailand, Laos and Vietnam (Ding & Liu, 2005; Sites & Vithepradit, 2011).

Discussion. — Originally described from Burma, *H. strabus* is widespread in Indochina north of the Isthmus of Kra, and as such is included in this treatment on the possibility that it may occur in far northern Peninsular Malaysia.

Subfamily CHEIROCHELINAE Montandon, 1897

Genus GESTROIELLA Montandon, 1897

Discussion. — Members of this genus are distinctive within the regional naucorid assemblage by having the body broadly oval to nearly round (Fig. 36), and strongly dorsoventrally flattened; a posteroventral folding of the preclypeal head; the retraction of the labrum, rostrum and antennae into cavities on the underside of the head; and the presence of large pads of bristle-like setae ventroapically on the middle and hind tibiae. The pronotum is very broad, with the posterior width approximately 2× the width of the head, the anterolateral angles of the pronotum are simple, not forming cup-shaped depressions ventrally at the apices as in the related Indochinese genus *Cheirochela*, and the posterolateral angles are acute but not spinose (Fig. 36). The hemelytra of brachypterous forms are long, with the apices angulate, reaching to or surpassing abdominal tergite VI (Fig. 36), and the abdominal and thoracic venter have a fine pile of short, closely appressed hydrofuge hairs. The male phallosome and parameres are symmetrical, with the paramere stout basally, then suddenly narrowing on the distal half to form a tapering arm, the apex of which is weakly notched (Fig. 38).

***Gestroiella siamensis* D. Polhemus, J. Polhemus
& Sites, 2008
Figs. 36–39**

Gestroiella siamensis, D. Polhemus, J. Polhemus & Sites, 2008: 275

Diagnosis. — This the smallest species in the genus, with a body length of 12.8–14.4 mm. The dorsomedial process of the male genital capsule is broadly triangular (Fig. 39), and the lateral spines of abdominal segments III and IV are relatively small. In males, the posterior margin of abdominal sternum VI is distinctly convex in the middle, and the opposable surfaces of the profemur and tibia are evenly arcuate, rather than having an anteriorly bowed profemur with a gap between it and the protibia as in other members of the genus. The male phallosome is abruptly narrowed beyond the tips of the parameres, the parameres themselves are relatively slender (Fig. 38), and a mat of dark hairs is present on the phallobase. The female subgenital plate is weakly notched apicomediaally (Fig. 37).

Range. — Described from Thailand (D. Polhemus et al., 2008), and to date known only from that country.

Discussion. — Members of the genus *Gestroiella* have a unique body shape that is immediately recognisable among extant Naucoridae (Fig. 36). The only member of this genus to occur near the region under study, *Gestroiella siamensis*, occupies an elongate north-to-south range extending from the southern Shan Plateau southward through the entire mountain spine of the Thai-Burmese border area to the Isthmus of Kra (see Fig. 35 in D. Polhemus et al., 2008), and as such may occur in the mountain streams of far northern Peninsular Malaysia. This species has been collected in clear, rocky-bottomed streams with a wide range of current velocities, but is absent from sluggish or stagnant reaches.

Family APHELOCHEIRIDAE Fieber, 1851

Genus APHELOCHEIRUS Westwood, 1833

Discussion. — Members of the Aphelocheiridae are similar to Naucoridae in regard to their dorsoventrally flattened bodies, lack of forewing venation, enlarged fore femora, anteriorly-directed male genitalia, and benthic ecology. As a result, they have been treated as a subfamily of Naucoridae by many previous authors (D. Polhemus & J. Polhemus, 1989 and references therein). Distinguishing characters for Aphelocheiridae include the antennae, which although 4-segmented as in Naucoridae are more slender and elongate, projecting well beyond the eyes when viewed from above; the labium, which is long, usually extending

