

STONEFLIES (Plecoptera) FROM SOUTHEAST ASIA¹By Teizi Kawai²

I have had an opportunity to examine specimens of stoneflies collected by members of Bishop Museum, Hawaii from SE Asia, Borneo, Philippines, Thailand and Viet Nam. These consist of 16 species (4 of which are new to science) which fall into 8 genera belonging to 4 families. Our knowledge of the stonefly fauna of SE Asia is very incomplete and it is evident that a large number of species remain unknown. Although many species have been described by European and American authors from these regions, most of the descriptions and figures are inadequate (Banks 1913-1939; Navas 1924-1934; Klapálek 1909-1923).

The specimens examined by me are as follows:

Borneo: *Peltoperlopsis concolor* (Banks), 3 ♀♀; *Amphinemura minuta* n. sp., 2 ♂♂, 3 ♀♀; *Nemoura* sp., 5 ♀♀; *Phanoperla anomala* (Banks), 1 ♂, 1 ♀. Philippines: *Peltoperlopsis mindanensis* (Banks), 4 ♂♂, 1 ♀; *Rhopalopsole femina* sp. nov., 1 ♀; *Neoperla oculata* Banks, 1 ♂. Thailand: *Peltoperlopsis sinensis* (Wu & Claassen), 4 ♂♂, 1 ♀; *Protonemura filigerai* sp. nov., 2 ♂♂; *Amphinemura* sp., 1 ♀. *Nemoura* sp., 1 ♀. Viet Nam: *Peltoperlodes bisaeta* Kawai, 1 ♀; *Amphinemura handschini* Gijsskes, 1 ♂; *Amphinemura gressitti* n. sp., 1 ♂; *Protonemura* sp., 1 ♀; *Nemoura* sp., 4 ♀♀; *Rhopalopsole* sp., 1.

The type specimens described in this article are deposited in the Bishop Museum, Hawaii.

I wish to express my sincere thanks to Prof. Dr Joachim Illies for his kindness in placing this interesting material at my disposal. I am also indebted to Mr and Mrs McLellan for reading and correcting my manuscript.

PELTOPERLIDAE

Peltoperlopsis concolor (Banks), 1931, *J. Fed. Malay St. Mus.* **16**: 411.—Köhno, 1946, *Ins. World* **50**: 13.—Hitchcock, 1962, *Bull. Brookl. Ent. Soc.* **62**: 83.—Illies, 1966, *Tierreich* **82**: 24.

LOCALITY: BORNEO: 1 ♀, Sabah, Tawau, Quoin Hill, Cocoa Res. Sta., 16.IX.1962, K. J. Kuncheria; 1 ♀, Sabah, Tenompok, Mt. Kinabalu, 3.IX.1958, T.C. Maa; 1 ♀, Sabah (SE), Tawau, Quoin Hill, Coca Res., 20.IX.1962, by Malaise trap, Y. Hirashima.

The species was originally described from Mt. Kinabalu and is known to be distributed in Borneo only. The present specimens are identical in the venation and other morphological characters by Hitchcock's redescription.

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2. Limnologische Flußstation des Max-Planck-Instituts für Limnologie, Schlitz, Germany. Permanent address: Zoological Institute, Nara Women's University, Japan.

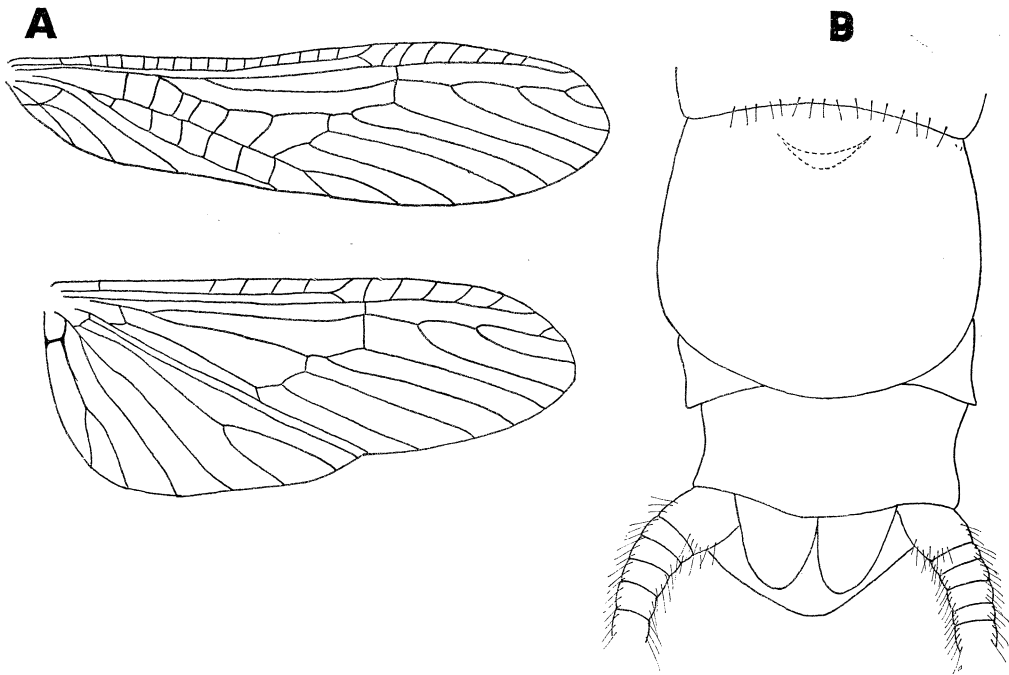


Fig. 1. *Peltoperlopsis concolor* (Banks): A, wings; B, ♀ terminal segments of abdomen, ventral view.

Subgenital plate of ♀ very large, with rounded hind margin covering most parts of 9th sternite. Cerci short, less than 10 joints, 1st joint normal.

