Raffles Bulletin Zoology 1988 36(2): 167-300

The Aphelocheirinae of tropical Asia (*Heteroptera: Naucoridae*)

Dan A. Polhemus
Research Associate, Dept. of Entomology
Bernice P. Bishop Museum
Honolulu, Hawaii, USA 96819
(mailing address: 3115 S. York St., Englewood, Colorado, USA 80110)

and John T. Polhemus
Univ. of Colorado Museum
3115 S. York St., Englewood, Colorado, USA 80110

The Aphelocheirinae of tropical Asia (Heteroptera: Naucoridae)

Abstract

The naucorid subfamily Aphelocheirinae, containing one genus, *Aphelocheirus*, is revised for tropical Asia. Generic concepts in the subfamily are reviewed; two subgenera are recognized, *Aphelocheirus* Westwood and *Micraphelocheirus* Hoberlandt and Štys, and *Tamopocoris* Hoberlandt and Štys is relegated to synonymy under *Aphelocheirus* (*Micraphelocheirus*). The following 22 new species are described in the subgenus *Aphelocheirus: A. celebensis* and *A. lorelindu* from Celebes, *A. kinabalu* and *A. minor* from Borneo, *A. javanicus* from Java, *A. palawanensis* from Palawan, *A. zamboanga* from Mindanao, *A. sculpturatus*, *A. baguio*, and *A. luzonicus* from Luzon, *A. malayanus* from the Malay Peninsula, *A. femoratus* and *A. grik* from the Malay Peninsula and Thailand, *A. lahu*, *A. fang*, *A. petersi*, *A. thai* from Thailand, *A. ashlocki* and *A. lao* from Laos, *A. similaris* from Vietnam, *A. dudgeoni* from Hong Kong, and *A. cantonensis* from China. One new species from Thailand, *A. brevirostris*, is described in the subgenus *Micraphelocheirus*. Discussion is made of the nomenclatural history of the subfamily, and a revised checklist of the *Aphelocheirus* species of the world is provided. Key characters used in species separation are explained, and information is given on ecology of the genus and its individual species in the region. A key is provided for all species in tropical Asia, accompanied by figures of dorsal habitus and male and female genital structures for all species.

Contents:

Introduction

This study received its major impetus when one of us (DAP) borrowed a series of undetermined *Aphelocheirus*, collected in Thailand, from the Los Angeles County Museum, anticipating that they would prove to be *A. inops* Horvath. Instead the series was found to contain three separate and easily distinguishable species, all undescribed. This in turn led to a careful examination of the collection of *Aphelocheirus* assembled over the years by the the second author, which revealed that most of the specimens from continental southeast Asia and the Malay Archipelago represented taxa new to science. Two expeditions to these regions in 1983 and 1985, funded by the National Geographic Society, provided us with the opportunity to make extensive collections of *Aphelocheirus*, and we now have several thousand specimens which have permitted the discrimination of many new species on the basis of consistent morphological differences, and allowed us to ascertain the extent of intraspecific and intersexual variation in most of the species involved. In addition the uncommon macropterous forms, which are often quite different structurally from the more common brachypterous morphs, are now known for the majority of the species at hand.

The 23 new species described herein nearly double the size of the genus, effectively dispelling the concept of *Aphelocheirus* as a predominantly Palearctic group with only a few representatives in the tropics (Usinger, 1937). Indeed, it appears instead that *Aphelocheirus* reaches its greatest diversity in the tropics of southeast Asia. In addition to previous records from India, Vietnam, the Philippines, New Guinea, and Australia, in this work we extend the range to include Borneo, Java, Sumatra, Celebes, Hainan, the Malay Peninsula and Thailand. Interestingly, the tropics of Africa appear to be relatively poor in *Aphelocheirus* species, with only four named species being known from the continent south of the Sahara and another two present on Madagascar (Linnavuori, 1975). Our collections on Madagascar in 1986, however, revealed at least 10 additional undescribed species on that island, and if our experience there and in Asia is any guide then the *Aphelocheirus* fauna of Africa may be vastly underestimated.

Methods

This work is intended as a regional faunal revision and as a guide for identification to aid freshwater ecologists who encounter *Aphelocheirus* in their samples. To this end extensive habitus illustrations and figures of key characters for each species have been provided. In addition, notes have been given where possible on the other benthic organisms co-occurring with *Aphelocheirus*, in order to aid ecologists in identifying potential faunal associations and patterns of community organization.

The geographical area covered by this work extends from 25 degrees north latitude to 20 degrees south, and from 75 degrees east longitude to 150 degrees east, or roughly from Hong Kong on the north to the Cape York Peninsula of Australia on the south, and from Ceylon on the west to New Guinea on the east. This area is essentially that portion of the world with a predominantly tropical Asian flora and entomofauna. The true northern

border of the Asian tropics lies at the Yangtze River and then follows southwestward along the margin of the Tibetan Plateau, but our knowledge of these regions in China is so limited that their presumably rich fauna must await future work.

Due to the great number of countries and variety of languages included in this work, geographical terms have been translated into English whenever possible for the sake of consistency. For example the Malay word "sungai" has been translated to the English "river", so that Sungai Gombak would be listed as Gombak River. All place names in China and Indochina are phonetic English approximations, since these cultures use alphabets totally unrelated to ours.

The majority of the material treated herein was collected by the authors during two expeditions, the first in 1983 to Australia and New Guinea, the second in 1985 to Southeast Asia, both funded by the National Geographic Society. Specimens were preserved in 75 percent ethanol in the field, with synoptic series subsequently mounted in the laboratory. Descriptions, including color, are taken from dry mounted specimens, with all measurements being given in millimeters and representing the dimensions of an average specimen. CL numbers following locality data refer to codes used by the authors to reference ecological data. Institutional codes for specimen repositories are noted in the acknowledgements.

Ecology

Members of the genus *Aphelocheirus* are specialized predators that live in the benthos of streams and lakes. These insects have a plastron respiration system which allows them to remain submerged indefinitely, and appear to be among the few insects which complete their entire life cycle, including mating, underwater. The efficiency of the underwater respiration system in *Aphelocheirus* versus that in other Naucoridae was tested experimentally in north Borneo by confining an individual of *A. kinabalu* in a completely filled jar of water overnight. The next morning the insect was still swimming about and apparently unaffected. A specimen of *Coptocatus oblongulus*, another swift water naucorid co-occurring with *A. kinabalu*, was similarly confined and died within two hours.

The general habits and life history of *Aphelocheirus* species are still very poorly understood, with the only species studied in any detail being *A. aestivalis* (Fabricius), which occurs in England and on the European continent. This species feeds on the larvae of chironomid diptera, hydropsychid trichoptera, and various molluscs belonging to the genera *Viviparus*, *Cyclas*, and *Pisidium* (Thorpe, 1965). The mollusc feeding habit is of particular interest, since it suggests that tropical species might be used as biological controls against the intermediate hosts of bilharzia, but at present little is known concerning the extent of mollusc predation by tropical *Aphelocheirus*.

We do know that *Aphelocheirus* will attack and immobilize prey many times their own size, since we observed a third instar nymph of *A. kinabalu* less than a centimeter long while it stunned and fed on a tadpole over 5 cm. in length. The bite of *Aphelocheirus*

is also traumatic to humans, producing a sharp, localized burning pain, followed by soreness, swelling and redness that persist for several hours. One of us (DAP) received several bites in quick succession on the palm of the left hand and sustained partial loss of muscular function in the fingers for over three hours, but this condition gradually abated with no discernable long term effects.

Aphelocheirus species are adaptable insects capable of existing even under cold temperate conditions, as witnessed by the existence of *A. ussuriensis* (Kiritshenko) and *A. amurensis* (Kiritshenko) in the Amur River of eastern Siberia, *A. nawae* Matsumura near Novosibirsk in western Siberia (I. M. Kerzhner, pers. comm.), and *A. aestivalis* (Fabricius) in Finland, but it is unknown whether the temperate and tropical species have differing habitat preferences and life cycles. Although our collections of tropical Asian *Aphelocheirus* species were almost entirely from swift rocky upland streams, African species have been recorded in several instances from considerable depths in lakes. *A. corbeti* Poisson, for example, has been recovered from depths of up to 10 m. in Lake Albert, and *A. kumbanus* Linnavuori was described from a specimen taken at light near a deep crater lake in Cameroon. Species also occur in deep waters in temperate regions, *A. aestivalis* having been taken in Russia at depths of 3 to 6 m. in the lower Volga River (Sirotinina, 1921), 6.5 m. in the Ob' River (Lepneva, 1930), and 8.8 m. in the Yenisey River (Pirozhnikov, 1929). In addition, Thorpe (1965) notes records of *A. aestivalis* from wells in England, stagnant pools along the Volga River, and brackish waters near Kiel, West Germany. *A. aestivalis* may be atypically adaptable, which would explain its wide distribution in Europe; no other species has been reported from such a broad range of situations, suggesting that most species in tropical regions occupy a more restricted set of habitats (see following discussion).

As noted above, *Aphelocheirus* species in tropical Asia are basically restricted to rocky upland streams as far as we know, but there is disagreement in the ecological literature concerning which particular microhabitats they prefer within such streams. Starmuhlner (1984) recorded *A. clivicolus* Polhemus in mountain streams on Ceylon from 50 to 100 meters elevation, classifying them as swimmers in lentic areas of low current. Dudgeon (1983, 1984) by contrast listed *Aphelocheirus* in Hong Kong as benthic predators present only in riffle areas. Bishop (1973), in his extensive limnological study of the Malaysian Gombak River, found *Aphelocheirus* at all five of his sampling stations from the fast headwaters to the slow valley sections, and considered them one of the most common and constant faunal elements in that stream's benthic community. In our experience *Aphelocheirus* are most typically found in gravelly riffles and rapids, where current speeds and dissolved oxygen are both high, but we have also found them clinging in numbers to the submerged edges of large rocks, trailing root mats, and undercut banks. We have even taken them occasionally in still side channels and pools, but this is uncommon.

One marked pattern that we have noted in many tropical Asian streams is for *Aphelocheirus* populations to occur in much higher densities in reaches of unshaded water. The entry of sunlight allows for the growth of algae on the rocky substrate, which in turn provides a food source for grazing aquatic insect larvae and mollusks on which *Aphelocheirus* reportedly prey. Light gaps in the riparian forest canopy caused by road crossings or tree falls can thus produce aggregations of *Aphelocheirus* species that are quite uncommon and widely dispersed elsewhere. Unshaded streams in open country cleared for cultivation are occa-

sionally even more favorable in this regard and may contain *Aphelocheirus* in incredible numbers, provided there is sufficient flow and low enough organic pollution to keep the water temperature cool and prevent the excessive buildup of filamentous algae. By contrast, low elevation streams near the coast with populations of crabs and other non-insect arthropods are usually devoid of *Aphelocheirus*.

Although considered quite rare by most authors, *Aphelocheirus* are in fact extremely abundant in many of the rocky streams of tropical Asia, and once an experienced collector learns how to find them he may often procure several hundred specimens in a short period of time. Generally the insects prefer streams with base substrates of sand or coarse gravel overlain by larger rocks; *Aphelocheirus* often appear to burrow in sand, and experience can allow one to judge the correct substrate by its "feel" under the feet while the stream is being waded. Some species occur only in a very restricted area or microhabitat in a stream, while other species are much less selective. The most effective collecting method is to disturb the substrate while holding a net just downstream, so that the dislodged insects are carried into it by the current.

Several species of *Aphelocheirus* may occur in the same stream, and appear to partition the habitat on the basis of current speed and substrate type. This pattern was especially evident at the Nam Chai River in northern Thailand, and is treated in more detail in the discussion under *A. lahu*. Additional ecological notes may also be found in the discussions of other individual species.

Nomenclature

We have followed the opinion of Hoberlandt and Štys (1979) in treating the Aphelocheirinae as a subfamily of the Naucoridae rather than as a separate family. Those authors ascribed its authorship to Douglas and Scott (1865), however it is actually attributable to Fieber (1851) who based the name on an emendation of *Aphelocheirus* Westwood 1833 (see generic synonymy below). The subsequent history of the use of Aphelocheiridae as a family name reveals its use at several levels under various emendations by Fieber (1860) and Douglas and Scott (1865), as a division of the Naucoridae by Stål (1876) and Oshanin (1910), and as a subfamily by Kirkaldy (1906), but these usages have been inconsistent. Among modern authors, La Rivers (1971) and De Carlo (1971) have treated the group as a family, China (1943, 1955) and Parsons (1966, 1969a, b, c) have treated it either as a family or a subfamily in different papers, and Usinger (1941), China and Miller (1959), Popov (1970, 1971), and Hoberlandt and Štys (1979) have consistently accepted the subfamilial status. The latter authors provided a thorough review of the morphological evidence supporting their position, and we agree with their conclusions. These authors cite the date for the authorship of the genus *Aphelocheirus* as Westwood 1840, but the generic name was actually proposed by Westwood in 1833 in the Magazine of Natural History (p. 229). In his 1840 citation Westwood failed to reference his earlier work, and the original description has thus been generally overlooked. The authorship and date of the family name has also been incorrectly cited by all authors to date whose works we have seen, probably because the 1964 Code of Zoological Nomenclature was not specific as to the

treatment of wrongly formed names; the 1985 Code is explicit in this regard, and we now attribute the family group name to Fieber 1851, as discussed below. The synonymy of the family group name is as follows:

Subfamily Aphelocheirinae Fieber 1851
Aphelochirae Fieber 1851: 15
Aphelochiridae Douglas and Scott 1865: 44
Aphelocheiraria Stål 1876: 143
Aphelocheirinae Kirkaldy 1906: 150
Aphelochiraria Oshanin 1910: 957
Aphelocheiridae China 1943: 279

The following annotated list of various emendations and uses of the subfamily name, though by no means complete, further traces the complicated nomenclatural history of this group.

Aphelochirae. Fieber, 1851, p. 15. Genera Hydrocoridum secundum ordinem naturalem in familias disposita. Acta Regiae Bohemicae Societis Scientarum, Calve, Pragae, pp. 1-31, 4 pls. (treats as subfamily given as "Turma I. Aphelochirae", under "Familia IV. Naucoridea" to hold "Genus IV. *Aphelochira*". This work was also published in Abhandlung der königlische böhemischen Gesellschaft der Wissenschaftlichen in Prag., Pragae, (5) 7: 181-212, 1852, but we have not seen the latter.) Here Fieber clearly treats Aphelochirae as a family group name (a turma is literally a mob or group), based on the unjustified emendation, *Aphelochira*, of *Aphelocheirus* Westwood 1833, which Fieber cites as *Aphelocheira*. According to the 1985 Code of Zoological Nomenclature [35. (d) (ii)] "a family-group name based upon an unjustified emendation of a generic name is valid but must be corrected"; the 1985 Code [35. (d) (i)] also states that "an incorrectly formed family-group name, or one based upon an incorrect spelling of the name of its type genus must be corrected", in this case to Aphelocheiridae.

Aphelochirae. Fieber, 1860, p. 23. Die Europäischen Hemiptera Halbflügler. (Rhynchota Heteroptera). Nach der analytischen Methode bearbeitet. Wien. pp. 1-112, 1860; pp. 113-144 and III-VI, 1861, 2 pls. (treats as family, given as "VI-Fam. Aphelochirae Fieb."). This usage of the family group name has been cited by some authors as the first (e.g. Poisson, 1957, see below).

Aphelochiridae. Douglas and Scott, 1865, p. 44. The British Hemiptera, vol. I. Hemiptera-Heteroptera. London. 627 pp. + addenda (1 p.) + 20 pls. (on p. 43 we find the following: "Div. 2. — Cryptocerata; Sub-Div. 2 — Aquatilia; Section 1. — Aphelochirina", with "Aphelochirae, Fieb." as a synonym; on p. 44 we find "Family 1. — Aphelochiridae; Genus 1. — Aphelocheirus Westw."). The "Section 1. — Aphelochirina" is apparently new here, as no author is given for it on p. 43 where it first appears, and authors are given for all other categories except families. For instance, Fieber (no date) is credited with Aphelochirae, which is apparently treated here as a superfamily.

Aphelocheiraria. Stål, 1876, p. 143. Enumeratio Naucoridarum *in* Enumeratio Hemipterorum, no. 5. Ofversight af Kongliga Svenska Vetenskaps-Akademiens Handlingar,

14: 1-162 (treats the group as a division within the family Naucoridae; attributes *Aphelocheirus* to Westwood 1840).

Aphelocheirinae. Kirkaldy, 1906, p. 150. List of the genera of the pagiopodous Hemiptera-Heteroptera, with their type species, from 1758 to 1904 and also of the aquatic and semi-aquatic trochalopoda. Transactions of the American Entomolological Society, 32: 117-156, 156a-b (treats group as subfamily with no author cited or discussion).

Aphelochiraria. Oshanin, 1910, p. 957. Verzeichnis der Palaearktischen Hemipteren mit besonderer Berücksichtigung ihrer verteilung im Russischen Reiche. Annuaire du Musée Zoologique de l'Académie Impériale des Sciences, Bd.1, Heteroptera, Leif III: 587-1087 (treats the group as a division within the family Naucoridae).

Aphelocheirinae. Usinger, 1941, p. 7. Key to the subfamilies of Naucoridae with a generic synopsis of the new subfamily Ambrysinae (Hemiptera). Annals of the Entomolological Society of America, 34: 5-16 (treats the group as subfamily with no author cited or discussion).

Aphelocheiridae. China, 1943, p. 279. The generic names of the British Insects, part 8. The generic names of the British Hemiptera-Heteroptera with a checklist of the British species. London: Royal Entomological Society of London, pp. 211-342 (treats the group as family but does not cite author). If there was an earlier usage of this combination we have not discovered it.

Aphelocheiridae. Poisson, 1957, p. 155. Faune de France. Heteropteres aquatiques. Paris: Lechevalier. 263 pp. (treats group as family and ascribes authorship to Fieber, 1860).

Aphelocheirinae. Popov, 1970, p. 97. Notes on the classification of the recent Naucoridae (Heteroptera, Nepomorpha). Bulletin de l'Academie Polonaise des Sciences, 18: 93-98 (treats the group as a subfamily and ascribes authorship to Stål, 1871).

Aphelocheirinae. Popov, 1971, p. 156. The historical development of Hemiptera, infraorder Nepomorpha (Heteroptera). Trudy Paleontological Institute, Academy of Sciences, USSR, 129: 228 pp. (treats group again as subfamily but ascribes authorship to Fieber, 1860).

Key characters

Figures 1 through 3 provide explanations of the various characters used in the keys to species; the interpretation of structures follows Parsons (1969a). All subsequent habitus figures are drawn to the same scale as figures 1 and 2, with the exception of the small species depicted in figures 139, 143, 147, 148, 152 and 153, which are drawn to a slightly larger scale and accompanied by a separate scale bar. All figures of inner propleural projections and female subgenital plates are drawn to the same scale as figure 3.

We offer the following notes on several key characters useful in the separation of *Aphelocheirus* species:

Inner propleural projections: the inner apex of the propleura bordering the fore coxal cavity (IP) is distinctively shaped in many species. This character is best viewed from a ventrolateral aspect (fig. 3), and in some specimens it may be necessary to lift the foreleg out of the way in order to examine it. The inner projection is notched in all Asian members of the subgenus *Aphelocheirus*, and lacks a notch in all members of the subgenus *Micraphelocheirus*. The figures generally depict the projection of the left propleuron, although in certain cases this structure was damaged or blocked from view, in which case the right side was illustrated instead.

Peg-like spines on abdominal ventrites: many species possess 3 to 6 small stout erect peg-like setae (PS) medially on the posterior margins of the abdominal ventrites. The number of ventrites bearing such setae is variable; they are usually present on ventrites IV through VI, but may be present only on ventrite V (*A. kinabalu*). The presence of such setae may also vary between macropterous and brachypterous morphs of a species, being absent in the former and present in the latter (*A. sculpturatus*), although in the majority of species they are present in both forms. The peg-like setae are detachable, and occasionally become lost even in living individuals, but if this occurs there is usually an obvious row of sockets left where the setae used to be. The setae may also be difficult to see in some species where they are very short, and are often best viewed in lateral aspect.

Length of head before eyes: the degree of prolongation of the head capsule ahead of the eyes varies greatly among species of *Aphelocheirus*. In order to to correctly measure this character one must orient the head in a horizontal plane (it is often angled slightly downward in relation to the remainder of the body in pinned specimens). The distance referred to in the keys is taken as that between a line run across the anterior margins of the eyes and another parallel line touching the anterior apex of the head. In the habitus figures the depicted length of the head may appear shorter than stated in the description, especially for macropterous forms, due to the orientation of the specimens being illustrated.

Female subgenital plate: the female subgenital plate (Sg) is diagnostic for most species of *Aphelocheirus*, and is easily visible at the tip of the female abdomen (fig. 2). In some species (*A. philippinensis*, *A. malayanus*, *A. thai*, *A. celebensis*) the plate bears small peg-like setae similar to those noted above on the abdominal ventrites; these are sometimes difficult to see, and may be best viewed in a lateral orientation or in alcohol immersion.

Male genital complex: the male genital capsule is usually easily removed with a pair of tweezers by pulling it straight out from behind, revealing the parameres lying on its dorsal side. The shapes of the parameres are generally diagnostic for each species, and have been illustrated as they lie in the capsule. If removed and mounted on a slide they will often present a different shape due to the change in orientation. Dry pinned specimens may often be dissected by soaking them in dilute alcohol or other relaxing fluid for several days, after which time the genital capsule may be removed without damaging the remainder of the insect. The vesica, which in *Aphelocheirus* lies above and behind

the parameres in the genital capsule, is illustrated for species in which it could be observed clearly, but is omitted from the figures for many others.

Abdominal segmentation: in Naucoridae the first abdominal segment (A1) is greatly reduced and nearly hidden, so that the first segment visible laterally represents abdominal segment II (A2, figs. 1, 2). In determining the number of an abdominal segment one should thus start at segment II and count backward toward the tip of the abdomen.

Key to subgenera and species of Aphelocheirinae in tropical Asia

Key to subgenera of *Aphelocheirus*

Length greater than 6.0 mm. Abdominal scent glands located closer to midline than to lateral margin of abdomen. Wing pads of brachypterous form large, covering at least half of metanotum laterally (figs. 65, 111). Inner propleural projections notched apically (figs. 113, 117) ..... Subgenus *Aphelocheirus* Westwood

Length less than 5.0 mm. Abdominal scent glands located closer to lateral margin of abdomen than to midline. Wing pads of brachypterous form small, not covering more than one fourth of metanotum laterally (figs. 147, 152). Inner propleural projections lacking notch apically (figs. 141, 154) ..... Subgenus *Micraphelocheirus* Hoberlandt and Štys

Key to species of *Aphelocheirus* in tropical Asia

Note: separate keys are given for macropterous and brachypterous forms due to their differences in structure. These keys also contain different sets of species, since in many cases a given species is known only from the macropterous or brachypterous morph. Species of the subgenera *Aphelocheirus* and *Micraphelocheirus* are treated in the same key, but the subgeneric classification of each species is noted.

Macropterous forms

1. a. Very small species, length less than 5.0 mm. (*Micraphelocheirus*) 2
   b. Larger species, length exceeding 6.0 mm. (*Aphelocheirus*) 5
2. a. Mesosternal plate with sharply raised longitudinal median carina on anterior half; abdominal ventrite III with posteriorly projecting knob medially on posterior margin (fig. 157); male parameres distinctive (fig. 142); Assam .... *A.* (*M.*) *pygmaeus* La Rivers
   b. Mesosternal plate with gently raised longitudinal median carina along entire length; abdominal ventrite III lacking projecting knob medially on posterior margin 3
3. a. Embolar margin with distinct inward angle on posterior half (fig. 148); male parameres distinctive (fig. 150); Ceylon ..... *A.* (*M.*) *clivicolus* J. Polhemus

b. Embolar margin gently curved to form a very broad and shallow outward angle, not angling distinctly inward on posterior half (figs. 143, 153); Indochina ... 4

4. a. Length exceeding 4.0 mm.; lateral margins of pronotum bearing short erect peg-like setae; head produced ahead of eyes for distance greater than .60 the dorsal length of an eye; inner projection of propleura with broadly rounded apex (fig. 154); male parameres distinctive (fig. 156); Thailand ... *A.* (*M.*) *brevirostris* n.sp.

b. Length less than 4.0 mm.; lateral margins of pronotum lacking short erect peg-like setae; head produced ahead of eyes for distance equal to .50 the dorsal length of an eye; inner projection of propleura with narrowly triangular apex (fig. 146); male parameres distinctive (fig. 145); Vietnam ... *A.* (*M.*) *asiaticus* (Hoberlandt and Štys)

5. a. Embolar margin rounded, not forming a sharp acute angle medially, anterior portion uniformly convex (figs. 5, 9, 14, 119, 135) ... 6

b. Embolar margin forming an acute produced angle medially, anterior portion usually sinuate or concave (figs. 23, 28, 40, 57, 88, 101); if convex then posterior portion cutting sharply inward behind apex to form distinct angle (figs. 125, 128, 131) ... 10

6. a. Rostrum short, not attaining middle trochanters ... 7

b. Rostrum longer, attaining or exceeding middle trochanters ... 8

7. a. Head produced ahead of eyes for only .40 the dorsal length of an eye; posterolateral angles of abdominal tergites barely produced, forming small triangular points (fig. 13); male genitalia distinctive (fig. 15); Celebes .... *A.* (*A.*) *celebensis* n.sp.

b. Head produced ahead of eyes for .60 the dorsal length of an eye; posterolateral abdominal angles produced, tapering and spinose (fig. 4); male genitalia distinctive (fig. 6); northern Australia ... *A.* (*A.*) *australicus* Usinger

8. a. Rostrum short, reaching at most to hind coxae; head capsule not exceptionally elongate, produced ahead of eyes for less than .60 the dorsal length of an eye ... 9

b. Rostrum longer, reaching to hind trochanters; head capsule extremely elongate and tapering, produced ahead of eyes for .70 the dorsal length of an eye (fig. 135); Laos ... *A.* (*A.*) *lao* n.sp.

9. a. Inner propleural projection terminating in two nearly equal sized lobes of equal length separated by a V-shaped notch (fig. 121); exposed dorsal abdominal tergites unicolorous dark brown; Laos ... *A.* (*A.*) *ashlocki* n.sp.

b. Inner propleural projection terminating in two unequal sized lobes, with one longer and narrower than the other (fig. 10); exposed dorsal abdominal tergites brown with posterior margins dark yellowish, giving striped appearance; New Guinea... *A.* (*A.*) *pallens* Horvath

10. a. Rostrum long, reaching to hind trochanters; abdominal venter with longitudinal raised carina medially (fig. 134) ... 11

b. Rostrum shorter, not attaining hind trochanters; abdominal venter lacking longitudinal carina medially ... 13

11. a. Abdominal ventrite III lacking conspicuous rearwardly projecting knob medially on posterior margin, bearing at most a small hump which does not project over the base of ventrite IV; female subgenital plate roughly triangular, not truncate

apically (figs. 126, 129); Vietnam 12
b. Abdominal ventrite III bearing conspicuous knob medially on posterior margin, knob projecting over base of ventrite IV (fig. 134); female subgenital plate truncate apically (fig. 132); male unknown; China ..... *A.* (*A.*) *cantonensis* n.sp.
12. a. Length less than 10 mm.; rostrum reaching to bases of hind coxae; coloration light brown; female subgenital plate distinctive (fig. 126) ..... *A.* (*A.*) *carinatus* Royer
b. Length exceeding 11 mm.; rostrum reaching beyond hind trochanters; coloration dark brown; female subgenital plate distinctive (fig. 129) ..... *A.* (*A.*) *similaris* n.sp.
13. a. Male with conspicuous projecting tab to right of center on abdominal ventrite IV (fig. 105); female with subgenital plate very short and truncate, bearing two prominent hair tufts along posterior margin (fig. 104); Malaysia and Thailand ..... *A.* (*A.*) *grik* n.sp.
b. Male without tab on abdominal ventrite IV; female subgenital plate longer, shape triangular or elongate trapezoidal with long lateral hair tufts 14
14. a. Abdominal ventrite III with raised posteriorly directed protruberance medially on posterior margin (fig. 26) 15
b. Abdominal ventrite III lacking such a protruberance 17
15. a. Head produced ahead of eyes for a distance greater than or equal to .70 the dorsal length of an eye; abdominal ventrite VI in males with a small posteriorly directed glabrous tab to left of center on posterior margin (fig. 99); female subgenital plate narrowing markedly on apical half (fig. 96); Indochina ..... *A.* (*A.*) *fang* n.sp.
b. Head shorter, produced ahead of eyes for distance less than .60 the dorsal length of an eye; males with abdominal ventrite VI lacking a small tab posteriorly; female subgenital plate not narrowing markedly on apical half (figs. 26, 27); Borneo 16
16. a. Larger species, length exceeding 8.0 mm. (fig. 28); female abdominal ventrites V and VI with stout peg-like setae medially along posterior margins (fig. 27), male genitalia distinctive (fig. 31) ..... *A.* (*A.*) *kinabalu* n.sp.
b. Small species, length less than 7.0 mm. (fig. 23); female abdominal ventrites IV-VI without stout peg-like setae medially on posterior margins (fig. 26); male genitalia distinctive (fig. 25) ..... *A.* (*A.*) *minor* n.sp.
17. a. Rostrum short, reaching only onto mesosternal plate, not attaining bases of middle coxae; Luzon ..... *A.* (*A.*) *philippinensis* Usinger
b. Rostrum longer, extending to at least the bases of the middle coxae 18
18. a. Head extremely short, produced ahead of eyes for a distance equal to only .30 the dorsal length of an eye; India ..... *A.* (*A.*) *nathani* La Rivers
b. Head longer, produced ahead of eyes for distance equal to at least .45 the dorsal length of an eye; Indochina, Malaysia and Philippines 19
19. a. Head produced ahead of eyes for distance equal to or greater than .60 the dorsal length of an eye; Malaysia 20
b. Head produced ahead of eyes for distance less than .60 the dorsal length of an eye; Indochina and Philippines 21
20. a. Moderately small species, length 8.0 mm. or less (fig. 72); male hind femur with raised dark ovate swelling basally on ventral face (fig. 70); female subgenital plate

lacking peg-like setae near apex (fig. 75) ..... *A.* (*A.*) *femoratus* n.sp.

b. Larger species, length 9.0 mm. or greater (fig. 66); male hind femur lacking dark swelling ventrally; female subgenital plate with peg-like setae near apex (fig. 69).. ..... *A.* (*A.*) *malayanus* n.sp.

21. a. Mesosternal plate with longitudinal median carina abruptly interrupted and raised on posterior two thirds, forming a keel-like structure with a sharply truncate anterior margin (figs. 80, 83); Indochina 22

b. Mesosternal plate with gently raised longitudinal median carina, not interrupted by keel-like tumescence; Philippines 24

22. a. Posterolateral angles of abdominal segment III not produced or spinose; head projecting ahead of eyes for distance less than .50 the dorsal length of an eye... ..... *A.* (*A.*) *petersi* n.sp.

b. Posterolateral angles of abdominal segment III produced and spinose to greater or lesser degree; head projecting ahead of eyes for distance greater than .50 the dorsal length of an eye 23

23. a. Rostrum reaching only to bases of middle coxae; spinose projections of abdominal segment III fairly long and tapering, directed posteriorly; coloration of abdominal tergites a uniform dull brown; mesosternal keel with anterior apex angled backward when viewed laterally (fig. 83); male genitalia distinctive (fig. 89) ... . *A.* (*A.*) *gularis* Horvath

b. Rostrum extending to tips of middle coxae; spinose projections of abdominal segment III small, angling slightly outward; posterolateral portions of abdominal tergites yellowish, giving abdomen a striped appearance; mesosternal keel with anterior margin angling forward when viewed laterally (fig. 80); male genitalia distinctive (fig. 78) ..... *A.* (*A.*) *thai* n.sp.

24. a. Smaller species, length less than 9.0 mm.; male genitalia distinctive (fig. 41); Mindanao ..... *A.* (*A.*) *zamboanga* n.sp.

b. Larger species, length exceeding 9.5 mm.; Luzon 25

25. a. Posterolateral angles of pronotum angulate (fig. 57); posterolateral angles of abdominal segment III in females produced to small spinose points; coloration of abdominal tergites uniform dull blackish brown; males bearing small stout peg-like setae medially on posterior margins of abdominal ventrites IV-VI .... *A.* (*A.*) *uichancoi* Usinger

b. Posterolateral angles of pronotum rounded (fig. 49); posterolateral angles of abdominal segment III in females produced to broad blunt posteriorly directed projections; coloration of abdominal tergites brown with posterolateral portions suffused with dull yellow, giving a striped appearance; males lacking small peg-like setae on posterior margins of abdominal ventrites .... *A.* (*A.*) *sculpturatus* n.sp.

Brachypterous forms

1. a. Very small species, length less than 5.0 mm. (*Micraphelocheirus*) 2

b. Larger species, length exceeding 6.0 mm. (*Aphelocheirus*) 3

2. a. Mesosternal plate rising to posterior tumescence when viewed laterally; inner projection of propleuron broadly triangular at apex (fig. 149); Ceylon .....

..... *A.* (*M.*) *clivicolus* J. Polhemus

b. Mesosternal plate not rising to posterior tumescence when viewed laterally; inner projection of propleuron roughly squared off at apex, not triangular (fig. 154); Thailand ..... *A.* (*M.*) *brevirostris* n.sp.

3. a. Abdominal tergite V of male asymmetrical, deeply concave on right margin as viewed from above (fig. 32); female unknown; Java .... *A.* (*A.*) *javanicus* n.sp.

b. Abdominal tergite V of male not asymmetrical in manner described above 4

4. a. Male with conspicuous projecting tab on abdominal ventrite IV (fig. 105); female subgenital plate very short and truncate, broader than long, with two long hair tufts on posterior margin (fig. 104); Thailand and Malaysia ... . *A.* (*A.*) *grik* n.sp.

b. Male lacking projecting tab on abdominal ventrite IV; female subgenital plate longer, shape triangular or elongate trapezoidal with long lateral hair tufts 5

5. a. Stout erect peg-like setae present medially on posterior margin of abdominal ventrite V (often on IV and VI as well) 6

b. Abdominal ventrites lacking stout peg-like setae 23

6. a. Rostrum short, not attaining middle coxae, reaching only onto mesosternal plate; Luzon 7

b. Rostrum longer, reaching to at least the middle coxae 8

7. a. Head produced ahead of eyes for over .50 the length of an eye; length exceeding 9.0 mm ..... *A.* (*A.*) *baguio* n.sp.

b. Head produced ahead of eyes for only .30 the length of an eye; length less than 8.0 mm (fig. 53) ..... *A.* (*A.*) *luzonicus* n.sp.

8. a. Abdominal ventrite III bearing a posteriorly directed hump medially on posterior margin (fig. 26); Borneo ..... *A.* (*A.*) *kinabalu* n.sp.

b. Abdominal ventrite III lacking a posteriorly directed hump medially on posterior margin 9

9. a. Head produced ahead of eyes for .70 the dorsal length of an eye or more 10

b. Head produced ahead of eyes for less than .65 the dorsal length of an eye 11

10. a. Male with dark raised ovate swelling on ventral face of hind femur (fig. 70); abdominal ventrite VI lacking a conspicuous projecting tab; length less than 8.0 mm; Malaysia and Thailand ..... *A.* (*A.*) *femoratus* n.sp.

b. Male lacking raised ovate swelling on ventral face of hind femur; abdominal ventrite VI with conspicuous projecting tab (fig. 99); length exceeding 8.0 mm; Thailand ..... *A.* (*A.*) *fang* n.sp.

11. a. Posterior projections of abdominal segment VII in males asymmetrical (fig. 106); female subgenital plate tapering to narrow acuminate point (fig. 110); Thailand ..... *A.* (*A.*) *petersi* n.sp.

b. Posterior projections of abdominal segment VII in males not asymmetrical; female subgenital plate not tapering to an acuminate point 12

12. a. Mesosternal plate lacking a distinct raised longitudinal carina anteromedially, broadly domed posteromedially but not forming an abrupt tumescence; Luzon ..... *A.* (*A.*) *philippinensis* Usinger

b. Mesosternal plate with distinct raised longitudinal carina anteromedially, rising to an abrupt and distinct tumescence posteromedially 13
13. a. Larger species, length exceeding 8.25 mm 14
b. Smaller species, length less than 8.0 mm 20
14. a. Head produced ahead of eyes for less than .50 the dorsal length of an eye 15
b. Head produced ahead of eyes for .60 the dorsal length of an eye or greater 19
15. a. Length less than 9.25 mm 16
b. Length exceeding 9.50 mm 17
16. a. Wing pads widely separated medially (fig. 111); India .... *A.* (*A.*) *nathani* La Rivers
b. Wing pads touching medially, or nearly so (fig. 13); Celebes .... *A.* (*A.*) *celebensis* n.sp.
17. a. Lateral margins of pronotum yellowish, translucent; Celebes .... *A.* (*A.*) *lorelindu* n.sp.
b. Lateral margins of pronotum dark brownish, not translucent; Luzon 18
18. a. Male left paramere stout, widening apically (fig. 49); female subgenital plate with indentation at tip (fig. 51); abdominal tergite VI deflexed sharply downward, projection on left side nearly vertical (fig. 51) ..... *A.* (*A.*) *sculpturatus* n.sp.
b. Male left paramere gently curving, becoming more slender apically (fig. 60); female subgenital plate lacking indentation at tip (fig. 59); female abdominal tergite VI not deflexed downward ..... *A.* (*A.*) *uichancoi* Usinger
19. a. Inner projection of propleura with apex coming to a slender acute point (fig. 68); male genitalia distinctive (fig. 67); Malay Peninsula . *A.* (*A.*) *malayanus* n.sp.
b. Inner projections of propleura with apex broadly triangular, somewhat rounded (fig. 124); male genitalia distinctive (fig. 123), female unknown; eastern China ... . *A.* (*A.*) *denticeps* Montandon
20. a. Abdomen ventrally with gently raised longitudinal glabrous carina medially; Australia ..... *A.* (*A.*) *australicus* Usinger
b. Abdominal ventrite IV lacking a posteriorly directed hump medially on posterior margin; Mindanao ..... *A.* (*A.*) *zamboanga* n.sp.
21. a. Head produced ahead of eyes for less than .45 the dorsal length of an eye; female subgenital plate notched apically (fig. 116); male genitalia distinctive (fig. 118); Hong Kong ..... *A.* (*A.*) *dudgeoni* n.sp.
b. Head produced ahead of eyes for .50 the dorsal length of an eye or greater; female subgenital plate lacking notch apically; Indochina 22
22. a. Mesosternum rising abruptly to a vertical blade-like keel with tip angling forward (fig. 80); male abdominal ventrite VI lacking a small triangular tab medially ... . *A.* (*A.*) *thai* n.sp.
b. Mesosternal keel not so abrupt, angling backward along anterior margin (fig. 83); male abdominal ventrite VI with a small triangular tab medially (fig. 84) .... *A.* (*A.*) *inops* Horvath
23. a. Abdominal ventrite IV with a small posteriorly directed hump medially on posterior margin (a similar hump may also be present on ventrite III) (fig. 26) 24
b. Abdominal ventrite IV lacking a posteriorly directed hump edially on posterior margin; Mindanao ..... *A.* (*A.*) *zamboanga* n.sp.

24. a. Wing pads widely separated medially (fig. 90); medial portion of mesosternal plate gradually rising to rounded tumescence on posterior half; Thailand .... *A.* (*A.*) *lahu* n.sp.
    b. Wing pads touching medially or nearly so; medial portion of mesosternal plate rising abruptly to keel-like ridge on posterior two thirds 25
25. a. Abdominal ventrites III and IV both with posteriorly directed humps medially on posterior margins (fig. 26); Borneo ..... *A.* (*A.*) *minor* n.sp.
    b. Only abdominal ventrite IV bearing a posteriorly directed hump medially on posterior margin; Palawan ..... *A.* (*A.*) *palawanensis* n.sp.

Genus *Aphelocheirus* Westwood

Aphelocheirus Westwood, 1833, Mag. Nat. Hist. 6: 229. Type-species *Naucoris aestivalis* Fabricius, 1794: 66, by original designation.

Aphelochira Agassiz, 1846, Nomenclatoris Zoologici Index Universalis, Soloduri, p. 28. (Unjustified emendation.)

Aphelocheira Fieber, 1851, Gen. Hydrocoridum, Calve, Pragae, p.15. (Unjustified emendation of *Aphelocheirus* Westwood.)

Aphelochirus Puton, 1880, Synopsis Hém.-Hét. France, 3^{e} Partie, Remiremont, p. 210. (Emendation.)

Suturgana Oshanin, 1909, Ann. Mus. Zool. Acad. Imp. Sci. St. Petersbourgh 14: 6. Type-species *Suturgana plumipes* Oshanin, 1909: 9, monobasic. Syn. by Montandon 1913, Bull. Sect. Sci. Acad. Roumaine 11: 219

Micraphelocheirus Hoberlandt and Štys, 1979, Acta Mus. Nat. Pragae 33B: 9 (As subgenus). Type-species *Aphelocheirus pygmaeus* La Rivers, 1971: 69, by original designation.

Microphelocheirus Hoberlandt and Štys, 1979, Acta Mus. Nat. Pragae 33B: 5 (Alternative spelling; lapsus)

Tamopocoris Hoberlandt and Štys, 1979, Acta Mus. Nat. Pragae 33B: 5. Type-species *Tamopocoris asiaticus* Hoberlandt and Štys, 1979: 6, by original designation. Syn. of *Micraphelocheirus*, new synonymy.

Discussion:

We have examined a male and female of *Tamopocoris asiaticus* Hoberlandt and Štys from Viet Nam. The foreleg of the male was dissected and examined in glycerine at 80X magnification against the edge of a dark background in order to study the setae and segmentation. We do not see in either male or female the degree of fusion between the second and third segments of the fore tarsus shown by Hoberlandt and Štys (1979). In the female (not dissected) the suture appears complete and in the male the two segments are also apparently free to articulate. In "dorsal" view, the pilosity of the anterior tarsus in this species closely matches figure 8 of Hoberlandt and Štys given for their *Aphelocheirus* (*Micraphelocheirus*) *pygmaeus* La Rivers, not their figure 10. The ventral pilosity is largely confined to the lateral margins of these segments, so the angle of viewing is important. As stated by Hoberlandt and Štys, the first anterior tarsal segment is bare beneath, has

no "dorsal edge", and there are no discernable parempodia or other pretarsal structures other than a single arolium.

The swimming hairs on the hind tarsi tend to become closely appressed to the tarsus when dry or in a viscous fluid, so we examined and drew those of *T. asiaticus* in alcohol (fig. 161). They are neither sparse nor short, but are dense and three times as long as the width of the tibia where they arise.

We have also studied a male and two female paratypes of *A. (M.) pygmaeus* La Rivers, and are unable to confirm the presence of the upper leaf-like sensillum apically on the anterior tarsus as shown by Hoberlandt and Štys (1979, fig. 8), however it is indeed possible that it was present and has been broken off in our specimens. In the same figure they show anterior tarsal segment 1 as long and visible dorsally; in the paratypes we studied segment 1 is short, not visible dorsally, and similar to *A. (M.) brevirostris* n. sp. (fig. 159). At a magnification of 80X the parempodia are barely visible in our specimen, and not nearly as evident as depicted by Hoberlandt and Štys.

We are unable to discern parempodia at a magnification of 80X in either *A. (M.) clivicolus* Polhemus or *A. (M) brevirostris*, so on the basis of this character they would run to *Tamopocoris* in Hoberlandt and Štys key. In *brevirostris* the rostrum (labium) reaches only onto the anterior ¼ of the mesosternum, except in specimens with the thorax and head bent downward where the tip of the rostrum can reach the posterior ¼; the length of the third rostral segment is 1.67 times the fourth. In *clivicolus* the rostrum reaches onto the posterior ⅓ of the mesosternum, and the length of the third rostral segment is 2.25 times the fourth. The short rostrum with a relatively short segment IV would thus seem to be a candidate character for the separation of genera in this group, however our new species *A. baguio* n. sp. from northern Luzon, which clearly belongs to the subgenus *Aphelocheirus* on other grounds, also has a short rostrum reaching only to the middle of the mesosternum, and the length of the third rostral segment is 2.43 times the fourth. Most *Aphelocheirus* species have a much longer rostrum than *baguio*, but the character is variable. Thus the characters associated with the rostrum seem too variable to delineate genera.

In all four species that we now place in *Micraphelocheirus* the first anterior tarsal segment is short, wedge shaped, and lacks a dorsal margin, and the swimming hairs on the posterior tibia are long and dense. Thus of the characters given by Hoberlandt and Štys to separate *Tamopocoris* and *Micraphelocheirus*, the only ones remaining are minute details of the fore tarsi (primarily sensilla), and we do not believe that these warrant generic separation. *Tamopocoris* is hereby placed as a junior synonym of *Micraphelocheirus*.

In addition to the taxa placed herein under *Micraphelocheirus*, there is another potentially separable genus group. This is a group of large species (length > 7 mm.) with the head prolonged in front of the eyes, the eyes narrowed and sculptured, the rostrum very long and extending at least to the hind coxae, and the abdominal venter with a distinctly raised longitudinal median carinae. In tropical Asia this group is typified by *A. carinatus* Royer, and in several of the species discussions we have referred to this and allied species as members of the "*carinatus* group". Other members of this group, which includes *A.*

amurensis Kiritschenko, range far northward and westward into Siberia, and it appears that this lineage is more boreally based and penetrates southward through China to the mountains of Vietnam, but has not become established in much of tropical Asia south of Indochina.

We have attempted to separate these species from the other more "typical" *Aphelocheirus* species having the general facies of *A. aestivalis* (F.), however we have been frustrated by the intergradation of characters among various species which precludes establishment of a clear cut generic or subgeneric division. We lack several of the species which appear to belong in this group, and do not have long series of any Palaearctic species at our disposal except *aestivalis*, thus it is still possible that a separate genus group taxon will be recognized when more material is available. If such a taxon is eventually recognized, the genus group name *Suturgana* Oshanin is available and would apply, as *plumipes* Oshanin, its type-species, is a member of the group.

Subgenus *Aphelocheirus* Westwood

Aphelocheirus (Aphelocheirus) australicus Usinger

Figs. 4-8, 162.