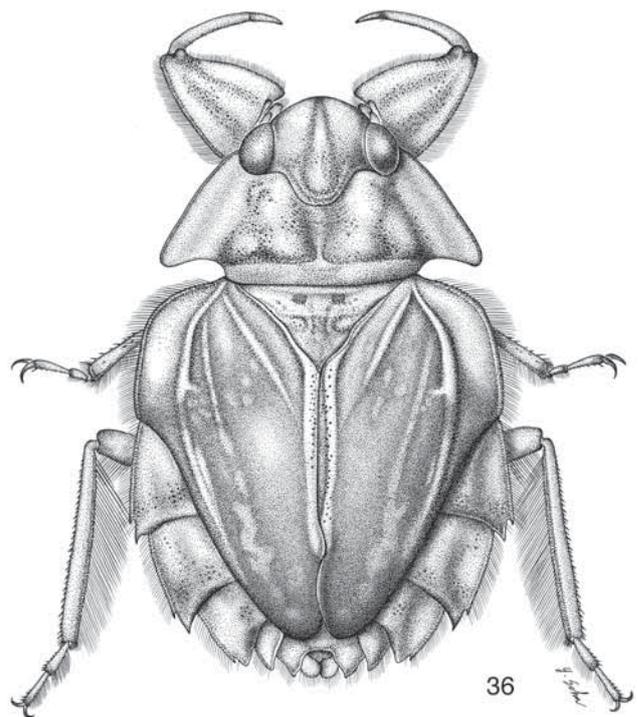


Fig. 36. *Gestroiella siamensis* D. Polhemus, J. Polhemus & Sites, male, dorsal habitus, specimen from Thailand, Songkla Prov., Ton Nga Chang (Young Sohn illustration).

onto the metasternum, with segment III very elongated; the tarsi, which are 3-segmented, with the fore tarsi articulated and not fused to fore femur as in Naucoridae; the persistent dorsal abdominal scent glands in adults; and the abdominal spiracles, which are surrounded by rosettes, this latter character diagnostic for the family. The combination of a long rostrum, long antennae, and abdominal spiracular rosettes is distinctive unique within the Nepomorpha (see Fig. 40, depicting the macropterous form of *A. pallens* Horváth from New Guinea as an exemplar of this family). Useful characters for separating individual species include the male genitalia (Figs. 43, 51, 55, 58, 59), female subgenital plate (Figs. 44, 50, 57), and shape of the proacetabula (Figs. 46, 52, 56).

Aphelocheirus species are inhabitants of rocky upland streams, where their use of plastron respiration, associated with the development of the spiracular rosettes, allows them to stay submerged underwater for an indefinite period of time. Individuals are most abundant in areas of mixed gravel and cobble substrate swept by moderate current (D. Polhemus & J. Polhemus, 1989). Such habitats are generally absent in Singapore, but are by contrast extensive in the mountains of Peninsular Malaysia, where representatives of both subgenera currently recognised in the genus, *Aphelocheirus* and *Micraphelocheirus*, are known to occur, and it is likely that the current aphelocheirid fauna of this area is underestimated. No species of *Aphelocheirus* has yet been recorded from Singapore, and the genus is unlikely to occur there given

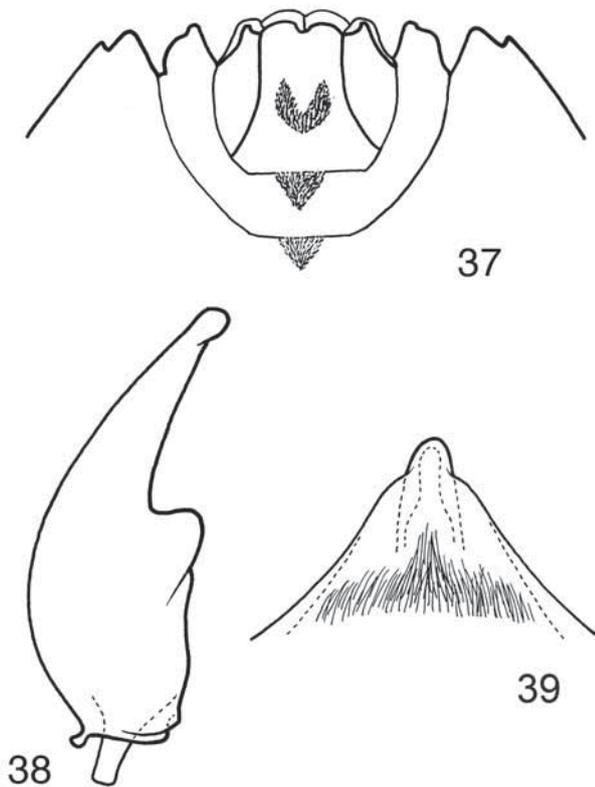
the general absence of suitable rocky streams on the island.