Peltoperlopsis mindanensis (Banks), 1924, *Bull. Mus. Comp. Zool.* **45**: 426.—Kohno, 1946, *Ins. World* **50**: 13.—Jewett, 1958, *Fieldiana Zool.* **42**: 78.—Hitchcock, 1962, *Bull. Brookl. Ent. Soc.* **62**: 82.—Illies, 1966, *Tierreich* **82**: 25.

LOCALITY: PHILIPPINES: 2 ♂♂, Misamis Or., Mt. Balatukan, 15 km SW of Gingoog, 1000–1200 m, 1–5. V. 1960, H. Torreallas; 1 ♂, Mindanao, Surigao, L. Mainit, 23. XI–I. XII. 1959, C. M. Yoshimoto; 1 ♂, Misamis Or., Hindangon, 20 km S of Gingoog, 600–700 m, 20–24. IV. 1960, by light, H. Torreallas; 1 ♀, Misamis Or., Minalwang, 1050 m, 24. III–4. IV. 1961, H. Torreallas.

The penial armature is membranous, anterior end bipartite with a minute membraneous filament on each tip, between which is present a membraneous process.

Peltoperlopsis sinensis (Wu & Claassen), 1934, *Bull. Peking Nat. Hist.* **9**: 125.—Wu, 1938, *Plecop. Simm.*, 158.—Kohno, 1946, *Ins. World* **50**: 13.—Kimmins, 1950, *Ann. Mag. Nat. Hist.* **3**: 196.—Illies, 1966, *Tierreich* **82**: 25.

LOCALITY: THAILAND: 4 ♂♂, 1 ♀, Chiangmai, Doi Sutep, 29. III–5. V. 1958, T. C. Maa.

The species was originally described from Szechuan in China. Kimmins (1950) reported finding this species in the Himalayas. I have examined 4 ♂♂ and 1 ♀ of this species for

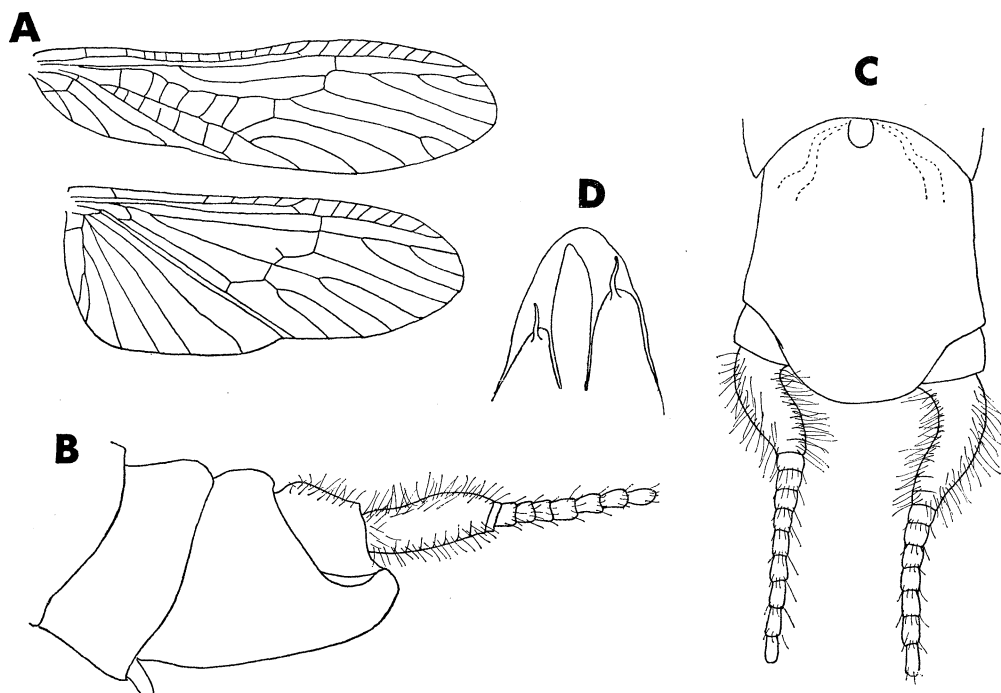


Fig. 2. *Peltoperlopsis minadanensis* (Banks): A, wings; B, ♂ terminal segments of abdomen, lateral; C, The same, ventral view; D, Tip of penial armature, dorsal view.

the first time from Thailand. It is identical in the venation, genital and cercal characters of ♂ by Wu's redescription in his monograph.

The penial armature is membranous, with rounded tip which has a membranous process.

Peltoperlodes bisaeta Kawai, 1968, *Orient. Ins.* 2: 109.

LOCALITY: VIET NAM: 1 ♀, Dok Song, 76 km SE of Ban Me Thout, 870 m, 19-21.V. 1960, L. W. Quate.

NEMOURIDAE

Amphinemura minuta Kawai, new species

Holotype ♂ (BISHOP 8234), Sabah=North Borneo (SE), Forest Camp, 19 km N of Kalabakan, 10.X.1962, Y. Hirashima. Paratype: 1 ♂, 1 ♀, same data as holotype; 1 ♀, North Borneo, Tenompok, 1460 m, 48 km E of Jesselton, 2-4.II.1959, T.C. Maa; 1 ♀, North Borneo, Ranau, 500 m, 8-18.X.1958, L. W. Quate.