Aphelocheirus australicus Usinger, 1937, Aust. Zool., 8: 341.
Aphelocheirus australicus: Usinger, 1938, Phil. J. Sci., 64: 305.
Aphelocheirus australicus: Hoberlandt and Štys, 1979, Acta Mus. Nat. Pragae, 33B: 17.

Description:

Brachypterous male: Of moderate size for genus, elongate ovate (fig. 4), length 7.78 mm; maximum width (across abdomen) 4.80 mm. Coloration brown, with scattered yellowish markings.

Head light brown, shining, minutely alveolate, width/length = 1.73/1.63, produced ahead of eyes for distance equal to .61 the length of an eye; eyes black, shining, width/length = .35/.91, outer margins barely sinuate; anterior/posterior interocular = 1.26/.86.

Pronotum brown, yellow laterally, surface rugose, bearing very fine recumbent gold setae, width/length (midline) = 4.03/.96; lateral margins gold, narrowly glabrous, each bearing ten very short stout setae, posterolateral angles acute. *Scutellum* brown, shining, rugose, width/length = 1.92/.96, lateral margins sinuate, basal margin with weak transverse sulcus. *Hemelytra* dull brown, rugose, with fine recumbent gold setae, brachypterous, not attaining base of abdominal tergite III, not touching medially, clavus obscure, embolar margin forming a right angle posterolaterally.

Abdomen brown, surface finely rugose, bearing recumbent gold setae, posterior margin of tergite V produced as an acute hump, posterolateral angles of tergites III-VI spinose.

Ventral surface yellowish brown, weakly pruinose, bearing fine gold setae; head, prothorax laterally, and abdomen narrowly along margins glabrous; antennae yellow, lengths of segments I-IV = .08, .13, .30, .45; rostrum gold, glabrous, length 3.03, attaining middle coxae; labrum gold, glabrous, margin evenly rounded; prothorax weakly carinate medially, inner margins of propleura notched (fig. 7); mesosternal plate brown, pruinose, weakly carinate medially, posteromedial portion bearing gold setae; metasternal plate brown, weakly produced posteromedially; abdomen lightly pruinose, with transverse rows of irregular glabrous depressions running inward from spiracular rosettes, sternites IV-VII with 3 small stout rearwardly directed spines medially on posterior margins.

Legs yellowish brown, covered with fine gold setae, fore femur, tibia, and tarsi with thick gold hair pads on inner faces; middle trochanter, femur, tibia and tarsi with thick pads of gold setae ventrally; fore, middle, and hind coxae with combs of long gold setae anteriorly; middle femur with scattered short spines ventrally, short erect spines along anterior margin; middle tibia with stout reddish spines along anterior margin plus three slender erect setae, a single transverse row of spines present apically; hind femur with scattered short stout spines ventrally, erect short spines along anterior margin; hind tibia with stout reddish spines along anterior margin plus five longer erect spines, a transverse row of spines apically; hind tibia and tarsi with long silvery swimming hairs; claws gold, weakly curved, tips infuscated.

Male genitalia with right paramere sinuate, tapering, bearing thick fringe of setae; left paramere expanded distally, bearing thick fringe of setae (fig. 6).

Brachypterous female: Similar to brachypterous male in general structure and coloration, length 7.97 mm; maximum width 5.18 mm. Subgenital plate roughly triangular, tip rounded, bearing terminal and lateral hair tufts (fig. 8).

Macropterous male: Coloration yellowish brown, hemelytra and anterior margins of abdominal tergites dark brown, length 8.16 mm; maximum width 4.80 mm (fig. 5). Structurally similar to brachypterous form with following exceptions: eyes more rounded, lateral margins not sinuate; pronotum more massive, posterolateral angles rounded; scutellum swollen, mesoscutum delineated by transverse furrow; hemelytra complete, exceeding apex of abdomen, surface dark brown, rugose, set with fine recumbent gold setae, membrane fumate, clavus and claval vein well defined, embolium expanded with lateral margin broadly rounded.

Macropterous female: Similar to macropterous male in general structure and coloration, length 8.45 mm; maximum width 4.90 mm.

Discussion: *A. australicus* may be recognized by the gently raised longitudinal carina medially on the abdominal venter, the male and female genital structures (figs. 6, 8), and other characters as given in the keys.

The sole member of the genus on the continent of Australia, *A. australicus* is confined to the tropical Cape York Peninsula. Originally described from a single female specimen from Cairns, this species has been taken in both rain forest and eucalyptus savannah habitats. Usinger's (1937) description of the macropterous female is excellent, but we now have examples of both macropterous and brachypterous males, as well as brachypterous females, which are described above. Our specimens from Jawolbinna were taken in a shallow, sandy, unshaded riffle.

Distribution: Known from east flowing drainages in northern Queensland (fig. 162).

Material examined: AUSTRALIA, **Queensland**: 15 brachypterous males, 4 brachypterous females, 1 nymph, Little Laura River at Jawolbinna, W. of Laura, CL 1744, 21 August 1983, J. T. Polhemus (JTPC); 1 macropterous male, 1 macropterous female, The Boulders, S. of Babinda, 15 December 1966, B. Cantrell (JTPC).

Aphelocheirus (Aphelocheirus) pallens Horvath Figs. 9-12, 163

Aphelocheirus pallens Horvath, 1899, Term. Fuz., 22: 258.
Aphelochirus pallens: Royer, 1920, Bull. Mus. Nat. Hist. Natur. 26: 60
Aphelochirus pallens: Kiritshenko, 1925, Russ. Hydrobiol. Zeitschr., 4: 41.
Aphelochirus pallens: Kiritshenko, 1929, C. R. Acad. Sci. URSS, (A) 1: 11.
Aphelocheirus pallens: La Rivers, 1971, Bull. So. Cal. Acad. Sci., 70: 69.
Aphelocheirus pallens: Hoberlandt and Štys, 1979, Acta Mus. Nat. Pragae, 33B: 18.

Description:

Macropterous male: Of moderate size for genus, elongate, length 7.68 mm; maximum width (across abdomen) 4.61 mm. Coloration light brown with scattered yellow markings.

Head light brown, shining, minutely alveolate, width/length = 1.54/1.63, produced ahead of eyes for distance equal to .56 the length of an eye; eyes black, shining, width/length = .35/.91, outer margins not sinuate, anterior/posterior interocular = 1.01/.76.

Pronotum brown, yellow laterally, surface rugose, bearing fine recumbent gold setae, width/length (midline) = 3.65/1.06, lateral margins narrowly glabrous, each bearing about ten minute stout setae, posterolateral angles obtuse, rounded, posterior margin sinuate. *Scutellum* light brown, darker basally, surface rugose, bearing short recumbent gold setae, width/length = 2.30/1.25, swollen, lateral margins sinuate, mesoscutum delineated by a sinuate transverse furrow. *Hemelytra* complete, exceeding tip of abdomen, surface dull brown, rugose, bearing fine recumbent gold setae, clavus and claval vein well defined,

embolium expanded with outer margin broadly rounded, membrane fumate, hind wings complete, functional.

Abdomen yellowish, anterior margins of tergites brown, giving lateral margins striped appearance; surface smooth, bearing recumbent gold setae, posterior margin of tergite V produced to an irregular rounded hump, posterolateral angles of tergites III-VI strongly spinose.

Ventral surface dull brown, lightly pruinose, bearing recumbent gold setae; antennae pale yellow, lengths of segments I-IV = .10, .15, .30, .45; rostrum gold, glabrous, length 3.13, reaching to middle coxae; labrum gold, glabrous, margin evenly rounded; prosternum weakly carinate medially, inner propleural projections deeply notched (fig. 10); mesosternal plate brown, pruinose, with medial tumescence bearing erect gold setae; metasternal plate brown, pruinose, barely produced posteromedially; abdomen pruinose, with irregular round glabrous depressions near spiracles, sternites IV-VII bearing three small stout posteriorly directed setae medially on posterior margins.

Legs pale yellow, covered with fine gold setae, fore femur, tibia, and tarsi with thick hair pads on inner faces; middle trochanter, femur, tibia, and tarsi with thick pads of gold setae ventrally; fore, middle, and hind coxae with combs of long gold setae distally; Middle femur with longitudinal row of short spines on ventral face, scattered short erect spines along anterior margin, and several long erect gold setae distally; middle tibia with long reddish spines along anterior margin, three very long erect gold setae basally, and transverse row of spines apically; hind femur with scattered short spines on ventral face, erect short spines along anterior margin, and row of fine erect setae along posterior margin; hind tibia with long stout reddish spines along anterior margin, transverse row of spines apically; hind tibia and tarsi with long silvery swimming hairs ventrally; claws pale, gently curving, tips infuscated.

Male genitalia with right paramere sinuate, blunt at apex, fringed with setae; left paramere curving, with expanded distal lobe, fringed with setae (fig. 11).

Macropterous female: Similar to macropterous male in general structure and coloration (fig. 9), length 7.78 mm.; width 4.70 mm. Subgenital plate roughly triangular, tip rounded, bearing terminal and lateral hair tufts (fig. 12).

Brachypterous form: unknown.

Discussion: We have examined the holotype of this species, a macropterous male bearing the labels "N. Guinea, Biro 96" and "Erima, Astrolabe Bay." This locality is near the present day Madang in Papua New Guinea. The type specimen is in moderately good condition, but badly pinned through the left wing and abdomen. Our more recently collected specimens from western Papua New Guinea match it quite well.

A. pallens may be distinguished by the spinose posterolateral angles of the abdominal tergites, the raised longitudinal median carina on the abdominal venter, and the male and

female genital structures (figs. 11, 12). We have yet to see a brachypterous example of this species, but new descriptions of the macropters of both sexes are provided above. The distributions plotted in figure 157 are based in part on records listed by La Rivers (1971).

This species is apparently the only *Aphelocheirus* present on the enormous island of New Guinea, and has been found in drainages to both the north and the south of the high central mountain ranges. Considering the geological youth of New Guinea and its well developed endemic naucorid fauna, it may well be that *Aphelocheirus* penetrated this island only relatively recently and have been unable to radiate in the face of competition from established taxa.

Distribution: Endemic to New Guinea, but occurs throughout the island (fig. 163).

Material examined: PAPUA NEW GUINEA, **Madang Prov.**: 1 macropterous male, N. Guinea, Erima, Astrolabe Bay, Biro 96 (holotype, HNHM). **Western Prov.**: 6 macropterous males, 3 macropterous females, Wai Somare River, nr. Ningerum on Ok Tedi road, CL 1778, 4 September 1983, J. T. and D. A. Polhemus (JTPC); 3 macropterous females, primary rain forest stream 10 km. S. of Ningerum on Ok Tedi road, CL 1779, 4 September 1983, J. T. and D. A. Polhemus (JTPC); 1 macropterous female, Fly River nr. Kiunga, December 1986, K. Hortle (JTPC). INDONESIA, **Irian Jaya Prov.**: 1 macropterous female, Mist Camp, Snow Mountains, upper Sahuweri River, 1800 m., January 1939, L. J. Toxopeus, Neth. Ind.-American New Guinea Exp. (RNHL)

Aphelocheirus (Aphelocheirus) celebensis n.sp.
Figs. 13-17, 164

Description:

Brachypterous male: Of moderate size for genus, ovate, length 9.02 mm; maximum width (across abdomen) 5.76 mm (fig. 13). Coloration dark brown with scattered yellowish brown markings.

Head yellowish brown, shining, width/length = 1.92/1.63, produced ahead of eyes for distance equal to .40 the length of an eye; eyes black, shining, width/length = .40/1.01, outer margins weakly sinuate; anterior/posterior interocular = 1.31/.91.

Pronotum dark brown, marked with yellowish laterally and to either side of midline, surface rugose, bearing fine recumbent gold setae, width/length = 4.61/1.25; lateral margins glabrous, bearing minute erect setae. *Scutellum* yellowish, base and lateral angles dark brown, surface rugose, bearing fine gold setae, width/length = 2.59/.96, lateral margins weakly sinuate, shallow transverse sulcus present basally. *Hemelytra* dark brown, brachypterous, touching medially, not attaining base of abdominal tergite III (second visible), surface rugose, bearing fine recumbent gold setae, clavus obscure, embolar margin cut sharply back to pronotum anteriorly, sharply terminated posteriorly (fig. 13).

Abdomen dark brown, yellowish patches present at posterolateral angles of tergites and to either side of midline producing striped appearance, surface weakly rugose, bearing fine recumbent gold setae, tergites II-VIII exposed, paired glandular openings present medially on posterior margin of tergite III, posterior margin of tergite V produced to a rounded hump medially, lateral margins of all tergites bearing short erect setae, posterolateral angles of tergites III-V weakly spinose.

Ventral surface dull brown, pruinose, head, pronotum, and lateral portions of abdominal segments yellow; antennae yellow, lengths of segments I-IV = .05, .15, .25, .40; rostrum gold, glabrous, length 2.88, reaching to middle coxae; labrum gold, shining, margin evenly rounded; prothorax with carina medially, propleura with inner projections notched (fig. 16); mesosternal plate brown, pruinose, tumescent posteromedially with weak longitudinal carina; metasternum brown, pruinose, bearing fine recumbent gold setae, medial plate yellow, glabrous, produced to sharp point posteriorly; abdomen brown, pruinose, with fine gold setae, posterior margins of sternites IV-VII with four to six rearwardly directed stout setae medially; genital segment light brown, shining.

Legs pale yellow, covered with fine gold setae, fore femur, tibia, and tarsi with thick hair pads on inner faces, fore claws barely curved; fore, middle, and hind coxae with combs of long gold setae on anterior margins; middle trochanter, femur, tibia, and tarsi with thick gold hair pads on ventral faces; middle femur sparsely set with short reddish spines, bearing six long erect setae on posterior margin; middle tibia sparsely set with stout reddish spines, bearing three long gold setae basally on anterior margin and two transverse rows of red spines apically; hind femur sparsely set with stout reddish spines; hind tibia with reddish spines along anterior margin; hind tibia and tarsi bearing silvery swimming hairs on ventral faces; claws reddish, shining, gently curved.

Male genitalia with right paramere strongly sinuate, tip tapered, left paramere tapering, weakly sinuate (fig. 15).

Brachypterous female: Similar to male in general structure and coloration, length 8.83 mm; maximum width 5.95 mm. Subgenital plate triangular, tip broadly rounded, bearing apical and lateral hair tufts (fig. 17).

Macropterous male: Similar in size and coloration to brachypterous form, length 9.03 mm; maximum width 5.76 mm (fig. 14), differing structurally in following details: pronotum more massive, margins expanded, posterolateral angles rounded; scutellum yellow,swollen, mesoscutum dark brown, shining, sharply delineated by transverse furrow; hemelytra complete, dark brown, rugose, bearing fine pale recumbent setae, clavus and embolium clearly delineated, embolar margin weakly produced to a rounded hump, membrane fumate, frequently broken behind corium; ventral surface with mesosternal plate swollen, longitudinal carina reduced.

Discussion: *A. celebensis* n.sp. is a moderate sized, rather broad species that may be recognized by the trapezoidal female subgenital plate (fig. 17), the distinctive male genitalia (fig. 15), and the patterning on the lateral margins of the abdominal tergites, which have a striped appearance formed by the presence of dark yellow patches at the posterolateral angles on an otherwise predominantly brown background.

The Marana River at the type locality was a wide, unshaded stream set in a deforested mountain valley terraced into seasonal rice paddies and flowing through a bed of rounded basalt boulders. *A. celebensis* was present here in incredible numbers amid cobbles and gravel in flowing riffles, and clinging to the submerged edges of larger rocks. The substrate was covered with a slippery layer of fine silt and algae, and the insects were more common in the central portions of the stream where this layer was extensively developed than near the margins where the rocks had less algae. This river was also notable for its high densities of prosopistomatid mayfly larvae (*Prosopistoma* sp.). Other associated benthic organisms included immature Trichoptera of the family Stenopsychidae (*Stenopsyche* sp.), mayfly immatures belonging to the families Tricorythidae, Baetidae (*Baetis* sp.), Heptageniidae (*Compsoneuriella* sp.), Caenidae and Leptophlebiidae (*Choroterpes* sp.), and beetles of the family Elmidae.

Etymology: The name "celebensis" refers to the island of Celebes, to which this species is endemic.

Distribution: Known only from the southwestern peninsula of Celebes (fig. 164).

Material examined: Holotype, brachypterous male, and allotype, brachypterous female: INDONESIA, Celebes, **Sulawesi Selatan Prov.**, Marana River at Laiya, nr. Camba, 50 km. E. of Maros, 450 m. (1476 ft.), CL 2167, 14 October 1985, J. T. and D. A. Polhemus (USNM). Paratypes as follows: **Sulawesi Selatan Prov.**: 1 macropterous male, 178 brachypterous males, 164 brachypterous females, same data as types (JTPC); 2 brachypterous females, Pattunuang River at Biseang Labboro recreation area, 7 km. SW. of Bantimurung, 50 m. (164 ft.), CL 2165, 13 October 1985, J. T. and D. A. Polhemus (JTPC).

Aphelocheirus (Aphelocheirus) lorelindu n.sp.
Figs. 18-21, 164

Description:

Brachypterous male: Large for genus, form elongate oval (fig. 18), length 10.08 mm; maximum width (across abdomen) 5.95 mm. Coloration blackish brown, head, pronotum, and scutellum yellowish.

Head yellowish brown, darker basally, shining, produced ahead of eyes for distance equal to .32 the length of an eye; eyes black, shining, width/length = .40/1.11, outer margins sinuate; anterior/posterior interocular = 1.57/1.01.

Pronotum yellow, shining, darker patches present laterally behind each eye and medially, anterior collar black, surface minutely rugose, set with short fine pale setae laterally, nearly glabrous medially, width/length (midline) = 5.18/1.15; lateral margins semitranslucent, bearing about ten minute erect dark setae. *Scutellum* yellowish, shining, bearing fine pale recumbent setae, width/length = 2.50/1.06, lateral margins weakly sinuate, shallow transverse sulcus present along anterior margin. *Hemelytra* blackish brown, brachypterous, touching medially, reaching posteriorly only to base of abdominal tergite III (second visi-

ble), surface rugose, set with fine pale setae, clavus and corium weakly delineated, embolar margin evenly curving anteriorly, sharply terminated posteriorly (fig. 18).

Abdomen brownish black, lateral margins yellowish, surface weakly rugose, set with fine pale setae, tergites II-VIII exposed, paired glandular openings present medially on posterior margin of tergite III, posterior margin of tergite V produced to a rounded hump caudad, lateral margins of all segments bearing short stout setae, posterolateral angles of tergites III-VII spinose, with tufts of long pale setae.

Ventral surface dull brown, pruinose, head, pronotum, spiracular regions and genital segment yellow; antennae yellow, lengths of segments I-IV = .10, .20, .39, .45; rostrum gold, glabrous, length = 2.73, reaching to middle coxae; labrum gold, shining, margin evenly rounded; prothorax with weak carina medially between forelegs, propleurae with deep notches apically on inner projections (fig. 20); mesosternal plate pruinose with irregular glabrous patches laterally, sparsely set with recumbent gold setae, tumescent medially, posterior margin with distinct vertical median carina; metasternum brown, pruinose, sparsely set with recumbent gold setae, medial plate yellow, glabrous, produced to a point posteriorly; abdomen brown, pruinose, sparsely set with recumbent gold setae, sternites IV-VI with six stout rearwardly directed setae medially on posterior margins; genital segment yellow, glabrous.

Legs pale yellow, covered with fine gold setae, fore femur and tibia with thick fringe of gold setae on inside faces; fore tarsi two segmented, bearing two gently curved claws; fore, middle, and hind coxae with comb of long gold setae on posterior margins; middle trochanters, femora, tibiae, and tarsi with thick pads of gold setae on ventral faces; middle with seven long gold erect setae on posterior margin, anterior and ventral faces with several intermittent longitudinal rows of short brown spines; middle tibia with four very long gold setae on anterior margin and fine gold setae on posterior margin, bearing stout reddish spines on dorsal face and one to two transverse rows of reddish spines apically; posterior femora set with short stout reddish spines, bearing a longitudinal row of longer spines on posterior margin; hind tibia and tarsi with long silver swimming hairs on ventral faces, bearing stout reddish spines, tibia with single transverse row of reddish spines apically; claws gently curved, gold, shining.

Male genitalia with right paramere sharply curved, broadened basally, tip blunt; left paramere tapering, weakly sinuate (fig. 19).

Brachypterous female: Similar to male in general structure and coloration, length 9.98 mm; maximum width 6.05 mm. Subgenital plate triangular, tip blunt, bearing gold setal tufts apically and marginally (fig. 21).

Macropterous form: unknown.

Discussion: The larger of the two species known from Celebes, *A. lorelindu* may be recognized by its short head, diagnostic male genitalia (fig. 19), domed triangular female subgenital plate (fig. 21), and translucent lateral pronotal margins. The shapes of the male parameres are similar to those seen in *A. celebensis* n.sp., *A. pallens* Horvath, and *A.*

australicus Usinger, suggesting that these taxa may be members of a monophyletic subgroup within *Aphelocheirus*. Coloration in *A. lorelindu* is variable, some individuals being uniformly dark or medium brown on the scutellum, wing pads and abdomen while others are marked with yellow to varying degrees.

The type locality was a cool, rushing, mostly shaded upland stream flowing through primary montane forest. *A. lorelindu* was found in sandy pockets along the margins and in short sunny riffle sections where the substrate consisted of small rocks resting on a base of sand. The benthic fauna of this stream was quite diverse, including freshwater crabs, immature Trichoptera of the family Stenopsychidae (*Stenopsyche* sp.), and immature Ephemeroptera belonging to the families Baetidae (*Platybaetis* sp., nr. *Pseudocloeon* sp.), Heptageniidae (*Compsoneuriella* sp.), Leptophlebiidae (*Choroterpes* sp.), Ephemerellidae (*Teloganodes* sp.), Tricorythidae (*Neurocaenis* sp.), Prosopistomatidae (*Prosopistoma* sp.), and Caenidae.

Etymology: The name "lorelindu" is a noun in apposition and refers to the beautiful Lore Lindu National Park which is the type locality.

Distribution: Known only from the mountains of central Celebes (fig. 164).

Material examined: Holotype, brachypterous male, and allotype, brachypterous female: INDONESIA, Celebes, **Sulawesi Tengah Prov.**, forest stream 10 km. SE. of Kamarora, upper Palolo Valley, Lore Lindu National Park, 950 m. (3116 ft.), CL 2156, 8 October 1985, J. T. and D. A. Polhemus (USNM). Paratypes as follows: **Sulawesi Tengah Prov.**: 20 brachypterous males, 11 brachypterous females, same data as types (JTPC); 1 brachypterous female, forest stream 5 km. SE. of Kamarora, upper Palolo Valley, Lore Lindu National Park, 750 m. (2460 ft.), CL 2157, 8 October 1985, J. T. and D. A. Polhemus (JTPC).

Aphelocheirus (Aphelocheirus) kinabalu n.sp.
Figs. 27-31, 166

Description:

Brachypterous male: Of moderate size for genus, form ovate, length 8.64 mm.; maximum width (across abdomen) 5.09 mm (fig. 28). Coloration dark brown, marked to greater or lesser degree with lighter brown.

Head yellowish brown, shining, darker basally and medially, width/length = 1.92/1.44, produced ahead of eyes for distance equal to .55 the length of an eye; eyes black, shining, anterolateral angles meeting anterior margin of pronotum, width/length = .45/1.01, inner and outer margins weakly sinuate; anterior/posterior interocular = 1.36/.91.

Pronotum dark brown, surface coarsely rugose, setiferation obscure, posterior portion

lighter brown, glabrous, posterior margin black, width/length = 4.13/1.15; lateral margins narrowly glabrous, bearing short erect stout setae, posterolateral angles acute, rounded. *Scutellum* yellowish brown, shining, rugose, width/length = 2.40/.96, lateral margins weakly sinuate, a transverse sulcus present basally. *Hemelytra* dark brown, brachypterous, coarsely rugose, not attaining posterior margin of abdominal tergite II, widely separated medially, area between brown, shining, clavus obscure, embolar margin produced to a sharp point (fig. 28).

Abdomen dark brown, sparsely set with very short recumbent pale setae, tergites II-VIII exposed, posterior margin of tergite V gently rounded, lateral margins of all tergites narrowly glabrous, bearing very short erect stout setae, posterolateral angles of tergites II-VI weakly spinose.

Ventral surface dull brown, pruinose, head, pronotum, and genital segment yellowish brown; antennae yellowish brown, lengths of segments I-IV = .05, .15, .25., .35; rostrum gold, shining, length 3.13, reaching to tips of middle coxae; labrum gold, shining, margin produced to an acute rounded angle apically; prosternum with carina medially; inner projection of propleura with apex produced, rounded (fig. 30); mesosternal plate brown, pruinose, with scattered round glabrous patches laterally, longitudinal carina medially; metasternum brown, pruinose, medial plate with deep longitudinal furrow, produced to a point posteriorly; abdomen brown, pruinose, set with very fine gold setae, posterior margin of sternite III bearing a rounded projection medially, posterior margin of sternite V with two rearwardly directed stout setae medially; genital segment light brown, shining, set with recumbent gold setae.

Legs yellowish brown, covered with fine gold setae, fore femur, tibia, and tarsi with thick pads of gold setae on inner faces; fore, middle, and hind coxae with combs of long gold setae on anterior margins; middle trochanter, femur, tibia and tarsi with thick pads of shining gold setae on ventral faces; middle femur very sparsely set with with short reddish spines along anterior margin, posterior margin with four erect slender setae; middle tibia with short reddish spines along anterior margin and transverse row of spines apically; hind femur sparsely set with short reddish spines along anterior margin; hind tibia thickly set with with reddish spines along anterior margin, transverse row of spines present apically; hind tibia and tarsi bearing silvery swimming hairs on ventral faces; claws shining, blackish, sharply curved.

Male genitalia with right paramere tapering, acuminate; left paramere expanded distally, tip concave (fig. 31).

Brachypterous female: Similar to male in general structure and coloration, length 8.74 mm; maximum width 5.38 mm. Abdominal sternites III and IV bearing rounded projections medially on posterior margins, sternites V and VI bearing six posteriorly directed stout setae medially on posterior margins; subgenital plate roughly triangular, tip broadly rounded, bearing apical and lateral hair tufts (fig. 27).

Macropterous male: Coloration black, shining, hemelytra and membrane dull, length 9.02 mm; maximum width 5.09 mm (fig. 29). Similar to brachypterous form with follow-

ing exceptions: pronotum more massive, margins expanded, posterolateral angles less acute; scutellum swollen, with distinct transverse sulci laterally delineating mesoscutum; wings fully developed, reaching beyond tip of abdomen, surface of hemelytra coarsely rugose, clavus and embolium clearly delineated, claval vein evident, embolar margin produced to a sharp point; membrane black, velvety, veination partially visible; ventral surface with mesosternal plate swollen, acarinate.

Macropterous female: Similar to macropterous male in general structure and coloration, length 8.83 mm; maximum width 5.09 mm.

Discussion: *A. kinabalu* is a moderate sized species of generally brownish coloration which may be recognized on the basis of widely separated wing pads in the brachypterous forms (fig. 28), the structure of the female subgenital plate (fig. 27), the distinctive male genitalia (fig. 31), and other characters as given in the key.

This species is apparently restricted to cool mountain streams, since none of our numerous records are from elevations below 800 m. The Liwagu River at the Kundassan type locality is a unshaded stream of moderate size flowing out of primary montane forest into a valley cleared for vegetable farming. The insects here were common amid moderate to small sized stones and gravels in shallow riffles, and also occasionally clung to undercut banks. At the Mesilau River, in the same drainage but 1000 meters higher, this species occurred sporadically in swift, cold waters heavily shaded by rhododendrons and other primary montane moss forest vegetation, in association with large heptageniid mayfly immatures of the genera *Atopopus* and *Epeorus*. The *Aphelocheirus* immatures at this latter locality were observed to aggregate in calm, protected pockets along the stream margins while the adults were taken in midstream locations. Several adult specimens of *A. kinabalu* were also taken in open watercress bogs laced with tiny streams near the summit of the Crocker Range, further illustrating the wide variety of habitats occupied by this species.

Etymology: The name "kinabalu" is a noun in apposition and refers to Mt. Kinabalu, the highest peak in Borneo, from the vicinity of which all known examples of this species have come.

Distribution: Common in the mountains of northern Borneo (fig. 166).

Material examined: Holotype, brachypterous male, and allotype, brachypterous female: EAST MALAYSIA, **Sabah**, Liwagu River at Kundassan, 900 m. (2934 ft.), CL 2021, 1 August 1985, J. T. and D. A. Polhemus (USNM). Paratypes as follows: EAST MALAYSIA, **Sabah**: 10 macropterous males, 10 macropterous females, 25 brachypterous males, 5 brachypterous females, same data as types; 2 macropterous males, 2 brachypterous males, 1 brachypterous female, Mesilau River, 8 km. N. of Kundassan, 1950 m. (6357 ft.), CL 2020, 1 August 1985, J. T. and D. A. Polhemus (JTPC); 2 brachypterous males, 2 brachypterous females, bog and streams at summit of Crocker Range, km. 62 on Keningau hwy., SE. of Kota Kinabalu, CL 2035, 6 August 1985, J. T. and D. A. Polhemus (JTPC); 1 macropterous male, 2 macropterous females, 1 brachypterous male, 4 brachypterous females, Liwagu River at Liwagu Cave, SE. of Kinabalu National Park headquarters, 1525 m. (4971 ft.), 11 to 16 August 1972, G. F. and C. H. Edmunds (JTPC); 2 brachypterous

males, 1 macropterous female, Silau-Silau stream, N. of Kinabalu National Park headquarters, 1585 m. (5167 ft.), 11 to 16 August 1972, W. L. and J. G. Peters, W. M. Beck (JTPC); 10 brachypterous males, 8 brachypterous females, Liwagu River, N. of Kundassan, 915 m. (2983 ft.), 16 to 17 August 1972, G. F. and C. H. Edmunds (JTPC).

Aphelocheirus (Aphelocheirus) minor n.sp.
Figs. 22-26, 165

Description:

Brachypterous male: Small for genus, ovate, length 6.53 mm; maximum width (across abdomen) 3.84 mm (fig. 22). Coloration dark blackish brown, head and pronotum medially lighter brown.

Head dark brown, shining, yellowish anteriorly and adjoining eyes, width/length = 1.44/1.06, produced ahead of eyes for distance equal to .52 the length of an eye; eyes black, shining, width/length = .30/.76, outer margins weakly sinuate; anterior/posterior interocular = 1.01/.66.

Pronotum blackish brown, rugose, pruinose, areas medially and narrowly along margins brown, glabrous, width/length (midline) = 3.07/.96, surface bearing very fine recumbent pale setae, posterolateral angles rounded, lateral margins bearing very short stout setae. *Scutellum* blackish brown, rugose, pruinose, width/length = 1.82/.67, transversely sulcate basally, margins weakly sinuate. *Hemelytra* blackish brown, rugose, pruinose, bearing very fine pale setae, touching medially, not attaining posterior margin of tergite II (first visible), clavus obscure, embolar margin produced to a rounded point (fig. 22).

Abdomen blackish brown, weakly rugose, pruinose, bearing pale recumbent setae, tergites II-VIII visible, posterior margin of tergite V weakly indented at tip (fig. 22), lateral margins of all tergites narrowly glabrous, bearing a few short stout setae, posterolateral angles of tergites III-VI weakly spinose, with tufts of long gold setae.

Ventral surface brown, pruinose, bearing fine gold setae, head, pronotum, and genital segment yellowish; antennae yellow, lengths of segments I-IV = .05, .15, .16, .30; rostrum gold, shining, length 2.32, reaching to middle trochanters; labrum gold, shining, margin rounded; prothorax with medial carina, propleura with notches apically on inner projections (fig. 24); mesosternal plate brown, pruinose, with sharply interrupted carina medially; metasternal plate brown, pruinose, medial portion glabrous, produced to a distinct point posteriorly; abdomen brown, pruinose, sense organ on paratergite II deeply recessed, sternites III and IV bearing rounded projections medially on posterior margins (fig. 26), sternites V-VII lacking rearwardly directed stout setae medially; genital segment yellowish brown, shining, bearing fine gold setae.

Legs yellowish brown, covered with fine gold setae, fore femur, tibia, and tarsi with

pads of thick gold setae on inner faces; fore, middle, and hind coxae with combs of long gold setae on anterior margins; middle trochanter, femur, tibia and tarsi with pads of shining gold setae ventrally; middle femur with tiny reddish spines along anterior margin; middle tibia bearing short reddish spines and five erect slender setae on anterior margin, transverse row of spines apically; hind femur lacking spines; hind tibia with short reddish spines on anterior margin; hind tibia and tarsi bearing silvery swimming hairs ventrally; claws blackish, shining, sharply curved.

Male genitalia with right paramere slender, tapering; left paramere expanded distally, tip broadly rounded (fig. 25).

Brachypterous female: Similar to male in general structure and coloration. length 6.82 mm; maximum width 4.22 mm. Female subgenital plate roughly triangular, tip gently rounded, bearing hair tufts marginally and behind apex (fig. 26).

Macropterous male: Coloration blackish brown, shining, hemelytra and abdomen dull, length 6.62 mm; maximum width 3.84 mm. Similar to brachypterous form with following exceptions: pronotum expanded, posterolateral angles broadly rounded; scutellum swollen, shining, mesoscutum clearly delineated by transverse sulcus; hemelytra complete, weakly rugose, bearing fine recumbent gold setae, clavus and embolium clearly delineated, claval vein well developed, embolar margin produced to a sharp point, membrane broken behind corium; ventral surface with mesosternal plate swollen, bearing distinct raised irregular median carina.

Macropterous female: Similar to macropterous male in general structure and coloration, length 7.01 mm.; maximum width 3.94 mm (fig. 23).

Discussion: This species may be recognized by its small size, dark coloration, male and female genital structures (figs. 25, 26), and other characters as given in the key. In its small size and dark coloration it superficially resembles *A. palawanensis* n.sp., but structurally it is more closely allied to its Bornean congener *A. kinabalu* n.sp. Both Bornean species possess small posteriorly directed humps medially on the posterior margins of abdominal ventrites III and IV, subapical hair tufts on the female subgenital plate, and similar plans in the male genitalia.

Although *A. minor* occasionally occurs sympatrically with *A. kinabalu* n.sp. it appears to prefer lower elevations than this latter taxon, being found abundantly in rocky streams and rivers draining the foothills of the Crocker Range. At the Nukakatan River type locality the majority of the specimens were taken from coarse sand deposited where the the current washed along the base of a vertical rock wall. This species co-occurred frequently with burrowing mayfly larvae belonging to the family Euthyplociidae (*Polyplocia* sp.) and large psephenid beetle larvae.

Etymology: The name "minor" refers to the small size of this species.

Distribution: Common in the mountains of northern Borneo (fig. 165).

Material examined: Holotype, brachypterous male, and allotype, brachypterous female: EAST MALAYSIA, **Sabah**, Nukakatan River, 26 km. S. of Ranau, CL 2028, 3 August 1985, J. T. and D. A. Polhemus (USNM). Paratypes as follows: EAST MALAYSIA, **Sabah**: 1 macropterous male, 1 macropterous female, 22 brachypterous males, 29 brachypterous females, same data as types; 13 macropterous males, 8 macropterous females, Liwagu river at Kundassan, 900 m. (2934 ft.), CL 2021, 1 August 1985, J. T. and D. A. Polhemus (JTPC); 2 macropterous females, 4 brachypterous males, 2 brachypterous females, stream 1 km. S. of Poring Hot Springs, CL 2023, 2 August 1985, J. T. and D. A. Polhemus (JTPC); 17 macropterous males, 7 macropterous females, 2 brachypterous females, Samalang River, 7 km. S. of Ranau, CL 2026, 3 August 1985, J. T. and D. A. Polhemus (JTPC); 1 macropterous female, 17 km. S. of Keningau, 13 August 1983, G. F. Hevel and W. E. Steiner (USNM); 1 brachypterous female, 16 km. E. of Ranau, 14 August 1983, G. F. Hevel and W. E. Steiner (USNM); 1 macropterous female, 1 brachypterous male, 2 brachypterous females, Mantukungan River, S. of Poring Hot Springs, 365 m. (1189 ft.), 12 August 1972, W. L. and J. G. Peters (JTPC); 1 macropterous female, Mamut River at Poring Hot Springs, 365 m. (1189 ft.), 12 August 1972, W. L. and J. G. Peters (JTPC).

Aphelocheirus (Aphelocheirus) javanicus n.sp.
Figs. 32-34, 171

Description:

Brachypterous male: Of moderate size for genus, ovate, length 8.93 mm; maximum width (across abdomen) 6.34 mm (fig. 32). Coloration dark brown with scattered yellowish brown markings.

Head yellowish brown, alveolate, shining, width/length = 2.02/1.73, produced ahead of eyes for distance equal to .68 the length of an eye; eyes black, shining, width/length = .38/.96, outer margins sinuate; anterior/posterior interocular = 1.41/1.01.

Pronotum dark brown, yellowish laterally, surface coarsely rugose, bearing fine short recumbent gold setae, width/length (midline) = 4.61/1.25; lateral margins narrowly glabrous, bearing tiny stout setae. *Scutellum* brown, rugose, bearing fine recumbent gold setae, width/length 2.40/.96, transversely sulcate basally, lateral margins not sinuate. *Hemelytra* dark brown, rugose, set with fine recumbent gold setae, brachypterous, not attaining base of abdominal tergite III, widely separated medially, clavus obscure, embolar margin curving evenly to pronotum, coming to a rounded point posterolaterally.

Abdomen dark brown, with yellowish patches laterally and to either side of midline, surface weakly rugose, bearing fine recumbent gold setae, tergite V asymmetrical, right margin when viewed from above deeply concave, then produced and spinose posterolaterally (fig. 32), posterior margin of tergite V coming to an evenly rounded hump, posterolateral angles of tergites III-V strongly spinose.

Ventral surface dull brown, pruinose, head and pronotum yellowish, shining; antennae yellow, lengths of segments I-IV = .10, .15, .25, .40; rostrum gold, glabrous, length 3.08, reaching to middle coxae; labrum gold, shining, margin evenly rounded; prothorax with median carina, scattered small round glabrous patches present along anterior margins of leg sockets, inner propleural projections coming to slender points (fig. 34); mesosternal plate brown, pruinose, weakly carinate medially, posteromedial portion tumescent, bearing gold setae, scattered small glabrous patches present near lateral margins; abdomen brown, pruinose, narrowly glabrous along margins, with irregular transverse rows of small round glabrous pits adjoining spiracular rosettes.

Legs yellow, covered with fine gold setae; fore femur, tibia, and tarsi with thick gold hair pads on inner faces; fore, middle, and hind coxae with combs of long gold setae anteriorly; middle trochanter, femur, tibia, and tarsi with thick hair pads ventrally; middle femur with scattered short spines ventrally and along anterior margin, a row of six slender erect setae running along posterior margin; middle tibia with stout spines along anterior margin, a transverse row of spines apically; hind femur with short spines on anterior margin; hind tibia with stout spines along anterior margin and transverse row of spines apically; hind tibia and tarsi with long silvery swimming hairs; claws gold, gently curved, tips darkened.

Male genitalia with right paramere L-shaped; left paramere broad basally, tip rounded (fig. 33).

Brachypterous female: unknown.

Macropterous form: unknown.

Discussion: *A. javanicus* n.sp. may be immediately recognized by the distinctively asymmetrical abdomen of the male (fig. 32). Only a single specimen is at hand bearing the label "Java, Belgique", the latter probably referring to the specimen's former residence in the Belgian Museum, but the species is so instantly recognizable that in this instance the description based on a unique male is sufficient. The genitalia on the specimen at hand were everted and opened, making an illustration of the entire genital complex impossible, so only the parameres are shown (fig. 33).

Etymology: The name "javanicus" refers to the island of Java, to which this species is apparently endemic.

Distribution: Java (fig 171).

Material examined: Holotype, brachypterous male: INDONESIA, Java, Belgique (CAS).

Aphelocheirus (Aphelocheirus) palawanensis n.sp. Figs. 35-38, 167, 168

Description:

Brachypterous male: Small for genus, ovate, length 6.43 mm; maximum width (across abdomen) 4.08 mm (fig. 35). Coloration dark blackish brown, head anteriorly, pronotum medially, and scutellum yellowish brown.

Head yellowish brown, dark medially and along posterior margin, width/length = 1.54/1.44, produced ahead of eyes for distance equal to .52 the length of an eye; eyes black, shining, width/length = .35/.91, lateral margins weakly sinuate, not exceeding anterolateral pronotal angles; anterior/posterior interocular = 1.16/.71.

Pronotum blackish brown, rugose, bearing fine recumbent pale setae, medial area and margins yellowish brown, shining, width/length (midline) = 3.26/.96, posterolateral angles rounded, lateral margins bearing tiny stout setae. *Scutellum* yellowish brown, darker basally, weakly rugose, shining, width/length = 2.02/.77, weak transverse sulcus basally, lateral margins barely sinuate. *Hemelytra* blackish brown, rugose, bearing fine pale setae, nearly touching medially, brachypterous, not attaining posterior margin of abdominal tergite II (first visible), clavus obscure, embolar margin produced to a sharp point (fig. 35).

Abdomen blackish brown, weakly rugose, bearing pale recumbent setae, tergites II-VIII visible, posterior margin of tergite V rounded (fig. 35), lateral margins of tergites III-VII serrate, bearing tiny erect setae, posterolateral angles spinose.

Ventral surface dark brown, pruinose, head and genital segment yellowish; antennae yellow, lengths of segments I-IV = .05, .15, .18, .35; rostrum gold, shining, length 2.27, attaining middle trochanters; labrum gold, shining, margin rounded; prothorax with low carina medially between forelegs, propleural projections with small notches apically (fig. 36); mesosternal plate dark brown, pruinose, with scattered round glabrous spots adjoining propleura, tumescent and carinate posteromedially; metasternal plate dark brown, pruinose, sparsely set with very fine gold setae, produced to small point medially; abdomen dark brown, pruinose, bearing very fine recumbent gold setae, lacking rearwardly projecting stout setae posteromedially on sternites III-V; genital segment gold, shining, with recumbent gold setae.

Legs yellowish brown, clothed with fine gold setae, fore femur, tibia, and tarsi with thick pads of gold setae on inner faces; fore, middle, and hind coxae with combs of long setae on anterior margins; middle trochanter, femur, tibia, and tarsi with thick gold hair pads ventrally; middle femur with longitudinal row of about eight short spines on ventral face and three erect slender setae on posterior margin; middle tibia thickly set with short reddish spines on anterior margin, bearing three erect slender setae basally and transverse row of spines apically; hind femur bearing very fine spines along anterior margin; hind tibia thickly set with reddish spines along anterior margin; hind tibia and tarsi with silvery swimming hairs ventrally; claws gently curved, gold, tips infuscated.

Male genitalia with right paramere long, slender, tip rounded; left paramere broad, blunt, tip expanded (fig. 37).

Brachypterous female: Similar to male in general structure and coloration but larger, length 7.01 mm; maximum width 4.51 mm. Subgenital plate roughly triangular, tip broadly rounded, bearing hair tufts laterally and behind apex (fig. 38).

Discussion: *A. palawanensis*, the only *Aphelocheirus* species known from Palawan and the nearby Calamianes island group, may be recognized by its small size, lack of peg-like setae on the abdominal venter, female subgenital morphology (fig. 38) and male genitalia (fig. 37). The general structure of the male genital complex indicates that this species is most closely related to *A. zamboanga* n. sp. from Mindanao, but that species lacks the posteriorly directed hump medially on the posterior margin of abdominal ventrite IV that is present in *A. palawanensis*.

The Mainit Falls type locality was a small, mostly shaded stream in primary lowland rain forest. The type series of *A. palawanensis* was taken above the falls in a few pockets of sand and gravel that had accumulated in what was otherwise a smooth rock bed with chutes and pools. Other associated benthic organisms at this locality included Coleoptera of the families Psephenidae and Elmidae, immature Plecoptera of the family Perlidae (*Neoperla* sp.), immature Trichoptera of the family Stenopsychidae (*Stenopsyche* sp.), and immature Ephemeroptera of the families Baetidae (*Platybaetis* sp., *Centroptilum* sp.), Heptageniidae (*Ecdyonurus* complex), Leptophlebiidae (nr. *Choroterpes*), Tricorythidae (*Neurocaenis* sp.), Prosopistomatidae (*Prosopistoma* sp.), and Caenidae.

Etymology: The name "palawanensis" refers to the island of Palawan, to which this species is endemic.

Distribution: Known from Palawan and the Calamianes group to the northeast (figs. 167, 168).

Material examined: Holotype, brachypterous male, and allotype, brachypterous female: PHILIPPINES, Palawan, **Palawan Prov.**, Mainit Falls at Mainit, 18 km. NW of Brooks Point, 50 m. (163 ft.), CL 2006, 26 July 1985, J. T. and D. A. Polhemus (USNM). Paratypes as follows: **Palawan Prov.**: 1 brachypterous male, 10 brachypterous females, same data as types; 1 brachypterous female, Sabsaban Falls, nr. Aribongas, 16 km. NE of Brooks Point, 50 m. (163 ft.), CL 2007, 26 July 1985, J. T. and D. A. Polhemus (JTPC); 1 brachypterous male, Taritien River nr. Trident Mine, 7 km. NW of Narra, CL 2011, 27 July 1985, J. T. and D. A. Polhemus (JTPC).1 brachypterous male, Busuanga Is., Calamianes group, Dimaniang, nr. sea level, stream through forest, March 1947, H. Hoogstraal, CNHM-Philippine Zool. Exp. (KU).

Aphelocheirus (Aphelocheirus) zamboanga n.sp. Figs. 39-43, 169

Description:

Brachypterous male: Of moderate size for genus, ovate, length 7.58 mm; maximum width (across abdomen) 4.99 mm (fig. 39). Coloration dark blackish brown with a few yellowish areas on head and thorax.

Head yellowish brown, dark brown anteriorly and medially, surface rugose, shining, width/length = 1.92/1.73, produced ahead of eyes for distance equal to .50 the length of an eye; eyes black, shining, width/length = .38/1.01, outer margins weakly sinuate, anterior/posterior interocular = 1.41/.96.