Following the monograph of D. Polhemus & J. Polhemus (1989), which established a firm taxonomic foundation for the genus in tropical Asia, a large number of additional species were described from this region (J. Polhemus, 1989; Chen & Nieser, 1991; D. Polhemus, 1994; Liu & Zheng, 1994; Sites et al., 1997; Zettel, 1998, 1999, 2000, 2001; Nieser et al., 2004; Sites, 2005; Sites & Zettel, 2005; Zettel & Papáček, 2006; Liu & Ding, 2005; Thirumalai, 2008; Zettel et al., 2008; Zettel & Tran, 2009; Zettel & Pangantihon, 2010). As a result, the genus currently contains 92 species worldwide (exclusive of subspecies), with the vast majority of the species added since 1989 having come from tropical Asia. This rush of new taxonomic work was not accompanied by any synthetic review or supplementary monograph, leading to a rather confusing situation for non-specialists at the present time.

KEY TO THE SPECIES OF APHELOCHEIRUS

occurring in Singapore and Peninsular Malaysia
(modified from D. Polhemus & J. Polhemus, 1989)

1. Small species, body length less than 5 mm (subgenus *Micraphelocheirus*)
 *Aphelocheirus malayensis* Zettel & Papáček
- Larger species, body length exceeding 7 mm (subgenus *Aphelocheirus*) 2
2. Male with conspicuous projecting tab on abdominal ventrite IV (Fig. 49); female subgenital plate very short and truncate,



Figs. 37–39. *Gestroiella siamensis* D. Polhemus, J. Polhemus & Sites, structural details, specimen from Thailand, Thailand, Songkla Prov., Ton Nga Chang. 37. Female terminal abdomen, ventral view, showing shape of subgenital plate. 38. Male left paramere. 39. Medial process of male phallosome.

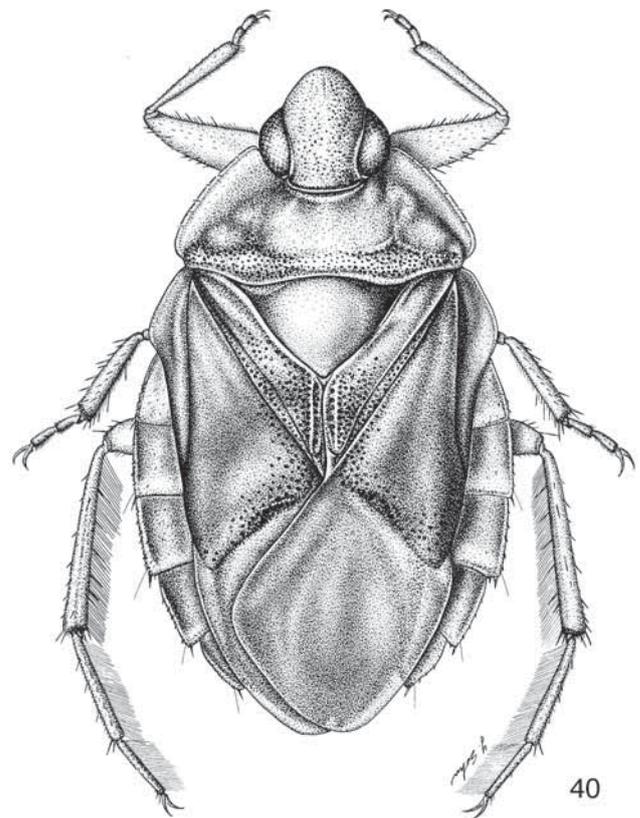


Fig. 40. *Aphelocheirus (Aphelocheirus) pallens* Horváth, macropterous male, dorsal habitus, specimen from Papua New Guinea, Gulf Prov., Sapoi River nr. Lakekamu, CL 7146 (Young Sohn illustration).