♂. Very small blackish-brown stonefly, less than 5 mm long in both sexes. Head wider than prothorax; with a few irregular black spots in front of anterior ocellus and an oblong pale brown

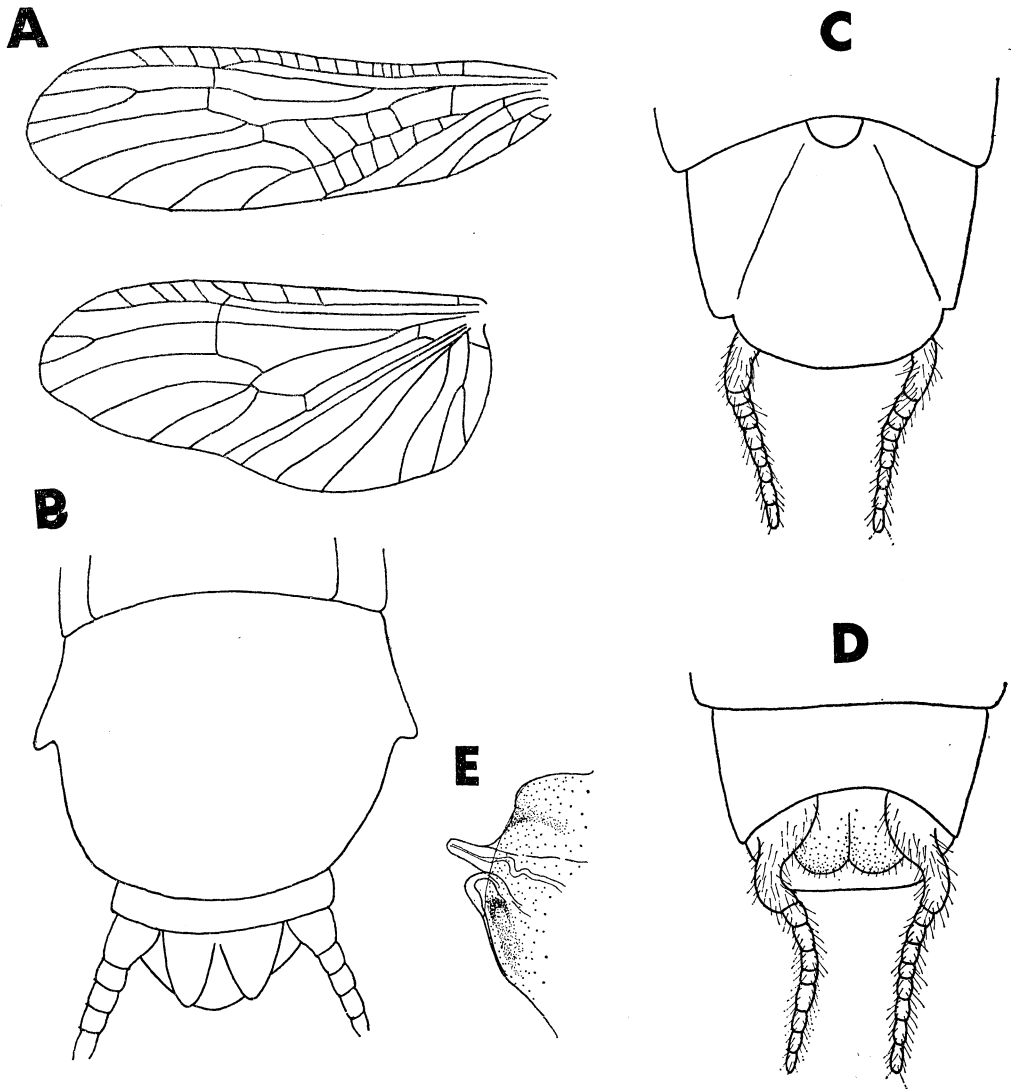


Fig. 3. *Peltoperlopsis sinensis* (Wu & Claassen): A, wings; B, ♀ terminal segments of abdomen, ventral; C, ♂ terminal segments of abdomen, ventral; D, the same, dorsal view; E, tip of penial armature, lateral view.

marking behind posterior ocelli; with 3 distinct ocelli, posterior two larger than anterior one, and distance between them nearly $2\times$ that between posterior one and inner margin of compound eye.

Pronotum quadrate, blackish brown, nearly as wide as long, all angles rounded; 4 pale brown markings present on dorsal surface; 2 tadpole-shaped marks on both lateral margins and 1 triangular mark on middle of frontal and hind margins with a small black spots on both lateral