Pronotum dull blackish brown, coarsely rugose, bearing extremely short recumbent gold setae, central portion yellowish brown, glabrous, width/length = 4.22/1.15; lateral margins narrowly glabrous, set with minute, barely visible stout setae, posterolateral angles acute, rounded. *Scutellum* dark brown, rugose, yellowish brown medially, width/length = 2.50/.91, lateral margins weakly sinuate. *Hemelytra* blackish brown, coarsely rugose, bearing very short recumbent gold setae, brachypterous, not attaining base of abdominal tergite III, touching medially, clavus obscure, embolar margin forming a right angle posterolaterally.

Abdomen blackish brown, rugose, covered with very short recumbent gold setae, posterior margin of tergite V evenly rounded, posterolateral angles of tergites III-VI weakly spinose.

Ventral surface brown, pruinose, covered with fine recumbent gold setae, head and prothorax yellowish, bare; antennae yellow, lengths of segments I-IV = .08, .15, .23, .38; rostrum gold, glabrous, length 2.27, attaining middle coxae; labrum gold, glabrous, margin broadly rounded; prosternum carinate medially, inner propleural projections with shallow notches apically (fig. 42); mesosternal plate with interrupted carina medially, leaving small knob anteromedially and tumescence posteromedially covered with erect gold setae; metasternal plate produced posteromedially to acute point; abdomen lacking stout rearwardly directed setae medially on sternites, irregular glabrous depressions inward of spiracles obscure, barely evident.

Legs yellowish brown, covered with fine gold setae, fore femur, tibia, and tarsi with thick hair pads on inner faces; middle trochanter, femur, tibia, and tarsi with pads of gold setae ventrally; fore, middle, and hind coxae with combs of gold setae on apices; middle femur with scattered short stout spines and longitudinal row of slightly larger spines on ventral face, about six long erect gold setae along posterior margin, very short spines along anterior margin, several long gold setae distally; middle tibia with numerous stout reddish spines along anterior margin, three very long erect gold setae basally, transverse row of spines apically; hind femur with scattered short spines ventrally forming

two irregular longitudinal rows, very short spines along anterior margin; hind tibia with thick stout reddish spines along anterior margin, transverse row of spines apically; hind tibia and tarsi with long silvery swimming hairs ventrally; claws gold, stout, gently curved, tips infuscated.

Male genitalia with right paramere slender, gently curving; left paramere stout, expanded distally, tip broadly rounded (fig. 41).

Brachypterous female: Similar to brachypterous male in general structure and coloration, length 7.82 mm; maximum width 5.04 mm. Subgenital plate roughly trapezoidal, apex broadly rounded, bearing hair tufts laterally and behind apex (fig. 43).

Macropterous male: Coloration dull blackish brown, with head, central portion of pronotum, and scutellum lighter brown, shining; length 8.13 mm; maximum width (across abdomen) 4.90 mm (fig. 40). Structurally similar to brachypterous form with following exceptions: pronotum more massive, posterior margin strongly sinuate; scutellum swollen, mesoscutum exposed, set off by shallow transverse sulcus; hemelytra complete, extending to tip of abdomen, surface of clavus and corium rugose, bearing extremely short fine recumbent gold setae, area between claval vein and claval suture shining, embolium with lateral margin produced to an acute point, membrane atrovelutinus, frequently disintegrated; mesosternal plate gently swollen, with low broad longitudinal carina.

Macropterous female: Similar to macropterous male in general structure and coloration; length 8.01 mm; maximum width 4.90 mm.

Discussion: *A. zamboanga* is the only species presently recognized from Mindanao, and may be distinguished by its lack of peg-like setae on the abdominal venter, the absence of a small posteriorly directed hump medially on the posterior margin of abdominal ventrite IV, the shape of the female subgenital plate (fig. 43), and the male genitalia (fig. 41). The degree of prolongation of the spines on the posterolateral angles of the abdominal tergites appears to vary among populations on the island, being greater in individuals from South Cotabato Province in comparison to those from the tip of the Zamboanga Peninsula. All other characters hold constant throughout these series, however, so this is assumed to be intraspecific variation.

The Bituti River type locality was a protected watershed lying in primary lowland rain forest. *A. zamboanga* here was most abundant in a partially shaded shallow riffle with a substrate of gravel and small diameter stones just downstream of a road ford, occurring sympatrically with the naucorids *Laccocoris hoogstraali* La Rivers and an undescribed *Asthenocoris* species. Other common benthic insects here included Coleoptera larvae of the family Psephenidae, immature Plecoptera of the family Perlidae (*Phanoperla* sp.), and mayfly immatures belonging to the families Baetidae (*Baetis* sp., *Platybaetis* sp., *Pseudocloeon* sp.), Heptageniidae (*Ecdyonurus* complex), Ephemerellidae (*Teloganodes* sp.) Tricorythidae (*Neurocaenis* sp.), Neoephemeridae (*Neoephemeropsis* sp.), and Caenidae.

In contrast to the above locality was the Luhib River in central Mindanao, an open sandy stream draining a deforested catchment. We collected here following a heavy rain

which had caused the stream to rise quickly and become heavily silted, but *A. zamboanga* still occurred in the benthos in extremely high densities, illustrating the ability of many *Aphelocheirus* species to survive in disturbed habitats.

Etymology: The name "zamboanga" is a noun in apposition and refers to the type locality.

Distribution: Widespread throughout the mountains of Mindanao (fig. 169).

Material examined: Holotype, brachypterous male, and allotype, brachypterous female: PHILIPPINES, Mindanao, **Zamboanga del Sur Prov.**, Bituti River, 7 km. NW of Zamboanga City, 50-100 m. (163-326 ft.), CL 1998, 22 July 1985, J. T. and D. A. Polhemus (USNM). Paratypes: **Zamboanga del Sur Prov.**: 3 macropterous males, 1 macropterous female, 32 brachypterous males, 15 brachypterous females, same data as types (JTPC); **South Cotabato Prov.**: 3 macropterous males, 6 macropterous females, 56 brachypterous males, 55 brachypterous females, Luhib River, 13.4 km. SW of Surallah, 600 m. (1956 ft.), CL 1993, 19 July 1985, J. T. and D. A. Polhemus (JTPC); 1 brachypterous male, 1 brachypterous female, Cacob River, SE of Koronadal, 550 m. (1793 ft.), CL 1995, 20 July 1985, J. T. and D. A. Polhemus (JTPC); **Davao Prov.**: 1 macropterous male, Mt. Apo, Catigan River, 920 m. (3000 ft.), 18 May 1979, F. A. Mulimbayan (UPLB).

Aphelocheirus (Aphelocheirus) philippinensis Usinger
Figs. 44-47, 169

Aphelocheirus philippinensis Usinger, 1938, Philippine J. Sci., 64: 307.
Aphelocheirus philippinensis: La Rivers, 1971, Bull. So. Calif. Acad. Sci. 70: 72
Aphelocheirus philippinensis: Hoberlandt and Štys, 1979, Acta Mus. Nat. Pragae, 33B: 18.

Description:

Brachypterous male: Of moderate size for genus, form elongate oval, length 7.97 mm; maximum width (across abdomen) 4.99 mm (fig. 44). Coloration brown, hemelytra and scutellum tan, lateral areas of pronotum and abdomen yellowish.

Head dark brown, surface rugose, shining, width/length = 2.21/1.68, produced ahead of eyes for distance equal to .45 the length of an eye; eyes blackish, shining, width/length = .55/1.01, lateral margins weakly sinuate; anterior/posterior interocular = 1.51/.91.

Pronotum brown, yellowish laterally and to either side of midline, surface rugose, bearing very short pale recumbent setae, width/length = 5.28/1.15, lateral margins narrowly glabrous, bearing 12 minute short setae, posterolateral angles acute, rounded. *Scutellum* pale tan, surface weakly rugose, width/length = 2.50/.96, lateral margins sinuate, basal

margin sulcate. *Hemelytra* pale tan, brachypterous, nearly touching medially, not attaining base of abdominal tergite III, surface rugose, setae not evident, clavus obscure, lateral margins strongly reflexed and folded basally, posterolateral embolar angle acute, bearing a stout peg-like seta.

Abdomen brown, yellowish along lateral margins, surface rugulose, bearing very fine recumbent pale setae, posterior margin of tergite V weakly concave apically, lateral margins of tergites III-VII serrate, bearing tiny stout setae, posterolateral angles of tergites III-VI blunt, not spinose or produced.

Ventral surface yellowish brown, weakly pruinose, head dark brown; antennae brown, lengths of segments I-IV = .05, .15, .20, .40; rostrum gold, glabrous, length 2.63, attaining middle coxae; labrum gold, glabrous, apex rounded; prosternum carinate medially, propleurae with inner projections weakly notched, tips rounded (fig. 45); mesosternal plate with scattered glabrous spots laterally, weakly reflexed anteromedially, tumescent and setose posteromedially; mesosternal plate produced to a distinct point caudad; abdomen weakly rugulose, bearing very fine recumbent pale setae, sternites III-V with distinct arrays of glabrous pits running inward from spiracular rosettes, sternites IV-VII bearing 2-5 stout rearwardly directed setae medially along posterior margins; genital segment gold, shining.

Legs gold, bearing fine pale setae, fore femur, tibia, and tarsi with thick gold hair pads on inner faces; fore, middle, and hind coxae with combs of long gold setae distally; middle trochanter, femur, tibia, and tarsi with thick gold hair pads ventrally; middle femur with longitudinal row of stout pale spines ventrally, several erect gold setae posteriorly, short spines along anterior margin; middle tibia with three long slender erect pale setae basally, three more such setae distally along posterior margin, many stout reddish spines anteriorly, transverse row of spines apically; hind femur thickly set with short stout reddish spines ventrally and along anterior margin; hind tibia thickly set with stout reddish spines along anterior margin, ventral face with five large spines; hind tibia and tarsi bearing long swimming hairs along posterior margins; claws gently curving, gold, tips brown.

Male genitalia with right paramere tapering, tip slightly expanded and rounded; left paramere stout, tip broad and blunt (fig. 46).

Brachypterous female: Similar to brachypterous male in general structure and coloration but larger, length 8.64 mm; maximum width 5.32 mm. Abdominal tergite VI with posterolateral angles produced, not spinose. Subgenital plate trapezoidal, apex truncate, bearing a transverse row of four stout peg-like setae behind tip (fig. 47).

Macropterous female: Darker than brachypterous form, coloration dull blackish brown, with shining brown on head, central portion of pronotum, and scutellum; length 9.90 mm; maximum width (across abdomen) 5.19 mm. Similar to brachypterous form in general structure with following exceptions: form more elongate; pronotum more massive, posterolateral angles more broadly rounded, posterior margin strongly sinuate; scutellum swollen, mesoscutum exposed, delineated by sinuate transverse furrow; hemelytra complete, attaining abdominal tergite VI, surface dull and shallowly rugose, shining along claval suture, bearing extremely short fine recumbent gold setae, embolar margin produced

to sharp point, membrane atrovelutinus; mesosternal plate broadly swollen, lacking longitudinal carina.

Macropterous male: unknown.

Discussion: We have examined the types of this species, a brachypterous male holotype and a brachypterous female allotype, both in excellent condition and housed in the California Academy of Sciences. *A. philippinensis* is an extremely distinctive species that may be recognized by its serrate abdominal margins and hemelytra bearing a peg-like seta at the posterolateral embolar angle. A row of similar peg-like setae are present on the female subgenital plate (fig. 47), a condition encountered in no other Asian species except *A. malayanus* n.sp., *A. thai* n.sp., and *A. celebensis* n.sp. The male genitalia are also diagnostic (fig. 46).

A. philippinensis appears to be quite uncommon in comparison to other species on Luzon. The only specimen we have collected came from the margins of a cold, rushing stream in a bed of granite boulders below the Camp John Hay hydro plant near Baguio City. Although *A. sculpturatus* n.sp. was abundant at this locality, no other individuals of *A. philippinensis* were found. A macropterous specimen in the Bishop Museum material from Liwo, Luzon is covered with moth scales and has a portion of a mayfly wing plastered to the head and pronotum, indicating that it was taken in a light trap.

Distribution: Known from the mountains of central Luzon (fig. 169).

Material examined: PHILIPPINES, Luzon, **Laguna Prov.**: 1 brachypterous male and 1 brachypterous female (holotype and allotype), Molawin Creek on Mt. Makiling, above Los Banos, 18 to 19 July 1936, R. L. Usinger (CAS); **Benguet Prov.**, 1 brachypterous female, stream below Camp John Hay hydro plant, S. of Baguio City along Kennon Road, 1000 m (3260 ft.), 8 July 1985, CL 1968, J. T. and D. A. Polhemus (JTPC); 1 brachypterous male, Baguio, C. F. Baker (JTPC); **Ifugao Prov.**, 2 macropterous females, 5 brachypterous males, 4 brachypterous females, 1 immature, Jacmal Bunhian, 24 km. E. of Mayoyao, 800-1000 m (2624-3280 ft.), 9 to 12 April 1967, H. M. Torrevillas (BPBM); 1 macropterous female, Liwo, 8 km. E. of Mayoyao, 1000-1300 m (3280-4264 ft.), 30 to 31 May 1967, H. M. Torrevillas (BPBM).

Aphelocheirus (Aphelocheirus) uichancoi Usinger
Figs. 56-60, 168

Aphelocheirus uichancoi Usinger, 1938, Philippine J. Sci., 64: 305.
Aphelocheirus uichancoi: La Rivers, 1971, Bull. So. Calif. Acad. Sci. 70: 72
Aphelocheirus uichancoi: Hoberlandt and Štys, 1979, Acta Mus. Nat. Pragae, 33B: 18.

Description:

Brachypterous male: Of large size for genus, form ovate, length 9.79 mm; maximum width (across abdomen) 6.53 mm (fig. 56). Coloration dark brown, head and scutellum yellowish.

Head yellowish, brown medially, shining, width/length = 2.30/1.92, produced ahead of eyes for a distance equal to .45 the length of an eye; eyes silvery black, shining, width/length = .96/1.11, outer margins very weakly sinuate; anterior/posterior interocular = 1.71/1.06.

Pronotum blackish brown, narrowly yellow medially, surface coarsely rugose, dull, bearing extremely short recumbent pale setae, width/length (midline) = 5.28/1.54; lateral margins glabrous, set with about ten very short stout setae. *Scutellum* blackish brown, yellowish centrally, surface dull, rugose, width/length = 2.59/.96, lateral margins weakly sinuate, basal margins sulcate. *Hemelytra* blackish brown, occasionally lighter posteriorly and adjoining commissure, brachypterous, not attaining base of abdominal tergite III, touching medially, surface coarsely rugose, dull, bearing bearing very short recumbent pale setae, clavus not delineated, embolar margin produced to an acute rounded point posterolaterally, apex frequently bearing a short peg-like seta.

Abdomen blackish brown, rugose, bearing very short recumbent pale setae, posterior margin of tergite V produced to an evenly rounded hump, lateral margins of tergites III-VII weakly serrate, posterolateral angles of tergites III-VI weakly spinose.

Ventral surface dark blackish brown, pruinose, bearing pale recumbent setae, head and genital segment yellowish; antennae yellow, lengths of segments I-IV = .13, .25, .25, .40; rostrum gold, glabrous, length 2.93, attaining middle coxae; labrum gold, glabrous, apex evenly rounded; prosternum carinate medially, propleurae with inner projections weakly notched, tips rounded (fig 58); mesosternal plate with small hump anteromedially, tumescent and setose posteromedially; metasternal plate produced to a slender point caudad; abdomen with a few small glabrous pits running inward from spiracular rosettes on segments III-V, sternites IV-VI with 4-6 stout rearwardly directed setae medially on posterior margins.

Legs yellowish brown, fore femur, tibia, and tarsi with thick gold hair pads on inner faces; fore, middle, and hind coxae with combs of long gold setae distally; middle trochanter, femur, tibia, and tarsi with thick gold hair pads ventrally; middle femur with longitudinal row of short stout gold to brown spines ventrally, 6 long erect gold setae along posterior margin, scattered short spines along anterior margin, 3 long gold setae apically; middle tibia with many stout reddish spines and 3 erect gold setae along anterior margin, 4 erect gold setae along posterior margin, transverse row of reddish spines apically; hind femur with longitudinal row of very short peg-like spines ventrally, short spines along anterior margin, transverse row of slender gold spines apically; hind tibia with many stout reddish spines along anterior margin, 5 erect reddish spines along posterior margin, transverse row of reddish spines apically; hind tibia and tarsi with long silvery swimming hairs along posterior margins; claws weakly curving, gold, tips brown.

Male genitalia with right paramere slender and tapering on distal half; left paramere blade-like, broadened basally (fig. 60).

Brachypterous female: Similar to brachypterous male in general structure and coloration, length 9.84 mm; maximum width 6.48 mm. Subgenital plate trapezoidal, tip rounded, bearing apical and lateral hair tufts (fig. 59).

Macropterous male: Coloration dull blackish brown, head, pronotum medially, and scutellum brown, shining, length 9.98 mm; maximum width (across abdomen) 5.95 mm. Similar to brachypterous form with following exceptions: pronotum expanded, posterior margin broadly glabrous; scutellum swollen, mesoscutum delineated by transverse sulci to either side of midline; hemelytra complete, clavus, embolium, and corium well defined, surface weakly rugose, bearing very fine recumbent pale setae, area between claval vein and outer claval margin brown, glabrous, embolar margin produced to a sharp point (fig. 57), membrane dull, velvety black; mesosternal plate broadly carinate medially, not tumescent.

Macropterous female: Similar to macropterous male in general structure and coloration, length 9.79 mm; maximum width 6.00 mm (fig. 57).

Discussion: We have examined the types of this species, a female holotype and male allotype, housed in the California Academy of Sciences. The female specimen is an old, badly beaten individual with broken areas on the pronotum and at the tip of the subgenital plate. The male specimen is in better condition but is missing the genital capsule. The redescriptions above were done from fresh specimens in excellent condition. There appears to be a degree of intraspecific variation among certain characters in this species, notably the amount of spination on the legs and the presence of the small peg-like seta at the apex of the embolar margin. The embolar seta is present in most males and absent in most females, but in each case there are exceptions. It may be that this seta is easily detached and frequently lost over time. Only two other species, *A. philippinensis* Usinger and *A. luzonicus* n.sp., are known to possess such a structure.

A. uichancoi is similar to *A. sculpturatus* n.sp., but may be recognized by its large size, the shape of the inner propleural projections (fig. 58) and female subgenital plate (fig. 59), and the diagnostic male genitalia (fig. 60). Macropterous forms have the posterolateral angles of the pronotum distinctively expanded and angulate (fig. 57), whereas in *A. sculpturatus* these angles are rounded. Females of *A. uichancoi* also lack the downwardly deflexed posterolateral projection on abdominal tergite VI characteristic of *A. sculpturatus* (see discussion under that species).

In the Cordillera Central of northern Luzon this species was frequently taken in the company of other Naucoridae belonging to the genera *Asthenocoris* and *Stalocoris*, with mayfly larvae belonging to the families Heptageniidae, Baetidae (*Pseudocloeon*, *Platybaetis*), Tricorythidae (*Neurocaenis*), and Ephemerellidae (*Teloganella*), and with larvae of the beetle family Psephenidae.

Distribution: Known from the mountains of northern and central Luzon (fig. 168).

Material examined: PHILIPPINES, Luzon, **Laguna Prov.**: 1 brachypterous male (allotype), Molawin Creek at Los Banos, June 1927, L. B. Uichanco (CAS); 1 brachypterous female (type), same locality, 17 July 1936, R. L. Usinger (CAS); 1 brachypterous male, same locality, no date, C. F. Baker (JTPC); **Cavite Prov.**, 1 macropterous male, 1 macropterous female, 27 brachypterous males, 24 brachypterous females, Humayo Creek nr. Alfonso Pajo, 17 May 1973, H. San Valentin (UPLB, JTPC); 3 macropterous males, 4 macropterous females, 13 brachypterous males, 11 brachypterous females, Tapat River, 2 km. S. of Alfonso, 24 July 1985, CL 2003, J. T. and D. A. Polhemus (JTPC); **La Union Prov.**, 1 macropterous female, 2 brachypterous females, Bayaling River, 15 km. E. of Bauang, 6 July 1985, CL 1958, J. T. and D. A. Polhemus (JTPC); **Benguet Prov.**, 2 brachypterous males, 3 brachypterous females, stream at km. 219.5 on Kennon Rd., approx. 30 km. S. of Baguio City, 8 July 1985, CL 1962, J. T. and D. A. Polhemus (JTPC); 2 brachypterous males, 3 brachypterous females, Asin Hot Springs, W. of Baguio City, 7 July 1970, M. Sato (JTPC).

Aphelocheirus (Aphelocheirus) sculpturatus n.sp.
Figs. 48-52, 170

Description:

Brachypterous male: Large for genus, form elongate, length 10.27 mm; maximum width (across abdomen) 6.34 mm (fig. 48). Coloration blackish brown, with head, central portion of pronotum and scutellum dark yellow.

Head dark yellow with brown stripe medially, surface alveolate, shining, width/length 2.40/1.82, produced ahead of eyes for distance equal to .48 the length of an eye; eyes silvery black, shining, width/length = 1.11/.55, lateral margins weakly sinuate, not exceeding anterolateral angles of pronotum; anterior/posterior interocular = 1.77/1.11.

Pronotum dull blackish brown, central portion frequently marked with dark yellow and lighter brown, shining, surface coarsely rugose, bearing extremely short recumbent pale setae, width/length (midline) = 5.38/1.54, lateral margins broadly glabrous, set with very short stout setae, posterolateral angles broadly rounded. *Scutellum* dark yellow, rugose, shining, width/length = 2.88/.96, lateral margins weakly sinuate. *Hemelytra* dull blackish brown, coarsely rugose, bearing very short recumbent pale setae, brachypterous, not attaining base of abdominal tergite III, touching medially, clavus not defined, embolar margin coming to a sharp right angle posterolaterally (fig. 48).

Abdomen dull blackish brown, rugose, with pale recumbent setae, posterior margin of tergite V broadly rounded, lateral margins of tergites III-VI narrowly glabrous, not serrate, bearing short stout setae set into shallow indentations, posterolateral angles of tergites III-V weakly spinose.

Ventral surface dull blackish brown, pruinose, with fine recumbent pale setae, head and genital segment yellowish; antennae yellowish, lengths of segments I-IV = .07, .25, .28, .40; rostrum gold, glabrous, length 3.23, attaining middle coxae; labrum gold, glabrous, apex evenly rounded; prosternum carinate medially, propleurae with inner projections weakly notched, apices rounded (fig. 51); mesosternal plate with many glabrous spots laterally, raised to a broadly rounded hump medially; metasternal plate with short point caudad; abdomen with small scattered glabrous pits running inward from spiracular rosettes on segments III-VI, sternites IV and V with stout rearwardly directed setae medially along posterior margins.

Legs yellowish brown, covered with fine recumbent gold setae, fore trochanter, femur, tibia, and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of long gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae ventrally; middle femur with longitudinal row of short brown spines ventrally, 6 erect gold setae along posterior margin, many short erect gold setae along anterior margin, 3 long gold setae apically; middle tibia with many stout reddish spines along anterior margin, 3 erect gold setae basally, 3 long gold setae along posterior margin, transverse row of spines apically; hind femur with two sparse rows of very short brown spines ventrally, many short gold spines along anterior margin, transverse row of gold spines apically; hind tibia with many stout reddish spines along anterior margin, 6 stout spines along posterior margin, transverse row of reddish spines apically; hind tibia and tarsi with long silvery swimming hairs along posterior margins; claws gold, gently curving.

Male genitalia with right paramere broad basally, tapering distally; left paramere broad, tip expanded, gently rounded apically (fig. 52).

Brachypterous female: Similar to male in general structure and coloration, but shorter and broader, length 9.79 mm; maximum width 6.82 mm. Posterolateral angle on left side of abdominal tergite VI (as seen from above) reflexed downward into vertical orientation, projecting beneath adjacent plate of tergite VII; central portion of tergite VI and plates of tergite VII angled downward at 45°; subgenital plate trapezoidal, tip weakly indented, bearing short subapical and lateral hair tufts (fig. 50).

Macropterous male: Coloration dark brown, with lateral portions of head, margins of pronotum, and posterolateral angles of abdomen dark yellow, scutellum and central portion of pronotum lighter brown; length 10.29 mm; maximum width (across abdomen) 6.37 mm. Similar to brachypterous form in general structure with following exceptions: form more elongate; pronotum expanded, posterolateral angles broadly rounded (fig. 49), posterior margin strongly sinuate; scutellum swollen, shining, mesoscutum exposed, delineated by sinuate transverse furrow; hemelytra complete, attaining tip of abdomen, surface of corium and clavus rugose, bearing extremely short fine gold setae, embolium smooth, lateral margin produced to blunt point, membrane atrovelutinus, frequently disintegrated; mesosternal plate gently swollen, with broad longitudinal medial carina.

Macropterous female: Similar to macropterous male but larger, length 10.93 mm; maximum width 6.66 mm. Abdominal tergites V and VI not deflexed downward as in brachypterous form; embolar margin with apex more rounded than in macropterous male.

Discussion: Females of *A. sculpturatus* n.sp. may be distinguished from those of all other known species by the odd downwardly deflexed posterolateral angle of abdominal tergite VI on the left side as viewed from above (fig. 50). The males are superficially similar to those of *A. uichancoi* but may be separated on the basis of their genital structures (fig. 52) and the gently arching tumescence on the mesosternal plate. Another simple character that will usually separate *A. sculpturatus* and *A. uichancoi* is the completely yellow scutellum of the former, as compared with the predominantly brown scutellum of the latter bearing only a small yellow spot centrally. *A. sculpturatus* also appears to prefer higher altitudes, generally above 500 m (approx. 1600 ft.).

At the Camp John Hay hydro plant type locality this species was taken in large numbers clinging to the submerged sides of granite boulders emerging from the water near shore in areas protected from the main current. These same pockets of slower water also harbored many other naucorid species, including *Philippinocoris usingeri* (La Rivers), *Aphelocheirus philippinensis* Usinger, an *Asthenocoris* species, and Helotrephidae (*Hydrotrephes* sp.).

Etymology: The name "sculpturatus" refers to the distinctively formed abdomen of the female.

Distribution: Known only from the Cordillera Central of northern Luzon (fig. 170).

Material examined: Holotype, brachypterous male, and allotype, brachypterous female: PHILIPPINES, Luzon, **Benguet Prov.**, stream below Camp John Hay hydro plant, S. of Baguio City, 1000 m (3260 ft.), 8 July 1985, CL 1968, J. T. and D. A. Polhemus (USNM). Paratypes: **Benguet Prov.**: 15 brachypterous males, 29 brachypterous females, same data as types (JTPC); 5 brachypterous males, 3 brachypterous females, stream at km. 230, Kennon Rd., 20 km. S. of Baguio City, 613 m (2000 ft.), 8 July 1985, CL 1966, J. T. and D. A. Polhemus (JTPC); 1 macropterous female, Baguio, C. F. Baker (JTPC); **Laguna Prov.**, 1 brachypterous male,, Tapat River, 2 km. S. of Alfonso, 24 July 1985, CL 2003, J. T. and D. A. Polhemus (JTPC); **Ifugao Prov.**, 1 macropterous male, 1 macropterous female, 2 brachypterous males, Jacmal Bunhian, 24 km. E. of Mayoyao, 800-1000 m (2624-3280 ft.), 16 April to 3 May 1967, H. M. Torrevillas (BPBM).

Aphelocheirus (Aphelocheirus) baguio n.sp. Figs. 61-64, 170

Description:

Brachypterous male: Large for genus, form elongate, length 9.12 mm; maximum width (across abdomen) 5.09 mm (fig. 61). Coloration blackish brown, head dark yellow.

Head dark yellow, infuscated basally, shining, alveolate, width/length = 2.21/1.44, widest

anteriorly, produced ahead of eyes for .56 the length of an eye; eyes black, shining, width/length = .45/.80, outer margins sinuate, barely exceeding adjacent anterolateral pronotal angles, acutely expanded anterolaterally; anterior/posterior interocular = 1.61/1.01.

Pronotum dull blackish brown, coarsely rugose, bearing very short recumbent pale setae, central portion lighter brown, shining, width/length = 4.61/1.30, lateral margins narrowly glabrous, each bearing eleven erect stout setae, posterolateral angles acute, rounded, produced posteriorly. *Scutellum* dull blackish brown, rugose, coarsely alveolate and shining medially, width/length = 2.69/1.15, lateral margins weakly sinuate, basal margin sulcate. *Hemelytra* dull blackish brown, rugose, yellowish posteriorly, bearing very short recumbent pale setae, brachypterous, attaining base of abdominal tergite III, touching medially, clavus undefined, embolar margin essentially straight, coming to a small acute point posterolaterally.

Abdomen dull blackish brown, rugose, with recumbent pale setae, posterior margin of tergite V broadly and evenly rounded, lateral margins of tergites II-V narrowly glabrous, not serrate, set with small erect stout setae set into tiny indentations, posterolateral angles of tergites IV and V produced, spinose.

Ventral surface dark blackish brown, pruinose, with recumbent pale setae, head and tip of abdomen yellowish; antennae yellow, lengths of segments I-IV = .07, .25, .25, .38; rostrum gold, glabrous, length 2.12, not attaining bases of middle coxae; labrum gold, glabrous, apex evenly rounded; prosternum carinate medially, propleurae with inner projections distinctively notched, apices angulate (fig. 63); mesosternal plate with numerous glabrous spots laterally, gently and broadly tumescent medially; metasternal plate produced to long slender point caudad (fig. 62); abdominal segments III-V with transverse rows of glabrous pits running inward from spiracular rosettes, sternites IV-VII with 4-7 stout rearwardly directed setae medially along posterior margins.

Legs dark yellow, clothed with recumbent gold setae, fore trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with long combs of gold setae distally; middle trochanter, femur, tibia and tarsi with pads of thick gold setae ventrally; middle femur with longitudinal row of 6 long brown spines ventrally, 3 long spines ventrally near anterior margin, about 6 erect gold setae along posterior margin, many erect gold spines along anterior margin; middle tibia with many stout reddish spines and 3 erect gold setae along anterior margin, 6 erect stout spines along posterior margin, transverse row of reddish spines apically; hind femur with a few very short scattered brown spines ventrally, many short gold spines along anterior margin, transverse row of gold spines apically; hind tibia with many stout reddish spines along anterior margin, several slender spines along posterior margin, transverse row of spines apically; hind tibia and tarsi with long silvery swimming hairs posteriorly; claws gold, sharply curved, tips brown.

Male genitalia with right paramere slender, tapering, with small projection near tip; left paramere hooked at tip (fig. 64).

Brachypterous female: unknown.

Macropterous form: unknown.

Discussion: *A. baguio* is an unusual and distinctive species that may be recognized by its short, broad head which is expanded anteriorly in front of the eyes, short rostrum that does not reach to the middle coxae, rearwardly produced posterolateral pronotal angles, distinctively angled embolar margins, slender habitus and characteristic genitalia (fig. 64). Although only a single male specimen is at hand, the above characters serve to differentiate it from any other species in the Philippines. This specimen, along with two nymphs, was taken from among loose rocks in shallow water at the head of a waterfall on the river below the Asin Hot Springs road. A diligent search failed to produce further specimens, and we have seen no others in collections from the same area.

Etymology: The name "baguio" is a noun in appostion and refers to the type locality near Baguio City.

Distribution: Known only from the type locality in the Cordillera Central of northern Luzon (fig. 170).

Material examined: Holotype, brachypterous male: PHILIPPINES, Luzon, **Benguet Prov.**, river along Asin Hot Springs road at km. 7, nr. Baguio City, 7 July 1985, CL 1960, J. T. and D. A. Polhemus (USNM).

Aphelocheirus (Aphelocheirus) luzonicus n.sp.
Figs. 53-55, 170

Description:

Brachypterous female: Of moderate size for genus, ovate, length 7.78 mm; maximum width (across abdomen) 5.09 mm (fig. 53). Coloration blackish brown, with head, pronotum centrally and tip of scutellum yellowish.

Head yellowish brown, darker along anterior margin, alveolate, shining, width/length = 1.78/1.54, produced ahead of eyes for .44 the length of an eye; eyes black, shining, width/length = .40/.96, outer margins weakly sinuate, exceeding adjacent anterolateral angles of pronotum; anterior/posterior interocular = 1.36/.86.

Pronotum dull blackish brown, coarsely rugose, bearing very short recumbent pale setae, central portion with roughly rectangular yellowish patch, shining, width/length = 3.94/1.15, lateral margins narrowly glabrous, bearing short erect stout setae, posterolateral angles obtuse, broadly rounded. *Scutellum* dull brown, rugose, with very short recumbent pale setae, tip yellow, shining, width/length = 2.21/.96, lateral margins weakly sinuate, basal margin sulcate. *Hemelytra* dull blackish brown, rugose, bearing very short recum-

bent pale setae, brachypterous, not attaining base of abdominal tergite III, touching medially, clavus undefined, embolar margin broadly curving, ending in rounded right angle posterolaterally, apex bearing 2 short peg-like setae.

Abdomen dull brownish black, rugose, with recumbent pale setae, lateral margins of tergites narrowly glabrous, set with short erect setae, posterolateral angles of tergites III-VI moderately produced, spinose.

Ventral surface yellowish brown, lateral margins blackish, surface lightly pruinose, bearing very short recumbent pale setae; antennae yellowish, lengths of segments I-IV = .07, .25, .25, .38; rostrum gold, glabrous, length 2.09, reaching onto mesosternum, not attaining middle coxae; labrum gold, glabrous, apex evenly rounded; prosternum carinate medially, propleurae with inner projections weakly notched, apices rounded (fig. 54); mesosternal plate with small hump anteromedially, broadly tumescent and setose posteromedially; metasternal plate produced to a short point caudad; abdominal sternites lacking stout rearwardly directed setae medially.

Legs yellowish brown, covered with fine recumbent gold setae, fore trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae ventrally; middle with longitudinal row of erect brownish spines ventrally, 6 erect gold setae along posterior margin, many small gold spines along anterior margin, three long gold setae apically; middle tibia with many stout reddish spines and 4 erect gold setae along anterior margin, 4 erect stout spines along posterior margin, transverse row of reddish spines apically; hind femur with scattered very short spines ventrally, many small gold spines along anterior margin, transverse row of gold spines apically; hind tibia with many stout reddish spines along anterior margin, 5 stout reddish spines along posterior margin, transverse row of reddish spines apically; hind tibia and tarsi with silvery swimming hairs posteriorly; claws sharply curved, gold, tips brown.

Subgenital plate roughly triangular, tip rounded, bearing long subapical and lateral hair tufts (fig. 55).

Brachypterous male: unknown.

Macropterous form: unknown.

Discussion: This species, the smallest occurring on Luzon, may be distinguished by its small size, lack of rearwardly directed peg-like setae medially on the abdominal ventrites, and presence of two small peg-like setae at the apex of the embolar margin. These latter structures are frequently lost in old and worn specimens. We have only female examples at the present.

Etymology: The name "luzonicus" refers to the island of Luzon, to which this species is endemic.

Distribution: Known from central Luzon (fig. 170).

Material examined: Holotype, brachypterous female: PHILIPPINES, Luzon, **Pampanga Prov.**, Porae, swift stream, 10 November 1946, H. Hoogstraal (KU). Paratypes: 2 brachypterous females, **Cavite Prov.**, Alfonso, Talong Malapad, 17 May 1977, V. P. Gapud (UPLB, JTPC).

Aphelocheirus (Aphelocheirus) femoratus n.sp. Figs. 70-75, 171

Description:

Brachypterous male: Of moderate size for genus, form elongate, length 7.78 mm; maximum width (across abdomen) 4.80 mm (fig. 71). Coloration dull blackish brown with extensive yellowish markings.

Head dark yellow, shining, minutely alveolate, width/length = 1.63/1.63, produced ahead of eyes for .70 the length of an eye; eyes black, shining, width/length = .86/.35, lateral margins weakly sinaute, barely exceeding adjacent anterolateral pronotal angles; anterior/posterior interocular = 1.11/.81.

Pronotum dull blackish brown, yellowish laterally, rugose, bearing short recumbent pale setae, central portion lighter brown, glabrous, width/length = 3.74/1.15; lateral margins narrowly glabrous, each bearing 11 short stout setae, posterolateral angles acute, rounded. *Scutellum* dull blackish brown, yellowish apically, rugose, width/length = 2.11/.86, lateral margins weakly sinuate, anterior margin weakly sulcate. *Hemelytra* dull blackish brown, yellowish posteriorly, on embolium, and adjoining scutellum, surface rugose, with short recumbent pale setae, brachypterous, not attaining base of abdominal tergite III, touching medially, embolar margin coming to an acute rounded apex posterolaterally, not folded basally.

Abdomen dull blackish brown, with scattered yellow patches laterally, surface weakly pruinose, bearing pale recumbent setae, posterior margin of tergite V broadly rounded, posterolateral angles of tergites III-V strongly spinose.

Ventral surface yellowish, weakly pruinose, mottled with fuscous areas; antennae yellowish, lengths of segments I-IV = .07, .20, .22, .45; rostrum gold, shining, length 3.03, attaining middle coxae; labrum gold, glabrous, apex acute, rounded; prosternum carinate medially, propleurae with inner projections deeply notched, apices produced to slender, acute angles (fig. 73); mesosternal plate with glabrous spots laterally, reflexed anteromedially, abruptly tumescent and setose posteromedially; metasternal plate produced to a short rounded point caudad; abdomen with segments V-VII extremely asymmetrical, segments III-V with irregular glabrous pits adjacent to and inward of spiracular rosettes, sternites IV and V with several short stout rearwardly directed setae medially on posterior margins.

Legs yellowish, clothed with fine gold setae, fore trochanter, femur, tibia and tarsi with

thick hair pads on inner faces; fore, middle and hind coxae with combs of long gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae posteriorly; middle femur with longitudinal row of erect pale spines ventrally, many fine gold spines along anterior margin, about 5 erect gold setae along posterior margin, several long gold setae apically; middle tibia with scattered stout reddish spines and 4 erect gold setae along anterior margin, transverse row of spines apically; middle and hind trochanters with raised brown swellings apically; hind femur with raised ovate brown swelling basally on ventral surface, many fine gold spines along anterior margin, transverse row of short gold spines apically; hind tibia with scattered stout reddish spines along anterior margin, several short reddish spines along posterior margin, transverse row of reddish spines apically; hind tibia and tarsi with long silvery swimming hairs posteriorly; claws gold, sharply bent, tips blackish.

Male genitalia with right paramere tapering, acuminate; left paramere broadly expanded basally, truncate apically (fig. 74).

Brachypterous female: Similar to male in general structure and coloration, length 7.44 mm; maximum width 4.51 mm. Middle and hind trochanters, hind femur lacking raised brown swellings ventrally; plates of abdominal tergite VII explanate along posterior margins; subgenital plate triangular, coming to acute rounded apex, bearing apical and lateral hair tufts (fig. 75).

Macropterous male: Coloration dark brown, pruinose, length 7.20 mm; maximum width (across abdomen) 4.42 mm. Structurally similar to brachypterous form with following exceptions: pronotum more massive, posterior portion expanded, posterolateral angles obtuse, rounded; scutellum swollen, shining, mesoscutum defined by sinuate transverse sulcus; hemelytra complete, rugose, bearing short recumbent pale setae, clavus, corium and embolium well defined, embolar margin coming to a blunt angle (fig. 72), membrane dull, fumate; posterolateral angles of abdominal tergites III-V less spinose than in brachypterous form; mesosternal plate weakly carinate, not tumescent.

Macropterous female: Similar to macropterous male in general structure and coloration (fig. 72), with sexually dimorphic differences as noted for brachypterous form, length 7.10 mm; maximum width 4.42 mm.

Discussion: *A. femoratus* n.sp. may be immediately distinguished by the unusual raised dark swellings on the ventral surface of the male hind femur and trochanter (fig. 70), and the explanate posterior margins of abdominal tergite VII in the female (fig. 75). The genital structures of both sexes are also diagnostic (figs. 74, 75). The unusual swellings on the male hind legs are a character state seen in no other Asian species, but are found in several undescribed *Aphelocheirus* species from Madagascar.

Specimens at the type locality were taken in the company of burrowing mayfly immatures of the family Ephemeridae (*Ephemera* sp.).

Etymology: The name "femoratus" refers to the oddly modified male hind femur.

Distribution: Known from peninsular Malaysia and north Thailand (fig. 171).
Material examined: Holotype, brachypterous male, and allotype, macropterous female: MALAYSIA, **Perak**, waterfall on Cameron Highlands road, 24 km. W. of Tapah, CL 2074, 18 August 1985, J. T. and D. A. Polhemus (USNM). Paratypes: **Perak**: 2 macropterous males, 7 macropterous females, 5 brachypterous males, same data as types (JTPC); **Selangor**, 1 macropterous male, 1 brachypterous male, 1 brachypterous female, 9 mi. S. Gombak road, July 1967, D. Tan (JTPC); 1 macropterous male, stream nr. Dusun Tua, 21 April 1959 (NUS). THAILAND, **Chiang Mai Prov.**, 1 brachypterous male, small stream and waterfalls on Mt. Doi Sutep, W. of Chiang Mai, 442 m (1450 ft.), 11 November 1964, W. L. and J. G. Peters (LACM); 1 brachypterous male, same data as above except 488 m (1600 ft.), XI-28-64 (LACM); 1 brachypterous male, same data as above except 350 m (1150 ft.), 2 November 1964 (LACM).

Aphelocheirus (Aphelocheirus) malayanus n.sp.
Figs. 65-69, 171

Description:

Brachypterous male: Moderately large for genus, form elongate oval, length 9.12 mm; maximum width (across abdomen) 5.76 mm (fig. 65). Coloration dark blackish brown, with extensive yellowish markings.

Head dark yellow, black along anterior margin, shining, alveolate, width/length = 2.02/1.83, produced ahead of eyes for .60 the length of an eye; eyes black, shining, width/length = .45/1.01, lateral margins weakly sinuate, barely exceeding adjacent anterolateral pronotal angles; anterior/posterior interocular = 1.36/.86.

Pronotum dull blackish, yellow laterally and centrally, rugose, bearing short recumbent pale setae, width/length = 4.51/1.20, lateral margins narrowly glabrous, each with about 12 short erect setae, posterolateral angles acute, rounded. *Scutellum* dark yellow, rugose, width/length = 2.50/1.06, lateral margins weakly sinuate, anterior margin sulcate. *Hemelytra* dark blackish brown, yellowish posteriorly and on embolium, coarsely rugose, with short recumbent pale setae, brachypterous, not attaining base of abdominal tergite III, touching medially, embolar margin coming to an acute rounded apex.

Abdomen dark yellow with broad blackish patches laterally on tergites III-V and medially on tergites II-V, surface rugose, with short recumbent pale setae, posterior margin of tergite V evenly rounded, posterolateral angles of tergites III-VI produced, spinose.

Ventral surface dark yellow, blackish along margins, weakly pruinose, bearing pale recumbent setae; antennae yellowish, lengths of segments I-IV = .10, .23, .30, .43; rostrum gold, glabrous, length 3.38, attaining middle coxae; labrum gold, glabrous, apex forming

rounded point; prosternum carinate medially, propleurae with inner projections deeply notched, apices coming to slender acute angles (fig. 68); mesosternal plate reflexed anteromedially, carinate medially, tumescent and setose posteromedially; metasternal plate coming to short point caudad; abdomen with irregular sets of glabrous pits mesad of spiracular rosettes on segments III-V, sternite III produced to a small rounded hump posteromedially, sternites IV-VII bearing 4-7 stout rearwardly directed setae medially along posterior margins.

Legs yellowish brown, clothed with fine recumbent gold setae, anterior trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae distally; middle trochanter, femur, tibia and tarsi with pads of short gold setae posteriorly; middle femur with longitudinal row of short brownish spines ventrally, many short gold spines along anterior margin, 5 erect gold setae along posterior margin; middle tibia with scattered stout reddish spines and 4 slender erect gold setae along anterior margin, 2 erect gold setae distally along posterior margin, transverse row of spines apically; hind femur with scattered very short stout gold spines ventrally, many short gold spines along anterior margin, transverse row of gold spines apically; hind tibia with scattered stout reddish spines along anterior margin, 4 long erect gold spines along posterior margin, transverse row of reddish spines apically; hind tibia and tarsi with long silvery swimming hairs posteriorly; claws gold, sharply curving, tips brown.

Male genitalia with right paramere slender, tapering, tip acuminate; left paramere stout, tip narrowed, squared off, blunt (fig. 67).

Brachypterous female: Similar to brachypterous male in general structure and coloration, length 8.92 mm; maximum width 5.81 mm. Subgenital plate triangular, tip rounded, bearing 4 small peg-like setae behind apex, short apical hair tuft, long lateral hair tufts (fig. 69).

Macropterous male: Coloration dark blackish brown with scattered yellowish patches, length 10.08 mm; maximum width (across abdomen) 5.57 mm. Similar to brachypterous form in general structure and coloration with following exceptions: pronotum expanded posteriorly, posterolateral angles rounded, yellowish; scutellum swollen, rugose, mesoscutum smooth, delineated by sinuate transverse sulcus,with yellowish patches laterally; hemelytra complete, blackish brown, rugose, extending to base of genital segment, bearing pale recumbent setae, clavus, corium and embolium well defined, embolar margin produced to rounded angle laterally, membrane velvety, fumate; abdominal tergites exposed laterally, with yellowish patches adjoining posterolateral angles; mesosternal plate broadly swollen, weakly carinate medially, not tumescent.

Macropterous female: Similar to macropterous male in general structure and coloration, length 8.83 mm; maximum width (across abdomen) 5.57 mm (fig. 66).

Discussion: *A. malayanus* n.sp. is similar to *A. femoratus* n.sp. but is larger in size, has more extensive yellowish coloration on the dorsum, and lacks raised swellings on the male hind femora. The female subgenital plate with four small peg-like setae near the apex is diagnostic (fig. 69), as are the male genital structures (fig. 67).

A single male at hand from Selangor is smaller than average but appears to represent this species.

The type series was taken in a highly disturbed, unshaded stretch of stream where the surrounding montane forest had been cleared to allow for construction of a new highway. Also present at this locality were mayfly immatures belonging to the families Heptageniidae (*Thalerosphyrus* sp.) and Ephemeridae (*Ephemera* sp.).

Etymology: The name "malayanus" refers to the Malay Peninsula where this species occurs.

Distribution: Known from peninsular Malaysia (fig. 171).

