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## Supplements to the Perlidae (Plecoptera) of Sumatra

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### Abstract

A number of Perlidae are recorded from Sumatra, an unidentified species of *Phanoperla* and *Phanoperla simplex* Zwick for the first time. Descriptions of several species are supplemented. *Neoperla inutilis* Zwick and *N. separanda* Zwick are raised to species rank. New species described are *Neoperla flavicincta* Zwick, *N. sitahoanensis* Sivec, and *N. diebli* Sivec. The new data suggest closer affinities than previously known between the Sumatran, Malay Peninsula and Bornean faunas.

The stonefly fauna of Sumatra includes only the family Nemouridae and subfamily Perlinae of Perlidae, mainly the tribe Neoperlini. The fairly numerous species of Perlidae have been treated recently (ZWICK 1982a–d, 1983), based on all available material. Some fresh light trap collections made by Dr. E. W. Diehl at or in the vicinity of Dolok Merangir (3°06' N/99°03' E), North Sumatra, were recently obtained through the courtesy of Dr. D. Erber (Gießen) and Dr. H. Malicky (Lunz). This limited material proved to be very interesting and adds considerably to our knowledge of the Sumatran Perlidae. There is additional evidence for relations of the Sumatran fauna with that of the Malay Peninsula, and previously unknown relations with the Bornean fauna are revealed.

We would like to thank Drs. Erber and Malicky for kindly making the collections available. Specimens are now kept in coll. Zwick in the Limnologische Flußstation Schlitz (LFS) and in the Prirodoslovni muzej Slovenije, Ljubljana (PMS), respectively. A few specimens in the Bernice P. Bishop Museum, Honolulu (BPBM) are also mentioned.

In the descriptions, HT, S, T stand for hemitergite, sternite, and tergite, respectively.

### *Etrocorema nigrogeniculatum* (Enderlein) (Fig. 1)

1909 *Ochthopetina nigrogeniculata* Enderlein, Zool. Anz. 34: 400.

Material: 1♂, 2♀♀, Dolok Merangir, Berge 1000 m, 12. III.–6. VII. 1983; 1♀, 3. X.–31. XII. 1983; 1♀, Sita-hoane, 1. 9. 1981; 1♂, ibidem, 1400 m, 1. 8. 1982 (PMS and LFS).

The species is widespread (ZWICK 1982a, b) and had already been reported from Sumatra. Specimens from Thailand, Sumatra and Borneo were all found to agree in the peculiar structure of the previously undescribed egg (Fig. 1). It is ca. 0.44 mm long, broadly oval, with short rim-like collar and a flat raised knob for anchor attachment. Micropyles are few. The chorion is completely smooth. The anchor has a wide short stalk. From the edge of the delicate outer layer of the anchor rise a number of feathery slender outgrowths.

### *Phanoperla guttata* Zwick

1982 *Phanoperla guttata* Zwick, Syst. Entomol. 7: 111, figs 17a–c.

Material: 1♂, Dolok Merangir, Ebene, 40 m, VI.–IX. 1983 (PMS).

The present specimen agrees completely with the type males, which were the only specimens known.

### **Phanoperla sumatrae** Zwick

1982 *Phanoperla sumatrae* Zwick, Syst. Entomol. 7: 108, figs 14a–c.

Material: 1♂, Sitahoane, 1. IX. 1981 (PMS).

The present male has dark tibiae and tarsi, slightly infuscate antennae, and a median patch of spinules on T9. Otherwise, especially in penial armature, it agrees completely with the syntypes, which were the only specimens known.

### **Phanoperla** sp. G (Figs 2, 3)

Material: 1♀, Dolok Merangir, Berge, 8. X.–31. XII. 1982 (LFS).

Wings 13 mm long, Rs simply forked. Ocelli small, about one diameter apart. Modified occipital area oval, small, poorly delimited. Pale, yellow except dark antennae, last tarsal segment, and last 6.5 cercus segments. C, Sc and R yellow, membrane between these veins lighter than between others, which are brown.

S8 with shallow rounded notch. Eggs ca. 0.40 mm long, oval. Funnel shaped collar almost filled by very wide striate stalk of short mushroom-shaped apparently simple anchor. Chorion smooth near collar, very finely punctate further up, punctures progressively larger towards opercle but again finer and disappearing in apical third. Opercular suture not visible. Opercle with groups of relatively large punctures.

The present female reminds one of *P. flaveola*, which, however, is smaller and so far known only from the Philippines, Borneo, and Java.

### **Phanoperla simplex** Zwick (Figs 4–6)

1982 *Phanoperla simplex* Zwick, Syst. Entomol. 7: 114, figs 20a–d.

Material: Thailand: 4♂♂, 1♀, Trang Prov., Khaophappa, Khaochang, 200–400 m, 1.–15. I. 1964 (Samuelson; BPBM); 1♂, Banna Chawang nr. Nabon, 70 m, 5. IX. 1958 (Gressitt; BPBM). Malaysia: 5♀♀, Kuala Lumpur, 24.–31. XII. 1958 (Quate; BPBM). Indonesia: Sumatra: Dolok Merangir, niedere Lagen: 6♂♂, 5♀♀, 15. VI. 1982–4. I. 1983; 8♀♀, 8.–25. I. 1983; 1♂, 4♀♀, Ebene, 50 m, VI.–IX. 1983; 2♂♂, Sitahoane, 24. XII. 1981–2. I. 1982 (PMS and LFS).