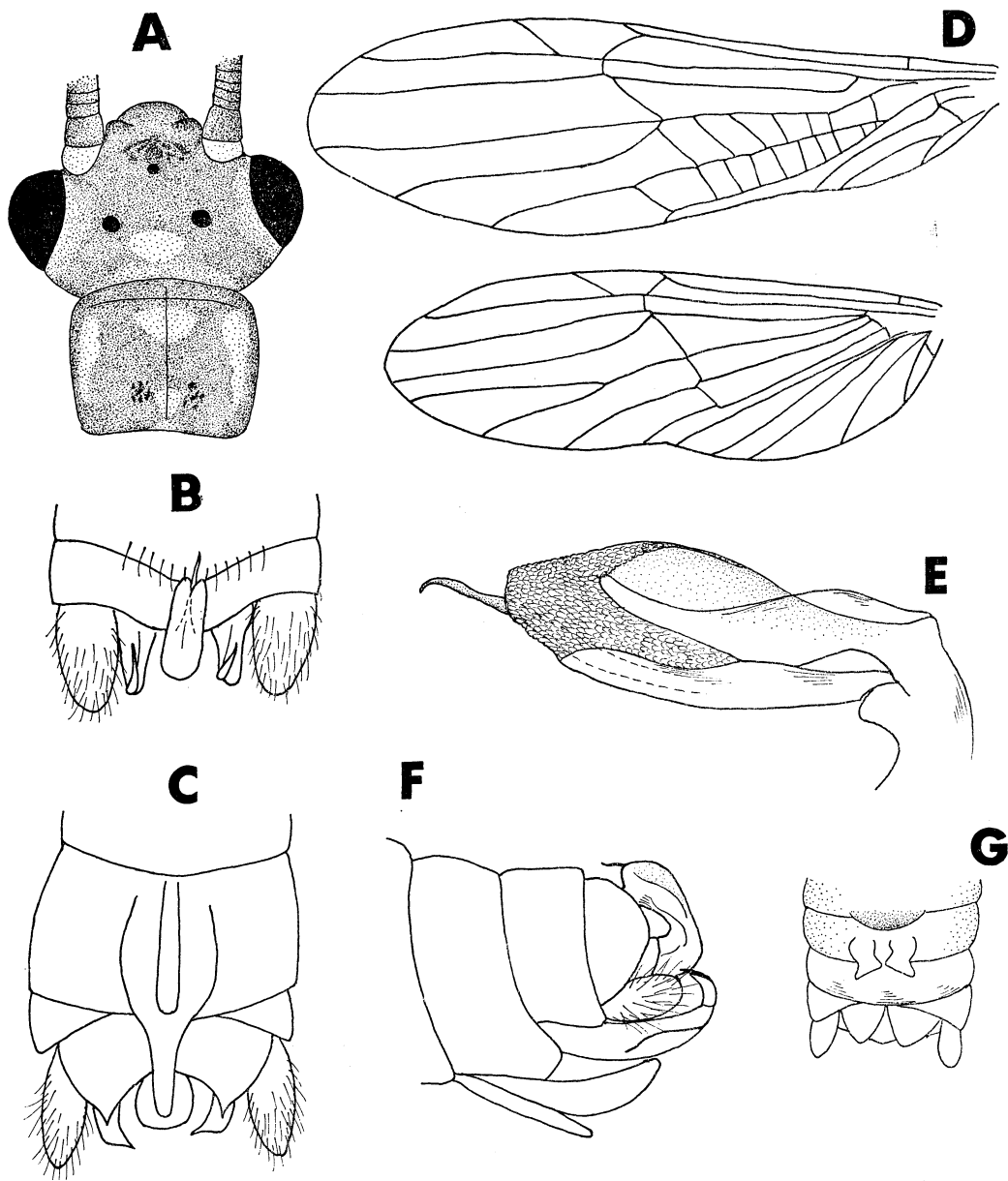


Fig. 4. *Amphinemura minuta* n. sp.: A, head and prothorax; B, ♂ terminal segments of abdomen, dorsal; C, the same, ventral; F, the same, lateral view; D, wings; E, supra-anal process, lateral view; G, ♀ terminal segments of abdomen, ventral view.

sides. Legs rather slender and long. Wings subhyaline, veins dark brown, venation characteristic of the genus.

Abdomen cylindrical, membranous but last 2 segments heavily chitinized. Subanal lobe triangular, produced a little backwards, ending in a sharp upturned hook with a black tip. Cerci small, heavily chitinized and hairy. Supra-anal process very small, heavily chitinized, middle part covered with membrane, with a narrow filamentous process on tip. Subgenital plate longer than wide, oblong, gradually narrowed posteriorly with a blunt tip; ventral lobe slender, nearly 1/2 as long as subgenital plate, extending a little beyond hind margin of 9th sternite.

♀. Similar to ♂ in most morphological features but a little larger. 7th sternite produced into a small semicircular subgenital plate, which is strongly chitinized at hind margin. Middle of 8th sternite with a pair of vaginal lobes.

	Body length mm	Fore wing mm	Hind wing mm
♂	4.5	5.5	4.6
♀	5.5	5.8	4.5

Remarks: This species is similar to *Amphinemura handschini* Gijskes, but is easily separable from the latter by the characters of the subanal lobe and subgenital plate.

Amphinemura handschini Gijskes, 1937, *Rev. Suisse Zool.* **44**: 147; 1952, *Arch. Hydrobiol. Suppl.* **21**: 283.—1966, Illies, *Tierreich* **82**: 181.

LOCALITY: VIET NAM: 1 ♂, Dalat, 1300 m, 12. IX. 1960, Gressitt.

Amphinemura gressitti Kawai, new species

Holotype ♂ (BISHOP 8235), Viet Nam, Dalat, 1550 m, 11. IX. 1960, Gressitt.

♂. Very small in size. General color brown with blackish-brown markings on head and prothorax. Head wider than prothorax, brown, frontal margin blackish brown, with a large blackish-brown marking between 3 ocelli, 1 translucent pale-brown marking situated just behind large blackish-brown marking and another between each posterior ocellus and inner margin of compound eye. With 3 ocelli, black, anterior one a little smaller than posterior two, distance between posterior 2 nearly 3 × as far as between posterior one and inner margin of compound eye. Dorsal callosities distinct, small, triangular and black.

Pronotum quadrangular, nearly as wide as long, brown, frontal and both lateral margins blackish brown, with a large symmetrical blackish-brown marking on dorsal surface. Legs slender and long, brown. Wings subhyaline, veins brown.

Abdomen cylindrical, membranous, except last 2 segments, but 1st to 7th segments with a pair of small chitin plates on anterior margin of both sides of each tergite, which are large and extend laterally towards apex of segment. 9th segment heavily chitinized, with a membranous area at middle, which receives tip of supra-anal process.