Material examined: Holotype, brachypterous male, and allotype, brachypterous female: MALAYSIA, **Perak**, swift stream and waterfall 60 km. W. of Jeli, 20 August 1985, CL 2081, J. T. and D. A. Polhemus (USNM). Paratypes: **Perak**, 1 macropterous male, 2 macropterous females, 18 brachypterous males, 22 brachypterous females, same data as types (JTPC); 1 macropterous male, 4 macropterous females, 3 brachypterous males, 5 brachypterous females, waterfall along Cameron Highlands road, 24 km. W. of Tapah, 18 August 1985, CL 2074, J. T. and D. A. Polhemus (JTPC); **Selangor**, 1 brachypterous male, Selangor River at Kota Kuba Baharu, 13 August 1978, G. F. and C. H. Edmunds (JTPC).

Aphelocheirus (Aphelocheirus) grik n.sp.
Figs. 100-105, 171

Description:

Brachypterous male: Small for genus, ovate, length 7.20 mm; maximum width (across abdomen) 4.85 mm (fig. 100). Coloration uniformly blackish to brownish, head dark yellow.

Head dark yellow, shining, alveolate, width/length 1.63/1.68, produced ahead of eyes for .59 eye length; eyes black, shining, width/length = .28/.81, outer margins weakly sinuate, barely exceeding adjacent anterolateral pronotal angles; anterior/posterior interocular = 1.16/.86.

Pronotum dull dark brown, rugose, bearing fine recumbent pale setae, width/length (midline) = 3.70/1.06, lateral margins narrowly glabrous, each bearing about 11 short stout setae, posterolateral angles broadly rounded. *Scutellum* dull dark brown, rugose, with fine recumbent pale setae, width/length = 2.30/.72, lateral margins sinuate, basal margin sulcate. *Hemelytra* dull dark brown, rugose, with fine pale recumbent setae, brachypterous, not attaining base of abdominal tergite III, touching medially, embolar margin coming to acute angle posterolaterally.

Abdomen dull dark brown, weakly rugose, thickly covered with recumbent pale setae, posterior margin of tergite V forming an asymmetrical rounded hump, lateral margins

of tergites III-VI narrowly glabrous, not serrate, bearing short stout setae, posterolateral angles of tergites IV-VII spinose.

Ventral surface dull brownish to blackish, weakly pruinose, bearing recumbent gold setae, head and genital segment dark yellow, shining; antennae pale yellowish, lengths of segments I-IV = .07, .15, .23, .45; rostrum gold, glabrous, length 2.52, attaining middle coxae; labrum gold, glabrous, apex evenly rounded; prosternum carinate medially, propleurae with inner projections broadly notched, apices coming to acute angles (fig. 103); mesosternal plate with scattered glabrous depressions laterally, reflexed to form small knob anteromedially, tumescent and setose posteromedially; metasternal plate produced to short point caudad; abdomen with irregular glabrous pits inward of spiracles, lacking stout rearwardly directed setae medially, sternite V with projection medially angling over base of sternite VI (fig. 105).

Legs yellowish, covered with fine recumbent gold setae, fore trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae posteriorly; middle femur with sparse longitudinal row of stout brownish spines ventrally, many short gold spines along anterior margin, 5 erect gold setae along posterior margin, several long gold setae apically; middle tibia with scattered stout reddish spines and 4 long erect gold setae along anterior margin, 3 long erect gold setae along posterior margin, transverse row of gold spines apically; hind femur with longitudinal row of very short pale spines ventrally, many short gold spines along anterior margin, transverse row of gold spines apically; hind tibia with scattered stout reddish spines along anterior margin, 4 erect reddish spines along posterior margin, transverse row of reddish spines apically; hind tibia and tarsi with long silvery swimming hairs posteriorly; claws gold, sharply curving, tips blackish.

Male genitalia with right paramere stout, broadening distally, tip blunt; left paramere sharply curving, tapering to acute tip (fig. 102).

Brachypterous female: Similar to brachypterous male in general structure and coloration, length 7.68 mm; maximum width 4.99 mm. Abdominal sternites III-V produced to small rounded projections posteromedially; subgenital plate short, truncate, with 4 hair tufts along posterior margin (fig. 104).

Macropterous male: Coloration dark brown, hemelytra blackish, length 8.26 mm; maximum width (across abdomen) 4.90 mm. Similar to brachypterous form with following exceptions: posterior margin of pronotum expanded, sinuate; scutellum swollen, rugose, shining, mesoscutum broadly exposed, defined by sinuate transverse sulcus; hemelytra complete, attaining genital segment, surface covered with pale recumbent setae, clavus rugose, embolium smooth, with lateral margin produced to a rounded angle, corium smooth, dull, with numerous tiny raised glabrous dots, membrane velvety, fumate; mesosternal plate reflexed anteromedially, swollen and carinate posteromedially.

Macropterous female: Similar to macropterous male in general structure and coloration, length 7.93 mm; maximum width 5.09 mm (fig. 101).

Discussion: *A. grik* can be immediately distinguished from all other Asian species by the truncate subgenital plate of the female (fig. 104), the projecting tab on the posterior margin of abdominal sternite V in the male (fig.105), and the male genitalia (fig. 102). The macropterous form has a distinct texturing on the corium of the hemelytra consisting of minute raised shining dots on a dull background. Brachypterous specimens show two distinct color morphs, some being brown while others are dark and blackish.

The very long type series (over 200 specimens) was taken below a highway bridge on the Kerunai River, where an opening in the forest canopy caused by the road allowed sunlight to reach the otherwise shaded stream.

Etymology: The name "grik", a noun in apposition, refers to the type locality near the town of Grik, Malaysia.

Distribution: Known from peninsular Malaysia north to Thailand (fig. 171).

Material examined: Holotype, brachypterous male, and allotype, brachypterous female: MALAYSIA, **Perak**, Kerunai River, 9 km. N. of Grik at highway bridge, 19 August 1985, CL 2078 (USNM). Paratypes: **Perak**, 1 macropterous male, 1 macropterous female, 111 brachypterous males, 121 brachypterous females, same data as types (JTPC); 6 brachypterous males, 6 brachypterous females, stream 58 km. S. of Grik, 19 August 1985, CL 1977, J. T. and D. A. Polhemus (JTPC). THAILAND, **Chiang Mai Prov.**, 3 brachypterous males, 6 brachypterous females, E. Fork Mai Ping River, 56 km. N. of Chiang Mai, 396 m. (1300 ft.), 24 November 1964, W. L. and J. G. Peters (JTPC, LACM); 7 macropterous males, 2 macropterous females, 17 brachypterous males, 16 brachypterous females, E. Fork Mai Ping River at junction with small stream, 59 km. N. of Chiang Mai, 411 m. (1350 ft.), 30 November 1964, W. L. and J. G. Peters (JTPC, LACM).

Aphelocheirus (Aphelocheirus) inops (Horvath)
Figs. 82-87, 172

Aphelochirus inops Horvath, 1918, Ann. Mus. Nat. Hung., 16: 140.
Aphelochirus inops: Szabó-Patay, 1924, Ann. Mus. Nat. Hung., 21: 34.
Aphelochirus inops: Kiritshenko, 1925, Russ. Hydrobiol. Zeitschr., 4: 41.
Aphelochirus inops: Kiritshenko, 1929, C. R. Acad. Sci. URSS, (A) 1: 11.
Aphelochirus inops: Lundblad, 1933, Arch. Hydrobiol., Suppl. Bd. 12, Trop. Binnengewass. 4: 62
Aphelochirus inops: Hoffmann, 1933, Lingnan Sci. J. 12, Suppl., p. 254.
Aphelocheirus inops: Usinger, 1937, Phil. J. Sci., 64: 307.
Aphelochirus inops: Hoffmann, 1941, Lingnan Sci. J. 20: 46.
Aphelocheirus inops: Hoberlandt and Štys, 1979, Acta Mus. Nat. Pragae, 33B: 18.

Description:

Brachypterous male: Small for genus, ovate, length 6.91 mm; maximum width (across abdomen) 4.56 mm. Coloration dull brown, head yellowish.

Head dark yellow, shining, alveolate, width/length = 1.54/1.58, produced ahead of eyes for .56 eye length; eyes black, shining, width/length = .30/.81, lateral margins weakly sinuate, not exceeding adjacent anterolateral pronotal angles; anterior/posterior interocular = 1.11/.76.

Pronotum brown, weakly rugose, bearing pale recumbent setae, width/length = 3.60/1.06, lateral margins narrowly glabrous, bearing very short erect stout setae, posterolateral angles acute, rounded. *Scutellum* dull brown, with recumbent pale setae, width/length = 2.30/.77, lateral margins weakly sinuate, basal margin sulcate. *Hemelytra* dull brown, weakly rugose, with recumbent pale setae, brachypterous, not attaining base of abdominal tergite III, touching medially, embolar margin coming to sharp angle posterolaterally.

Abdomen dull brown, with recumbent pale setae, posterior margin of tergite V forming a rounded hump, posterolateral angles of tergites III-V produced, spinose.

Ventral surface dull light brown, pruinose, covered with very fine recumbent pale setae, head and genital segment gold, shining; antennae gold, shining, lengths of segments I-IV = .10, .15, .25, .30; rostrum gold, glabrous, length 2.68, exceeding middle coxae; labrum gold, glabrous, apex evenly rounded; prosternal plate carinate medially, propleurae with inner projections broadly notched, apices coming to acute points (fig. 85); mesosternal plate reflexed to small knob anteromedially, abruptly tumescent and setose posteromedially; metasternal plate coming to short point caudad; abdomen with irregular glabrous depressions adjacent to spiracles on segments III-VII, sternites IV and V with 4-6 stout rearwardly directed setae medially along posterior margins, sternite VI with small rearward projection medially (fig. 84).

Legs gold, covered with fine recumbent gold setae, anterior trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae posteriorly; middle femur with longitudinal row of short gold spines ventrally, several slender erect gold setae along posterior margin, many short gold spines along anterior margin; middle tibia with scattered stout reddish spines and 4 long erect gold setae along anterior margin, 2 long gold setae distally along posterior margin, transverse row of gold spines apically; hind femur lacking spines ventrally, with scattered short gold spines along anterior margin; hind tibia with scattered stout reddish spines along anterior margin, erect gold setae distally along posterior margin, transverse row of reddish spines apically; hind tibia and tarsi with long swimming hairs along posterior faces; claws gently curving gold, tips black.

Male genitalia with right paramere slender, acuminate; left paramere broad, tip concave (fig. 86).

Brachypterous female: Similar to male in general structure and coloration, length 7.00 mm; maximum width 4.61 mm. Subgenital plate roughly triangular, coming to narrow acute tip apically with rounded shoulders basally, bearing long lateral and short apical hair tufts (fig. 87).

Macropterous form: unknown.

Discussion: We have examined the holotype and two paratypes of *A. inops*, all brachypterous specimens bearing the locality data "Annam, Laos". These specimens are in excellent condition, being housed in the Hungarian Natural History Museum and the J. T. Polhemus collection respectively. Among Indochinese species *A. inops* is closest to *A. thai* n.sp., from which it may be separated by the differing structure of the median keel on the mesosternal plate (figs. 80, 83). *A. inops* also possesses a small triangular tab medially on the posterior margin of abdominal ventrite V in males (fig. 84), and lacks small peg-like setae medially on the posterior margin of ventrite VI in both sexes. In *A. thai* the tab is lacking, and both sexes possess conspicuous peg-like setae medially on the posterior margin of abdominal ventrite VI. Males of *A. fang* n. sp. also possess a small tab on the posterior margin of abdominal ventrite V, but may be distinguished from *A. inops* by their larger size, longer head capsule, and distinctive male genitalia. *A. inops* is also closely allied to *A. gularis* (Horvath) on the basis of the male genitalia (see discussion under that species below), but may be distinguished by the shape of the left paramere.

Distribution: Indochina (fig. 172).

Material examined: 1 brachypterous male (*A. inops* holotype), ANNAM, Laos (HNHM); 1 brachypterous male, 1 brachypterous female (*A. inops* paratypes), same data as holotype (JTPC).

Aphelocheirus (Aphelocheirus) gularis (Horvath) Figs. 88, 89, 172

Aphelochirus gularis Horvath, 1918, Ann. Mus. Nat. Hung., 16: 141.
Aphelochirus gularis: Kiritshenko, 1925, Russ. Hydrobiol. Zeitschr., 4: 41.
Aphelochirus gularis: Kiritshenko, 1929, C. R. Acad. Sci. URSS, (A) 1: 11.
Aphelochirus gularis: Lundblad, 1933, Arch. Hydrobiol., Suppl. Bd. 12, Trop. Binnengewass. 4: 62
Aphelochirus gularis: Hoffmann, 1933, Lingnan Sci. J. 12, Suppl., p. 254.
Aphelochirus gularis: Hoffmann, 1941, Lingnan Sci. J. 20: 46.
Aphelocheirus gularis: Hoberlandt and Štys, 1979, Acta Mus. Nat. Pragae, 33B: 18.

Description:

Macropterous male: General coloration dull dark brown, with small dark yellowish patches

basally on hemelytra, length 5.80 mm.; maximum width 4.42 mm (fig. 88).

Head dark brown, shining, alveolate, width/length = 1.71/1.44, produced ahead of eyes for .53 eye length; eyes black, shining, width/length = .36/.81, lateral margins weakly sinuate, not exceeding adjacent anterolateral pronotal angles; anterior/posterior interocular = 1.08/.79.

Pronotum brown, weakly rugose, bearing pale recumbent setae, width/length = 3.41/.91, lateral margins expanded, narrowly glabrous, bearing very short erect stout setae, posterolateral angles rounded, posterior margin sinuate. *Scutellum* brown, width/length = 2.52/1.36, swollen, raised, mesoscutum exposed, delineated by sinuate transverse furrow. *Hemelytra* complete, with clavus, claval vein, corium and embolium well defined, entire hemelytral surface rugose, set with fine very short recumbent gold setae, embolar margin produced to a sharp angle, wing membrane dull brown, partially disintegrated.

Abdomen dull brown, with recumbent pale setae, posterior margin of tergite V forming a rounded hump, posterolateral angles of abdominal tergites III-V slender, prolonged, spinose.

Ventral surface dull light brown, pruinose, covered with very fine recumbent pale setae, head and genital segment gold, shining; antennae gold, shining, lengths of segments I-IV = .10, .15, .25, .30; rostrum gold, glabrous, length 2.48, attaining middle coxae; labrum gold, glabrous, apex evenly rounded; prosternal plate carinate medially, propleurae with inner projections broadly notched, apices coming to slender acute points (see fig.); mesosternum with sharply raised longitudinal median carina, this carina rising abruptly on anterior portion of mesosternum, becoming lower on posterior portion; metasternal plate coming to short point caudad; abdomen with irregular glabrous depressions adjacent to spiracles on segments III-VII, sternites IV and V with 4-6 stout rearwardly directed setae medially along posterior margins, sternite VI with small rearward projection medially (fig. 84).

Legs gold, covered with fine recumbent gold setae, anterior trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae posteriorly; middle femur with longitudinal row of short gold spines ventrally, several slender erect gold setae along posterior margin, many short gold spines along anterior margin; middle tibia with scattered stout reddish spines and 4 long erect gold setae along anterior margin, 2 long gold setae distally along posterior margin, transverse row of gold spines apically; hind femur lacking spines ventrally, with scattered short gold spines along anterior margin; hind tibia with scattered stout reddish spines along anterior margin, erect gold setae distally along posterior margin, transverse row of reddish spines apically; hind tibia and tarsi with long swimming hairs along posteror faces; claws gently curving gold, tips black.

Male genitalia with right paramere slender, acuminate; left paramere broad, tip concave (fig. 89).

Brachypterous form: unknown.

Discussion: We have examined the holotype of *A. gularis* Horvath, a macropterous male in excellent condition which bears the data "Annam, Laos" and forms the basis for the redescription above. This specimen is presently housed in the Hungarian Natural History Museum. *A. gularis* is similar in many respects to *A. inops*, and possesses a similar small triangular tab medially on abdominal ventrite VI in the males (fig. 84), at first leading us to believe that the two were conspecific. The male genitalia of the two species, however, show differences, particularly in the structure of the left paramere, which is broader apically in *A. gularis*. The slender right paramere is similar to other Indochinese species, but a general comparison is difficult since only the single macropterous male is known. The spinose posterolateral angles on the abdominal tergites and the distinctive male genitalia should allow future recognition of the brachypterous form.

Distribution: Indochina (fig. 172).

Material examined: 1 macropterous male (*A. gularis* holotype), ANNAM, Laos (HNHM).

Aphelocheirus (Aphelocheirus) lahu n.sp.
Figs. 90-93, 171

Description:

Brachypterous male: Of small size for genus, form ovate, length 6.96 mm; maximum width (across abdomen) 4.51 mm (fig. 90). Coloration dark brown, with head, pronotum laterally, scutellum and first abdominal segment dark amber yellow.

Head dark yellow, shining, alveolate, width/length = 1.57/1.44, produced ahead of eyes for .56 the length of an eye; eyes black, shining, width/length = .35/.81, outer margins weakly sinuate, barely exceeding adjacent anterolateral angles of pronotum; anterior/posterior interocular = 1.14/.76.

Pronotum dull dark brown, lateral portions yellowish, central portion shining, width/length (midline) = 3.63/.98, surface coarsely rugose, bearing very fine short recumbent gold setae, lateral margins narrowly glabrous and translucent, each bearing about 12 short peg-like setae, posterolateral angles coming to a rounded right angle. *Scutellum* dull yellowish, width/length = 2.11/.73, surface coarsely rugose, with extremely short recumbent gold setae, lateral margins weakly sinuate, basal margin sulcate. *Hemelytra* dull dark brown, brachypterous, not touching medially, reaching posteriorly only to middle of abdominal segment II, surface rugose with small shining asperities, bearing fine recumbent gold setae, embolar margin forming a sharp acute angle.

Abdomen dull dark brown, narrowly yellowish along lateral margins, surface weakly rugose, bearing recumbent gold setae, posterior margin of tergite V weakly concave apically,

posterolateral angles of tergites III-VI weakly produced, coming to small conical points.

Ventral surface yellowish brown, weakly pruinose, darker laterally on abdomen and thorax, sparsely covered with fine recumbent gold setae; antennae pale yellow, lengths of segments I-IV = .07, .15, .25, .38; rostrum gold, glabrous, length 2.15, attaining middle coxae; prosternum acutely carinate medially, inner projections of propleurae with apices rounded (fig. 92); mesosternal plate longitudinally carinate medially, reflexed along anterior margin, rising to a large rounded setose tumescence posteromedially; abdomen with segments III and IV produced to small humps posteromedially, posterior projections of segment VII symmetrical, apices acute, rounded, not exceeding tip of genital segment, all segments lacking stout peg-like setae medially.

Legs yellowish brown, covered with fine recumbent gold setae; anterior trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae posteriorly; middle femur with longitudinal row of short reddish spines dorsally, numerous fine gold spines along anterior margin, several erect slender gold spines along posterior margin; middle tibia sparsely set with stout reddish spines along anterior margin intermixed with 4 long slender erect gold spines, several similar erect spines present along posterior margin, transverse row of reddish spines apically; hind femur with sparse very short gold spines ventrally, larger short gold spines along anterior margin; hind tibia with scattered short stout reddish spines along anterior margin, 4 stout reddish spines ventrally, transverse row of reddish spines apically; hind tibia and tarsi with long swimming hairs along posterior faces; claws gently curving, gold, tips darkened.

Male genitalia with right paramere tapering, acuminate; left paramere slender, gently curving, tip squared off (fig. 93).

Brachypterous female: Similar to brachypterous male in general structure and coloration, length 7.35 mm; maximum width 4.90 mm. Plates of abdominal segment VII angulate, posterior apices rounded, subgenital plate broadly triangular, tip rounded, bearing long lateral hair tufts and a single broad apical hair tuft (fig. 91).

Macropterous form: unknown.

Discussion: *A. lahu* n.sp. may be recognized by the absence of peg-like setae on the abdominal venter, the widely separated wing pads that do not touch medially, the weakly concave tip of abdominal tergite V in males, and the distinctive genital structures of both sexes (figs. 91, 93).

This species was extremely abundant at the Nam Chai River type locality, a cool, swift stream rushing down out of the hills along the Thai-Burmese border and supporting a diverse benthic fauna. *A. lahu* occurred sympatrically here with a wide variety of other naucorids, including *Cheirochela* sp., *Gestroiella* sp., *Heleocoris* sp., *Ctenipocoris* sp., *Aphelocheirus fang* n.sp., *Aphelocheirus brevirostris* n.sp., and *Aphelocheirus thai* n.sp. Distinct habitat preferences were observed among the various *Aphelocheirus* species here, with

A. lahu frequenting swiftly flowing midstream sections among small rocks and gravel, *A. fang* typically found downstream of large rocks along the stream margins, and *A. brevirostris* localized in areas of coarse gravel in relatively shallow water. *A. thai* was uncommon and had no clear microhabitat association, with only a few macropterous individuals being taken. Other common benthic insects at this locality included mayfly immatures belonging to the families Baetidae (*Platybaetis*), Heptageniidae (*Thalerosphyrus, Epeorus, Rhithragena*), Leptophlebiidae (*Choroterpes*), Potamanthidae (*Potamanthodes*), Ephemeridae (*Ephemera*), and Ephemerellidae (*Acerella, Hyrtanella*), and aquatic beetles of the family Elmidae.

Etymology: The name "lahu" refers to the native Lahu hill people of north Thailand, who watched with reserved curiosity as we collected the type series of this species.

Distribution: Known only from north Thailand, but undoubtedly ranges into Burma (fig. 171).

Material examined: Holotype, brachypterous male, and allotype, brachypterous female: THAILAND, **Chiang Mai Prov.**, Nam Chai River above hydro intake at Fang Horticultural Experiment Station, 550 m. (1804 ft.), 15 November 1985, CL 2197, J. T. and D. A. Polhemus (USNM). Paratypes: 196 brachypterous males, 185 brachypterous females, same data as types (JTPC, AMNH); 1 brachypterous male, small stream and waterfalls on Mt. Doi Sutep, W. of Chiang Mai, 488 m. (1600 ft.), 28 November 1964, W. L. and J. G. Peters (LACM).

Aphelocheirus (Aphelocheirus) fang n.sp.
Figs. 94-99, 172

Description:

Brachypterous male: Of moderate size for genus, form ovate, length 8.33 mm; maximum width (across abdomen) 5.63 mm (fig. 94). Coloration yellowish brown, marked to varying degrees with dark to blackish brown on pronotum, wing pads and abdomen.

Head dark amber yellow, shining, alveolate, width/length = 1.77/1.79, elongate, produced ahead of eyes for .71 the length of an eye; eyes black, shining, width/length = .38/.88, lateral margins weakly sinuate, not exceeding adjacent anterolateral pronotal angles; anterior/posterior interocular = 1.31/.86.

Pronotum dark brown, yellowish laterally and medially, width/length (midline) = 4.41/1.18, surface coarsely rugose, shining centrally, bearing short recumbent gold setae, lateral margins narrowly glabrous and translucent, each with about 12 minute erect peglike setae, posterolateral angles broadly rounded. *Scutellum* dark yellow, frequently infuscated basally, width/length = 2.84/1.18, surface rugose, shining, bearing very short recum-

bent gold setae, lateral margins sinuate, basal margin broadly sulcate. *Hemelytra* dark brown, frequently yellowish posteriorly and on embolium, brachypterous, not attaining base of abdominal segment III, touching medially, surface rugose, with short fine recumbent gold setae, embolar margin coming to a sharp acute angle.

Abdomen dull dark yellowish, mottled to varying degrees with darker brown, surface with small glabrous asperities, sparsely covered with recumbent gold setae, posterior margin of tergite V evenly rounded, posterolateral angles of segments III, IV and VI produced to short spines, angles of segment V forming longer spines.

Ventral surface yellowish brown, weakly pruinose, sparsely covered with short recumbent gold setae; antennae pale yellow, lengths of segments I-IV = .08, .18, .30, .35; rostrum gold, glabrous, length 3.43, attaining middle trochanters; prosternum reflexed anteromedially, longitudinally carinate medially, inner projections of propleurae broadly notched, apices acute (fig. 98); mesosternal plate with sharp longitudinal medial carina, rising abruptly to a keel-like tumescence posteromedially; abdomen with segments IV-VI with 4 -6 short rearwardly directed peg-like setae medially along posterior margins, segment VI with conspicuous projecting glabrous tab to right of midline on posterior margin (fig. 99), posterior projections of segment VII with apices blunt, not exceeding tip of genital capsule.

Legs dark yellowish, clothed with fine recumbent gold setae; anterior trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae posteriorly; middle femur with longitudinal row of short brownish spines ventrally, many short recumbent gold spines along anterior margin, 4 slender erect gold spines basally along posterior margin; middle tibia with scattered stout reddish spines and 4 slender erect gold spines along anterior margin, 3 slender erect gold spines along posterior margin, transverse row of reddish spines apically; hind femur with very short stout gold spines along anterior margin; hind tibia with stout reddish spines along anterior margin, 4 small sharp reddish spines ventrally, transverse row of reddish spines apically; hind tibia and tarsi with long swimming hairs on posterior faces; claws gently curving, gold, tips brown.

Male genitalia with right paramere tapering, acuminate; left paramere more massive, roughly triangular, with blunt projection at tip (fig. 97).

Brachypterous female: Similar to brachypterous male in general structure and coloration, length 8.82 mm; maximum width 6.12 mm. Plates of abdominal segment VII with posterior margins weakly concave, subgenital plate broadly triangular, narrowing apically, tip squared off (fig. 96).

Macropterous male: Similar to brachypterous form with following exceptions: length 8.30 mm; maximum width 5.19 mm.; dorsal coloration uniformly dark blackish brown, pronotum with lateral margins greatly expanded, posterolateral angles broadly rounded; scutellum swollen, mesoscutum evident, delineated by sinuate transverse furrow; hemelytra complete, wing membrane atrovelutinus, mostly disintegrated in older specimens, corium

with surface dull, bearing scattered glabrous asperities and recumbent gold setae, clavus and claval vein well defined, embolar margin coming to a rounded acute angle; prosternum not reflexed anteromedially; mesosternal plate broadly and gently tumescent.

Macropterous female: Similar to macropterous male in general structure and coloration but slightly larger, length 9.30 mm; maximum width 5.60 mm (fig. 95).

Discussion: *A. fang* may be recognized by its size (length exceeding 8 mm), the elongate head capsule which extends ahead of the eyes for over .70 the length of an eye, the conspicuous glabrous tab on ventral abdominal segment VI in males (fig. 99), and the characteristic male and female genital structures (figs. 96, 97). Coloration in this species is variable, with some individuals uniformly dull dark brown, others predominantly brown with the head, scutellum and posterior portions of the wing pads yellowish, and still others yellowish brown with contrastingly dark wing pads and pronotal patches.

Ecological preferences of this species at the Nam Chai River type locality are noted under *A. lahu*. *A. fang* was also found in a small, shallow tributary creek to the Nam Chai, the Huay Hia, where *A. lahu* was not taken, indicating once again the preference of this species for shallower, more slowly flowing stream habitats.

Etymology: The name "fang" refers to the type locality near Fang, Thailand.

Distribution: Known only from north Thailand (fig. 172).

Material examined: Holotype, brachypterous male, and allotype, brachypterous female: THAILAND, **Chiang Mai Prov.**, Nam Chai River above hydro intake at Fang Horticultural Experiment Station, 550 m. (1804 ft.), 15 November 1985, CL 2197, J. T. and D. A. Polhemus (USNM). Paratypes: THAILAND, **Chiang Mai Prov.**: 6 macropterous males, 2 macropterous females, 22 brachypterous males, 14 brachypterous females, same data as types; 23 brachypterous males, 15 brachypterous females, Huay Hia Creek, Fang Horticultural Experiment Station, 500 m. (1640 ft.), 15 November 1985, CL 2198, J. T. and D. A. Polhemus (JTPC); 12 brachypterous males, 10 brachypterous females, Mae Sa Waterfall, 7 km. W. of Mae Rim, 18 November 1985, CL 2203, J. T. and D. A. Polhemus (JTPC); 2 brachypterous males, 5 brachypterous females, East Fork Mae Ping River, 56 km. N. of Chiang Mai, 396 m. (1300 ft.), 24 November 1964, W. L. and J. G. Peters (LACM, JTPC); 2 brachypterous females, East Fork Mae Ping River, 59 km. N. of Chiang Mai, 411 m. (1350 ft.), 30 November 1964, W. L. and J. G. Peters (LACM).

Aphelocheirus (Aphelocheirus) petersi n.sp. Figs. 106-110, 173

Description:

Brachypterous male: Of small size for genus, ovate, length 6.86 mm; maximum width (across abdomen) 4.41 mm (fig. 106). Coloration dull medium brown, head yellowish.

Head dark amber yellow, shining, alveolate, width/length = 1.57/1.46, produced ahead of eyes for .44 the length of an eye; eyes black, width/length = .30/.86, outer margins sinuate, barely exceeding adjacent anterolateral pronotal angles; anterior/posterior interocular = 1.31/.86.

Pronotum brown, shining centrally, width/length (midline) = 3.33/.98, surface rugose, bearing short recumbent gold setae, lateral margins narrowly glabrous, each bearing about 11 stout peg-like setae, posterolateral angles rounded. *Scutellum* brown, width/length = 2.20/.73, surface rugose, bearing short recumbent gold setae, lateral margins weakly sinuate, basal margin sulcate. *Hemelytra* dull brown, brachypterous, attaining base of abdominal segment III, touching medially, surface rugose, bearing short recumbent setae, embolar margin broadly rounded, posterolateral angles obtuse.

Abdomen dull brown, surface weakly rugose, bearing fine recumbent gold setae, posterior margin of tergite V broadly rounded, posterolateral angles of tergites IV-VI coming to small conical spinose projections.

Ventral surface dark brown, weakly pruinose, sparsely covered with very fine recumbent gold setae, head yellowish, glabrous; antennae pale yellow, lengths of segments I-IV = .07, .15, .25, .40; rostrum gold, glabrous, length 2.52, attaining middle trochanters; prosternum shallowly but sharply carinate medially, inner projections of propleurae broadly notched, apices acute (fig. 109); mesosternal plate sharply tumescent longitudinally, rising abruptly to a keel-like medial projection; abdomen with segments IV-VI bearing 4-6 rearwardly directed peg-like setae medially along posterior margins, posterior projections of segment VII asymmetrical, apices rounded, exceeding tip of genital capsule (fig. 106).

Legs yellowish brown, clothed with fine recumbent gold setae; anterior trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae posteriorly; middle femur with longitudinal row of scattered short gold spines ventrally, numerous short gold spines along anterior margin, 4 slender erect gold spines along posterior margin; middle tibia with scattered stout reddish spines and 4 long erect gold spines anteriorly, transverse row of reddish spines apically; hind femur with sparse very short gold spines ventrally, scattered short recumbent gold spines anteriorly; hind tibia with scattered stout reddish spines anteriorly, transverse row of reddish spines apically; hind tibia and tarsi with long swimming hairs along posterior margins; claws gently curving, tips dark.

Male genitalia with right paramere tapering, acuminate; left paramere gently curving, coming to an irregular rounded tip apically (fig. 108).

Brachypterous female: Similar to brachypterous male in general structure and coloration, length 6.66 mm.; maximum width 4.61 mm. Subgenital plate forming an elongate triangle, tip acuminate (fig. 110).

Macropterous female: Coloration dull light to medium brown, length 6.96; maximum width 4.51 (fig. 107). Similar to brachypterous form with following exceptions: lateral pronotal margins expanded, posterolateral angles broadly rounded; scutellum enlarged, raised, mesoscutum exposed, delineated by sinuate transverse furrow; hemelytra complete, dull brown, surface rugose, bearing recumbent gold setae, membrane broken and lacking on older specimens, clavus and claval vein well defined, embolium with lateral margin forming a rounded obtuse angle; mesosternal plate longitudinally carinate medially, tumescent posteromedially, tumescence produced to a small forward projecting knob anteromedially.

Macropterous male: unknown.

Discussion: *A. petersi* is a small, distinctive species that may be recognized by the asymmetrical processes of abdominal segment VII in the male (fig. 106), the male parameres (fig. 108), the tapering female subgenital plate (fig. 110), and the rounded embolar margin in brachypterous forms (fig. 107).

Etymology: The name "petersi" is in honor of William and Janet Peters, who collected the type series.

Distribution: Known only from north Thailand (fig. 173).

Material examined: Holotype, brachypterous male, and allotype, brachypterous female: THAILAND, **Chiang Mai Prov.**, East Fork Mae Ping River, 56 km. N. of Chiang Mai, 396 m. (1300 ft.), 24 November 1964, W. L. and J. G. Peters (LACM). Paratypes: **Chiang Mai Prov.**: 6 brachypterous males, 5 brachypterous females, same data as types (JTPC, LACM); 2 macropterous females, 5 brachypterous males, 7 brachypterous females, East Fork Mae Ping River, 59 km. N. of Chiang Mai, 411 m. (1350 ft.), 30 November 1964, W. L. and J. G. Peters (JTPC, LACM)

Aphelocheirus (Aphelocheirus) thai n.sp.
Figs. 76-81, 173

Description:

Brachypterous male: Small for genus, ovate, length 7.35 mm; maximum width (across abdomen) 5.00 mm (fig. 76). Coloration dull dark brown, with head, lateral areas of prono-

tum, and posterolateral abdominal angles yellowish.

Head dark amber yellow, shining, alveolate, width/length = 1.51/1.16, produced ahead of eyes for distance equal to .51 the length of an eye; eyes black, shining, width/length = .35/.88, barely exceeding adjacent anterolateral pronotal angles, lateral margins weakly sinuate; anterior/posterior interocular = 1.24/.91.

Pronotum dull brown, yellowish laterally and centrally, width/length (midline) = 3.92/.98, surface weakly rugose, covered with recumbent gold setae, lateral margins narrowly glabrous, each bearing about 10 small peg-like setae, posterolateral angles acute, rounded. *Scutellum* dull dark brown, often yellowish laterally, width/length = 2.20/.78, surface finely rugose, bearing recumbent gold setae, lateral margins weakly sinuate, basal margin weakly sulcate. *Hemelytra* dull dark brown, weakly rugose, bearing recumbent gold setae, brachypterous, touching medially, not attaining base of abdominal segment III, embolar margin coming to a sharp acute angle posterolaterally.

Abdomen dull dark brown, posterolateral portions of all tergites frequently yellowish, surface bearing recumbent gold setae, posterior margin of tergite V forming a broadly and evenly rounded hump, posterolateral angles of tergites III-V progressively more produced and spinose.

Ventral surface dark brown, weakly pruinose, sparsely set with fine recumbent gold setae, posterolateral portions of all abdominal segments yellowish producing striped effect; antennae pale yellowish, lengths of segments I-IV = .07, .15, .28, .40; rostrum gold, glabrous, length 2.78, attaining bases of middle trochanters; prosternal plate sharply carinate medially, inner projections of propleurae broadly notched, coming to sharp acute angles apically (fig. 79); mesosternal plate produced medially to an abrupt forward angling keel-like projection (fig. 80); abdomen with segment III produced to a small knob posteromedially, segments IV-VII with small rearwardly directed peg-like setae medially along posterior margins, posterior projections of segment VII with apices rounded, not exceeding genital capsule.

Legs light yellowish, clothed with fine gold setae; fore trochanter, femur, tibia and tarsi with thick pads of gold setae on inner faces; fore, middle and hind coxae with combs of gold setae apically; middle trochanter, femur, tibia and tarsi with thick pads of setae along posterior margins; middle femur with longitudinal row of short brownish spines ventrally, numerous fine recumbent gold spines along anterior margin, several erect slender gold spines along posterior margin; middle tibia with scattered stout reddish spines and several long erect slender spines along anterior margin, several slender erect gold spines along posterior margin, transverse row of reddish spines apically; hind femur with irregular longitudinal row of short stout gold spines ventrally, scattered recumbent short fine gold spines along anterior and posterior margins; hind tibia with scattered stout reddish spines anteriorly, 4 stout reddish spines along ventral margin, transverse row of reddish spines apically; hind tibia and tarsi with long swimming hairs along posterior margins; claws gently curving, gold, tips brown.

Male genitalia with right paramere tapering, tip acuminate; left paramere sinuate, tip

squared off, transversely carinate; vesica with tip expanded (fig. 78).

Brachypterous female: Similar to brachypterous male in general structure and coloration, length 7.30 m; maximum width 5.00 mm. Plates of abdominal segment VII angulate, subgenital plate roughly triangular, tip rounded, bearing long lateral hair tufts and single thick apical hair tuft bordered basally by several small stout peg-like setae (fig. 81).

Macropterous female: Similar to brachypterous form in general structure with following exceptions: length 7.25 mm; maximum width (across abdomen) 4.65 mm (fig. 77); coloration dark brown, posterolateral portions of pronotum and abdominal tergites dark yellowish; pronotum expanded, posterolateral angles obtuse, broadly rounded, posterior margin sinuate; scutellum swollen, coarsely rugose punctate, mesoscutum exposed, delineated by sinuate transverse furrow; hemelytra complete, attaining abdominal tergite VI, membrane frequently disintegrated, embolar margin produced to a sharp acute point, corium and clavus coarsely rugose, bearing recumbent gold setae, claval vein evident, membrane atrovelutinus; mesosternal plate with weak longitudinal medial carina, coming to a small knob anteromedially.

Macropterous male: unknown.

Discussion: *A. thai* n.sp. may be recognized by the striped appearance of the abdominal margins, the highly produced mesosternal plate of the brachypterous forms (fig. 80), the female subgenital plate with small peg-like setae below the apical hair tufts (fig. 81), and the male parameres (fig 78). This species frequented slower streams in more open country than its sympatric congeners in northern Thailand, and was taken amid coarse sand and small rocks, frequently in the company of mayfly larvae belonging to the families Potamanthidae (*Potamanthodes, Rhoenanthopsis*), Ephemeridae (*Ephemera*), Neoephemeridae (*Potamanthellus*), and Tricorythidae.

Etymology: The name "thai" refers to Thailand and the incredibly friendly and helpful Thai people.

Distribution: Known only from north Thailand (fig. 173)

Material examined: Holotype, brachypterous male, and allotype, brachypterous female: THAILAND, **Chiang Mai Prov.**, Mae Mao River, SW of Fang Horticultural Experiment Station, 500 m (1640 ft.), 16 November 1985, CL 2200, J. T. and D. A. Polhemus (USNM). Paratypes: **Chiang Mai Prov.**, 11 brachypterous males, 18 brachypterous females, same data as types; 1 brachypterous male, 3 brachypterous females, Mae Sa waterfall, 7 km. W. of Mae Rim, 18 November 1985, CL 2203, J. T. and D. A. Polhemus (JTPC); 2 macropterous females, Nam Chai River above hydro intake at Fang Horticultural Experiment Station, 550 m. (1804 ft.), 15 November 1985, CL 2197, J. T. and D. A. Polhemus (JTPC); 1 brachypterous male, small stream and waterfalls on Mt. Doi Sutep, W. of Chiang Mai, 488 m. (1600 ft.), 28 November 1964, W. L. and J. G. Peters (LACM).

Aphelocheirus (Aphelocheirus) nathani La Rivers
Figs. 111-114, 175

Aphelocheirus nathani La Rivers, 1971, Bull So. Cal. Acad. Sci., 70: 70.
Aphelocheirus nathani: Hoberlandt and Štys, 1979, Acta Mus. Nat. Pragae, 33B: 18.

Description:

Brachypterous male: Of moderate size for genus, form ovate, length 8.82 mm; maximum width (across abdomen) 6.17 mm. Coloration dull light brown, darker on wing pads and abdomen.

Head light brown, darker basally and apically, width/length = 2.15/1.77, produced ahead of eyes for .30 the length of an eye; eyes dark brown, shining, width/length = .50/1.16, outer margins sinuate, not exceeding adjacent anterolateral angles of pronotum; anterior/posterior interocular = 1.51/1.01.

Pronotum light brown, darker behind eyes, width/length (midline) = 4.90/1.18, surface rugose, bearing very fine recumbent gold setae, lateral margins narrowly glabrous, with short peg-like setae, posterolateral angles forming sharp rearwardly curving points. *Scutellum* light brown, darker basally, width/length = 3.18/1.22, surface rugose, bearing very fine recumbent gold setae, lateral margins sinuate, basal margin sulcate. *Hemelytra* dull medium brown, brachypterous, not attaining base of abdominal tergite III, widely separated medially, surface rugose, with short recumbent gold setae, embolar margin curving evenly downward to sharp acute angle posterolaterally.

Abdomen dull medium brown, yellowish laterally, surface rugose, bearing short fine recumbent gold setae, posterior margin of tergite V irregularly rounded, very weakly concave apically, posterolateral angles of tergites III and IV weakly produced and spinose, those of tergites V and VI longer and moderately spinose.

Ventral surface light brown, weakly pruinose, sparsely covered with short recumbent gold setae; antennae gold, lengths of segments I-IV = .10, .22, .30, .50; rostrum gold, glabrous, length 3.23, attaining middle trochanters; prosternum with weak longitudinal carina medially, inner propleural projections sharply notched, apices rounded (fig. 113); mesosternal plate with longitudinal medial carina, forming small knob anteromedially, rising to roughly conical setose tumescence posteromedially; abdomen with segments IV and V bearing small posteriorly directed peg-like setae medially along posterior margins, segment VII with gently rounded posteriorly directed glabrous tab medially.

Legs light brown, covered with fine gold setae; fore trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae apically; middle trochanter, femur, tibia and tarsi with pads of gold setae on posterior faces; middle femur with longitudinal row of gold spines ventrally, scattered short recum-

bent gold spines along anterior margin, row of slender erect gold spines posteriorly; middle tibia with stout reddish spines and 3 slender erect gold spines along anterior margin, transverse row of reddish spines apically; hind femur with longitudinal row of peg-like spines ventrally, scattered short recumbent gold spines along anterior margin, several fine erect short gold spines along posterior margin; hind tibia with stout reddish spines anteriorly, erect slender reddish spines posteriorly, transverse row of reddish spines apically; hind tibia and tarsi with long swimming hairs along posterior margins; claws gold, sharply curved apically, tips brown.

Male genitalia with right paramere sinuate, tapering on apical half; left paramere gently curving, tip rounded, truncate (fig. 114).

Brachypterous female: Similar to brachypterous male in general structure and coloration, length 9.31 mm; maximum width 6.17 mm (fig. 111). Subgenital plate roughly triangular with apex broadly rounded, bearing long lateral and subapical hair tufts (fig. 112).

Macropterous female: Coloration dark brown with pronotum yellowish brown, length 9.41 mm; maximum width (across abdomen) 5.68 mm. Structurally similar to brachypterous form with following exceptions: pronotum expanded, posterolateral angles more broadly rounded, not sharply acute; scutellum swollen, shining, mesoscutum exposed, delineated by sinuate transverse furrow; hemelytra complete, dark brown, attaining tip of abdomen, surface rugose, set with tiny glabrous asperities and very short fine gold setae, embolar margin produced to shallow obtuse angle, membrane dull, fumate; mesosternal plate broadly and gently tumescent medially, lacking longitudinal carina.

Macropterous male: unknown.

Discussion: La Rivers (1971) gave a detailed original description of this species based on material collected by P. Nathan in the Anamalai Hills of Tamil Nadu, south India. The redescriptions above are based on three paratypes from the original type series. *A. nathani*, the only *Aphelocheirus* species so far known from peninsular India, may be recognized by its very short head which barely projects ahead of the eyes, the wing pads in the brachypterous form which are widely separated medially (fig. 111), the sharp acute posterolateral pronotal and embolar angles, and the male and female genital structures (figs. 112, 114).

Distribution: Southern peninsular India (fig. 175).

Material examined: 1 macropterous female, 1 brachypterous male, 1 brachypterous female: INDIA, **Tamil Nadu**, Anamalai Hills, Kadamparai, 1067 m (3500 ft.), June 1963, P. S. Nathan (paratypes, JTPC).

Aphelocheirus (Aphelocheirus) denticeps Montandon
Figs. 122-124, 173

Aphelocheirus denticeps Montandon, 1910, Bull. Soc. Sci. Bucharest, 19: 438.
Aphelochirus denticeps: Kiritshenko, 1925, Russ. Hydrobiol. Zeitschr., 4: 41.
Aphelochirus denticeps: Kiritshenko, 1929, C. R. Acad. Sci. URSS, (A) 1: 11.
Aphelochirus denticeps: Lundblad, 1933, Arch. Hydrobiol., Suppl. Bd. 12, Trop. Binnengewass. 4: 62
Aphelochirus denticeps: Hoffmann, 1933, Lingnan Sci. J. 12, Suppl., p. 254.
Aphelochirus denticeps: Wu, 1935, Cat. Ins. Sinensium 2: 45.
Aphelochirus denticeps: Hoffmann, 1941, Lingnan Sci. J. 20: 45.
Aphelocheirus denticeps: Hoberlandt and Štys, 1979, Acta Mus. Nat. Pragae, 33B: 18.

Description:

Brachypterous male: Of moderate size for genus, ovate, length 8.43 mm; maximum width (across abdomen) 5.98 mm (fig. 122). Coloration medium brown, with head, scutellum and lateral portions of thorax and abdomen yellowish.

Head yellowish brown, shining, alveolate, width/length = 2.02/1.72, produced ahead of eyes for .61 the length of an eye; eyes black, shining, width/length = .38/.91, outer margins weakly sinuate; anterior/posterior interocular = 1.51/1.06.

Pronotum dull medium brown, yellowish laterally, surface rugose, bearing fine recumbent gold setae, width/length (midline) = 4.61/1.08, lateral margins narrowly glabrous, bearing minute peg-like setae. *Scutellum* dark yellowish, rugose, with short recumbent gold setae, width/length = 2.94/1.18, lateral margins very weakly sinuate, basal margin sulcate. *Hemelytra* dull brown, brachypterous, not touching medially, not attaining base of abdominal tergite III, surface rugose, bearing fine recumbent gold setae, embolar margin coming to a sharp, acute angle.

Abdomen dull brown, yellowish laterally, surface rugose, bearing fine gold setae, posterior margin of tergite V evenly rounded, posterolateral angles of tergites III-VI moderately produced and spinose.