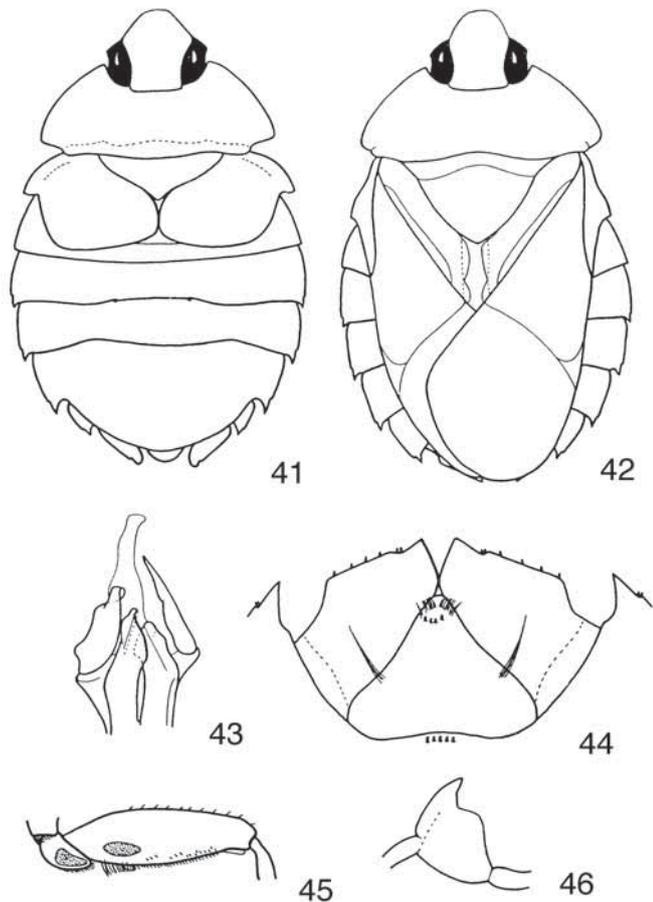
- broader than long, with two long hair tufts on posterior margin (Fig. 50).....*A. grik* D. Polhemus & J. Polhemus
- Male lacking a projecting tab on abdominal ventrite IV; female subgenital plate longer, shape roughly triangular or elongate trapezoidal with elongate lateral hair tufts (Figs. 44, 57).....3
 - 3. Male with dark, raised, ovate swelling on ventral face of hind femur (Fig. 45); body length in both sexes less than 8.0 mm; head produced ahead of eyes for 0.70 the dorsal length of an eye (Figs. 41, 42)...*A. femoratus* D. Polhemus & J. Polhemus
 - Male lacking dark, raised, ovate swelling on ventral face of hind femur; body length in both sexes exceeding 8.5 mm; head produced ahead of eyes for 0.60 the dorsal length of an eye (Figs. 53, 54).....*A. malayanus* D. Polhemus & J. Polhemus

Subgenus *Aphelocheirus* Westwood, 1833

***Aphelocheirus* (*Aphelocheirus*) *femoratus* D. Polhemus & J. Polhemus, 1989**
(Figs. 41–46)

Aphelocheirus femoratus D. Polhemus & J. Polhemus, 1989: 214

Material examined. — MALAYSIA, **Perak**: 2 macropterous males, 5 brachypterous males, 7 brachypterous females, Iskandar Waterfall, 24 km W. of Tapah on Cameron Highlands road, 450 m, 4°19'28"N, 101°19'30"E, 18 Aug.1985, CL 2074, D. A. & J. T.



Figs. 41–46. *Aphelocheirus* (*Aphelocheirus*) *femoratus* D. Polhemus & J. Polhemus, structural details, specimens from Malaysia, Pahang, Cameron Highlands. 41. Brachypterous male, dorsal habitus. 42. Macropterous male, dorsal habitus. 43. Male parameres and phallosome. 44. Female subgenital plate. 45. Male hind femur, ventral view. 46. Proacetabula.

Polhemus coll. (paratypes, JTTC). **Selangor**: 1 macropterous male, 1 brachypterous male, 1 brachypterous female, 9 mi. S. Gombak road, Jul.1967, D. Tan coll. (paratypes, JTTC).

Diagnosis. — Brachypterous forms with length 7.4–7.8 mm; maximum width (across abdomen) 4.5–4.8 mm (Fig. 41); macropterous forms with length 7.1–7.2 mm, maximum width (across abdomen) 4.4 mm (Fig. 42). Colouration dull blackish-brown with extensive yellowish markings. Males are easily recognised by the presence of dark, raised swellings on the ventral surfaces of the hind femora and trochanters (Fig. 45), and by the genitalic structures (Fig. 43). Females may be recognised by the shape of the subgenital plate (Fig. 44) and the explanate posterior margins of abdominal tergite VII (Fig. 44).

Distribution. — Described from peninsular Malaysia (Perak), with paratypes from additional Malaysian localities in Selangor, and from northern Thailand. Further records from Thailand and southwestern China were provided by Sites et al. (1997) and Liu & Ding (2005).