Subanal lobe divided into 2 lobes—inner lobe slender and pointed at tip and outer lobe very modified and recurved upwards and backwards; apical part expanded with 2 sharp pointed spines, one of which is slender and long, situated on middle and the other very short and situated on inner margin which is hairy. Supra-anal process wide and short, recurved on 9th tergite, gradually expanded at tip, which is bipartite with a pair of slender processes at middle; covered with thin membrane which is clothed with many minute spines on apical and lateral margins. Cerci blunt and hairy. Subgenital plate longer than wide, shield-shaped, extending beyond end

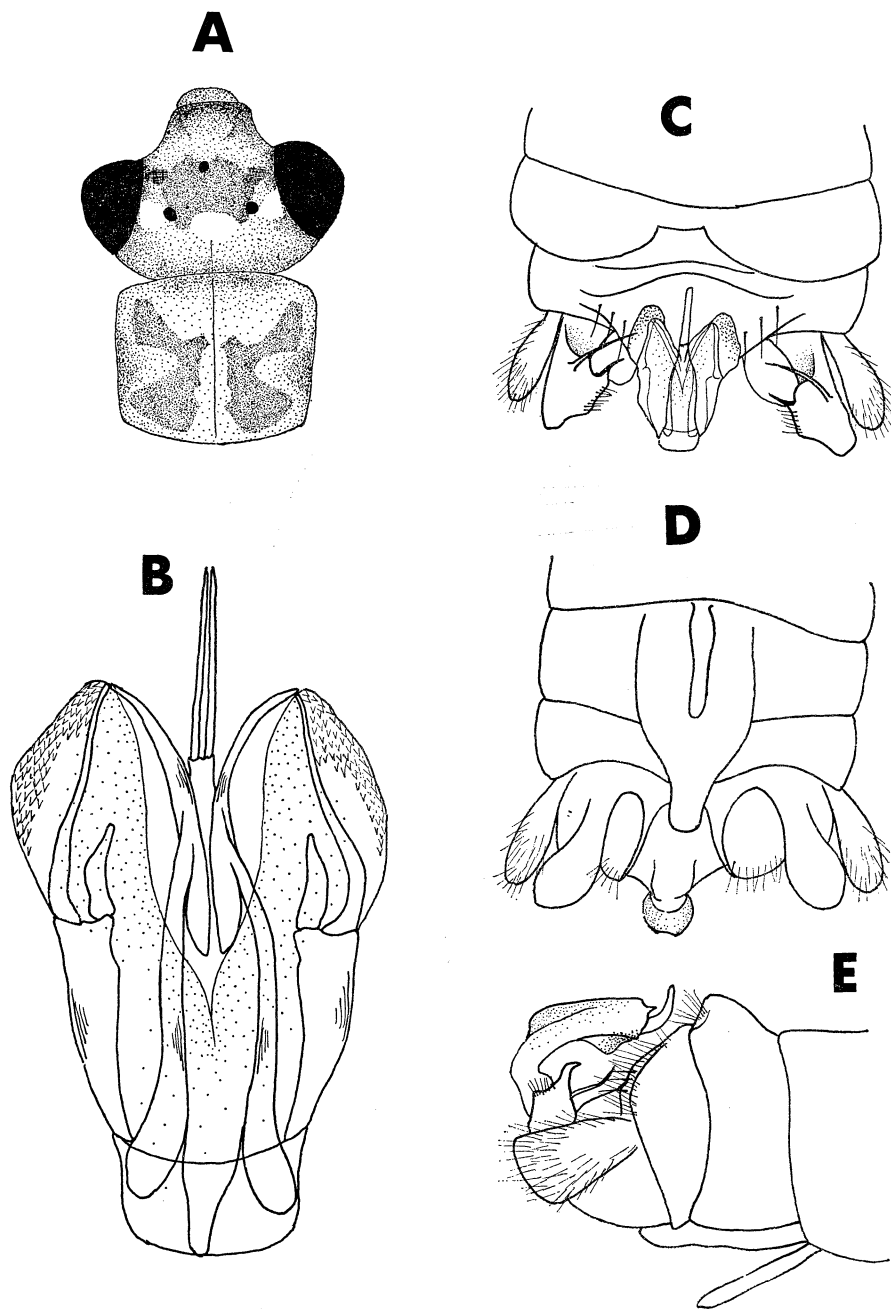


Fig. 5. *Amphinemura gressitti* n. sp.: A, head and prothorax; B, supra-anal process, dorsal view; C, ♂ terminal segments of abdomen, dorsal; D, the same, ventral; E, the same, lateral view.

of abdominal segment; ventral lobe nearly $1/2$ as long as subgenital plate, reaching posterior margin of 8th sternite.

♀. Unknown.

Length of body 5.5 mm, of fore wing 6 mm and of hind wing 4.8 mm.

Remarks: This new species is closely related to *Amphinemura minuta* Kawai and *Amphinemura handshini* Gijskes, but differs from the latter by the markings on head and prothorax and the features of subanal lobe and supra-anal process.

***Amphinemura* sp.**

LOCALITY: THAILAND: 1 ♀, (S), Banna, Chawan, N of Nabon, 4. IX. 1958, J. L. Gressitt.

***Nemoura* sp.**

LOCALITY: BORNEO: 1 ♀, Sarawak, Kapit District, Meriai Vall, 28-31. VII. 1958, T. C. Maa; 1, Tawau, Quoin Hill, 8-14. VII. 1962, by Malaise trap, H. Holtmann; 1 ♀, Tenompok, 1460 m, 48 km E of Jesselton, 2-4. II. 1959, T. C. Maa; 1 ♀, Forest Camp, 9.8 km SW of Tenom, 18. XII. 1962, K. J. Kuncheria; 1 ♀, Borneo, Sarawak, Gungong Matang, 14. IX. 1958, J. L. Gressitt & T. C. Maa. VIET NAM: 3 ♀♀, Fyan, 900-1000 m, 11. VII-9. VIII. 1961, N. R. Spencer; 1 ♀, Mt. Lang Biam, 1500-2000 m, 19. V-8. VI. 1961, Spencer. THAILAND: 1 ♀, Chengmai, Fang, 500 m, 12-19. IV. 1958, T. C. Maa.