Ventral surface dull brown, weakly pruinose, head yellowish, shining; antennae yellow, lengths of segments I-IV = .10, .15, .25, missing; rostrum gold, glabrous, length 2.27, attaining middle coxae; prothorax longitudinally carinate medially, propleurae with inner projections broadly notched, forming blunt points apically (fig. 124); mesosternal plate longitudinally carinate medially, rising to abrupt rounded tumescence on posterior half; abdomen with segment II slightly raised and swollen posteromedially, segments III-VI bearing 4-6 small posteriorly directed peg-like setae medially along posterior margins, posterior projections of segment VII long, with apices rounded, exceeding tip of genital segment.

Legs yellowish, covered with fine gold recumbent setae; anterior trochanter, femur, tibia and tarsi bearing thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae posteriorly; middle femur with irregular longitudinal row of short gold spines ventrally, a few short spines along anterior margin, several long gold setae apically; middle tibia with numerous stout gold spines along anterior margin, a transverse row of stout spines apically; hind femur lacking spines ventrally, with scattered short gold spines along anterior margin; hind tibia with numerous stout gold spines along anterior margin, several long reclining spines dorsally, transverse row of stout spines apically; hind tibia and tarsi with long swimming hairs along posterior margins; claws gently curving, gold, tips brown.

Male genitalia with right paramere tapering, broadly curved; left paramere roughly L-shaped, tip narrowed and squared off (fig. 123).

Brachypterous female: unknown.

Macropterous form: unknown.

Discussion: Montandon (1910) described *A. denticeps* on the basis of a single brachypterous male from Fou-tcheou, China. This locality is probably a phonetic approximation of the modern Fouchou. We have been unable to locate Montandon's type, but do have a brachypterous male specimen in our material from the type locality that appears to match Montandon's description and is the basis for the redescription above. Montandon gave no figures, but the proportions of the insect are correct (the original description gives the length as 8.6 mm and the width as 6.0 mm) and as noted in his discussion the posterior projections of abdominal segment VII are elongated and exceed the tip of the genital capsule. Our specimen is in generally good condition, although dirty and somewhat faded.

A. denticeps may be recognized by its wing pads which do not meet medially in brachypterous forms, the above mentioned projections of abdominal segment VII and the male genitalia (fig. 123). It may be separated from the closely related *A. dudgeoni* n.sp. by the greater degree of prolongation of the head in front of the eyes, which in *A. denticeps* exceeds .60 the length of an eye, and by the structure of the male parameres.

Distribution: Known only from the central coast of China (fig. 173).

Material examined: 1 brachypterous male, CHINA, Foochow (Fouchou), C. R. Kellog (CAS).

Aphelocheirus (Aphelocheirus) dudgeoni n.sp. Figs. 115-118, 173

Description:

Brachypterous male: Of moderate size for genus, length 7.25 mm; maximum width (across abdomen) 5.05 mm (fig. 115). Coloration dull medium brown, with head, central portion of scutellum and first abdominal segment yellowish.

Head dark yellow, shining, surface alveolate, width/length = 1.82/1.51, produced ahead of eyes for .42 the length of an eye; eyes black, shining, width/length = .40/.96, outer margins sinuate, barely exceeding adjacent anterolateral pronotal angles; anterior/posterior interocular = 1.29/.88.

Pronotum dull brown, shining centrally, width/length (midline) = 4.02/.98, surface coarsely rugose, bearing very short recumbent gold setae, lateral margins narrowly glabrous, each bearing about 10 short stout setae, posterolateral angles rounded. *Scutellum* dark brown, dark yellow centrally, width/length = 2.65/.69, surface coarsely rugose, bearing very short recumbent gold setae, lateral margins weakly sinuate, basal margin sulcate. *Hemelytra* dull brown, brachypterous, not touching medially, not attaining base of abdominal tergite III, surface rugose, with short recumbent gold setae, embolar margin curving evenly from pronotum to an acute angle posterolaterally.

Abdomen dull brown, posterior margin of tergite V evenly rounded, posterolateral angles of segments III-VI weakly spinose.

Ventral surface yellowish brown with dark blackish areas along lateral margins of thorax and abdomen, weakly pruinose, sparsely covered with very fine recumbent gold setae; antennae pale yellow, lengths of segments I-IV = .10, .18, .25, .38; rostrum gold, glabrous, length = 2.52, reaching to middle coxae; prosternum reflexed anteriorly, weakly longitudinally carinate medially, inner projections of propleurae with right angled notches, apices forming acute points (fig. 117); mesosternal plate reflexed anteriorly, longitudinally carinate medially, abruptly tumescent posteromedially; metasternum with central plate deeply excavate; abdomen with segment III produced to a small hump posteromedially, segments IV-VI bearing 4-5 short rearwardly directed peg-like setae medially on posterior margins.

Legs dark yellowish, covered with fine recumbent gold setae; anterior trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae posteriorly; middle femur with scattered stout brown spines ventrally, numerous short slender gold spines along anterior margin, 4 long slender spine-like setae basally on ventral margin; middle tibia with scattered stout reddish spines intermixed with shorter gold spines and 3 long erect gold setae along anterior margin, transverse row of reddish spines apically; hind femur with scattered very short stout gold spines ventrally, slender recumbent gold spines along anterior margin; hind tibia with scattered stout reddish spines

along anterior margin, 4 long very slender erect reddish spines along posterior margin; hind tibia and tarsi with long swimming hairs along posterior margins; claws gold, curving distally, tips black.

Male genitalia with right paramere long and slender, tip rounded; left paramere with tip forming an upturned knob (fig. 118).

Brachypterous female: Similar to brachypterous male in general structure and coloration, length 7.55 mm; maximum width 5.15 mm. Subgenital plate with distinct notch at apex, bearing long lateral and single apical hair tufts (fig. 116).

Macropterous form: unknown.

Discussion: *A. dudgeoni* is allied to *A. denticeps* Montandon from which it may be separated by its head structure. In *A. dudgeoni* the head projects in front of the eyes for only .42 the length of an eye while in *A. denticeps* it projects forward for over .60 the eye length. Other distinguishing characters include the wing pads that do not meet medially (fig. 115), the distinctive apical notch on the female subgenital plate (fig. 116), and the male genitalia (fig. 118).

A detailed description of the Tai Po Kao forest stream type locality may be found in Dudgeon (1983), whose references to *Aphelocheirus* from the Hong Kong area (Dudgeon, 1983, 1984) pertain to this species. The type series was taken from amidst small stones and gravel at the end of a swiftly flowing chute where the water swirled out into a still pool. The species was very local in the stream, with the adults found at only the one spot, in company with burrowing mayfly larvae of the family Ephemeridae (*Ephemera*), while the immatures were somewhat more widespread but by no means common.

Etymology: Named for Dr. David Dudgeon of the University of Hong Kong, who brought the presence of this species to our attention.

Distribution: Known only from the vicinity of Hong Kong (fig. 173).

Material examined: Holotype, brachypterous male, and allotype, brachypterous female: HONG KONG, New Territories, Tai Po Kao forest stream, 23 November 1985, CL 2208, J. T. and D. A. Polhemus (USNM). Paratypes: 3 brachypterous males, 5 brachypterous females, same data as types (JTPC); 1 brachypterous male, HONG KONG, Taipo Market, 24 February 1969, T. Kunou and Y. Arita (JTPC).

Aphelocheirus (Aphelocheirus) carinatus (Royer) Figs. 125-127, 174

Aphelochirus carinatus Royer, 1920, Bull. Mus. Paris, 26: 59.
Aphelochirus carinatus: Kiritshenko, 1925, Russ. Hydrobiol. Zeitschr., 4: 41.
Aphelochirus carinatus: Kiritshenko, 1929, C. R. Acad. Sci. URSS, (A) 1: 11.
Aphelochirus carinatus: Hoffmann, 1933, Lingnan Sci. J. 12, Suppl., p. 254.
Aphelochirus carinatus: Hoffmann, 1941, Lingnan Sci. J. 20: 45.
Aphelocheirus carinatus: Hoberlandt and Štys, 1979, Acta Mus. Nat. Pragae, 33B: 18.

Description:

Macropterous female: Of large size for genus, length 9.21 mm; maximum width (across abdomen) 5.88 mm (fig. 125). Coloration pallid brown, with head, scutellum and central portion of pronotum darker.

Head medium brown, darker basally, surface shining, alveolate, width/length = 1.67/1.78, produced ahead of eyes for .50 the length of an eye; eyes black, shining, width/length = .38/1.01, outer margins not sinuate, exceeding adjacent anterolateral pronotal angles; anterior/posterior interocular = 1.06/.75.

Pronotum light brown, shining, darker centrally, yellowish laterally, width/length (midline) = 4.12/1.13, surface rugose, bearing fine recumbent gold setae, lateral margins narrowly glabrous, each set with about 9 short peg-like setae, posterolateral angles obtuse, rounded. *Scutellum* brown, shining, darker basally, width/length = 2.69/1.47, surface rugose, bearing very fine recumbent gold setae, lateral margins sinuate, mesoscutum defined by sinuate transverse sulcus. *Hemelytra* dull light brown, complete, attaining tip of abdomen, surface rugose, bearing recumbent gold setae, these setae longer on embolium; clavus and claval vein well defined; embolar margin forming a broadly rounded acute angle; membrane fumate.

Abdomen light brown, smooth, shining, bearing recumbent gold setae, posterolateral angles of segments III-VI prolonged into slender spinose projections, plates of segment VII sharply angulate, coming to acute points posteriorly.

Ventral surface dark brown, pruinose, sparsely covered with fine recumbent pale setae; antennae yellowish brown, lengths of segments I-IV = .10, .15, .35, .48; rostrum gold, glabrous, length = 3.69, attaining bases of hind coxae; prosternum sharply carinate medially, inner projections of propleurae deeply notched, terminating in slender acute apices (fig. 127); mesosternal plate longitudinally carinate medially, broadly tumescent posteromedially; abdomen with segments III-VI weakly and broadly carinate medially, these carinae forming posteriorly directed protruberances posteromedially on segments III-VI, protruberances bearing 4 short stout setae on segments IV-VI, rows of small glabrous pits present running inward from spiracular rosettes and along base of segment III.

Legs gold, shining, covered with fine recumbent gold setae; anterior trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae posteriorly; middle femur with irregular longitudinal row of short stout gold spines ventrally, numerous fine gold spines along anterior margin, 4 long erect gold setae posteriorly; middle tibia with scattered stout reddish spines along anterior face intermixed with several very long erect spine-like setae, transverse row of reddish spines apically; hind femur with short recumbent gold spines along anterior margin, scattered erect stout setae along posterior margin; hind tibia sparsely set with stout reddish spines anteriorly, transverse row of reddish spines apically; hind tibia and tarsi with long swimming hairs posteriorly; claws gently curving, gold, tips darkened.

Subgenital plate roughly triangular, narrowing on apical third to acute rounded tip, bearing short thick apical and long sparse lateral hair tufts (fig. 126).

Macropterous male: unknown.

Brachypterous form: unknown.

Discussion: Royer (1920) described *A. carinatus* from 2 males and 2 females taken at Hanoi, Vietnam. We have been unable to examine Royer's types, but do have available two female specimens kindly loaned to us by Dr. I. M. Kerzhner of Leningrad from unidentified material which match Royer's description and form the basis of the redescription given above. *A. carinatus* females may be recognized by the rostrum which does not exceed the hind trochanters, and the relatively narrow and elongate subgenital plate (fig. 126). We have as yet seen no male specimens from which to compare the genitalia.

Distribution: Known only from northern Vietnam (fig. 174).

Material examined: 2 macropterous females, VIETNAM, Hanoi, October 1961 (ZMAS).

Aphelocheirus (Aphelocheirus) ashlocki n.sp.
Figs. 119-121, 174

Description:

Macropterous female: Of large size for genus, length 9.31 mm; maximum width (across abdomen) 4.80 mm (fig. 119). Coloration uniform dark brown, with head, scutellum and central portion of pronotum more reddish.

Head dark reddish brown, surface shining, alveolate, width/length = 1.59/1.64, produced ahead of eyes for .54 the length of an eye; eyes black, shining, width/length = .35/.93, outer margins not sinuate, exceeding adjacent anterolateral pronotal angles; anterior/posterior interocular = 1.01/.81.

Pronotum dark reddish brown, shining, lighter laterally, width/length (midline) = 3.84/1.16, surface rugose, bearing fine recumbent pale setae, lateral margins narrowly glabrous, set with very short peg-like setae, posterolateral angles obtuse, rounded. *Scutellum* reddish brown, shining, width/length = 2.63/1.41, surface rugose, sparsely set with very fine recumbent pale setae, lateral margins sinuate, mesoscutum narrowly exposed, defined by sinuate transverse sulcus. *Hemelytra* dull dark brown, complete, exceeding tip of abdomen, surface rugose, bearing recumbent pale setae; clavus and claval vein well defined; embolar margin forming a broadly rounded obtuse angle; membrane pale fumate.

Abdomen brown, smooth, dull, bearing recumbent pale setae, posterolateral angles of segments III-VI prolonged into slender spinose projections of progressively increasing length, plates of segment VII sharply angulate, terminating in acute points posteriorly.

Ventral surface brown, weakly pruinose, sparsely covered with fine recumbent pale setae; antennae yellowish brown, lengths of segments I-IV = .10, .15, .30, .51; rostrum gold, glabrous, length = 3.33, attaining metasternal plate but not extending to bases of hind coxae; prosternum sharply carinate medially, inner projections of propleurae forming two equal sized lobes apically separated by a V-shaped notch (fig. 121); mesosternal plate longitudinally carinate anteromedially, broadly tumescent posteromedially; abdomen with segments III-VI weakly and broadly carinate medially, these carinae not forming posteriorly directed protruberances posteromedially, segments III-VI bearing 4 short peg-like setae on medially on posterior margins, rows of very small glabrous pits present running inward from spiracular rosettes and along base of segment III.

Legs dark yellowish brown, shining, covered with fine recumbent gold setae; anterior trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae posteriorly; middle femur with irregular longitudinal row of short stout gold spines ventrally, numerous fine gold spines along anterior margin, 4 long erect gold setae posteriorly; middle tibia with scattered stout reddish spines along anterior face intermixed with several very long erect pale spine-like setae, transverse row of reddish spines apically; hind femur with short recumbent gold spines along anterior margin, scattered erect stout setae along posterior margin; hind tibia sparsely set with stout reddish spines anteriorly, transverse row of reddish spines apically; hind tibia and tarsi with long swimming hairs posteriorly; claws gently curving, gold, tips darkened.

Subgenital plate roughly triangular, narrowing evenly, tip rounded, bearing short thick apical and long sparse lateral hair tufts (fig. 120).

Macropterous male: unknown.

Brachypterous form: unknown.

Discussion: Among Indochinese species, *A. ashlocki* is similar to *A. carinatus*, from which it may be separated by the absence of a posteriorly directed knob on abdominal sternite IV, the shape of the female subgenital plate (fig. 120), and the shape of the inner propleural projection (fig. 121). In the key it runs to a couplet with *A. pallens* Horvath from New

Guinea, from which it may be separated on coloration and the structure of the inner propleural projections.

Like many other members of the *carinatus* group, the types of *A. ashlocki* were taken at light.

Etymology: Named for Peter Ashlock, a noted hemipterist who collected the type specimens while working for the Bernice P. Bishop Museum in Laos.

Distribution: Laos (fig. 174).

Material examined: Holotype, macropterous female: LAOS, **Vientiane Prov.**, Vientiane, 3 May 1965, at light, P. D. Ashlock (BPBM). Paratype: one macropterous female, same data as type (JTPC).

Aphelocheirus (Aphelocheirus) similaris n.sp.
Figs. 128-130, 174

Description:

Macropterous male: Large for genus, length 11.27 mm; maximum width (across abdomen) 6.86 mm (fig. 128). Coloration uniform dark brown.

Head dark brown, shining, surface alvelolate, width/length = 1.89/2.02, produced ahead of eyes for .61 the length of an eye; eyes black, shining, width/length = .40/1.11, outer margins not sinuate, exceeding adjacent anterolateral pronotal angles; anterior/posterior interocular = 1.26/.96.

Pronotum dark brown, lighter laterally, shining, width/length (midline) = 5.24/1.27, surface rugose, bearing long fine recumbent gold setae, lateral margins narrowly glabrous, each with about 9 very short stout setae, posterolateral angles rounded. *Scutellum* dark brown, shining, swollen, width/length = 2.45/2.06, surface rugose, bearing short recumbent gold setae, lateral margins sinuate, mesoscutum defined by sinuate transverse furrow. *Hemelytra* dull dark brown, complete, attaining tip of abdomen, surface rugose, bearing recumbent gold setae, these setae longer on embolium; corium, clavus, claval vein and embolium well defined, embolar margin coming to an acute, rounded angle; membrane fumate.

Abdomen dull dark brown, lateral margins faintly yellowish, surface covered with long fine recumbent gold setae, posterolateral angles of segments III-VI forming slender spinose projections.

Ventral surface dark brown, pruinose, spiracular rosettes yellowish, surface sparsely covered with very fine recumbent gold setae; antennae yellowish brown, lengths of seg-

ments I-IV = .10, .15, .40, .55; rostrum gold, glabrous, length 5.43, extending to hind trochanters; prosternum sharply carinate medially, propleurae with inner projections deeply notched, coming to a slender pointed tip apically (fig. 130); mesosternal plate gently longitudinally carinate medially, broadly tumescent posteromedially; abdominal segments III-VI with gentle longitudinal median carinae, these carinae produced to rearwardly projecting knobs on segments III-V, knobs on segments IV-VI with 4 small rearwardly directed peg-like setae, small glabrous pits present running inward from spiracles and along basal margin of segment III.

Legs yellowish brown, covered with fine recumbent gold setae; anterior trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae along posterior margins; middle femur with irregular longitudinal row of short stout gold spines ventrally, scattered small gold spines along anterior margin, 4 long erect slender spines along posterior margin; middle tibia with scattered stout reddish spines along anterior margin along with 4 long slender erect spines, transverse row of reddish spines apically; hind femur with scattered short recumbent gold spines along anterior margin, slender erect gold setae along posterior margin; hind tibia with a very few stout reddish spines along anterior margin, transverse row of reddish spines apically; hind tibia and tarsi with long swimming hairs along posterior margins; claws gold, gently curving, tips brown.

Male genitalia with parameres asymmetrical, broadly curved, massive, blunt.

Macropterous female: Similar to macropterous male in general structure and coloration, length 11.47 mm; maximum width 7.25 mm. Plates of abdominal segment VII coming to sharp points posteriorly, subgenital plate roughly triangular, bearing short apical and long lateral hair tufts (fig. 129).

Brachypterous form: unknown.

Discussion: *A. similaris* n.sp. resembles *A. carinatus* Royer from which it may be separated by its longer rostrum (attaining the hind trochanters), larger size, darker coloration, and differently shaped female subgenital plate (fig. 129). The genitalia from the one male specimen at hand had been dissected and badly glued to a card below the insect, making a rendering of the genital complex impossible.

Etymology: The name "similaris" refers to the close resemblance to this species to *A. carinatus.*

Distribution: Known only from northern Vietnam (fig. 174).

Material examined: Holotype, macropterous male, and allotype, macropterous female: VIETNAM, Hanoi, October 1961 (ZMAS). Paratypes: 1 macropterous female, same data as types (JTPC).

Aphelocheirus (Aphelocheirus) cantonensis n.sp Figs. 131-134, 174

Description:

Macropterous female: Large for genus, form elongate, length 11.02 mm; maximum width (across abdomen) 7.84 mm (fig. 131). Coloration light yellowish buff, darker on head and pronotum.

Head brown, shining, elongate, surface alveolate, width/length = 1.94/2.02, produced ahead of eyes for .59 the length of an eye; eyes dark brown, shining, width/length = .45/1.11, outer margins not sinuate, exceeding adjacent anterolateral pronotal angles; anterior/posterior interocular = 1.14/.96.

Pronotum dull brown, yellowish medially and along margins, width/length (midline) = 5.05/1.37, surface finely rugose, bearing moderately long recumbent gold setae, area medially behind head raised, swollen, lateral portions expanded, explanate, lateral margins narrowly glabrous, bearing short peg-like setae, posterior margin broadly sinuate. *Scutellum* yellowish brown, shining, width/length = 3.43/1.96, surface rugose, set with very fine recumbent gold setae, lateral margins sinuate, mesoscutum evident, delineated by sinuate transverse furrow. *Hemelytra* including membrane dull yellowish, complete, attaining tip of abdomen, surface coarsely rugose, bearing short recumbent gold setae; corium, clavus, claval vein and embolium well defined, embolar margin produced to an acute rounded angle.

Abdomen broadly expanded beyond hemelytral margins, bearing long recumbent gold setae, posterolateral angles of tergites II-VI produced into long slender spinose projections.

Ventral surface dark brown, pruinose, sparsely covered with fine recumbent gold setae, head yellowish brown, shining; antennae broken; rostrum gold, glabrous, length 4.80, reaching to hind coxae; prosternum with low, sharp carina medially, inner propleural projections deeply notched, apices rounded (fig. 133); mesosternal plate with small knob anteromedially, broadly and gently tumescent posteromedially, medial swelling bearing long erect gold setae, lateral areas more sparsely set with recumbent gold setae; abdomen with sternites III-VI gently longitudinally carinate medially, these carinae coming to small points posteromedially (fig. 134), each bearing 4 short peg-like setae, small glabrous pits present running inward of spiracles and along base of sternite III, plates of segment VII angulate.

Legs yellowish, covered with fine recumbent gold setae; fore trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae on posterior faces; middle femur with longitudinal row of short stout gold spines ventrally, about 6 long gold spines along posterior margin, numerous short gold spines

along anterior margin; middle tibia with numerous stout reddish spines along anterior margin, transverse row of reddish spines apically; hind femur with scattered short stout gold spines along anterior margin, fine gold spines along posterior margin; hind tibia with scattered long stout reddish spines along anterior margin, transverse row of reddish spines apically; hind tibia and tarsi with long swimming hairs along posterior margins; claws gently curving, gold, tips dark brown.

Subgenital plate trapezoidal, bearing long apical and lateral hair tufts, apical margin truncate, weakly sinuate (fig. 132).

Macropterous male: unknown.

Brachypterous form: unknown.

Discussion:*A. cantonensis* n.sp. is a member of the *carinatus* group, and bears superficial resemblance to *A. similaris* n.sp., but may be separated by its shorter rostrum, which reaches only to the hind coxae, and truncate female subgenital plate with a sinuate apical margin (fig. 132). Our single macropterous female type is in generally good condition, but the yellowish coloration may be an artifact of age and method of preservation.

Etymology: The name "cantonensis" refers to the type locality near Canton, China.

Distribution: Known only from southern China (fig. 174).

Material examined: Type, macropterous female: CHINA, Canton, Hong Lak, 30 May 1935, T. L. Chan (JTPC; to be placed in the USNM when more material is available).

Aphelocheirus (Aphelocheirus) lao n.sp.
Figs. 135-138, 172

Description:

Macropterous female: Small for genus, form elongate, length 7.87 mm; maximum width (across abdomen) 4.22 mm (fig. 135). Coloration light yellowish brown, with head and central portion of pronotum darker.

Head medium brown, shining, alveolate, width/length = 1.31/1.67, produced ahead of eyes for distance equal to .77 the length of an eye; eyes black, shining, width/length = .30/.88, lateral margins not sinuate, greatly exceeding adjacent anterolateral pronotal angles; anterior/posterior interocular = .88/.66.

Pronotum light yellowish brown, shining, darker behind eyes, width/length (midline) = 3.18/.98, surface finely rugose punctate, bearing very fine recumbent gold setae, lateral

margins narrowly glabrous, bearing very short peg-like setae, posterolateral angles obtuse, broadly rounded, posterior margin sinuate. *Scutellum* yellowish brown, shining, width/length = 2.25/1.18, surface rugose punctate, bearing fine recumbent gold setae, lateral margins sinuate, mesoscutum exposed, delineated by shallow sinuate transverse sulcus. *Hemelytra* yellowish brown, complete, exceeding tip of abdomen, surface of corium and clavus rugose punctate, bearing recumbent gold setae, claval vein well defined, embolium smooth, lateral margin broadly and gently rounded, membrane dull yellowish.

Abdomen dark yellow, anterior margins of tergites embrowned creating striped effect, posterolateral angles of tergites III-VI slenderly produced and spinose.

Ventral surface yellowish brown, weakly pruinose; antennae dark yellowish, lengths of segments I-IV = .10, .11, .25, .40; rostrum gold, glabrous, exceeding hind trochanters, length 4.19; prosternum carinate and tectiform anteromedially, inner projections of propleurae broadly notched, apices angulate (fig. 137); mesosternal plate broadly and gently tumescent medially, with low longitudinal median carina; abdominal segments III-VI gently and broadly carinate longitudinally along median axis, each bearing about 4 small peg-like setae posteromedially, plates of segment VII with posterior margins gently curving, apices sharply angulate, subgenital plate roughly triangular in shape, broadly rounded, with long lateral and thick apical hair tufts (fig. 136).

Legs dark yellowish, covered with fine recumbent gold setae; fore trochanter, femur, tibia and tarsi with thick gold hair pads on inner faces; fore, middle and hind coxae with combs of long gold setae apically; middle trochanter, femur, tibia and tarsi with thick pads of short gold setae along posterior margins; middle femur with sparse longitudinal row of short stout gold spines ventrally, several long erect slender gold spines basally along posterior margin, numerous fine short recumbent gold spines along anterior margin; middle tibia with stout reddish spines along anterior margin, transverse row of reddish spines apically; hind femur with scattered short recumbent gold spines along along anterior and posterior margins; hind tibia with stout reddish spines along anterior margin, transverse row of reddish spines apically; swimming hairs typical; claws gold, gently curving.

Macropterous male: Similar in general structure and coloration to macropterous female but slightly smaller; length 7.01 mm.; maximum width (across abdomen) 3.90 mm. Genitalia with right paramere tapering from base, expanded distally into rounded lobe; left paramere broadly curved and hooked over at tip; vesica slender with expanded flanges to either side of tip (fig. 138).

Brachypterous form: unknown.

Discussion: The smallest member of the *carinatus* group so far seen from Asia, *A. lao* may be recognized by its size (length less than 8 mm), long rostrum which exceeds the hind trochanters, greatly prolonged head, distinctive female subgenital plate (fig. 136) and male genitalia (fig. 138).

The macropterous male in our possession was taken at light, and the macropterous female at hand is covered with moth scales, suggesting that it was taken in a light trap as well.

This habit is not surprising since other Asian aphelocheirines have also been taken at light (Hoberlandt and Štys, 1979).

Etymology: The name "lao" refers to the native people who inhabit the country from which this species was taken.

Distribution: Known from Laos (fig. 172).

Material examined: Holotype, macropterous female: LAOS, **Vientiane Prov.**, Ban Van Eue, 31 January 1967, native collector (BPBM). Paratype: 1 macropterous male, LAOS, **Vientiane Prov.**, Vientiane, 8 May 1965, P. D. Ashlock, at light (BPBM).

Aphelocheirus (Aphelocheirus) sp. from Sumatra

A single macropterous female is at hand bearing the data "Medan, Mjoberg" (RNHL). Although the specimen probably represents an undescribed Sumatran species, its lack of exceptional distinguishing characteristics precludes a description at this time. The authors made an attempt to secure further specimens during a week in north Sumatra but were unsuccessful, so the clarification of this species' status must await future collections.

Aphelocheirus (Aphelocheirus) sp. from Hainan Island

A single brachypterous male is at hand bearing the data "Hainan Id., S. China, Fan-ta-ts'eun to Kap-wa-ts'eun, Hung-mo-tung K'iung-shan Dist., May 6, 1929, Lingnan Univ. Fifth Hainan Expedition" (CAS). In addition we have also seen one immature bearing the data "Chung Kon, Hainan Id., VII-18-35, J. L. Gressitt" (CAS). The male specimen is in good condition, but dirty, and appears on the basis of the genitalia to be close to *A. gularis* (Horvath). We are hesitant to make a precise specific determination, however, until more material becomes available.

Subgenus *Micraphelocheirus* Hoberlandt and Stys

Micraphelocheirus Hoberlandt and Štys 1979 Acta Mus. Nat. Pragae, 33: 9.
Microphelocheirus Hoberlandt and Štys 1979 Acta Mus. Nat. Pragae, 33: 5. (Alternative spelling)
Tamopocoris Hoberlandt and Štys 1979 Acta Mus. Nat. Pragae, 33: 5. New synonymy. (See discussion under *Aphelocheirus*)

Aphelocheirus (Micraphelocheirus) pygmaeus La Rivers Figs. 139-142, 157, 175

Aphelocheirus pygmaeus La Rivers, 1971, Bull. So. Cal. Acad. Sci., 70: 69.
Aphelocheirus (Micraphelocheirus) pygmaeus: Hoberlandt and Štys,1979, Acta Mus. Nat. Pragae, 33: 5.

Description:

Macropterous female: Small for genus, length 3.94 mm; maximum width (across abdomen) 2.09 mm (fig. 139). Basic coloration light brown, with head, scutellum, and pronotum centrally dark brown.

Head dark brown, shining, surface alvelolate, width/length = .96/.71, produced ahead of eyes for .58 the length of an eye; eyes black, shining, width/length = .20/.40, inner margins separated from vertex by deep furrows, outer margins rounded, barely exceeding adjacent anterolateral pronotal angles; anterior/posterior interocular = .61/.50.

Pronotum dark brown, yellowish laterally and adjacent to posterior margin, shining, width/length (midline) = 1.67/.50, surface rugose, bearing fine recumbent gold setae, lateral margins narrowly glabrous, bearing a few short peg-like setae, posterolateral angles rounded, posterior margin sinuate, produced to small subconical humeral protruberances above wing bases. *Scutellum* dark brown, shining, swollen, width/length = 1.11/.61, surface rugose, glabrous, lateral margins weakly sinuate, mesoscutum barely exposed, defined by sinuate transverse furrow. *Hemelytra* light brown, complete, exceeding tip of abdomen, surface rugose, bearing recumbent gold setae; corium, clavus, claval vein and embolium well defined, embolar margin coming to sharp obtuse angle; membrane pale fumate.

Abdomen brown, surface covered with long fine recumbent gold setae, posterolateral angles of segments II-VI not produced or spinose, plates of segment VII roughly triangular, posterior margins straight, meeting evenly.

Ventral surface dark brown, lightly pruinose, spiracular rosettes yellowish, surface sparsely covered with very fine recumbent gold setae; antennae yellowish brown, lengths of segments I-IV = .06, .09, .17, .32; rostrum gold, glabrous, length 1.01, extending to middle of mesosternum; prosternum longitudinally carinate medially, propleurae with inner projections broadly triangular, not notched, apices rounded (fig. 141); mesosternal plate gently and broadly tumescent, with low longitudinal carina anteromedially; abdominal segments III-VI with longitudinal glabrous areas medially, sternite III with small posteriorly directed pointed knob medially on posterior margin (fig. 157), sternites IV and V with small rearwardly directed peg-like setae medially on posterior margins, all segments with small glabrous pits present inward of spiracles.

Legs yellowish brown, covered with fine recumbent gold setae; anterior trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae along posterior margins; middle femur with longitudinal row of slender gold spines ventrally, scattered small gold spines along anterior margin, 4 long erect gold spines along posterior margin; middle tibia with scattered stout gold spines along anterior margin along with 3 or 4 long slender erect spines, transverse row of gold spines apically; hind femur with scattered short recumbent gold spines along anterior margin, short reclining gold setae along posterior margin; hind tibia with a very few stout gold spines along anterior margin, transverse row of gold spines apically; hind tibia and tarsi with long swimming hairs along posterior margins; claws gold, gently curving, tips brown.

Subgenital plate roughly trapezoidal, broad on basal half, narrowing on apical half, tip acutely rounded, bearing long lateral and short subapical hair tufts (fig. 140).

Macropterous male: Similar to macropterous female in general structure and coloration, length 3.48 mm.; maximum width 1.92 mm.

Male genitalia with right paramere narrowing basally, expanded and lobed apically; left paramere broadly crescentic (fig. 142).

Brachypterous form: Unknown.

Discussion: This species may be separated from others in the subgenus *Micraphelocheirus* by the characters given in the key, the shape of the inner projection of the propleuron (fig. 141), and the distinctive male genitalia (fig. 142). A discussion of morphology was given immediately following the synonymy of the genus *Aphelocheirus*.

Distribution: Assam (fig. 175).

Material examined: 2 macropterous females, INDIA, **Assam**, Kohara, Kaziranga, 110 m. (361 ft.), 7 October 1961, E. S. Ross and D. Q. Cavagnaro (Paratypes, JTPC).

Aphelocheirus (Micraphelocheirus) clivicolus J. Polhemus, n. comb. Figs. 147-151, 175

Aphelocheirus clivicolus Polhemus, 1979, Bull. Fish. Res. Stn., Sri Lanka, 29: 107.

Description:

Brachypterous male: Small for genus, form ovate, length 4.44 mm; maximum width (across abdomen) 2.57 mm. Coloration brown, lateral portions of pronotum and abdomen dark yellowish.

Head amber yellow, shining, alveolate, width/length = 1.11/.91, elongate, produced ahead of eyes for .62 the length of an eye; eyes black, shining, width/length = .22/.45, lateral margins rounded, barely exceeding adjacent anterolateral pronotal angles, divergent anteriorly, anterior/ posterior interocular = .81/.71.

Pronotum brown, lateral margins and small patch centrally dark yellowish, width/length (midline) = 2.02/.45, surface rugose, shining, bearing extremely short recumbent gold setae, lateral margins narrowly glabrous, bearing minute erect peg-like setae, posterolateral angles acutely rounded. *Scutellum* brown, lighter centrally, width/length = 1.51/.55, surface rugose, shining, bearing extremely short recumbent gold setae, lateral margins sinuate, basal margin broadly sulcate. *Hemelytra* light brown, micropterous, barely covering basal angles of abdominal segment II, widely separated medially broadly exposing metanotum and abdominal tergite I, surface rugose, with short fine recumbent gold setae, embolar margin forming sharp obtuse angle, narrowly glabrous.

Abdomen dull brown, dark yellowish along lateral margins, surface finely rugose, bearing recumbent gold setae, posterior margin of tergite V sinuate, posterolateral angles of segments IV weakly produced and spinose, angles of segments V and VI acute, those of segment VII rounded.

Ventral surface dark brown, weakly pruinose, sparsely covered with short recumbent gold setae; antennae pale yellow, lengths of segments I-IV = .07, .09, .16, .32; rostrum gold, glabrous, length 1.06, attaining base of mesosternum; prosternum longitudinally carinate medially, inner projections of propleurae broadly triangular, not notched, apices acutely rounded (fig. 149); mesosternal plate weakly reflexed anteromedially, with low longitudinal medial carina, rising gradually to a broad tumescence posteromedially; abdominal segments IV and V bearing short rearwardly directed peg-like setae medially along posterior margins, posterior projections of segment VII with apices blunt, not exceeding tip of genital capsule.

Legs dark yellowish, clothed with fine recumbent gold setae; anterior trochanter, femur, tibia and tarsi with thick hair pads on inner faces; middle trochanter, femur, tibia and

tarsi with thick pads of gold setae posteriorly; middle femur with longitudinal row of short brownish spines ventrally, scattered short recumbent gold spines along anterior margin, 4 slender erect gold spines along posterior margin; middle tibia with scattered stout reddish spines and 2 slender erect gold spines along anterior margin, 3 or 4 slender erect gold spines along posterior margin, transverse row of reddish spines apically; hind femur with scattered recumbent gold spines along anterior margin and scattered stout brownish spines on ventral face; hind tibia with stout reddish spines along anterior margin, 3 long gold spines along posterior margin, transverse row of reddish spines apically; hind tibia and tarsi with long swimming hairs on posterior faces; claws gently curving, gold, tips brown.

Male genitalia with right paramere slender, tip rounded; left paramere more massive basally, narrowing to a rounded tip distally (fig. 150).

Brachypterous female: Similar to brachypterous male in general structure and coloration, length 4.54 mm; maximum width 2.68 mm (fig. 147). Plates of abdominal segment VII with posterior margins nearly straight; subgenital plate broadly triangular, bearing long lateral hair tufts (fig. 151).

Macropterous female: Similar to brachypterous form with following exceptions: length 4.54 mm; maximum width 2.52 mm (fig. 148); dorsal coloration dark brown, with anterior margin of head, lateral margins of pronotum, and small patches laterally on abdomen dark yellow; pronotum with lateral margins greatly expanded, posterolateral angles broadly rounded; scutellum swollen, mesoscutum evident, delineated by sinuate transverse furrow; hemelytra complete, wing membrane brownish fumate, mostly disintegrated in older specimens, hemelytral surface rugose, shining, bearing recumbent gold setae, clavus and claval vein well defined, embolar margin rounded; mesosternum not reflexed anteromedially, mesosternal plate broadly and gently tumescent.

Macropterous male: Unknown.

Discussion: This is the largest species of the subgenus *Micraphelocheirus*. It may be distinguished from the other species by the characters given in the keys. Although closest in habitus to *brevirostris* it has a longer rostrum than the latter, and distinctive male genitalia (fig. 150). Detailed descriptions of the collection localities for *A. clivicolus* may be found in Costa and Starmühlner (1972).

Distribution: Ceylon (fig. 175).

Material examined: SRI LANKA, **Ratnapura**: 1 macropterous female, 2 brachypterous females, Kalu Ganga, nr. Malwalla, 100 m. (328 ft.), 21 November 1970, F. Starmühlner (paratypes, JTPC); 1 brachypterous male, Bodathpitiya Ela, 17 November 1970, F. Starmühlner (paratype, JTPC).

Aphelocheirus (Micraphelocheirus) brevirostris n.sp. Figs. 152-156, 175

Description:

Brachypterous male: Small for genus, form ovate, length 4.17 mm; maximum width (across abdomen) 2.53 mm (fig. 152). Coloration yellowish brown, abdomen darker.

Head amber yellow, shining, alveolate, width/length = 1.14/.88, elongate, produced ahead of eyes for .64 the length of an eye; eyes black, shining, width/length = .25/.50, lateral margins very weakly sinuate, not exceeding adjacent anterolateral pronotal angles; divergent anteriorly, anterior/ posterior interocular = .71/.61.

Pronotum yellowish brown, anterior margins bordering head and lateral margins narrowly black, width/length (midline) = 1.97/.73, surface rugose, shining, bearing extremely short recumbent gold setae, lateral margins narrowly glabrous, bearing minute erect peg-like setae, posterolateral angles broadly rounded. *Scutellum* yellowish brown, width/length = 1.51/.43, surface rugose, shining, bearing extremely short recumbent gold setae, lateral margins sinuate, basal margin broadly sulcate. *Hemelytra* yellowish brown, micropterous, barely covering basal angles of abdominal segment II, widely separated medially, surface rugose, with short fine recumbent gold setae, embolar margin broadly rounded, narrowly glabrous, bearing a few short pale peg-like setae.

Abdomen dull brown, dark yellowish centrally, surface rugose, bearing recumbent gold setae, posterior margin of tergite V weakly concave medially, posterolateral angles of segments II-V not produced or spinose, angles of segment VI acute, those of segment VII rounded.

Ventral surface dark blackish brown, weakly pruinose, sparsely covered with short recumbent gold setae; antennae pale yellow, lengths of segments I-IV = .07, .09, .14, .32; rostrum gold, glabrous, length .88, attaining base of mesosternum; prosternum longitudinally carinate medially, inner projections of propleurae broadly rounded, not notched (fig. 154); mesosternal plate reflexed anteromedially, with low longitudinal medial carina, rising gradually to a broad tumescence posteromedially; abdominal segments lacking short rearwardly directed peg-like setae medially along posterior margins, sternite II with small rounded conical posteriorly directed projection medially on posterior margin, posterior projections of segment VII with apices blunt, not exceeding tip of genital capsule.

Legs dark yellowish, clothed with fine recumbent gold setae; anterior trochanter, femur, tibia and tarsi with thick hair pads on inner faces; middle trochanter, femur, tibia and tarsi with thick pads of gold setae posteriorly; middle femur with longitudinal row of short brownish spines ventrally, many short recumbent gold spines along anterior margin, 4 slender erect gold spines basally along posterior margin; middle tibia with scattered stout reddish spines and 2 slender erect gold spines along anterior margin, 3 or 4 slender erect

gold spines along posterior margin, transverse row of reddish spines apically; hind femur with many short recumbent gold spines along anterior margin, intermixed with scattered short stout gold spines, scattered stout brownish spines present on ventral face; hind tibia with stout reddish spines along anterior margin, 3 small sharp reddish spines ventrally, transverse row of reddish spines apically; hind tibia and tarsi with long swimming hairs on posterior faces; claws gently curving, gold, tips brown.

Male genitalia with right paramere slender, tip rounded; left paramere more massive, coming to acute angle distally (fig. 156).

Brachypterous female: Similar to brachypterous male in general structure and coloration, length 4.52 mm; maximum width 2.80 mm. Plates of abdominal segment VII with posterior margins straight, meeting evenly; subgenital plate broadly triangular, bearing long lateral and subapical hair tufts (fig. 155).

Macropterous male: Similar to brachypterous form with following exceptions: length 4.24 mm; maximum width 2.30 mm; dorsal coloration dark reddish brown, hemelytra and abdomen lighter brown; pronotum with lateral margins greatly expanded, posterolateral angles broadly rounded; scutellum swollen, mesoscutum evident, delineated by sinuate transverse furrow; hemelytra complete, wing membrane brownish fumate, mostly disintegrated in older specimens, hemelytral surface rugose, shining, bearing recumbent gold setae, clavus and claval vein well defined, embolar margin broadly rounded; mesosternum not reflexed anteromedially, mesosternal plate broadly and gently tumescent.

Macropterous female: Similar to macropterous male in general structure and coloration but slightly larger, length 4.54 mm; maximum width 2.47 mm (fig. 153).

Discussion: The characters given in the key, short rostrum, male genitalia (fig. 156) and the shape of the inner propleural projections (fig. 154) will distinguish *brevirostris* from the other known species of the subgenus *Micraphelocheirus*

A description of the Nam Chai River type locality and its rich benthic fauna may be found under *A. lahu. A. brevirostris* was very abundant here, frequenting areas of coarse sand and fine gravel swept by fast to moderate current, and the insects were often difficult to discern when mixed in the net among the substrate particles that they closely resembled. The largest concentration was found just downstream of a fallen tree which deflected the current and allowed a shallow sheet of water to wash across an bar of sand and cobbles.

Distribution: Northern Thailand (fig. 175).

Material examined: Holotype, brachypterous male, and allotype, brachypterous female, THAILAND, **Chiang Mai Prov.**, Nam Chai River above hydro intake at Fang Horticultural Experiment Station, 550 m. (1804 ft.), 15 November 1985, CL 2197, J. T. and D. A. Polhemus (USNM). Paratypes: THAILAND, **Chiang Mai Prov.**: 46 brachypterous males, 63 brachypterous females, same data as types (JTPC); 1 brachypterous male, Huay Hia Creek, Fang Horticultural Experiment Station, 550 m. (1806 ft.), 15 Novem-

ber 1985, CL 2198, J. T. and D. A. Polhemus (JTPC); 1 macropterous male, 1 macropterous female, 1 brachypterous male, small stream and waterfalls on Mt. Doi Sutep, W. of Chiang Mai, 442 m. (1450 ft.), 18 November 1964, W. L. and J. G. Peters (JTPC, LACM); 1 macropterous male, 1 macropterous female, 2 brachypterous females, same locality as above, 488 m. (1600 ft.), 28 November 1964, W. L. and J. G. Peters (JTPC, LACM); 1 macropterous male, same locality as above, 351 m. (1150 ft.), 2 December 1964, W. L. and J. G. Peters (LACM).

Aphelocheirus (Micraphelocheirus) asiaticus (Hoberlandt and Štys) n. comb. Figs. 143-146, 175

Tamopocoris asiaticus Hoberlandt and Štys,1979, Acta Mus. Nat. Pragae, 33: 6. .

Description:

Macropterous male: Small for genus, length 3.53 mm; maximum width (across abdomen) 1.89 mm (fig. 143). Basic coloration dark brown, hemelytra lighter.

Head dark brown, shining, surface alvelolate, width/length = .88/.71, produced ahead of eyes for .50 the length of an eye; eyes black, shining, width/length = .20/.40, inner margins separated from vertex by shallow furrows, lateral margins rounded, exceeding adjacent anterolateral pronotal angles; anterior/posterior interocular = .50/.43.

Pronotum dark brown, shining, width/length (midline) = 1.51/.45, surface rugose, sparsely set with fine recumbent gold setae, lateral margins narrowly glabrous, lacking short peg-like setae, posterolateral angles rounded, posterior margin weakly sinuate, produced to small rounded humeral protruberances above wing bases. *Scutellum* dark brown, shining, swollen, width/length = 1.06/.61, surface rugose, glabrous, lateral margins weakly sinuate, mesoscutum barely exposed, defined by sinuate transverse furrow. *Hemelytra* brown, complete, exceeding tip of abdomen, surface rugose, bearing recumbent gold setae; corium, clavus, claval vein and embolium well defined, embolar margin coming to rounded obtuse angle; membrane pale fumate.

Abdomen brown, surface covered with long fine recumbent gold setae, posterolateral angles of segments II-VII not produced or spinose.

Ventral surface dark brown, lightly pruinose with gold reflections, spiracular rosettes dark, surface sparsely covered with very fine recumbent gold setae; antennae yellowish brown, lengths of segments I-IV = .06, .09, .14, .32; rostrum gold, glabrous, length .71, extending to middle of mesosternum; prosternum longitudinally carinate medially,

propleurae with inner projections broadly triangular, not notched, apices angulate (fig. 146); mesosternal plate gently and broadly tumescent, narrowing to low longitudinal carina anteromedially; abdominal segments III-VI with longitudinal glabrous areas medially, sternite III lacking small posteriorly directed pointed knob medially on posterior margin, sternites IV and V with very small rearwardly directed peg-like setae medially on posterior margins, all segments with small glabrous pits present inward of spiracles.