Discussion. — Although originally described from Peninsular Malaysia, *A. femoratus* has proven to be widely distributed in Southeast Asia, and has one of the largest geographic ranges of any *Aphelocheirus* in this region. The unusual swellings on the ventral surface of the male hind legs are seen in no other Southeast Asian species, although this character state does occur in several *Aphelocheirus* species from Madagascar (D. Polhemus & J. Polhemus, 1989; Zettel, 2002, 2009).

***Aphelocheirus* (*Aphelocheirus*) *grik* D. Polhemus & J. Polhemus, 1989**
(Figs. 47–52)

Aphelocheirus grik D. Polhemus & J. Polhemus, 1989: 218

Material examined. — MALAYSIA, **Perak**: 50 brachypterous males, 50 brachypterous females, Kerunai River, 9 km N. of Grik, 135 m, 5°30'53"N, 101°07'50"E, 19 Aug.1985, CL 2078, D. A. & J. T. Polhemus coll. (paratypes, JTTC); 6 brachypterous males, 6 brachypterous females, stream 58 km S. of Grik, 19 Aug.1985, CL 2077, D. A. & J. T. Polhemus coll. (paratypes, JTTC); 1 female, Gerik [Grik], 17 Feb.1997, LHK324, coll. H. K. Lua coll. (ZRC).

Diagnosis. — Brachypterous forms with length 7.2–7.7 mm, maximum width (across abdomen) 4.8–5.0 mm (Fig. 47); macropterous forms with length 7.9–8.3 mm, maximum width (across abdomen) 4.9–5.1 mm (Fig. 48). Colouration of brachypterous forms uniformly blackish to brownish, with head dark yellow; colouration of macropterous forms entirely dark brown. This species may be immediately recognised by its relatively small size, the short, truncate female subgenital plate (Fig. 50), the projecting tab on the posterior margin of abdominal sternite V in the male (Fig. 49), and the male genitalic structures (Fig. 51).

Distribution. — Described from peninsular Malaysia (Perak), with paratypes from additional Malaysian localities in that state, and from northern Thailand (Chiang Mai Province).

Discussion. — *Aphelocheirus grik* is the smallest of the species in the subgenus *Aphelocheirus* known to occur in Peninsular Malaysia, and may be quickly recognised by the distinctive ventral abdominal characters of both males and females as noted in the diagnosis. Brachypterous specimens of *A. grik* exhibit two distinct colour morphs, with some individuals brown, and others black, in each case with the head dark yellow. The macropterous forms also have a distinctive texture on the hemelytral corium consisting of small, raised, shiny dots on an otherwise dull background.

***Aphelocheirus (Aphelocheirus) malayanus* D. Polhemus & J. Polhemus, 1989**
(Figs. 53–57)

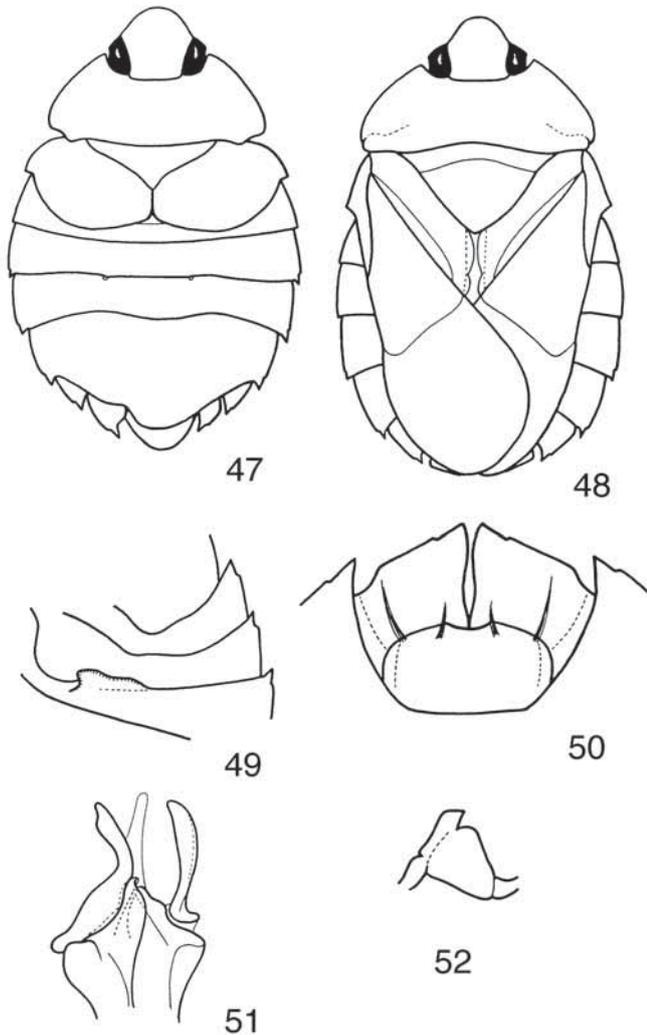
Aphelocheirus malayanus D. Polhemus & J. Polhemus, 1989: 216.
Aphelocheirus malayensis: D. Polhemus & Polhemus, 1989: 264.
Incorrect emendation.