***Protonemura filigera* Kawai, new species**

Holotype ♂ (BISHOP 8236), Thailand, Chiangmai, Fang, 18. IV. 1958, T. C. Maa. Paratype: 1 ♂, same data as holotype.

♂. Very small stonefly. General color yellowish brown with a brown marking on head. Head wider than prothorax, yellowish brown, frontal margin (epistomal suture) dark brown, with a large brown marking on middle of head. With 3 ocelli, black, anterior one smaller than posterior two, distance between them nearly $3 \times$ that between posterior one and inner margin of compound eye. Dorsal callosities indistinct.

Pronotum quadrate, yellowish brown without markings, nearly as long as wide, with rounded angles. A pair of sausage-shaped gill vestiges present on ventral side of prothorax near frontal margin. Legs rather slender and long, yellowish brown, mid dorsal side of each femur and apical joints of each tarsus brown. Wings subhyaline, veins brown, a little smoked on pterostigma of both wings and anal fan of hind wing small; venation typical to that of the genus.

Abdomen cylindrical, membranous, last 2 segments heavily chitinized. Hind margin of 8th tergite concave anteriorly and with a row of bristles. 9th tergite divided into 2 sclerites, between which is membranous and receives tip of supra-anal process. Subanal lobe large, produced backwards and upwards, ending in a blunt tip; heavily chitinized except dorsal side with a membranous ball-like knob at tip. Two sharp-pointed spines on inner margin near tip. Supra-anal process small, membranous on dorsal side which has a pair of comb-like processes near tip and a remarkable filament on middle; heavily chitinized in ventral side with a group of small spines. Subgenital plate oval, wider in hind margin than in frontal margin, extending beyond hind margin of 9th sternite; ventral lobe long, nearly as long as subgenital plate, with a small expansion at near basal part. Cerci, single segmented, cylindrical, a little recurved inwards at tip, hairy.

♀. Unknown.

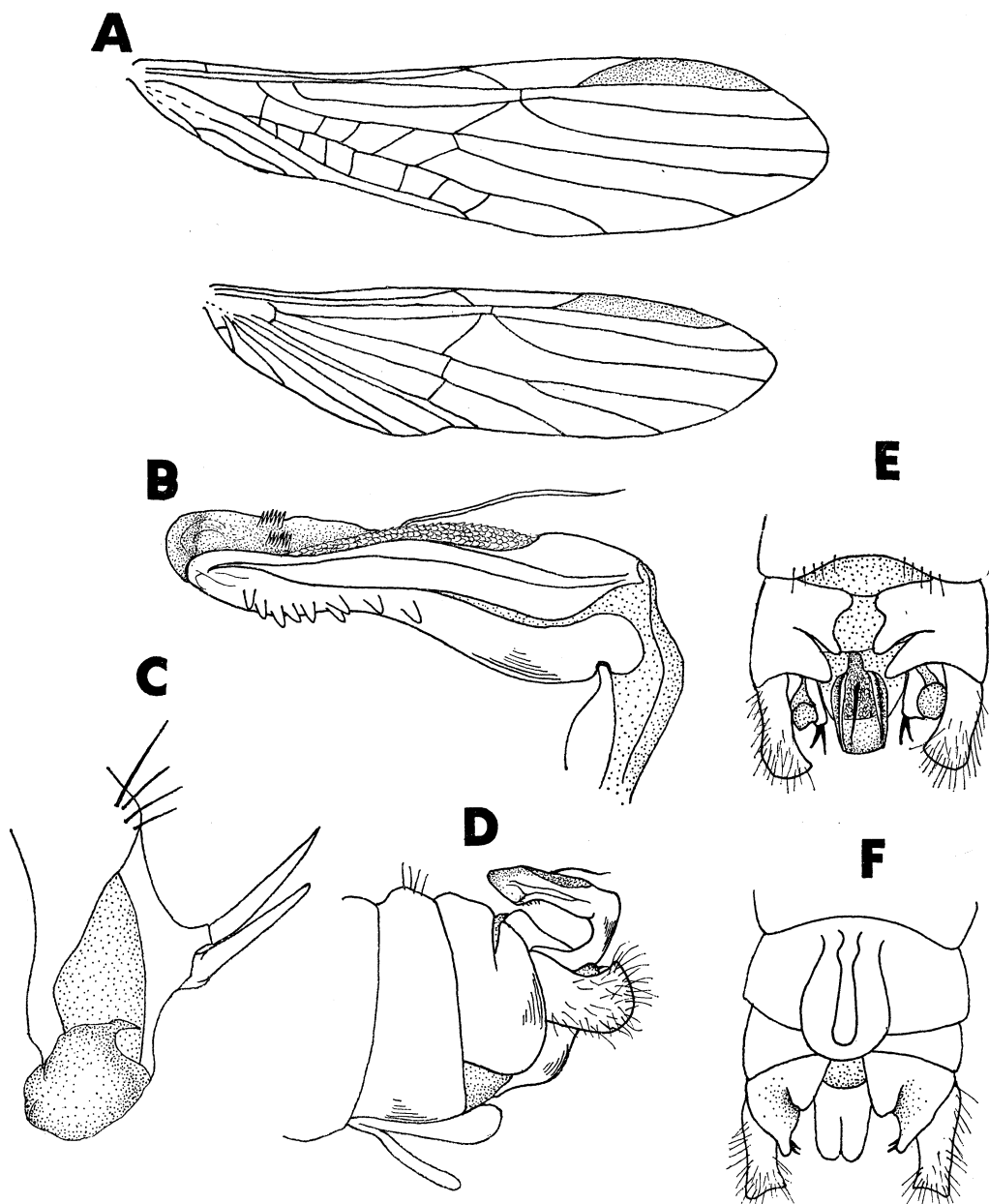


Fig. 6. *Protonemura filigera* n. sp.: A, wings; B, supra-anal process, lateral; C, subanal lobe, dorsal; D, ♂ terminal segments of abdomen, lateral; E, the same, dorsal; F, the same, ventral view.