Legs pale brown, covered with fine recumbent gold setae; anterior trochanter, femur, tibia and tarsi with thick hair pads on inner faces; fore, middle and hind coxae with combs of gold setae distally; middle trochanter, femur, tibia and tarsi with thick pads of gold setae along posterior margins; middle femur with longitudinal row of short gold spines ventrally, scattered small gold spines along anterior margin, 4 long erect gold spines along posterior margin; middle tibia with scattered stout gold spines along anterior margin, transverse row of gold spines apically; hind femur with sparse row of short recumbent gold spines along ventral face, short reclining gold setae along anterior and posterior margins; hind tibia with a very few stout reclining gold spines along anterior margin, transverse row of gold spines apically; hind tibia and tarsi with long swimming hairs along posterior margins; claws gold, gently curving, tips brown.

Male genitalia with right paramere broad basally, narrowing apically to blunt tip; left paramere gently curving, leaf-shaped (fig. 145).

Macropterous female: Similar to male in general structure and coloration, length 3.61 mm.; maximum width 1.92 mm. Subgenital plate broadly triangular, tip rounded (fig. 144).

Brachypterous form: Unknown.

Discussion: The characters given in the key, male genitalia (fig. 145) and the shape of the inner propleural projections (fig. 146) will distinguish *asiaticus* from the other known *Micraphelocheirus* species. A discussion of morphology is given immediately following the synonymy of the genus *Aphelocheirus*.

Distribution: North Vietnam (fig. 175).

Material examined: VIETNAM: 1 macropterous male, Hanoi, at hotel lights, 13 September 1963, T. Pócs (JTPC); 1 macropterous female, Lao-cai, 300 m. (984 ft.), at light trap in secondary tropical forest, 21 September 1963, L. Pócs (paratype, CAS).

Checklist of species of Aphelocheirinae of the World

Genus *Aphelocheirus* Westwood, 1833
Aphelochira Fieber 1851
Suturgana Oshanin, 1909

aestivalis (Fabricius, 1794), Ent. Syst. 4: 66 [*Naucoris*] = *annosus* Stichel, 1955, Ill. Best. Wanz. II: 1: 90 (form) = *breviceps* Horvath, 1895, Rev. Ent. 14: 160 = *cineroniger* Stichel, 1955, Ill. Best. Wanz. II: 1:90 (form) = *kervillei* (Kuhlgatz, 1898), Wiss. Meeresuntersuchungen 3: 144 [*Aphelochira*] = ? *montandoni* Horvath, 1899, Termész. Füz. 22: 257 (subspecies of British Isles and Ireland?) = ? *nigritus* Horvath, 1899, Termész. Füz. 22: 257 (species proper from Yugoslavia and Finland?)	Europe, Turkey, Egypt
amurensis (Kiritshenko, 1925), Russ. Gidrobiol. Zh. 4: 35 [*Aphelochirus*]	East Siberia
ashlocki n.sp.	Laos
australicus Usinger,1937, Austr. Zool. 8: 341	Australia (Cape York)
baguio n.sp.	Philippines (Luzon)
bianchii (Kiritshenko, 1933), Trudy Bajkal limnol. stn. 4: 101 [*Aphelochirus*]	Turkestan
cantonensis n.sp.	South China
carinatus (Royer, 1920), Bull Mus. Paris 1920: 59 [*Aphelochirus*]	Vietnam
celebensis n.sp.	Celebes
corbeti Poisson, 1955, Ann. Mus. Stor. Nat. Genova 68: 165	Uganda (Lake Albert)
debilis (Kiritshenko, 1925), Russ. Gidrobiol. Zh. 4: 39 [*Aphelochirus*]	Kenya, Madagscar(?)
denticeps Montandon, 1910, Bull. Soc. Sci. Bucarest 19: 438	Central China
dudgeoni n.sp.	Hong Kong
fang n.sp.	Thailand
femoratus n.sp.	Malaya, Thailand
grik n.sp.	Malaya, Thailand
gularis (Horvath, 1918), Ann. Mus. Nat. Hung. 16: 141 [*Aphelochirus*]	Vietnam
improcerus (Kiritshenko, 1929), Dokl. A. N. SSR 1929: 12 [*Aphelochirus*]	China, East Siberia

inops (Horvath, 1918), Ann. Mus. Nat. Hung. 16: 140 [*Aphelochirus*]	Vietnam
javanicus n.sp.	Java
kawamurae (Matsumura, 1915), Ent. Mag., Kyoto 1: 104 [*Aphelochirus*]	Japan
kinabalu n.sp.	Borneo (Sabah)
kolenatii (Kiritshenko, 1925), Russ. Gidrobiol. Zh. 4: 38 [*Aphelochirus*] = *nigrita* Horvath, 1899 sensu Kiritshenko 1918, Mem. Mus. Caucase (A) 6: 170 (Misid.)	Transcaucasia, Caucasus
kumbanus Linnavuori, 1975, Not. Ent. 55: 91	Cameroons
lahu n.sp.	Thailand
lao n.sp.	Laos
lorelindu n.sp.	Celebes
lugubris Horvath, 1899, Termész. Füz. 22: 257	Madagascar
luzonicus n.sp.	Philippines (Luzon)
malayanus n.sp.	Malaya
minor n.sp.	Borneo (Sabah)
nathani La Rivers, 1971, Bull. So. Calif. Acad. Sci. 70: 70	South India
nawae Matsumura, 1905, J. Sapporo Agric. Coll. 22: 56	Japan, Korea
palawanensis n.sp.	Philippines (Palawan)
pallens Horvath, 1899, Termész. Füz. 22: 257	New Guinea
petersi n.sp.	Thailand
philippinensis Usinger, 1938, Phil. J. Sci. 64: 307	Philippines (Luzon)
plumipes (Oshanin,1909), Ann. Mus. St. Pétersbourg 14: 9 [*Suturgana*] = *turanicus* Montandon, 1911, Bull. Soc. Sci. Bucarest 20: 83	Turkestan, Afghanistan
routroi (Bergevin, 1925), Bull. Soc. Hist. nat. Afr. N. 16: 80 [*Aphelochirus*]	Morocco
schoutedeni Montandon, 1914, Rev. Zool Afr. 4: 117	Zaire
sculpturatus n.sp.	Philippines (Luzon)
similaris n.sp.	North Vietnam
sinensis (Montandon, 1892), Rev. Ent. 11: 73 [*Aphelochirus*]	Central China
takeuchii (Esaki, 1934), Mushi 7: 26 [*Aphelochirus*]	Japan
thai n.sp.	Thailand
tuleari Poisson, 1963, Bull. I. F. A. N. (A) 25: 1191	Madagascar
uichancoi Usinger, 1938, Phil. J. Sci. 64: 305	Philippines (Luzon)

ussuriensis (Kiritshenko, 1929), Dokl. A. N. SSR 1929: 13 [*Aphelochirus*]	East Siberia
variegatus (Kiritshenko, 1925), Russ. Gidrobiol. Zh. 4: 40 [*Aphelochirus*]	South Siberia
vittatus Matsumura, 1905, J. Sapporo Agric. Coll. 22: 57 = *shirakii* Matsumura, 1905, J. Sapporo Agric. Coll. 22: 58 (var.)	Japan
yaumatsui Miyamoto, 1960, Mushi 33: 79	North China
zamboanga n.sp.	Philippines (Mindanao)
Genus *Micraphelocheirus* Hoberlandt and Štys, 1979 = *Tamopocoris* Hoberlandt and Štys, 1979	
asiaticus (Hoberlandt and Štys, 1979), Acta Mus. Nat. Pragae 33B: 6 [*Tamopocoris*]	Vietnam
pygmaeus La Rivers, 1971, Bull. So. Calif. Acad. Sci. 70: 69	India (Assam)
clivicolus Polhemus, 1979, Bull. Fish. Res. Stn. Sri Lanka 29: 107	Ceylon
brevirostris n.sp.	Thailand

Acknowledgments

We offer deep thanks to the following people who have helped us during the course of our travels in tropical Asia, New Guinea and Australia; without them this work could not have been completed: Matt Trezise, Jawolbinna, Queensland; Vance Woodyard and family, Kiunga, Papua New Guinea; Dr. Victor Gapud, University of the Philippines, Los Banos; Bert Barrion, International Rice Research Institute, Los Banos; Dr. S. Ramalingan, University of Malaysia, Kuala Lumpur; Mr. Surasek and Mr. Wewat, Fang Horticultural Research Station, Thailand; Dr. David Dudgeon, University of Hong Kong; Jason Weintraub, Cornell University. The following individuals and museums provided gracious loans of specimens (institutional abbreviations used in the text are indicated in parentheses): Dr. Charles Hogue, Los Angeles County Museum (LACM); Dr. Paul Arnaud, California Academy of Sciences (CAS); Dr. Tamas Vasarhelyi, Hungarian Natural History Museum (HNHM); Dr. P. H. van Doesburg, Rijksmuseum Van Natuurlijke Historie, Leiden (RNHL); Dr. Victor Gapud, University of the Philippines, Los Banos (UPLB); Dr. Wayne Gagne, Bernice P. Bishop Museum, Honolulu (BPBM); Dr. D. H. (Paddy) Murphy, National University of Singapore (NUS); Dr. I. M. Kerzhner, USSR Academy of Sciences, Leningrad (ZMAS), who also helped with obscure Russian literature; Dr. George Byers, University of Kansas (KU); Dr. George F. Edmunds, Jr., University of Utah. Dr. James A. Slater of the University of Connecticut provided helpful review and comments on the completed manuscript. Types are deposited in the United States National Museum of Natural History (USNM) unless otherwise noted; paratypes are held in the J. T. Polhemus collection, Englewood, Colorado (JTPC), the American Museum of Natural History,

New York (AMNH), and the Museum Zoologicum Bogoriense, Bogor, Indonesia (MZB), and the USNM. This research was sponsored in part by a grant from the National Geographic Society, Washington, D. C., to whom we are especially grateful.

Literature Cited

Agassiz, L. 1846. Nomenclatoris Zoologici Index Universalis. Soloduri. viii + 393pp.

Bishop, J. E. 1973. Limnology of a small Malayan river Sungai Gombak. The Hague: Dr. W. Junk, B. V. 485 pp.

China, W. E. 1943. The generic names of the British Insects, part 8. The generic names of the British Hemiptera-Heteroptera with a checklist of the British species. London: Royal Entomological Society of London, pp. 211-342

_____. 1955 The evolution of the water bugs. Bulletin of the National Institute of Sciences of India 7: 91-103.

China, W. E. and N. C. E. Miller. 1959. Check-list and keys to the families and subfamilies of the Hemiptera-Heteroptera. Bulletin of the British Museum (Natural History), Entomology 8: 1-45.

Costa, H. H. and F. Starmühlner 1972. Results of the Austrian-Ceylonese hydrobiological mission 1970 of the 1st Zoological Institute of the University of Vienna (Austria) and the Department of Zoology of the Vidyalankara University of Ceylon, Kelaniya. Part I. Preliminary report: introduction and descriptions of stations. Bulletin of the Fisheries Research Station, Sri Lanka (Ceylon) 23: 43-76.

De Carlo, J. A. 1971. Valor sistematico del Estudio del aparto genital macho en los Hemipteres acuaticos y semiacuaticos. Division de la Familia Naucoridae en dos familias. Caracteristica externa de la capsula genital. Revista de la Sociedad Entomológica Argentina 38: 159-166.

Douglas, J. W. and J. Scott, 1865. The British Hemiptera, vol. I. Hemiptera-Heteroptera. London. 627 pp. + addenda (1 p.) + 20 pls.

Dudgeon, D. 1983. An investigation of the drift of aquatic insects in Tai Po Kao Forest Stream, New Territories, Hong Kong. Archiv für Hydrobiologie 96: 434-447.

_____. 1984. Seasonal and long-term changes in the hydrobiology of the Lam Tseun River, New Territories, Hong Kong, with special reference to benthic macroinvertebrate distribution and abundance. Archiv für Hydrobiologie, Supplement 69: 55-129.

Fieber, F. X. 1860. Die europäischen Hemiptera Halbflügler. (Rhynchota Heteroptera). Nach der analytischen Methode bearbeitet. Wien. pp. 1-112, 1860; pp. 113-144 and III-VI, 1861, 2 pls.

Hoberlandt, L. and P. Štys. 1979. *Tamopocoris asiaticus* gen. and sp. n. — A new Aphelocheirinae from Vietnam and further studies on Naucoridae (Heteroptera). Acta Entomologica Musei Nationalis Pragae 33 B: 1-20.

Horvath, G. 1899. Monographia generis *Aphelocheirus*. Termeszetrajzi Füzetek 22: 256-267.

_____. 1918. De Hydrocorisis nonnullis extraeuropaeis. Annales Musei Nationalis Hungarici 16: 140-146.

La Rivers, I. 1971. Descriptions and notes concerning some Oriental *Aphelocheirus* (Hemiptera: Aphelocheiridae). Bulletin of the Southern California Academy of Sciences 70: 69-72.

Lepneva, S. G. 1930. On the study of the bottom fauna of the upper Ob'. Zapiski Gosudarstvennovo Gidrologicheskovo Instituta 3: 121-198. (In Russian)

Linnavuori, R. 1975. On the genus *Aphelocheirus* (Heteroptera, Naucoridae) of tropical Africa. Notulae Entomologicae 55: 89-91.

Montandon, A. L. 1910. Trois especes nouvelles de la famille Naucoridae. Bulletin de la Société (Roumaine) des Sciences de Bucarest-Roumanie 19: 438-444.

Parsons, M. C. 1966. Studies on the cephalic anatomy of Naucoridae (Heteroptera). Transactions of the Royal Entomological Society of London 118: 119-151.

_____. 1969a. Skeletomusculature of the pterothorax and first abdominal segment in micropterous *Aphelocheirus aestivalis* F. (Heteroptera: Naucoridae). Transactions of the Royal Entomological Society of London 121: 1-39.

_____. 1969b. The labium of *Aphelocheirus aestivalis* F. as compared with that of typical Naucoridae (Heteroptera). Canadian Journal of Zoology 47: 295-306.

_____. 1969c. The food pump of *Aphelocheirus aestivalis* F. as compared with that of typical Naucoridae (Heteroptera). Journal of Morphology 129: 17-30.

Pirozhnikov, P. L. 1929. On the study of the benthos of the Yenisey River. Russkii Girdobiologicheskii Zhurnal 8: 68-73. (In Russian)

Poisson, R. 1957. Faune de France. Heteropteres aquatiques. Paris: Lechevalier. 263 pp.

Polhemus, J. T. 1979. Results of the Austrian-Ceylonese hydrobiological mission 1970, of the Institute of Zoology of the University of Vienna (Austria) and the Department of Zoology of the University of Sri Lanka, Vidyalankara Campus, Kelaniya. Part XIX:

Aquatic and semiaquatic Hemiptera of Sri Lanka from the Austrian Indo-Pacific Expedition, 1970-71. Bulletin of the Fisheries Research Station, Sri Lanka (Ceylon) 29: 89-113.

Popov, Y. 1970. Notes on the classification of the recent Naucoridae (Heteroptera, Nepomorpha). Bulletin de l'Academie Polonaise des Sciences, Série des sciences biologiques 18: 93-98

_____. 1971. The historical development of Hemiptera, infraorder Nepomorpha (Heteroptera). Trudy Palaeontological Institute, Academy of Sciences, USSR 129: 228 pp., pls. I-IX. (In Russian)

Royer, M. 1920. Description d'un *Aphelochirus* nouveau du Tonkin [Hem. Naucoridae]. Bulletin du Museum National d'Histoire Naturelle, Paris 26: 59-60.

Sirotinina, O. N. 1921. Materials of the fauna and biology of aquatic bugs (Rhynchota) of the lower Volga basin. Raboty Volzhskoi Biologicheskoi Stanskii, 5: 1-39. (In Russian)

Stål, C. 1876. Enumeration Naucoridarum *in* Enumeratio Hemipterorum, no. 5. Ofversigt af Kongliga Svenska Vetenskaps-Akademiens Handlingar 14: 1-162.

Starmühlner, F. 1984. Mountain stream fauna, with special reference to Mollusca, pp. 215-255 *in* Ecology and Biogeography in Sri Lanka (C. H. Fernando, ed.). The Hague: Dr. W. Junk, B.V.

Thorpe, W. H. 1965. The habitat of *Aphelocheirus aestivalis* (F.) (Hem.-Het., Aphelocheiridae). Entomologist's Monthly Magazine, 100: 251-253.

Usinger, R. L. 1937. A new species of *Aphelocheirus* from Australia (Hemiptera, Naucoridae). Australian Zoologist 8: 341-342.

_____. 1937. The Naucoridae of the Philippine Islands (Hemiptera). Philippine Journal of Science 64: 299-309.

_____. 1941. Key to the subfamilies of Naucoridae with a generic synopsis of the new subfamily Ambrysinae (Hemiptera). Annals of the Entomological Society of America 34: 5-16

Figures: Legend

Figs. 1-3: *Aphelocheirus nawae* Matsumura. Specimens illustrated from South Korea, Kangneung area, trib. of Sacheon River. Explanation of lettering: AG = abdominal gland; A1 = abdominal segment I; A2 = abdominal segment II; A3 = abdominal segment III; A4 = abdominal segment IV; A5 = abdominal segment V; A6 = abdominal segment VI; A7 = abdominal segment VII; Fw = forewing; G = male genital capsule; H = head; Hy = hydrostatic sensory organ; IP = inner projection of propleuron; Mp = metapleuron; Ms = mesosternum; Msp = mesopleuron; Mt = metanotum; Mts = metasternum; P = pronotum; Pp = propleuron; PS = peg-like setae; R = rostrum; S = scutellum; Sg = female subgenital plate; SR = spiracular rosettes.

1. Brachypterous male, dorsal habitus.
2. Brachypterous female, ventral habitus.
3. Brachypterous female, detail of left propleuron, ventrolateral view.

Figs. 4-8: *Aphelocheirus* (*A.*) *australicus* Usinger.

4. Brachypterous male from Little Laura River, Queensland; dorsal habitus.
5. Macropterous female from Babinda, Queensland; dorsal habitus.
6. Male genitalia.
7. Inner projection of right propleuron.
8. Female subgenital plate.

Figs. 9-12: *Aphelocheirus* (*A.*) *pallens* Horvath.

9. Macropterous female from near Ningerum, Papua New Guinea; dorsal habitus.
10. Inner projection of right propleuron.
11. Male genitalia.
12. Female subgenital plate.

Figs. 13-17: *Aphelocheirus* (*A.*) *celebensis* n.sp.

13. Brachypterous male from Marana River, Celebes; dorsal habitus.
14. Macropterous male from Marana River, Celebes; dorsal habitus.
15. Male genitalia.
16. Inner projection of right propleuron.
17. Female subgenital plate.

Figs. 18-21: *Aphelocheirus* (*A.*) *lorelindu* n.sp.

18. Brachypterous male from near Kamarora, Celebes; dorsal habitus.
19. Male genitalia.
20. Inner projection of right propleuron.
21. Female subgenital plate.

Figs. 22-26: *Aphelocheirus* (*A.*) *minor* n.sp.

22. Brachypterous male from Nukakatan River, Borneo; dorsal habitus.
23. Macropterous female from Liwagu River, Borneo; dorsal habitus.
24. Inner projection of right propleuron.
25. Male genitalia.

26. Female abdomen, ventral view, showing subgenital plate and small medial humps on posterior margins of ventrites III and IV.

Figs. 27-31: *Aphelocheirus* (*A.*) *kinabalu* n.sp.
27. Female subgenital plate.
28. Brachypterous male from Liwagu River, Borneo; dorsal habitus.
29. Macropterous female from Liwagu River, Borneo; dorsal habitus.
30. Inner projection of right propleuron.
31. Male genitalia.

Figs. 32-34: *Aphelocheirus* (*A.*) *javanicus* n.sp.
32. Brachypterous male holotype from "Java"; dorsal habitus.
33. Male parameres, viewed flat after removal from genital capsule (L = left paramere, R = right paramere).
34. Inner projection of left propleuron.

Figs. 35-38: *Aphelocheirus* (*A.*) *palawanensis* n.sp.
35. Brachypterous male from Brook's Point, Palawan; dorsal habitus.
36. Inner projection of right propleuron.
37. Male genitalia.
38. Female subgenital plate.

Figs. 39-43: *Aphelocheirus* (*A.*) *zamboanga* n.sp.
39. Brachypterous male from Zamboanga, Mindanao; dorsal habitus.
40. Macropterous male from Luhib River, Mindanao; dorsal habitus.
41. Male genitalia.
42. Inner projection of right propleuron.
43. Female subgenital plate.

Figs. 44-47: *Aphelocheirus* (*A.*) *philippinensis* Usinger
44. Brachypterous male from Jacmal Bunhian, Luzon; dorsal habitus.
45. Inner projection of right propleuron.
46. Male genitalia.
47. Female subgenital plate.

Figs. 48-52: *Aphelocheirus* (*A.*) *sculpturatus* n.sp.
48. Brachypterous male from near Baguio, Luzon; dorsal habitus.
49. Macropterous female from Jacmal Bunhian, Luzon; detail of posterolateral pronotal margin.
50. Female subgenital plate.
51. Inner projection of right propleuron.
52. Male genitalia.

Figs. 53-55: *Aphelocheirus* (*A.*) *luzonicus* n.sp.
53. Brachypterous female from Alfonso, Luzon; dorsal habitus.
54. Inner projection of right propleuron.
55. Female subgenital plate.

Figs. 56-60: *Aphelocheirus* (*A.*) *uichancoi* Usinger
56. Brachypterous male from Tapat River, Luzon; dorsal habitus.
57. Macropterous female from Tapat River, Luzon; dorsal habitus.
58. Inner projection of left propleuron.
59. Female subgenital plate.
60. Male genitalia.

Figs. 61-64: *Aphelocheirus* (*A.) baguio* n.sp.
61. Brachypterous male holotype from Baguio, Luzon; dorsal habitus.
62. Apex of metasternal plate.
63. Inner projection of left propleuron.
64. Male genitalia.

Figs. 65-69: *Aphelocheirus* (*A.*) *malayensis* n.sp.
65. Brachypterous male from near Jeli, Malaysia; dorsal habitus.
66. Macropterous female from Cameron Highlands, Malaysia; dorsal habitus.
67. Male genitalia.
68. Inner projection of left propleuron.
69. Female subgenital plate.

Figs. 70-75: *Aphelocheirus* (*A.*) *femoratus* n.sp.
70. Ventral face of male hind trochanter and femur, showing raised dark patches
71. Brachypterous male from Cameron Highlands, Malaysia; dorsal habitus.
72. Macropterous female from Cameron Highlands, Malaysia; dorsal habitus.
73. Inner projection of left propleuron.
74. Male genitalia.
75. Female subgenital plate.

Figs. 76-81: *Aphelocheirus* (*A.*) *thai* n.sp.
76. Brachypterous male from Fang, Thailand; dorsal habitus.
77. Macropterous female from Fang, Thailand; dorsal habitus.
78. Male genitalia.
79. Inner projection of left propleuron.
80. Keel on mesosternal plate, lateral view.
81 Female subgenital plate.

Figs. 82-87: *Aphelocheirus* (*A.*) *inops* (Horvath)
82. Brachypterous female paratype from "Annam, Laos"; dorsal habitus.
83. Keel on mesosternal plate, lateral view.
84. Vental view of male abdomen showing location of small projecting tab on sternite VI.
85. Inner projection of left propleuron.
86. Male genitalia.
87. Female subgenital plate.

Figs. 88-89: *Aphelocheirus* (*A.*) *gularis* (Horvath)
88. Macropterous male holotype from "Annam, Laos"; dorsal habitus.
89. Male genitalia.

Figs. 90-93: *Aphelocheirus* (*A.*) *lahu* n.sp.
90. Brachypterous male from Fang, Thailand; dorsal habitus.
91. Female subgenital plate
92. Inner projection of left propleuron.
93. Male genitalia.

Figs. 94-99: *Aphelocheirus* (*A.*) *fang* n.sp.
94. Brachypterous male from Fang, Thailand; dorsal habitus.
95. Macropterous female from Fang, Thailand; dorsal habitus.
96. Female subgenital plate.
97. Male genitalia.
98. Inner projection of left propleuron.
99. Ventral view of male abdomen showing location of small projecting tab on sternite VI.

Figs. 100-105: *Aphelocheirus* (*A.*) *grik* n.sp.
100. Brachypterous male from Grik, Malaysia; dorsal habitus.
101. Macropterous female from Mae Ping River, Thailand; dorsal habitus.
102. Male genitalia.
103. Inner projection of left propleuron.
104. Female subgenital plate.
105. Ventral view of male abdomen showing location of projecting tab on sternite V.

Figs. 106-110: *Aphelocheirus* (*A.*) *petersi* n.sp.
106. Brachypterous male from Mae Ping River, Thailand; dorsal habitus.
107. Macropterous female from Mae Ping River, Thailand; dorsal habitus.
108. Inner projection of left propleuron.
109. Male genitalia.
110. Female subgenital plate.

Figs. 111-114: *Aphelocheirus* (*A.*) *nathani* La Rivers
111. Brachypterous female from Anamalai Hills, India; dorsal habitus.
112. Female subgenital plate.
113. Inner projection of left propleuron.
114. Male genitalia.

Figs. 115-118: *Aphelocheirus* (*A.*) *dudgeoni* n.sp.
115. Brachypterous male from Hong Kong; dorsal habitus.
116. Female subgenital plate.
117. Inner projection of left propleuron.
118. Male genitalia.

Figs. 119-121: *Aphelocheirus* (*A.*) *ashlocki* n.sp.
119. Macropterous female from Vientiane, Laos; dorsal habitus.
120. Female subgenital plate.
121. Inner projection of left propleuron.

Figs. 122-124: *Aphelocheirus* (*A.*) *denticeps* Montandon
122. Brachypterous male from Fuchou, China; dorsal habitus.
123. Male genitalia.
124. Inner projection of left propleuron.

Figs. 125-127: *Aphelocheirus* (*A.*) *carinatus* (Royer)
125. Macropterous female from Hanoi, Vietnam; dorsal habitus.
126. Female subgenital plate.
127. Left propleuron, ventrolateral view, showing location of inner projection.

Figs. 128-130: *Aphelocheirus* (*A.*) *similaris* n.sp.
128. Macropterous female from Hanoi, Vietnam; dorsal habitus.
129. Female subgenital plate.
130. Inner projection of left propleuron.

Figs. 131-134: *Aphelocheirus* (*A.*) *cantonensis* n.sp.
131. Macropterous female holotype from Hong Lak, China; dorsal habitus.
132. Female subgenital plate.
133. Inner projection of right propleuron.
134. Longitudinal median carina on abdominal ventrites III — VI, lateral view showing projection of ventrite III over base of ventrite IV.

Figs. 135-138: *Aphelocheirus* (*A.*) *lao* n.sp.
135. Macropterous female from Van Ban Eue, Laos; dorsal habitus.
136. Female subgenital plate.
137. Inner projection of left propleuron.
138. Male genitalia.

Figs. 139-142: *Aphelocheirus* (*M.*) *pygmaeus* La Rivers.
139. Macropterous female from Kaziranga, Assam; dorsal habitus.
140. Female subgenital plate.
141. Left propleuron, ventrolateral view, showing shape of inner projection.
142. Male genitalia.

Figs. 143-146: *Aphelocheirus* (*M.*) *asiaticus* (Hoberlandt and Štys)
143. Macropterous female from Hanoi, Vietnam; dorsal habitus.
144. Female subgenital plate.
145. Male genitalia..
146. Right propleuron, ventrolateral view, showing shape of inner projection.

Figs. 147-151: *Aphelocheirus* (*M.*) *clivicolus* J. Polhemus
147. Brachypterous female from Ratnapura, Ceylon; dorsal habitus.
148. Macropterous female, dorsal habitus.
149. Female subgenital plate.
150. Male genitalia.
151. Left propleuron, ventrolateral view, showing shape of inner projection.

Figs. 152-156: *Aphelocheirus* (*M.*) *brevirostris* n.sp.
152. Brachypterous male from Fang, Thailand; dorsal habitus.
153. Macropterous female from Doi Sutep, Thailand; dorsal habitus.
154. Left propleuron, ventrolateral view, showing shape of inner projection.
155. Female subgenital plate.
156. Male genitalia.

Figs. 157-161: Subgenus *Micraphelocheirus*, structural details.
157. *A.* (*M.*) *pygmaeus*, lateral view of abdomen showing raised posteriorly directed protuberance on abominal segment III.
158. *A.* (*M.*) *clivicolus* J. Polhemus, fore tarsus.
159. *A.* (*M.*) *brevirostris* n.sp., fore tarsus.
160. *A.* (*M.*) *brevirostris* n.sp., antenna.
161. *A.* (*M.*) *asiaticus* (Hoberlandt and Štys), hind tarsi, showing length and location of swimming hairs.

Fig. 162: Distribution of *Aphelocheirus* (*A.*) *australicus* Usinger in Australia.

Fig. 163: Distribution of *Aphelocheirus* (*A.*) *pallens* Horvath in New Guinea. Areas above 2000 m. shaded.

Fig. 164: Distribution of *Aphelocheirus* species in Celebes.
Circles = *A.* (*A.*) *celebensis* n.sp.
Squares = *A.* (*A.*) *lorelindu* n.sp.

Fig. 165: Distribution of *Aphelocheirus* (*A.*) *minor* n.sp. in Borneo.

Fig. 166: Distribution of *Aphelocheirus* (*A.*) *kinabalu* n.sp. in Borneo.

Fig. 167: Distribution of *Aphelocheirus* (*A.*) *palawanensis* n.sp. on Palawan.

Fig. 168: Distribution of *Aphelocheirus* species in the Philippines.
Circles = *A.* (*A.*) *uichancoi* Usinger
Triangles = *A.* (*A.*) *palawanensis* n.sp.

Fig. 169: Distribution of *Aphelocheirus* species in the Philippines.
Circles = *A.* (*A.*) *philippinensis* Usinger
Triangles = *A.* (*A.*) *zamboanga* n.sp.

Fig. 170: Distribution of *Aphelocheirus* species in the Philippines.
Circles = *A.* (*A.*) *sculpturatus* n.sp.
Triangles = *A.* (*A.*) *luzonicus* n.sp.
Diamonds = *A.* (*A.*) *baguio* n.sp.

Fig. 171: Distribution of *Aphelocheirus* species in Southeast Asia.
Circles = *A.* (*A.*) *grik* n.sp.
Squares = *A.* (*A.*) *femoratus* n.sp.

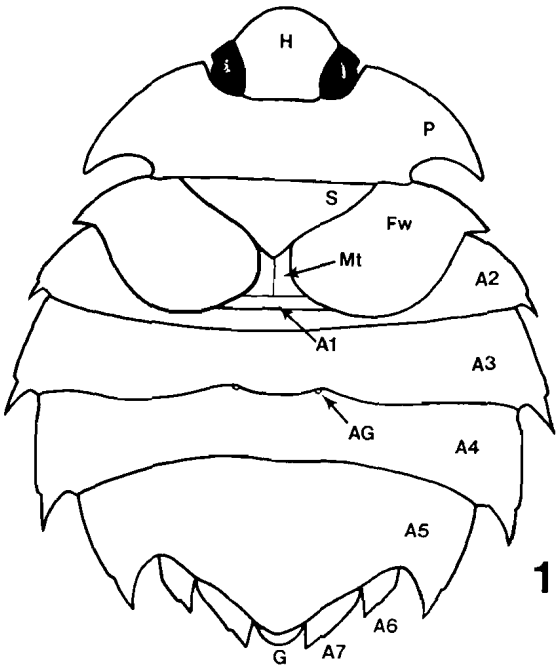
Triangles = *A.* (*A.*) *malayensis* n.sp.
Diamonds = *A.* (*A.*) *lahu* n.sp.
Half-filled circles = *A.* (*A.*) *javanicus* n.sp.

Fig. 172: Distribution of *Aphelocheirus* species in Southeast Asia.
Circles = *A.* (*A.*) *fang* n.sp.
Squares = *A.* (*A.*) *gularis* (Horvath)
Triangles = *A.* (*A.*) *lao* n.sp.
Diamonds = *A.* (*A.*) *inops* (Horvath)

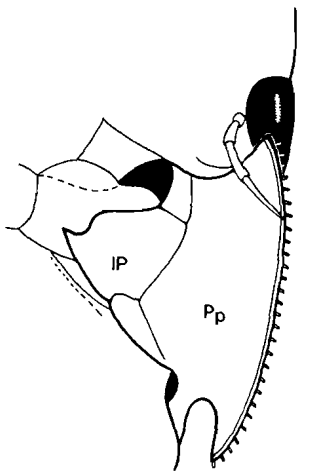
Fig. 173: Distribution of *Aphelocheirus* species in Southeast Asia.
Circles = *A.* (*A.*) *petersi* n.sp.
Squares = *A.* (*A.*) *denticeps* Montandon
Triangles = *A.* (*A.*) *dudgeoni* n.sp.
Diamonds = *A.* (*A.*) *thai* n.sp.

Fig. 174: Distribution of *Aphelocheirus* species in Southeast Asia.
Circles = *A.* (*A.*) *ashlocki* n.sp.
Squares = *A.* (*A.*) *carinatus* (Royer)
Triangles = *A.* (*A.*) *similaris* n.sp.
Diamonds = *A.* (*A.*) *cantonensis* n.sp.

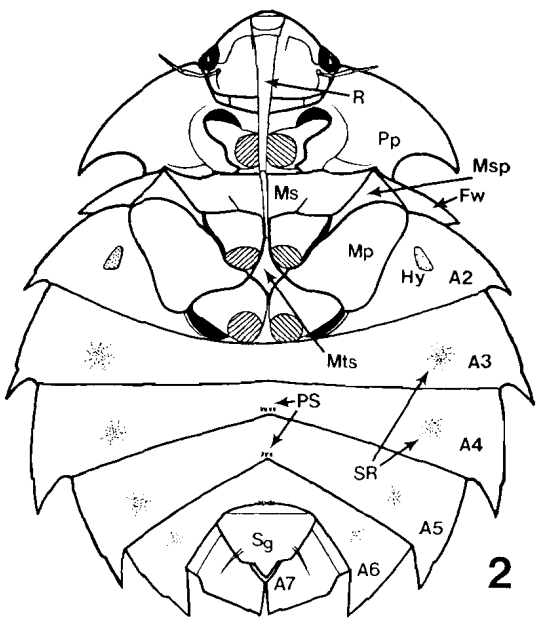
Fig. 175: Distribution of *Aphelocheirus* species in Asia.
Circles = *A.* (*M.*) *asiaticus* (Hoberlandt and Štys)
Squares = *A.* (*M.*) *brevirostris* n.sp.
Triangles = *A.* (*M.*) *clivicolus* J. Polhemus
Diamonds = *A.* (*M.*) *pygmaeus* La Rivers
Half-filled circles = *A.* (*A.*) *nathani* La Rivers


H
P
S
Fw
Mt
A2
A1
A3
AG
A4
A5
A6
G
A7
1mm.

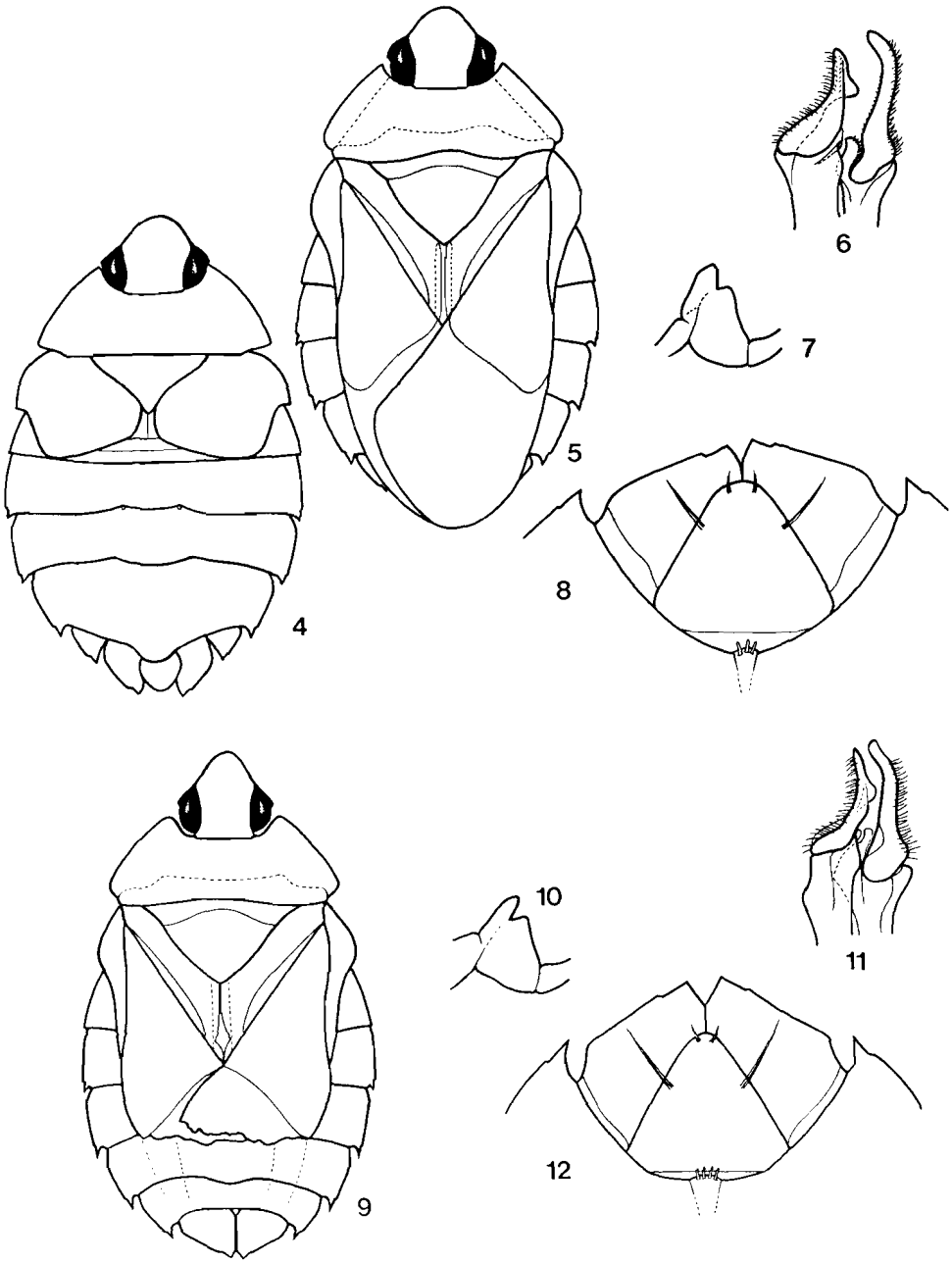
1

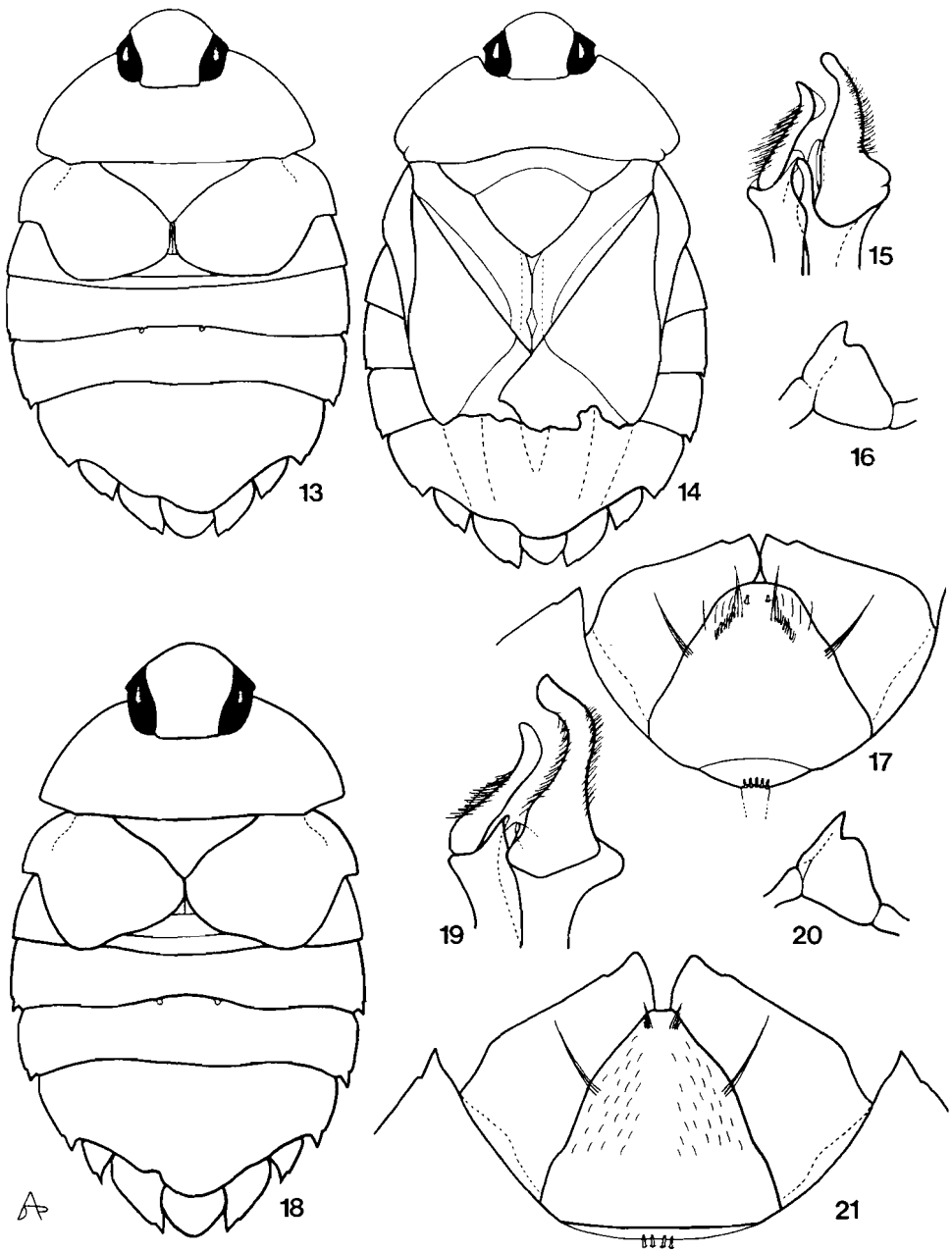

IP
Pp
1mm.