Material examined. — MALAYSIA, **Perak**: 15 brachypterous males, 20 brachypterous females, waterfall and rocky stream 60 km W. of Jeli, 20 Aug. 1985, CL 2081, D. A. & J. T. Polhemus coll. (paratypes, JTPC); 3 brachypterous males, 5 brachypterous females, Iskandar Waterfall, 24 km W. of Tapah on Cameron Highlands road, 450 m, 4°19'28"N, 101°19'30"E, 18 Aug. 1985, CL 2074, D. A. & J. T. Polhemus coll. (paratypes, JTPC). **Selangor**: 1 brachypterous male, Selangor River nr. Kota Kuba Baharu [Kuala Kuba Bharu], 160 m, 3°34'09"N, 101°41'44"E, 13 Aug. 1978, G. F. & C. H. Edmunds coll. (paratype, JTPC).

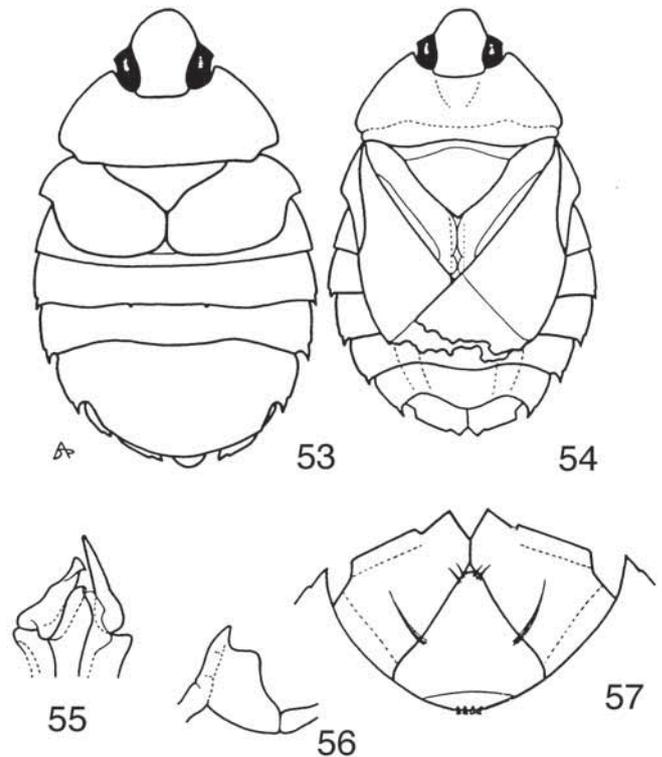
Diagnosis. — Brachypterous forms with length 8.9–9.1 mm, maximum width (across abdomen) 5.8–5.9 mm (Fig. 53); macropterous forms with length 8.8–10.1 mm, maximum width (across abdomen) 5.6 mm (Fig. 54). Colouration dark blackish-brown with extensive yellowish markings. This species may be recognised among the local set of *Aphelocheirus* species occurring in the Peninsular Malaysia by its relatively large size, extensive yellowish colouration on the dorsum, male genitalic structures (Fig. 55), triangular female subgenital plate (Fig. 57), and the absence of raised, dark swellings on the ventral surfaces of the male hind legs.

Distribution. — Described from peninsular Malaysia (Perak), with paratypes from additional Malaysian localities in Perak and Selangor.