Length of body, 5 mm, fore wing, 5 mm; hind wing, 4 mm.

Remarks: This species closely resembles *Protonemura pieli* Wu but differs in having a remarkable filament on the supra-anal process.

***Protonemura* sp.**

Locality: VIET NAM: 1 ♀, Dalat, 8. VI-7. VII. 1961, N. R. Spencer.

LEUCTRIDAE

***Rhopalopsole femina* Kawai, new species**

Holotype ♀ (BISHOP 8237), Philippine Is., Mountain Prov., Abatan, Buguias, 60 km S of Bontoc, 1800-2000 m, 11. V. 1964, by light trap, H. M. Torrevillas.

♀. General color brown, head darker. Head small without markings, dorsal callosities triangular, dark brown; with 3 small ocelli, distance between posterior two nearly $2.5\times$ as that between posterior one and inner margin of compound eye. Antennae slender and long, about half as long as body, 4.3 mm.

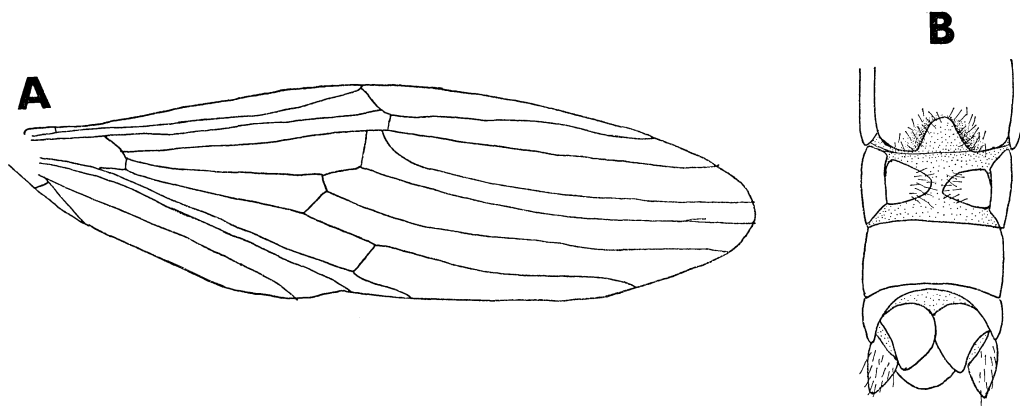


Fig. 7. *Rhopalopsole femina* n. sp.: A, hind wing; B, ♀ terminal segments of abdomen, ventral view.

Pronotum quadrangular, longer than wide, with many irregular dark brown markings on surface. Prosternal structure and venation of hind wing typical for the genus. Prothoracic presternum and precoxal bridge completely separated from basisternum which is Y-shaped. Prothoracic furcal sternum small and oblong, completely fused with end of basisternum. Cross-vein *m-cu* of hind wing joins upper branch of Cu_1 near at base and situated on inner part of the situation of cross-vein *m*.

Abdomen somewhat cylindrical, membranous except for last 2 segments. Subgenital plate of 7th sternite not so large, quadrate, middle of hind margin with a rounded notch which are heavily chitinized at inner margin and hairy. 8th sternite divided into 2 sclerites, with membranous area between. Cerci normal, 1-segmented, conical and hairy.

Length of body 8 mm, of fore wing 8 mm and of hind wing 6.5 mm.

Remarks: This new species is somewhat related to *Rhopalopsole malayana* (Banks) but

easily distinguished from the latter by the features of hind margin of subgenital plate and of the 8th sternite.

Rhopalopsole sp.

LOCALITY: VIET NAM: 1, Mt. Lang, Bian, 1500–2000 m, 19. V–8. VI. 1961, N. R. Spencer.

It is impossible to identify that specimen to the specific name and sex because the tip of abdomen is broken off.

PERLIDAE

Phanoperla anomala (Banks), 1939, *Bull. Mus. Comp. Zool.* **84**: 451.—Illies, 1966, *Tierreich* **82**: 298.

LOCALITY: BORNEO: 1 ♂, 1 ♀, Tawau, Quoin Hill, 3–7. VII. 1962, by light trap, H. Holtmann.