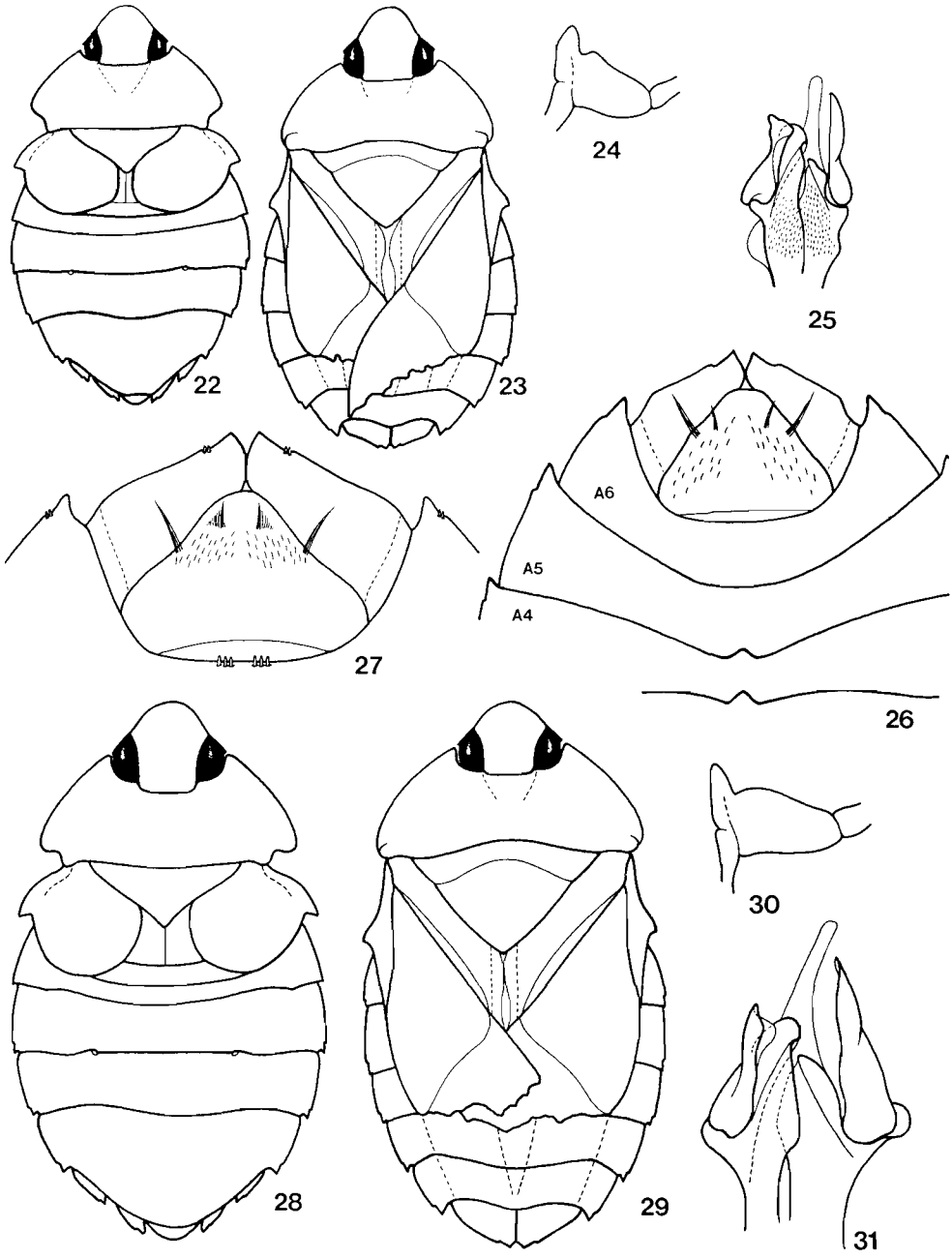
3

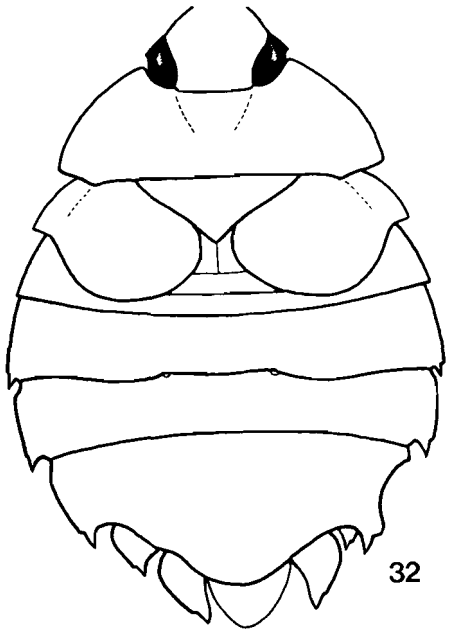

R
Pp
Msp
Ms
Fw
Mp
Hy
A2
Mts
A3
PS
A4
SR
A5
Sg
A6
A7

2

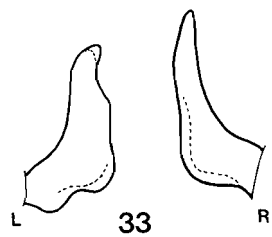

4
5
6
7
8
9
10
11
12


13
14
15
16
17
18
19
20
21


22
23
24
25
A6
A5
A4
26
27
28
29
30
31

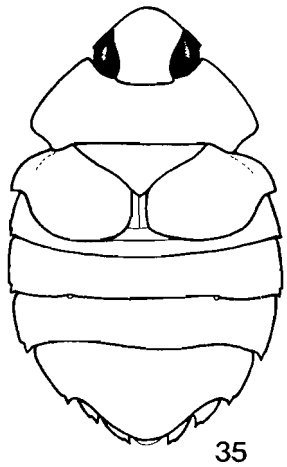


32

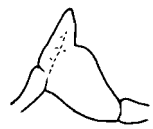


33

34

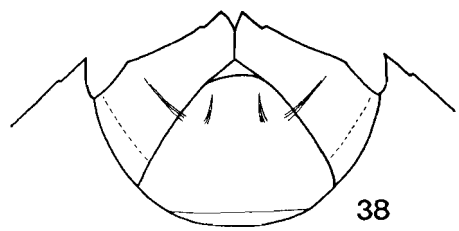


35

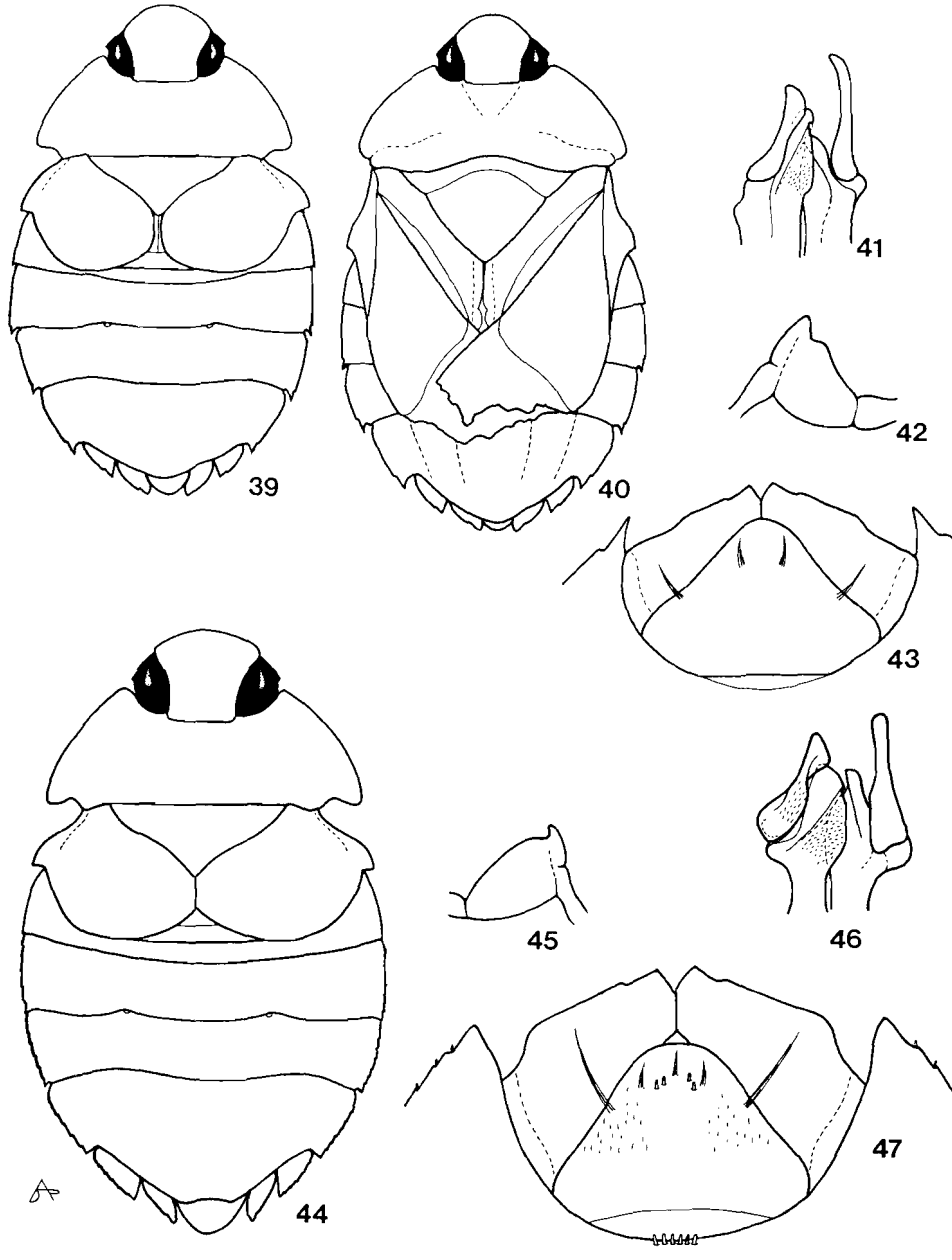


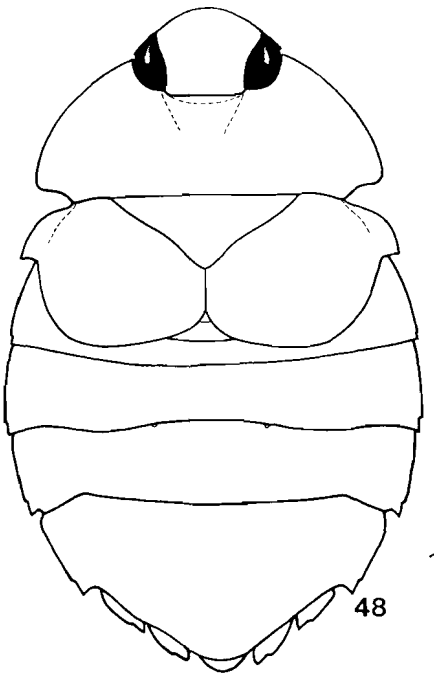
36

37

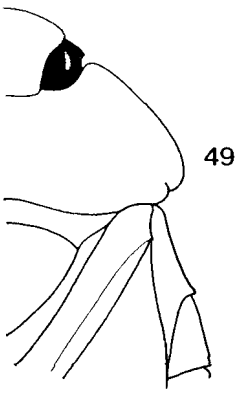


38

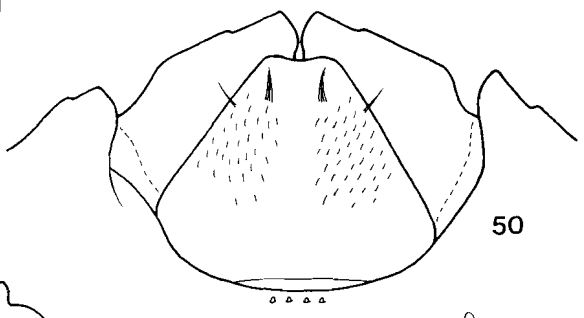

39
40
41
42
43
44
45
46
47



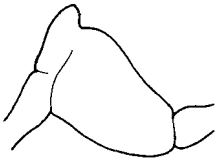
48



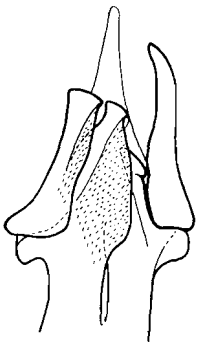
49



50

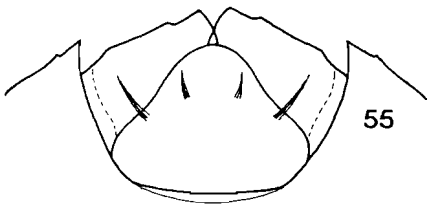


51

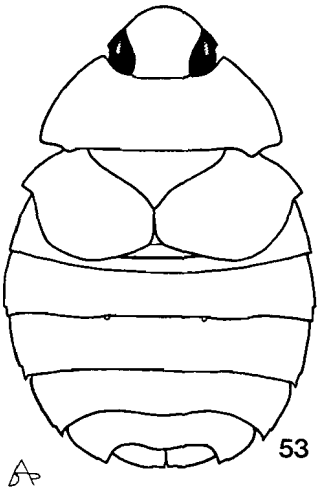


52

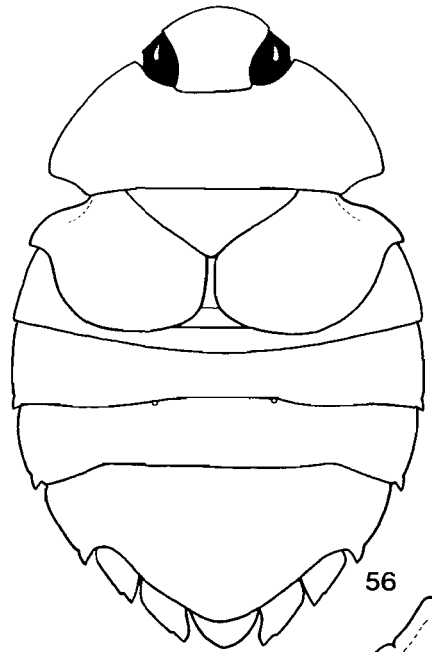
54

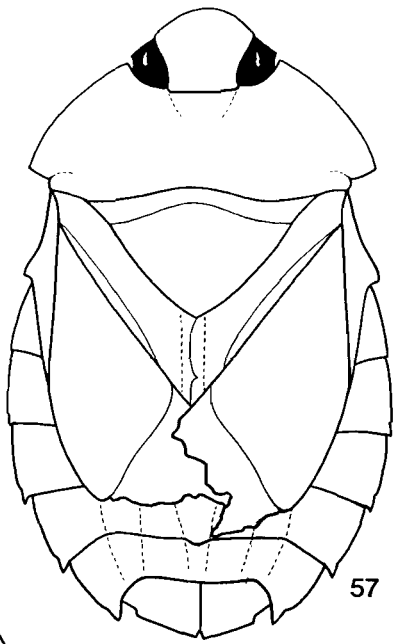


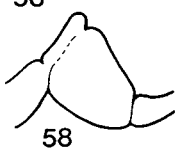
55

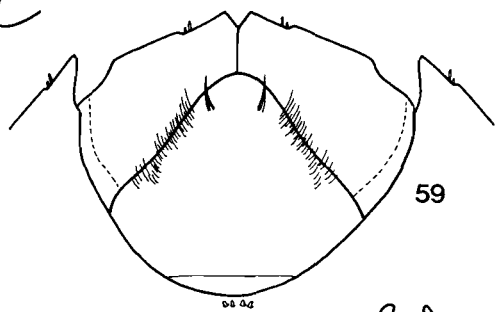


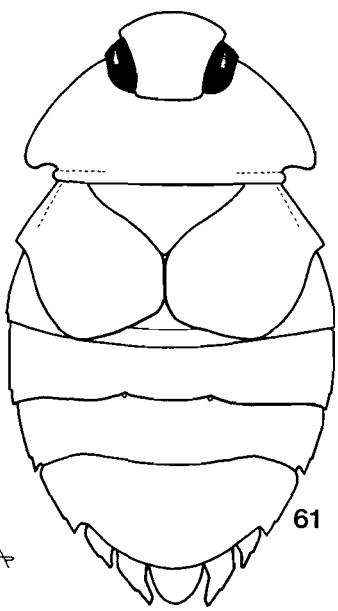
53

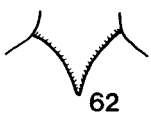

56


57

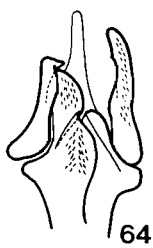

58

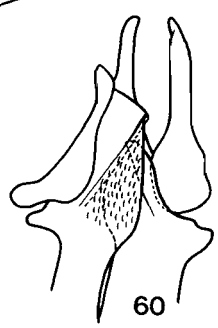

59

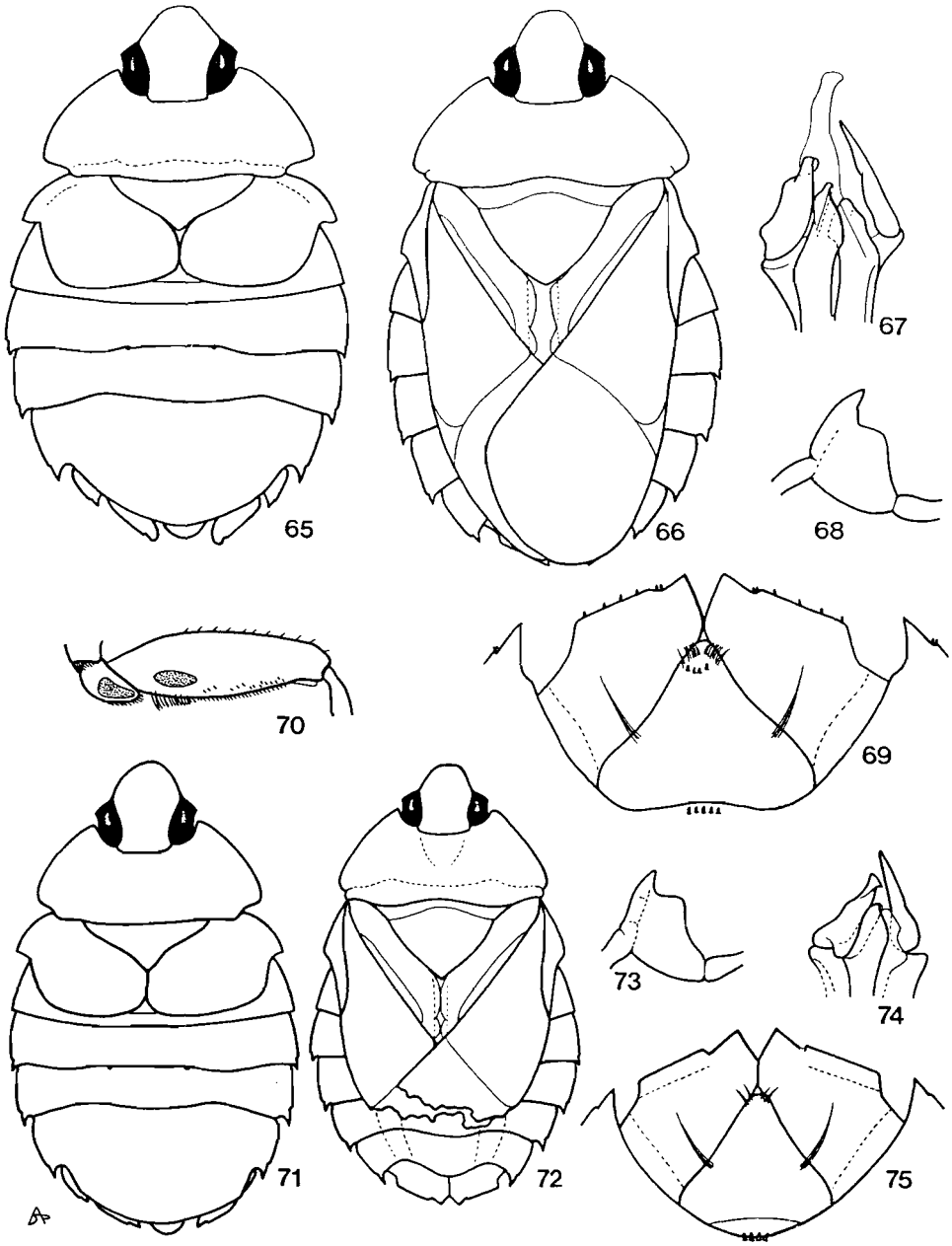

61

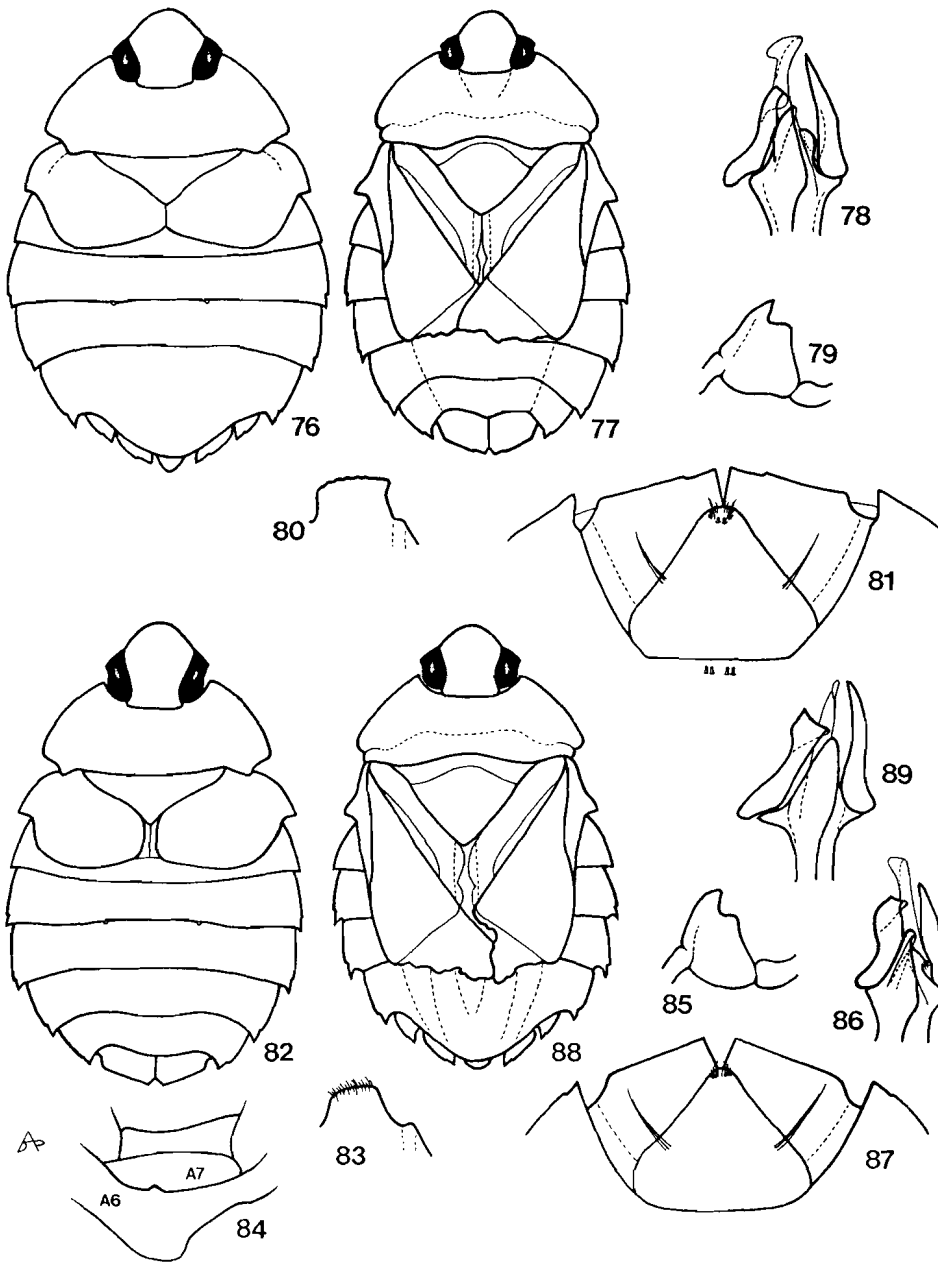

62

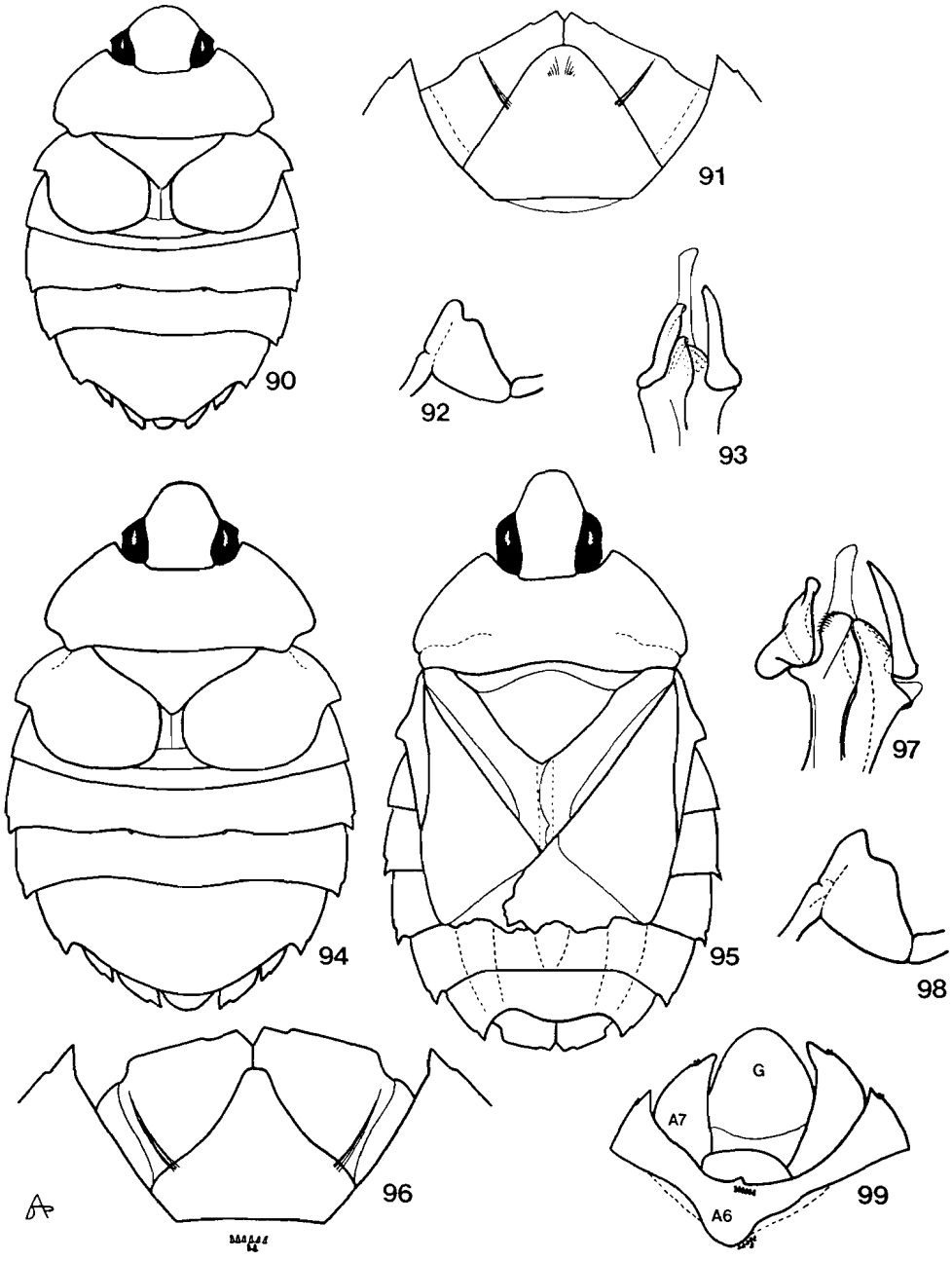

63

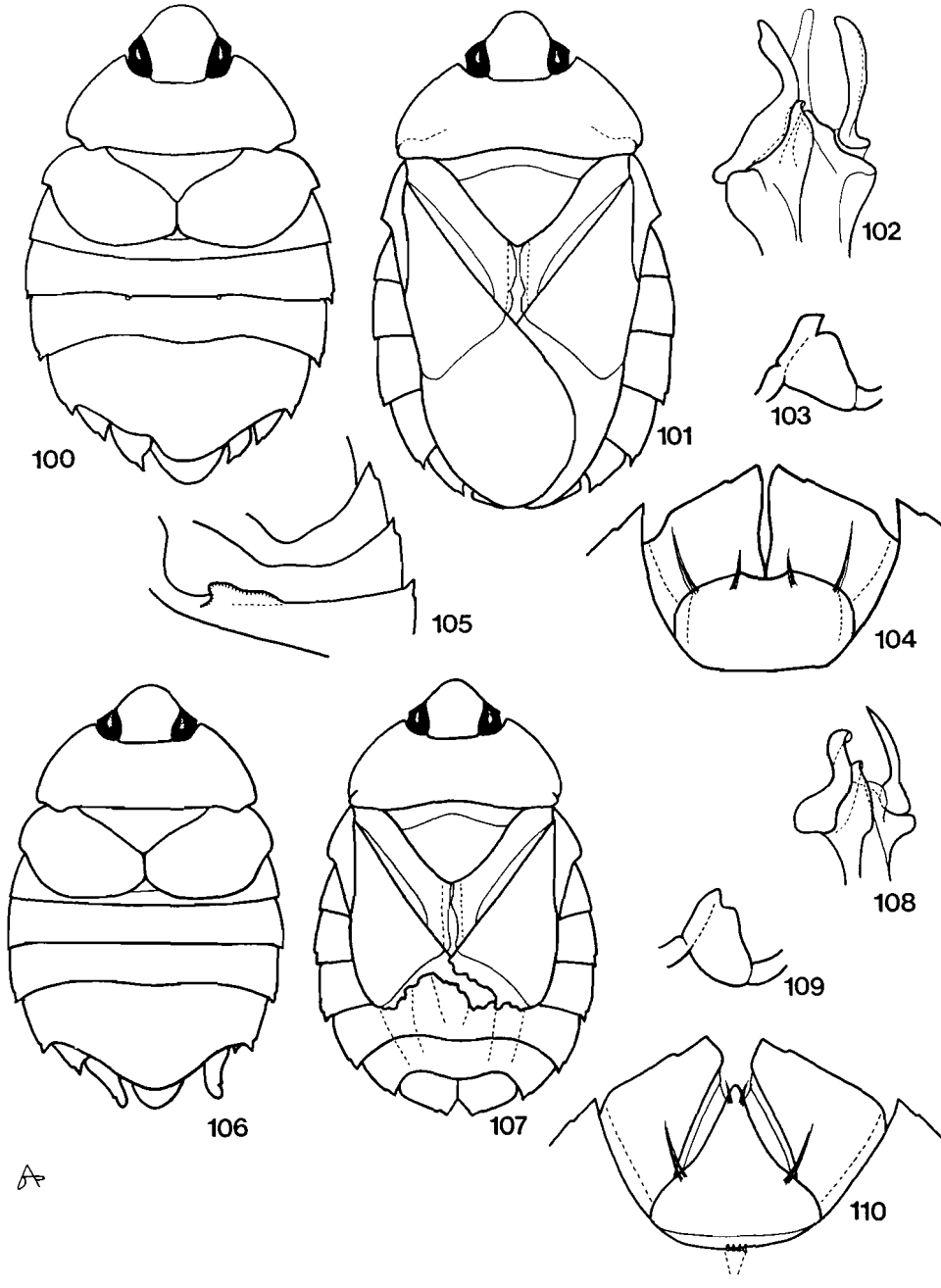

64

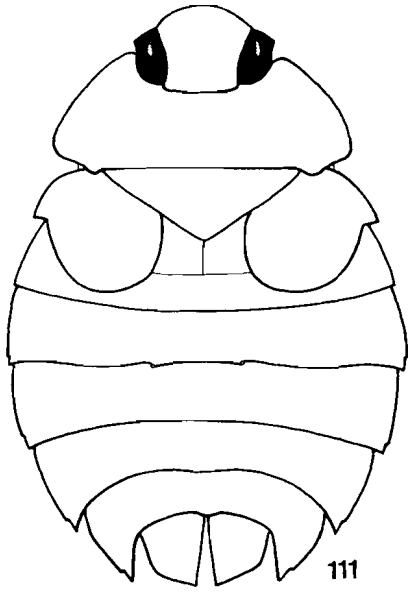

60


65
66
67
68
70
69
71
72
73
74
75

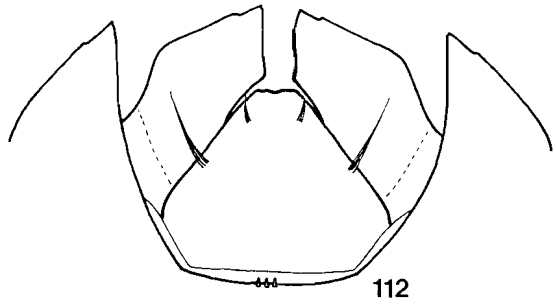

76
77
78
79
80
81
82
83
84
A7
A6
85
86
87
88
89


90
91
92
93
94
95
97
98
96
G
A7
A6
99

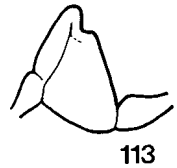

100
101
102
103
104
105
106
107
108
109
110



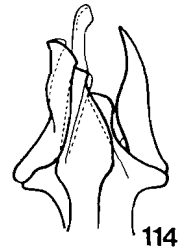
111



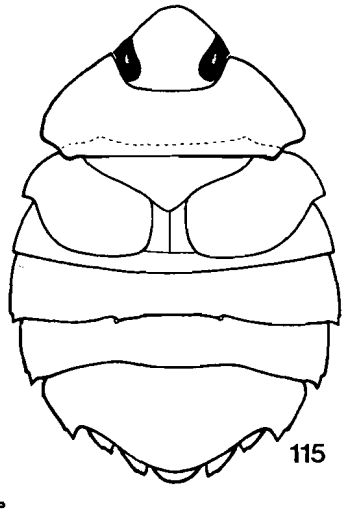
112



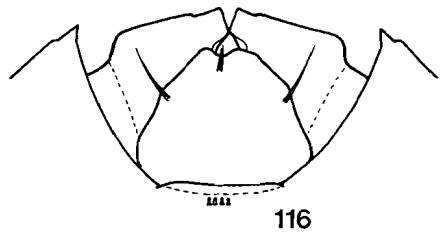
113



114



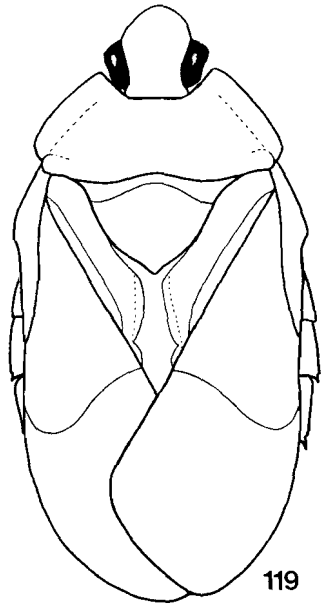
115



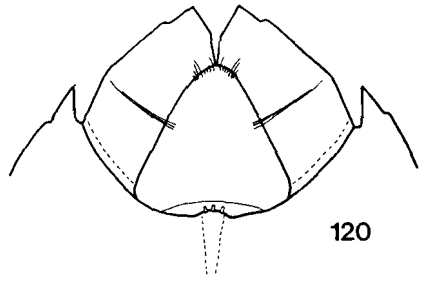
116

117

118

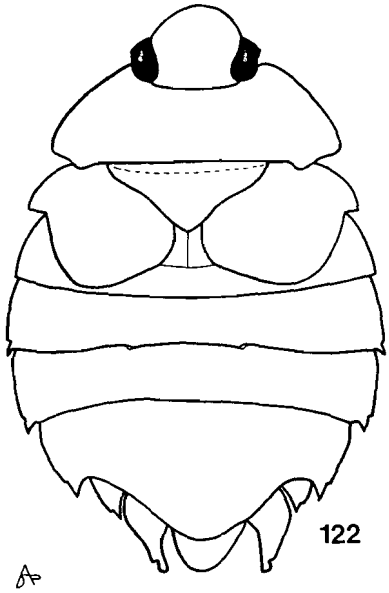


119

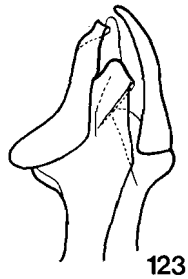


120

121

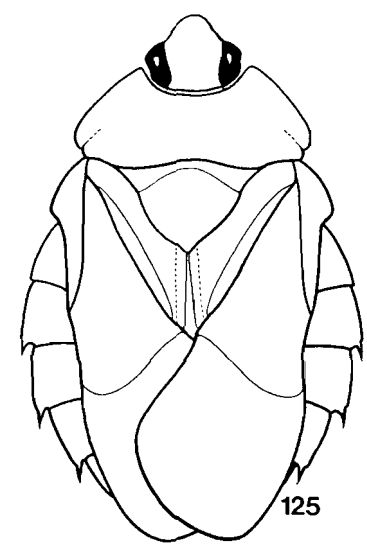


122

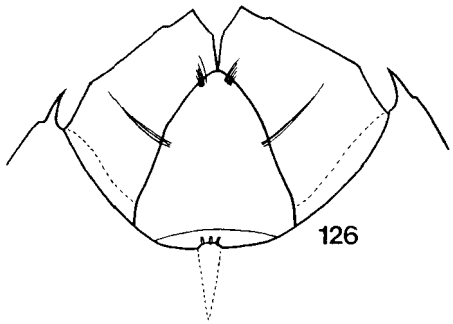


123

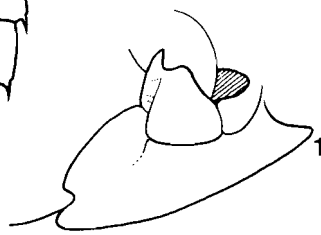
124



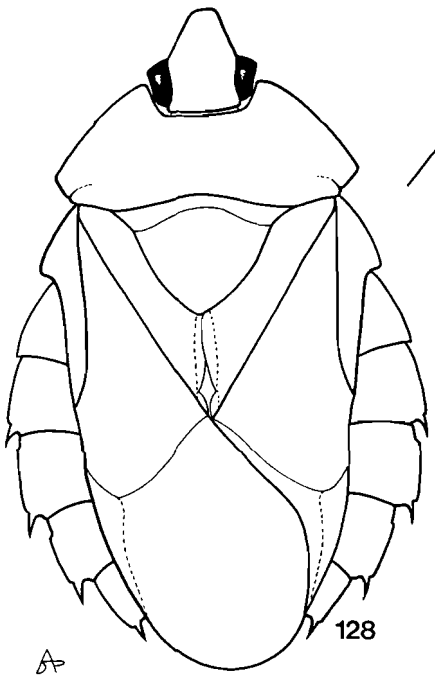
125



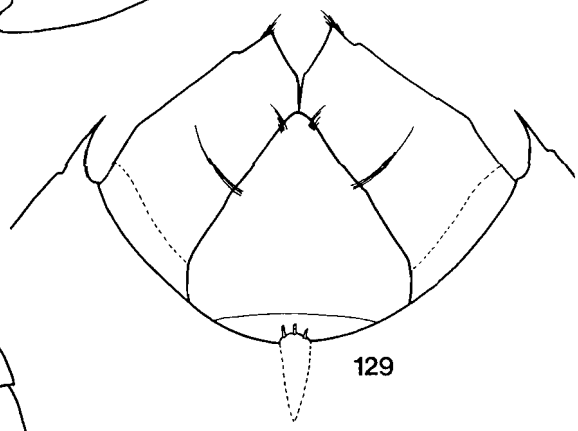
126



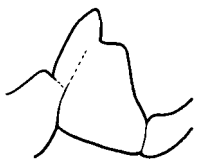
127



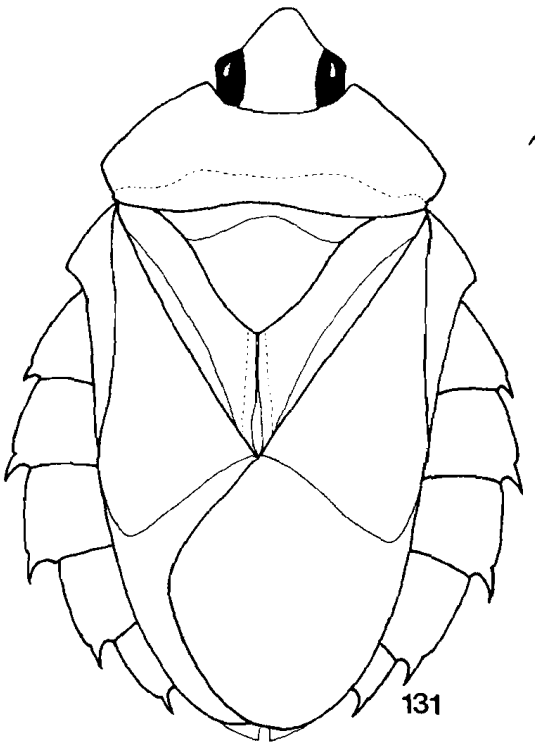
128

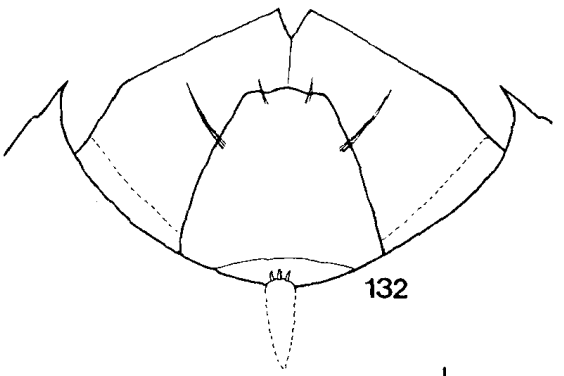


129

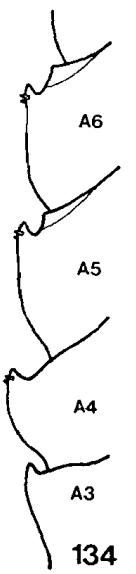


130

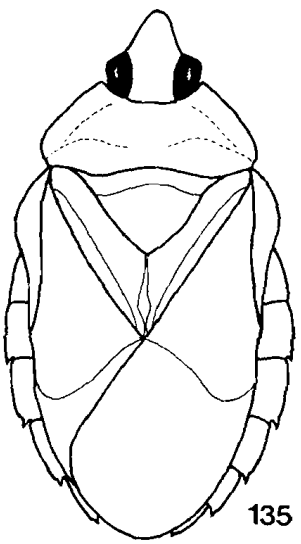

131

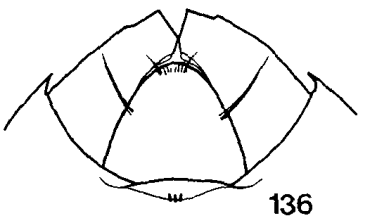

132


133



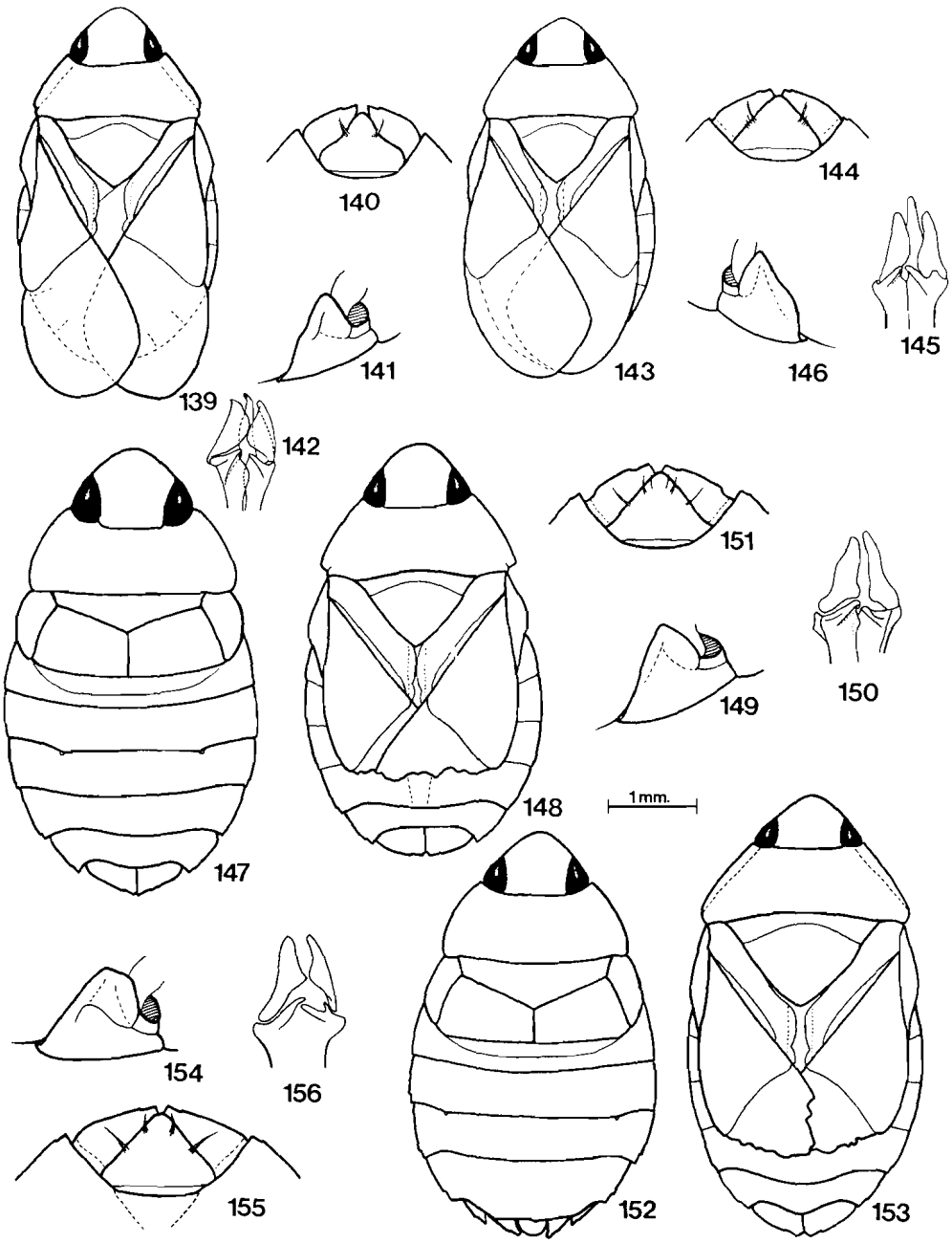
134

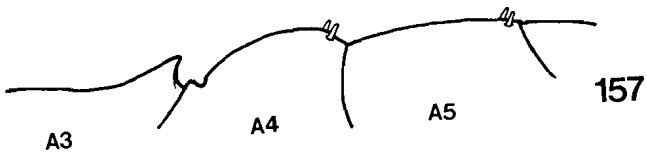

135


136

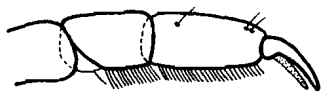

137


138


139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
1mm.

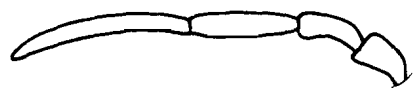


157



158

159



160

161

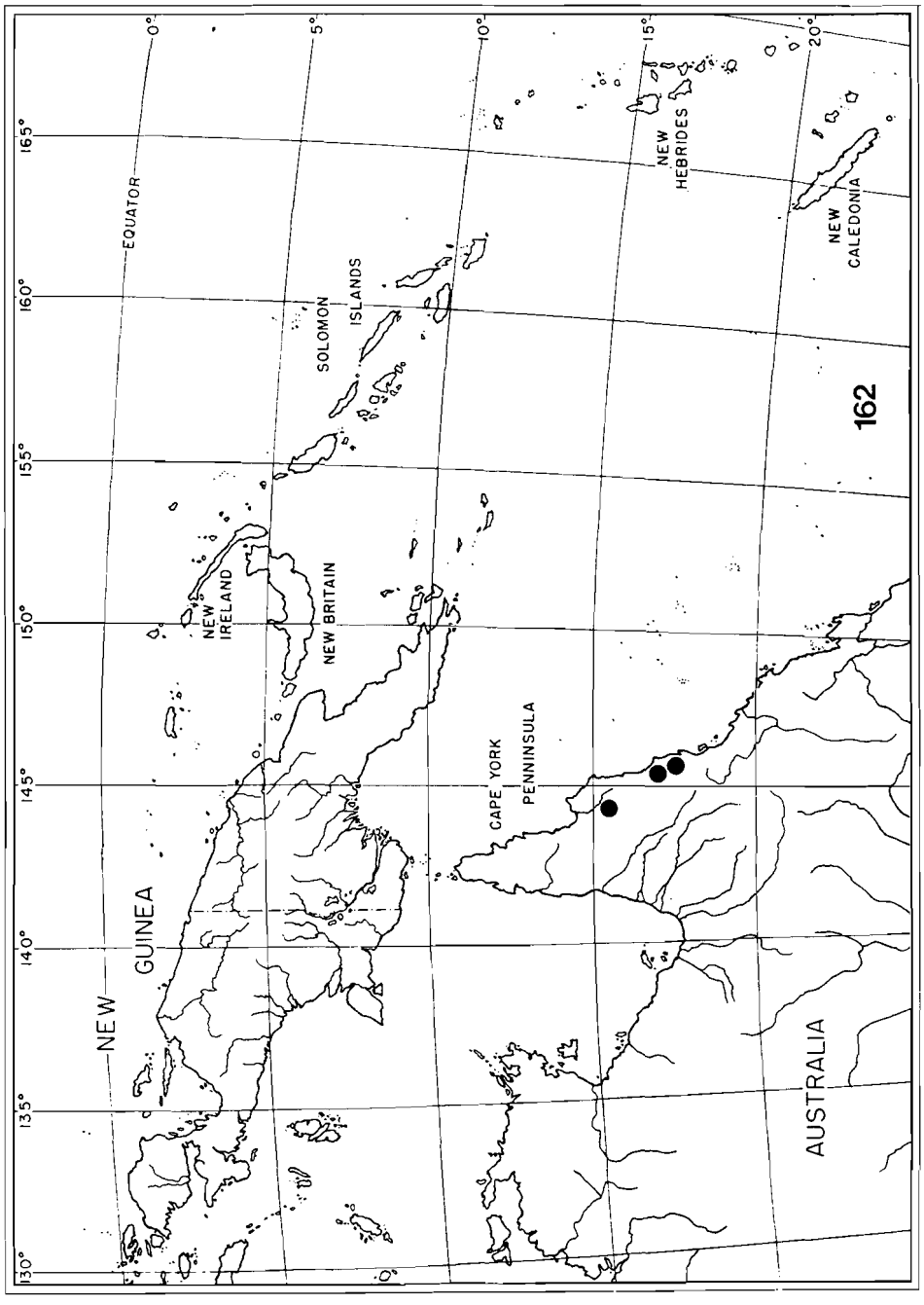


Fig. 162: Distribution of *Aphelocheirus* (*A.*) *australicus* Usinger in Australia.