Discussion. — Originally described from material collected in Perak, *A. malayanus* appears to be endemic to Peninsular Malaysia, with records to date from the above state as well



Figs. 47–52. *Aphelocheirus (Aphelocheirus) grik* D. Polhemus & J. Polhemus, structural details. 47. Brachypterous male, dorsal habitus, Malaysia, Perak, Grik. 48. Macropterous female, dorsal habitus, specimen from Thailand, Chiang Mai Prov., Mae Ping River. 49. Male ventral abdomen, showing tab on abdominal ventrite IV. 50. Female subgenital plate. 51. Male parameres and phallosome. 52. Proacetabula.



Figs. 53–57. *Aphelocheirus (Aphelocheirus) malayanus* D. Polhemus & J. Polhemus, structural details. 53. Brachypterous male, dorsal habitus, specimen from Malaysia, Perak, near Jeli. 54. Macropterous female, dorsal habitus, specimen from Malaysia, Pahang, Cameron Highlands. 55. Male parameres and phallosome. 56. Proacetabula. 57. Female subgenital plate.

as Selangor. No subsequent collections of this species have been reported since the original description. This relatively large, yellowish species is an inhabitant of rocky upland streams, and is somewhat similar in dorsal aspect to *A. femoratus*, with which it occasionally co-occurs. It is easily separated from the latter species by the absence of raised, dark swellings on the ventral surfaces of the male hind legs (Fig. 45), and other characters as given in the diagnosis.

Subgenus *Micraphelocheirus* Hoberlandt & Štys, 1979

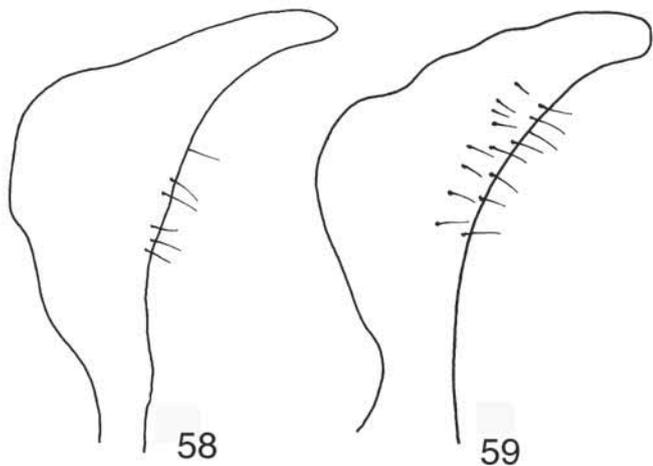
Aphelocheirus (*Micraphelocheirus*) *malayensis* Zettel & Papáček, 2006 (Figs. 58, 59)

Aphelocheirus (*Micraphelocheirus*) *malayensis* Zettel & Papáček, 2006: 104

Diagnosis. — Macropterous forms with length 4.02–4.36 mm, maximum width (across abdomen) 1.97–2.23 mm. Brachypterous forms unknown. Colouration with head and pronotum dark brown, hemelytra pale brown with clavus yellowish, ventral surface medium to dark brown with rostrum and legs other than coxae light yellow. Male parameres as in Figs. 58, 59.

Distribution. — Described from “Ipoh, 5 km from Tanjong Rambutan” in Peninsular Malaysia (Zettel & Papáček 2006), and so far not recorded elsewhere. We have not examined the type series of this species, and no subsequent collections of this species have been reported from either Singapore or peninsular Malaysia.

Discussion. — Easily recognised among the currently known suite of Peninsular Malaysian *Aphelocheirus* by its small size and male genitalic structures (Figs. 58, 59). For additional discussion of salient morphological characters see Zettel & Papáček (2006).



Figs. 58, 59. *Aphelocheirus* (*Micraphelocheirus*) *malayensis* Zettel & Papáček, male parameres. 58. Left paramere. 59. Right paramere (after Zettel & Papáček 2006).

ACKNOWLEDGEMENTS

We wish to thank Lanna Cheng, of the Scripps Institute of Oceanography, La Jolla, California, for providing the constant encouragement that allowed completion of this work; and Peter K. L. Ng and Yang Chang Man, of the National University of Singapore, for providing generous logistical support to the authors during several visits to Singapore for work in the collections held there. We also acknowledge the kind assistance of Eric Guilbert of the Muséum National de Histoire Naturelle in Paris for his generous assistance in clarifying the proper identity of *Heleocoris ovatus* by comparison with the holotype held in that collection.

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