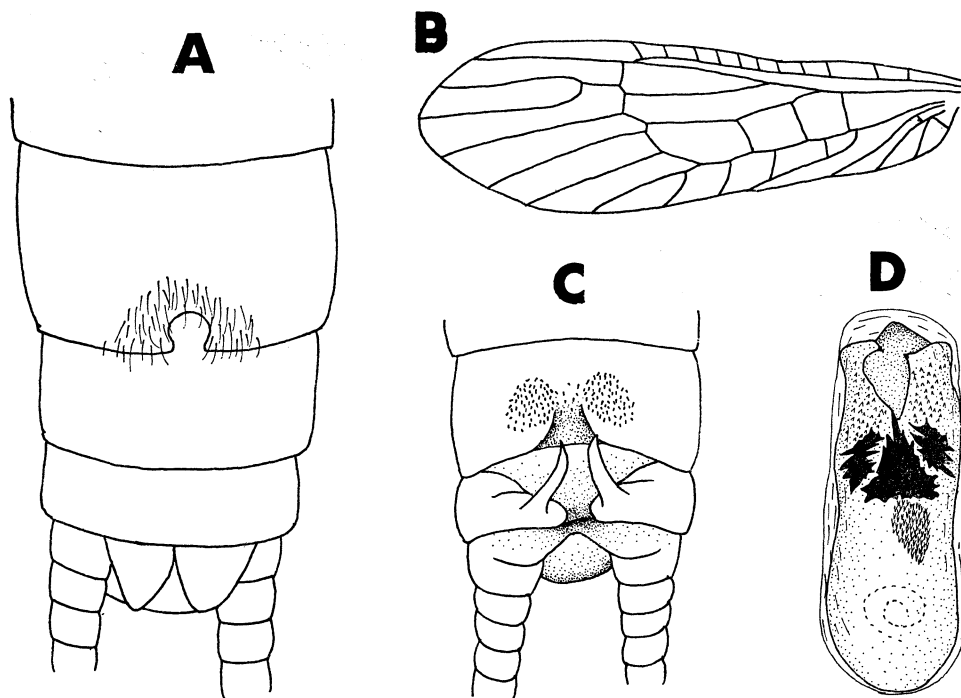


Fig. 8. *Phanoperla anomala* (Banks): A, ♀ terminal segments of abdomen, ventral; B, fore wing; C, ♂ terminal segments of abdomen, dorsal view; D, penial armature, dorsal view.

This species is identical in venation and body coloration with Banks' original description. A redescription of this species follows:

General color brownish yellow with brownish markings on head and prothorax.

Head narrowed anteriorly, nearly as wide as prothorax, with 2 large rounded, black ocelli, distance between which nearly $3 \times$ as far as between one and inner margin of compound eye. Behind ocelli with 2 curved ridges enclosing an oval depression which is divided longitudinally by basal arm of epicranial suture.

Pronotum quadrangular, wider than long, a little wider in frontal margin than in hind margin. Wings hyaline, veins sepia brown; venation typical for the genus. No cross-veins in pterostigma. Rs forking once in both wings. Cu_2 rather short and terminating $2/5$ from base.

Abdomen cylindrical. Hind margin of ♂ 7th sternite with a brush of brown short bristles. 9th tergite of ♂ divided into 2 sclerites, between them and sides of each sclerite scattered a group of short brown spines which have rounded tips. Ninth sternite with broad hind margin which is extended backwards and a little beyond the last segment. Tenth tergite cleft, each $1/2$ with a bifurcate process; upper one long and slender with pointed tip which is directed forwards into the pit of 9th tergite; lower one short and stout with rounded tip. Cerci long and hairy.

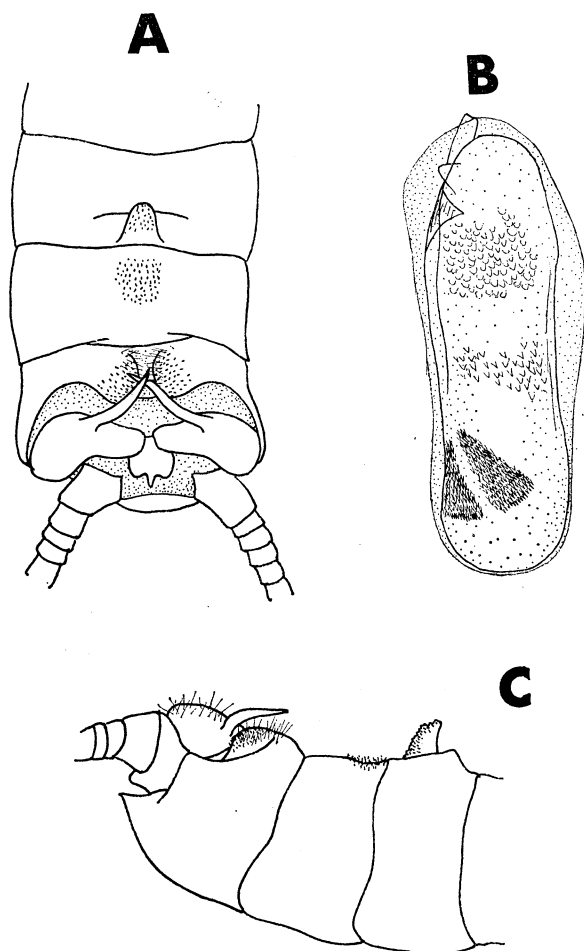


Fig. 9. *Neoperla oculata* Banks: A, ♂ terminal segments of abdomen, dorsal; C, the same, lateral view; B, penial armature, dorsal view.

Penial armature moderate in size, membranous, with many minute spines on dorsal side near tip and on middle of dorsal side with 3 small black chitin plates, one of which is triangular and other 2 are irregular in form; behind the chitin plates situated a group of minute spines.

Middle of hind margin of ♀ 8th sternite extends a little backwards into a subgenital plate which has a rounded notch at middle; and with many remarkable bristle-like hairs surrounding notch.

***Neoperla oculata* Banks, 1924, *Bull. Mus. Comp. Zool.* **65**: 428.—Jewett, 1958, *Fieldiana Zool.* **42**: 48.—Illies, 1966, *Tierreich* **82**: 275.**

LOCALITY: PHILIPPINES: 1 ♂, Mindanao, nr base of Mt. Malindang, 13. VII. 1958, by light trap H. E. Milliron.

This Philippine species was originally described by Banks (1924). He described, only color patterns and venation. The species was then also reported by Jewett (1958) from Mindanao, but he did not describe the genital section.

Hind margin of 7th tergite produced upwards into a small projection with dark brown small spines on back; 8th tergite with a group of dark brown small spines on near frontal margin; 9th tergite apparently divided at its hind margin, inner margin of which is produced a little upwards with rounded tip and scattered with dark brown spines and white fine hairs; 10th tergite cleft, each 1/2 bifurcate at its apex to form unequal forks, the upper one long and slender and directed forwards onto the 9th tergite, lower branch short and stout with rounded tip. Penial armature membranous, with many minute scale-like spines near tip, many minute pointed spines on middle and a pair of triangular patches of minute spines near the base.

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