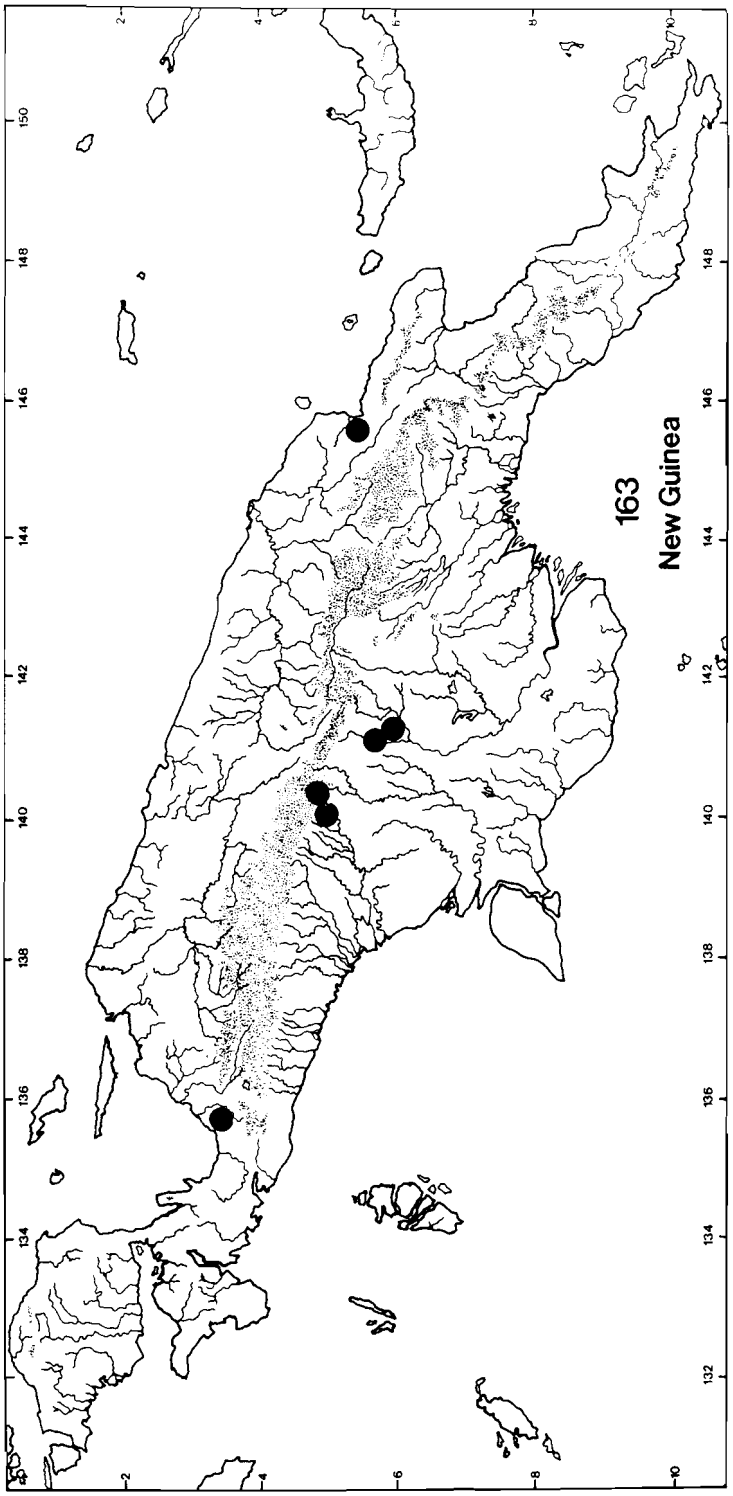


Fig. 163: Distribution of *Aphelocheirus (A.) pallens* Horvath in New Guinea. Areas above 2000 m. shaded.

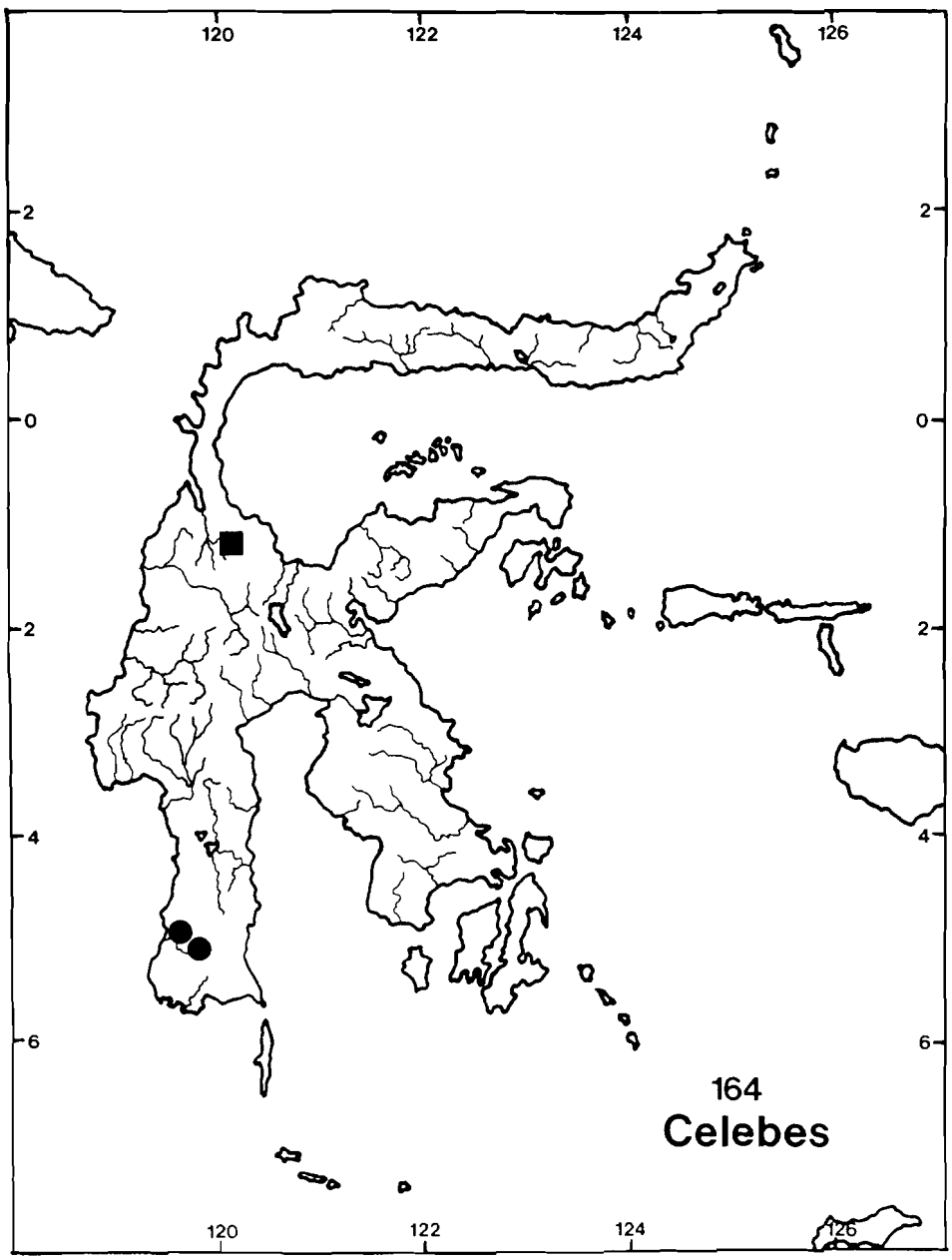


Fig. 164: Distribution of *Aphelocheirus* species in Celebes.
Circles = *A.* (*A.*) *celebensis* n.sp.
Squares = *A.* (*A.*) *lorelindu* n.sp.

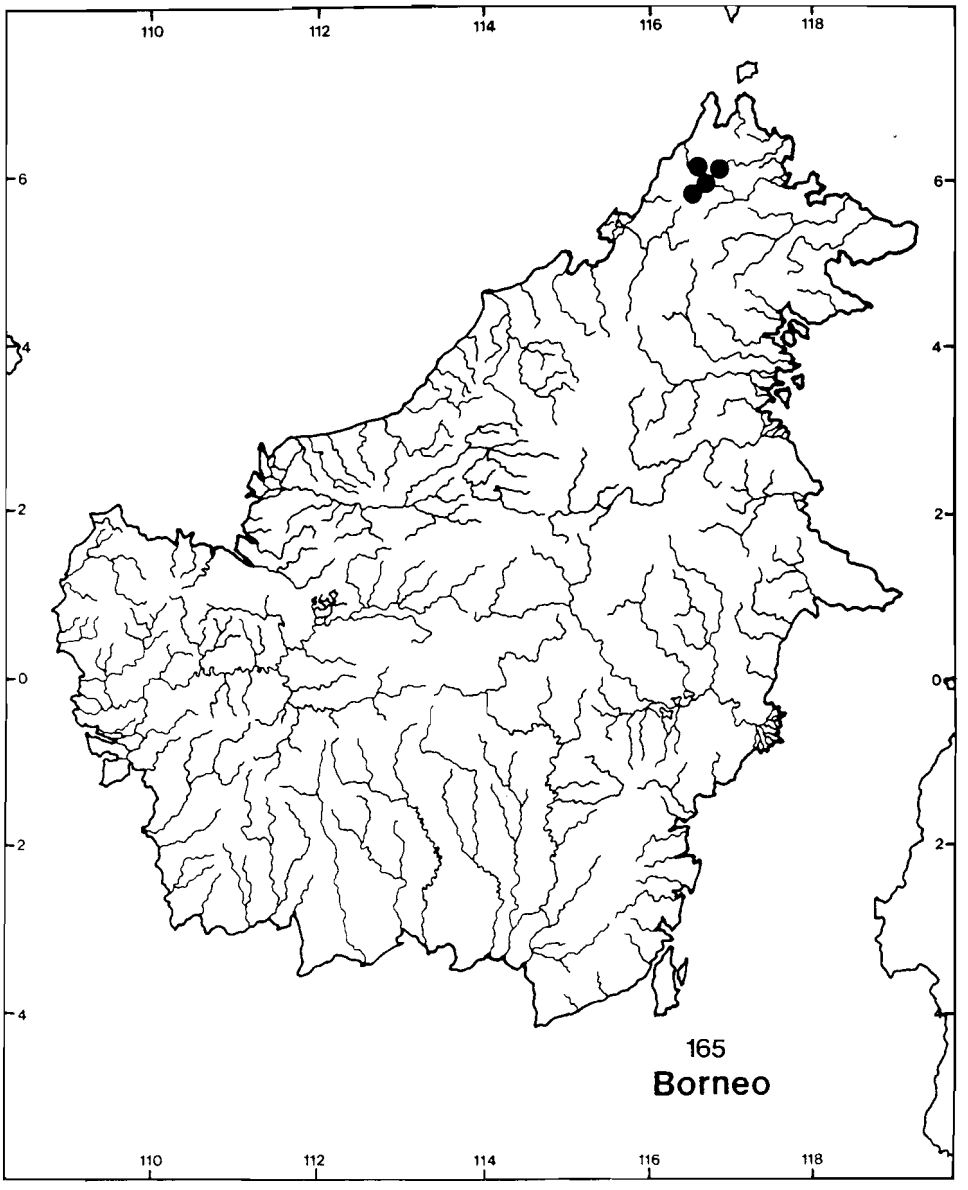


Fig. 165: Distribution of *Aphelocheirus* (*A.*) *minor* n.sp. in Borneo.

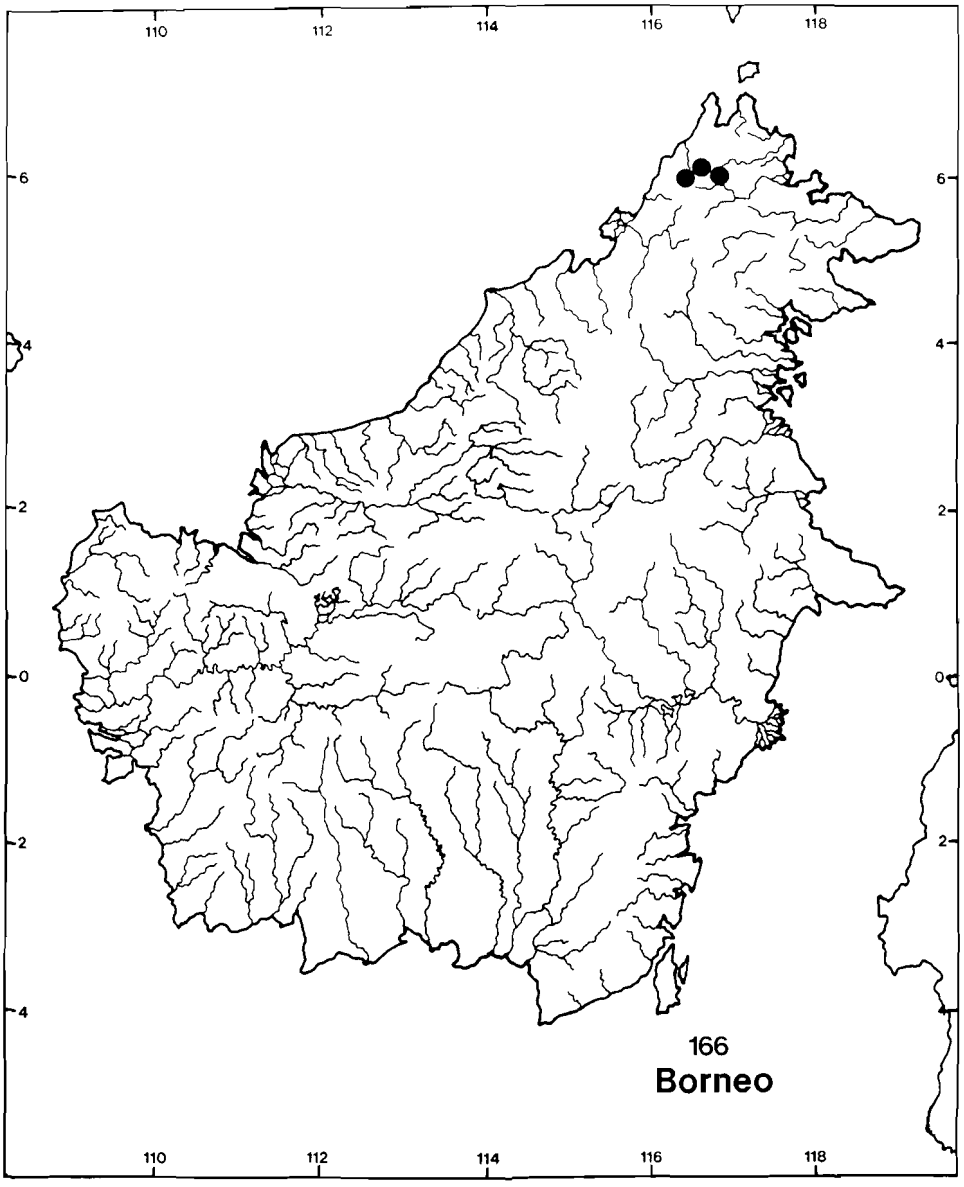


Fig. 166: Distribution of *Aphelocheirus* (*A.*) *kinabalu* n.sp. in Borneo.

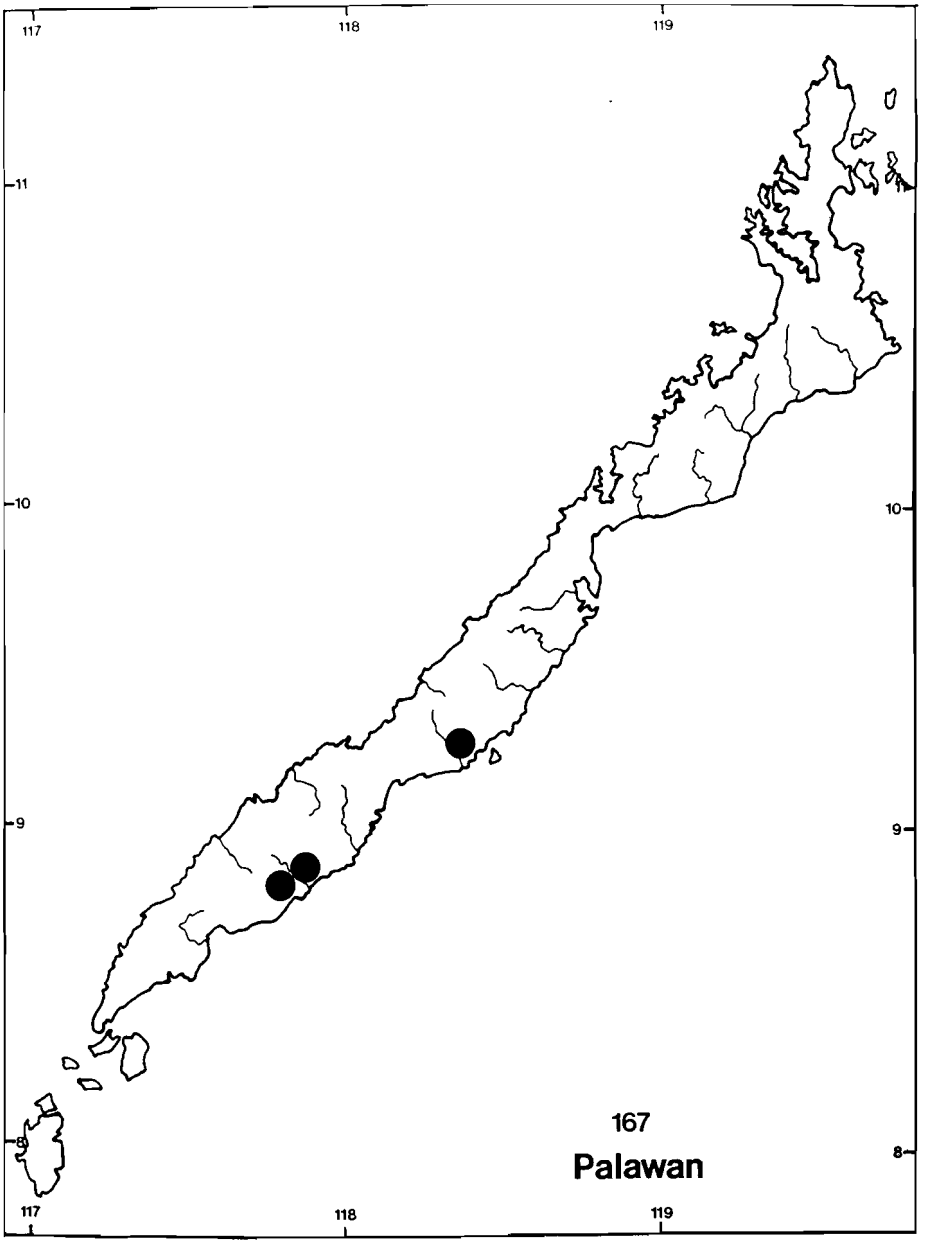


Fig. 167: Distribution of *Aphelocheirus* (*A.*) *palawanensis* n.sp. on Palawan.

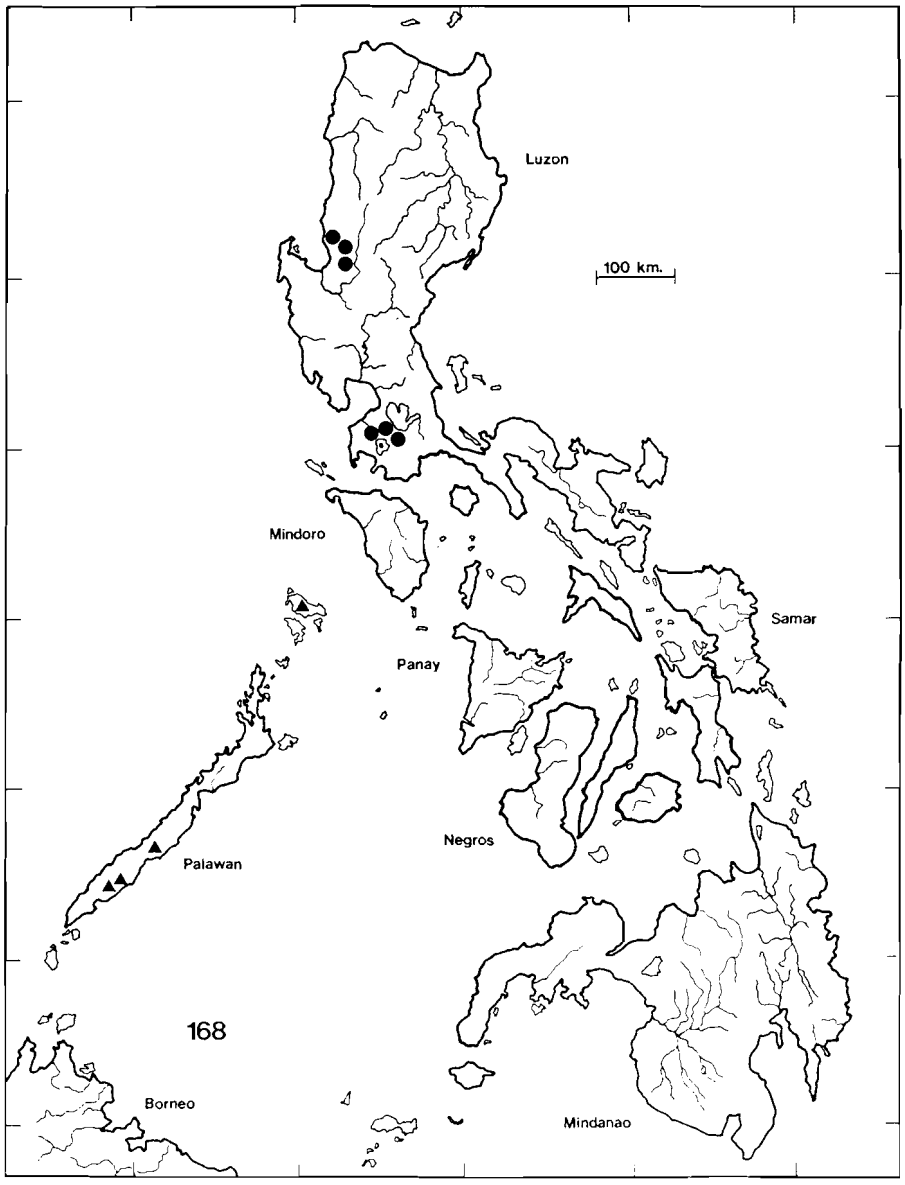


Fig. 168: Distribution of *Aphelocheirus* species in the Philippines.
Circles = *A.* (*A.*) *uichancoi* Usinger
Triangles = *A.* (*A.*) *palawanensis* n.sp.

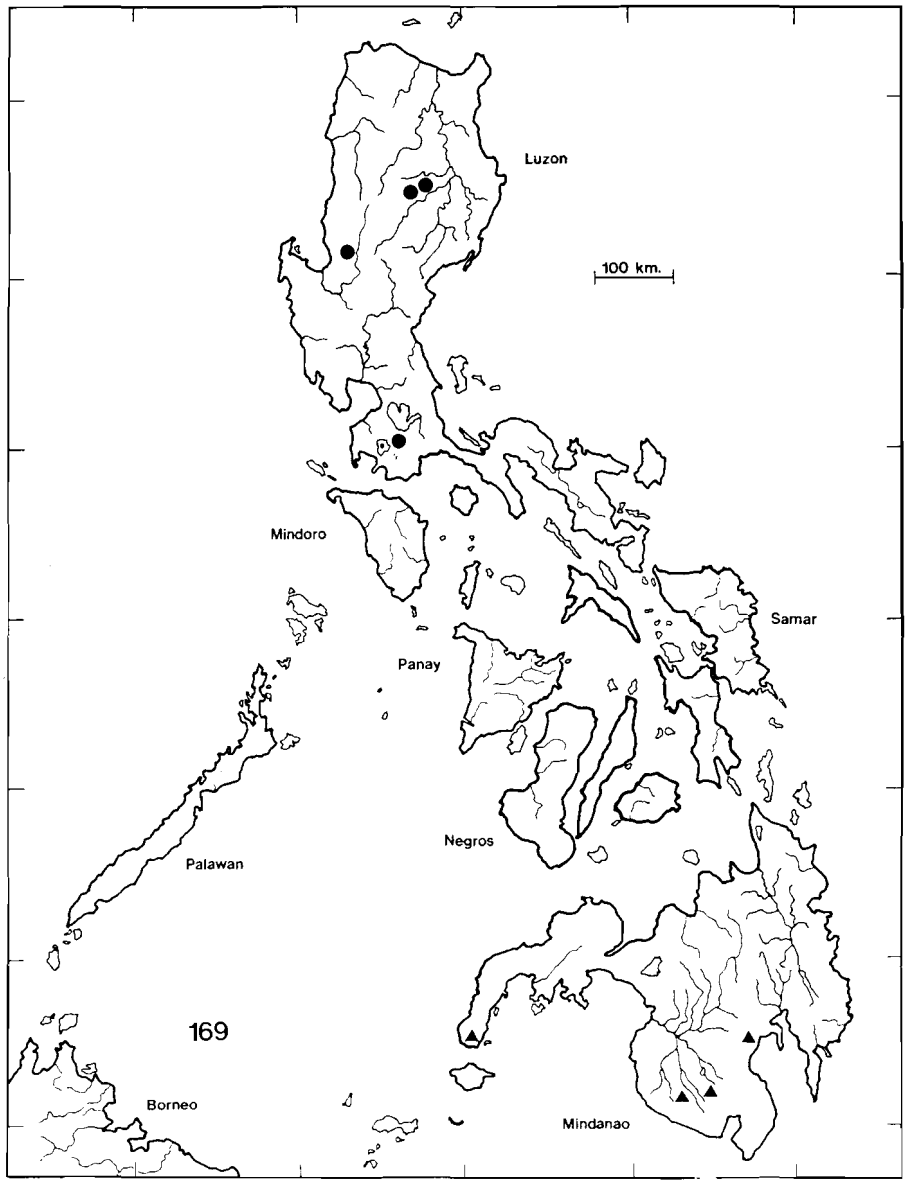


Fig. 169: Distribution of *Aphelocheirus* species in the Philippines.
Circles = *A.* (*A.*) *philippinensis* Usinger
Triangles = *A.* (*A.*) *zamboanga* n.sp.

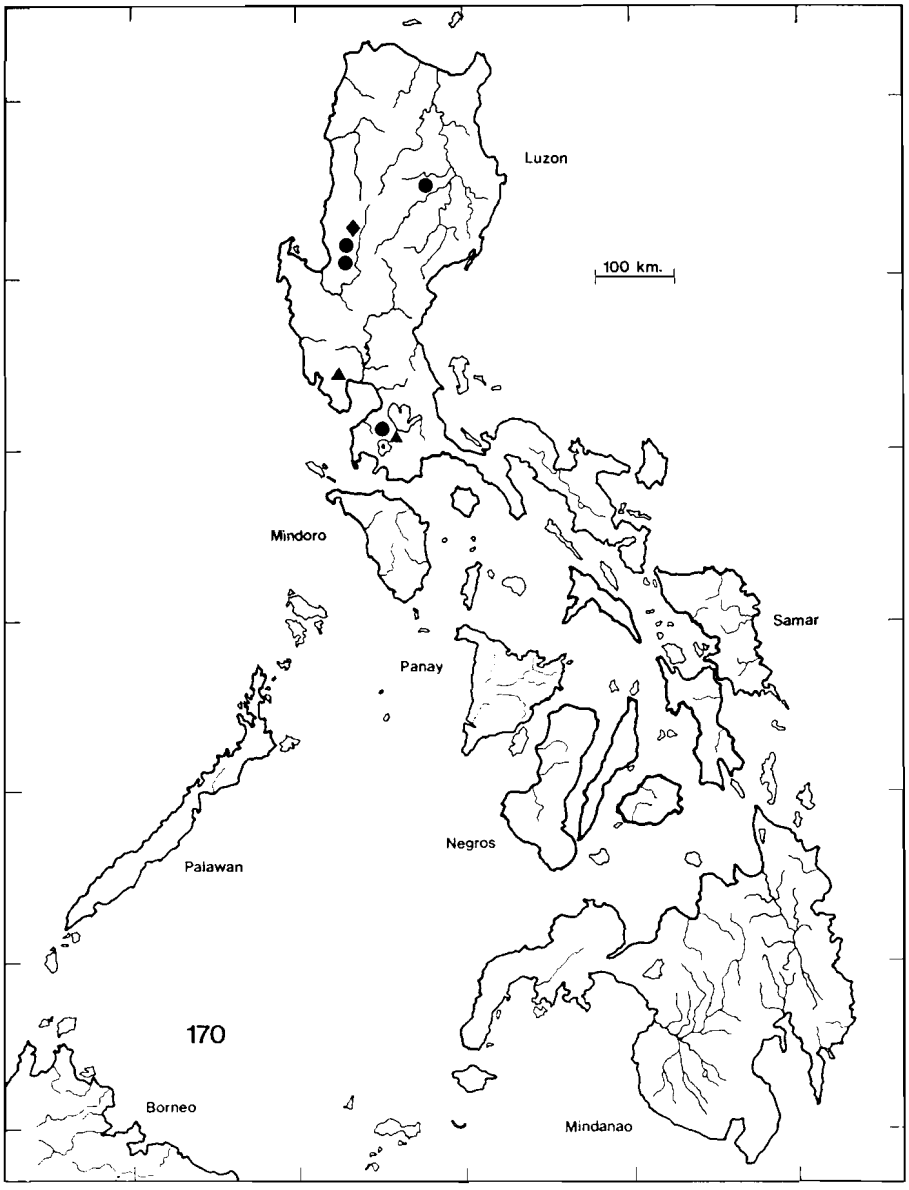


Fig. 170: Distribution of *Aphelocheirus* species in the Philippines.
Circles = *A.* (*A.*) *sculpturatus* n.sp.
Triangles = *A.* (*A.*) *luzonicus* n.sp.
Diamonds = *A.* (*A.*) *baguio* n.sp.

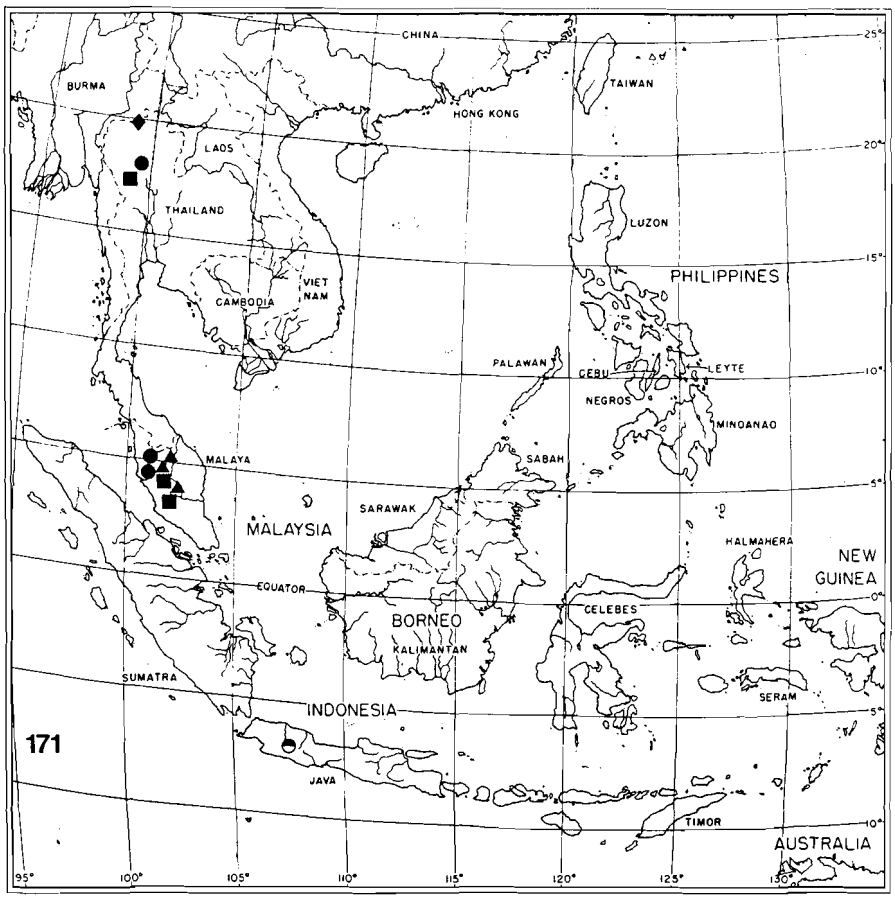


Fig. 171: Distribution of *Aphelocheirus* species in Southeast Asia.
Circles = *A.* (*A.*) *grik* n.sp.
Squares = *A.* (*A.*) *femoratus* n.sp.
Triangles = *A.* (*A.*) *malayensis* n.sp.
Diamonds = *A.* (*A.*) *lahu* n.sp.
Half-filled circles = *A.* (*A.*) *javanicus* n.sp.

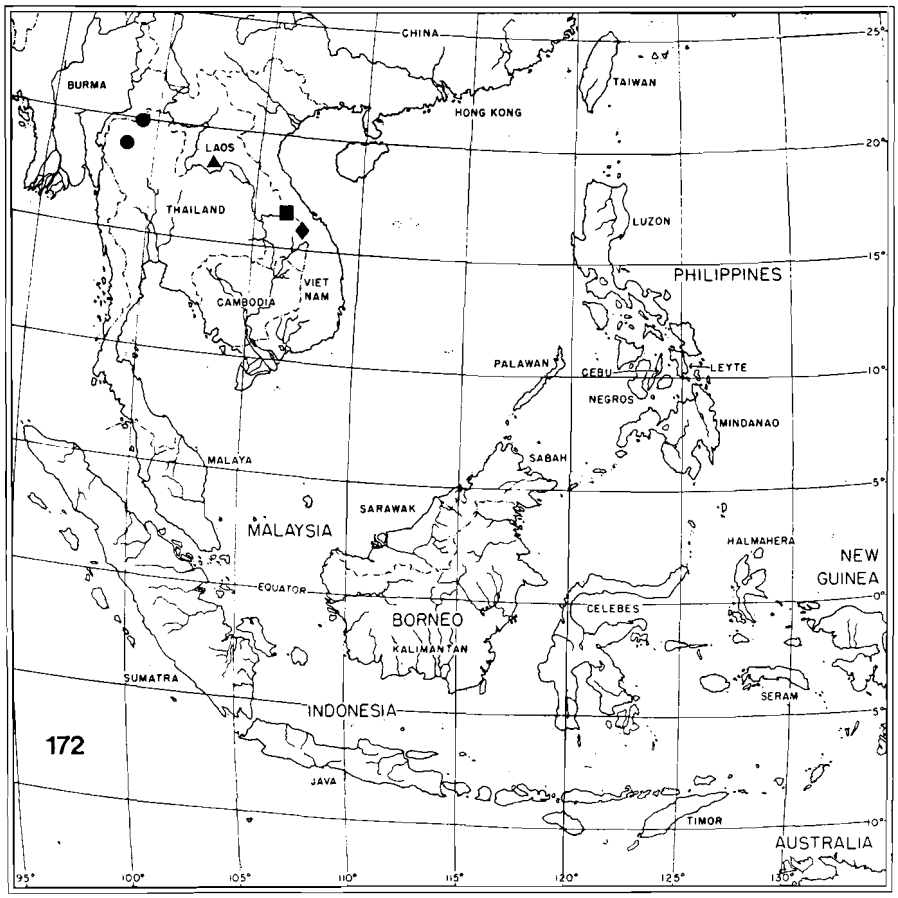


Fig. 172: Distribution of *Aphelocheirus* species in Southeast Asia.
Circles = *A.* (*A.*) *fang* n.sp.
Squares = *A.* (*A.*) *gularis* (Horvath)
Triangles = *A.* (*A.*) *lao* n.sp.
Diamonds = *A.* (*A.*) *inops* (Horvath)

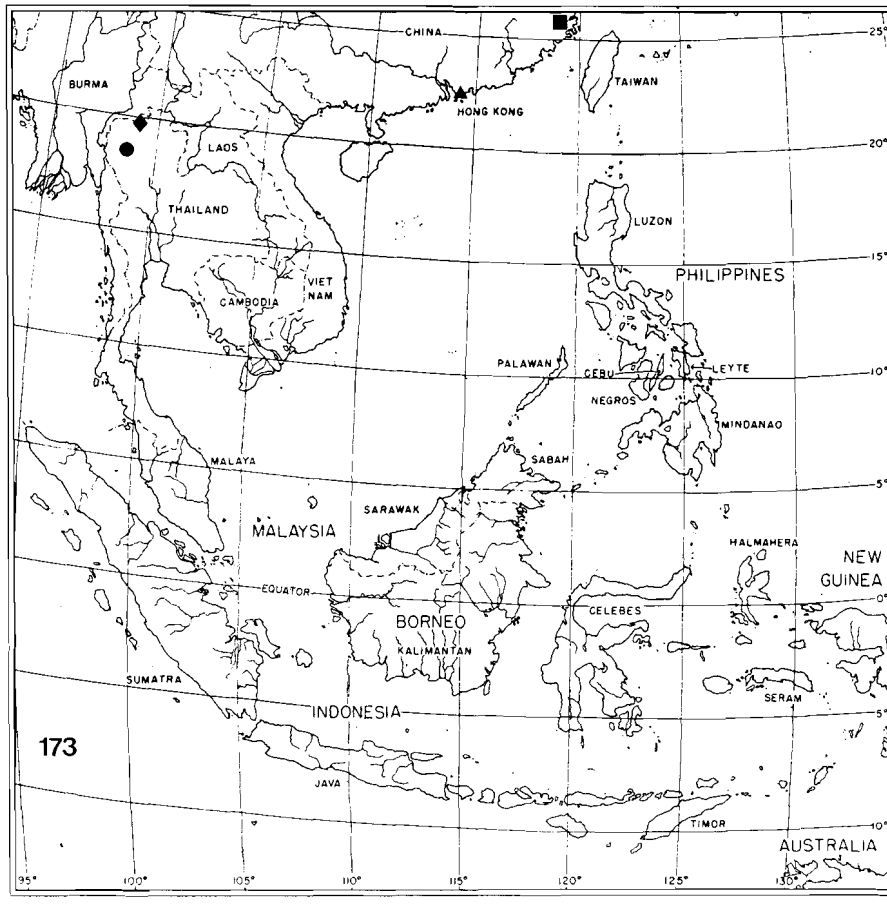


Fig. 173: Distribution of *Aphelocheirus* species in Southeast Asia.
Circles = *A.* (*A.*) *petersi* n.sp.
Squares = *A.* (*A.*) *denticeps* Montandon
Triangles = *A.* (*A.*) *dudgeoni* n.sp.
Diamonds = *A.* (*A.*) *thai* n.sp.

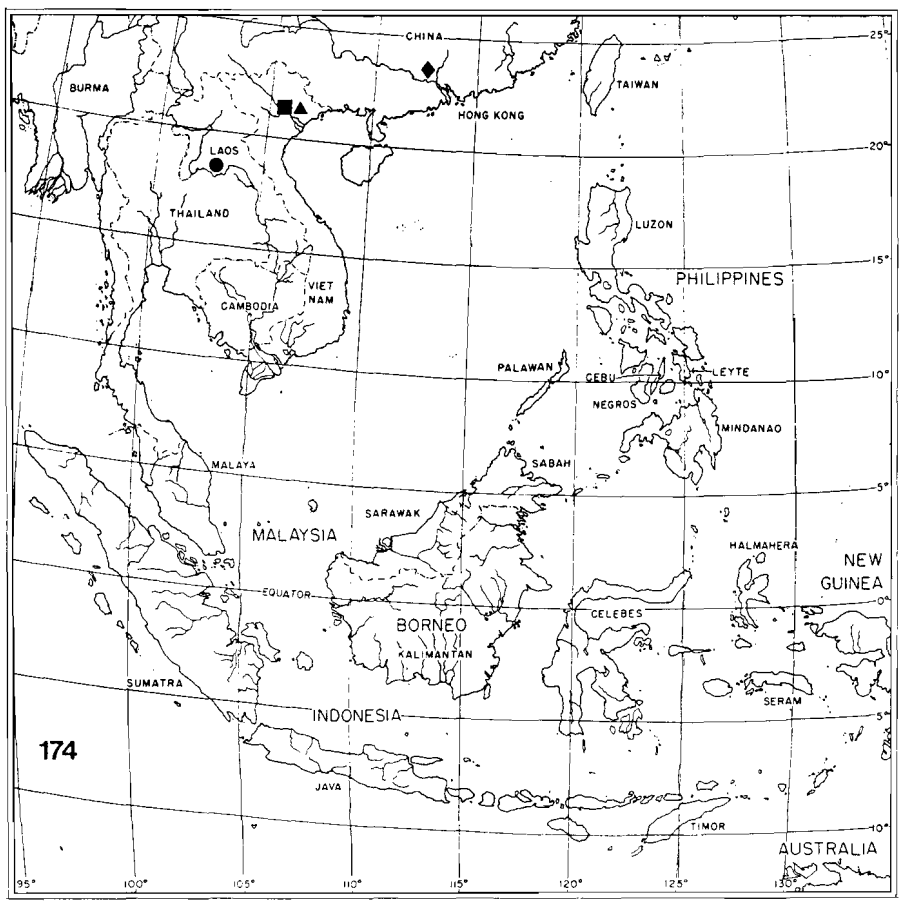


Fig. 174: Distribution of *Aphelocheirus* species in Southeast Asia.
Circles = *A.* (*A.*) *ashlocki* n.sp.
Squares = *A.* (*A.*) *carinatus* (Royer)
Triangles = *A.* (*A.*) *similaris* n.sp.
Diamonds = *A.* (*A.*) *cantonensis* n.sp.

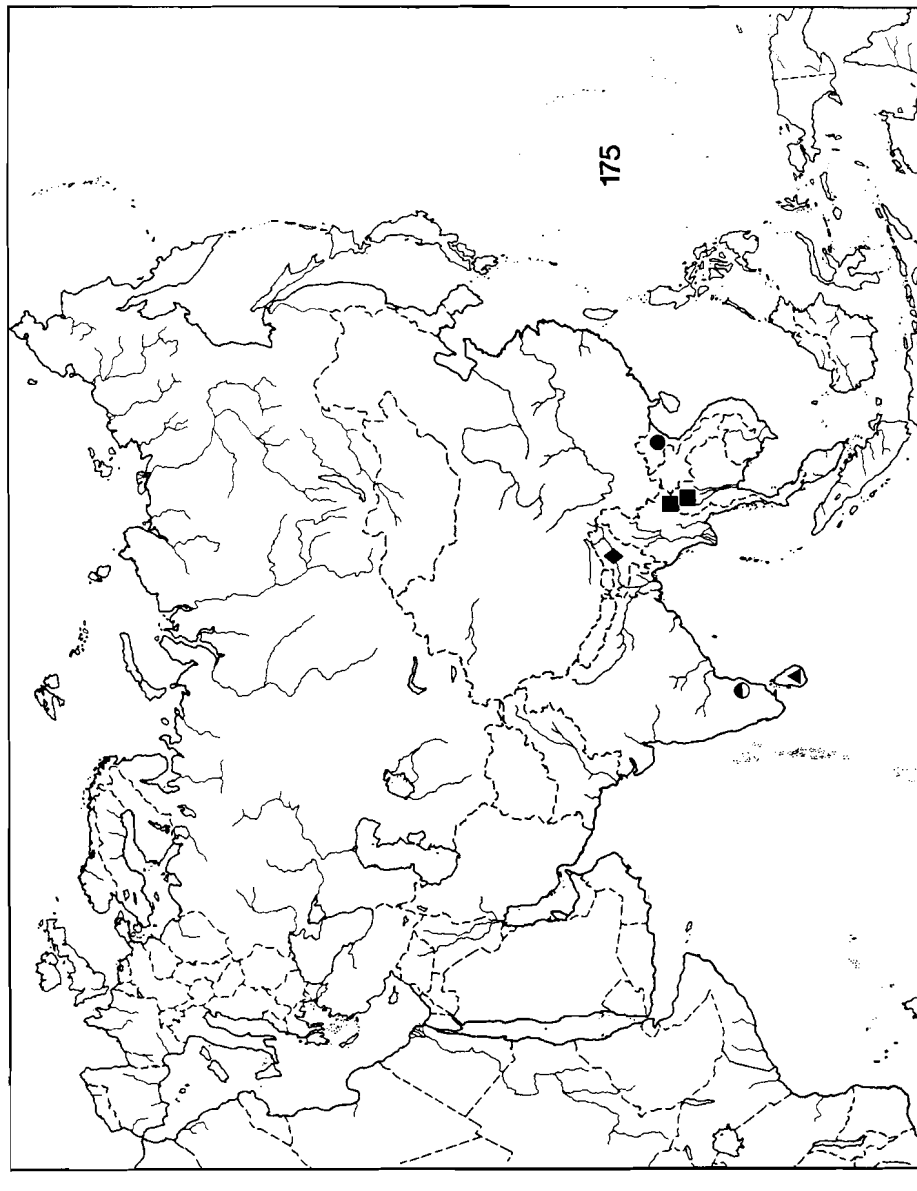


Fig. 175: Distribution of *Aphelocheirus* species in Asia.
Circles = *A.* (*M.*) *asiaticus* (Hoberlandt and Štys)
Squares = *A.* (*M.*) *brevirostris* n.sp.
Triangles = *A.* (*M.*) *clivicolus* J. Polhemus
Diamonds = *A.* (*M.*) *pygmaeus* La Rivers
Half-filled circles = *A.* (*A.*) *nathani* La Rivers