Wings of the Sumatran specimens 6.5–9.0 mm long. Structurally, they agree with mainland specimens but have distinctly infuscate wings, antennae (in most cases, except for scape) and outer faces of tibiae are dark. The only structural difference from mainland specimens was observed in eggs. In mainland specimens, the opercle is pointed, and the narrow collar has an outwardly bent rim; a few delicate longitudinal crests on the collar had been overlooked and not described in the original description. Eggs of Sumatran females have a more prominent, almost nipple shaped opercle. The collar lacks the rim and is more or less reduced, somewhat variable between specimens.

Notes: *P. simplex* had been assigned to the *testacea*-group on account of general similarity of penis and obliquely positioned male hemitergites, with anterior processes not rising above median processes. The last character cannot be confirmed from fresh material, hemitergites of the few previously available males appear to have been in some exceptional position. The significance of differences between mainland and Sumatran specimens is not clear and no separate name is therefore proposed.

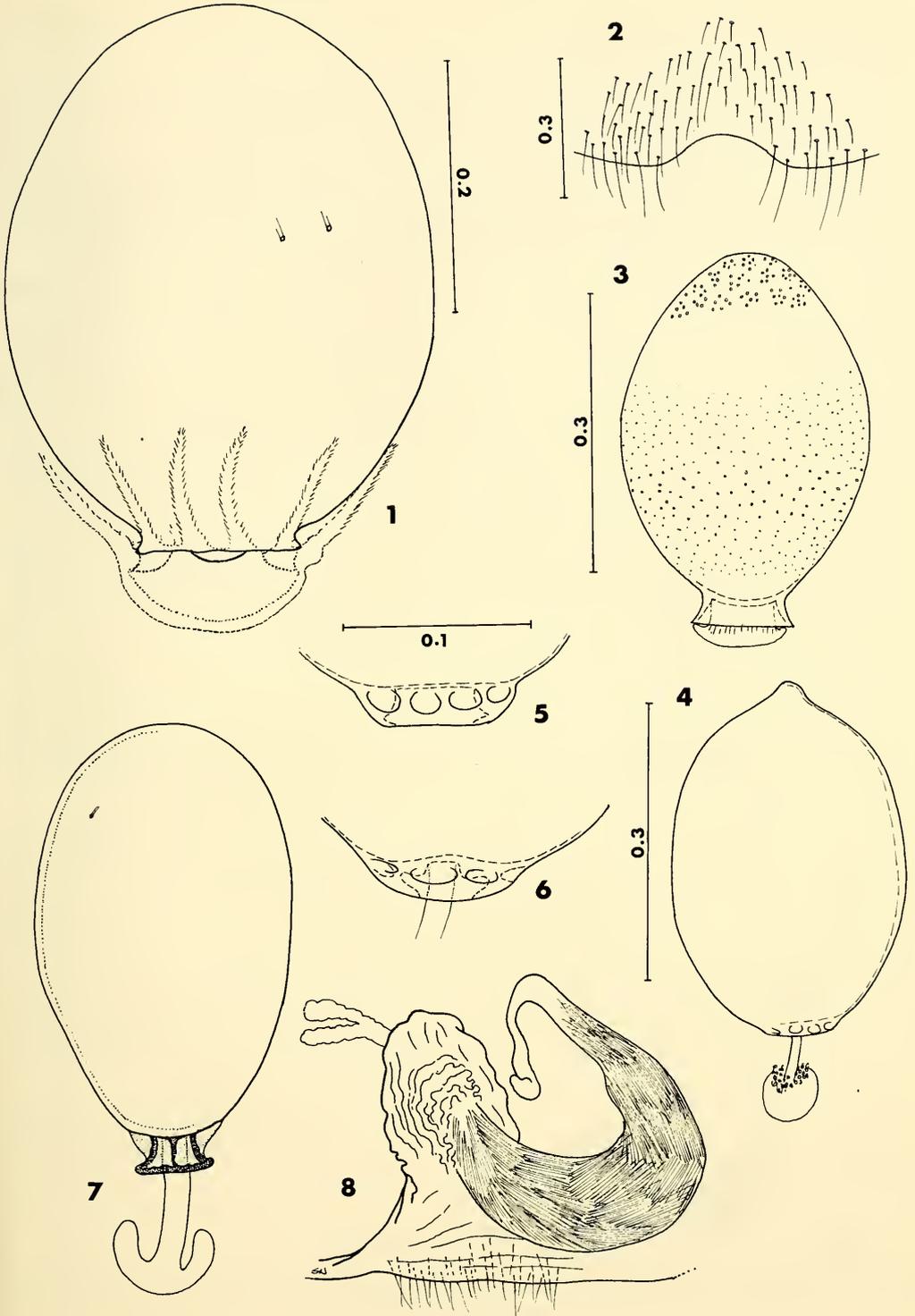
### **Phanoperla minutissima** (Enderlein) (Figs 7, 8)

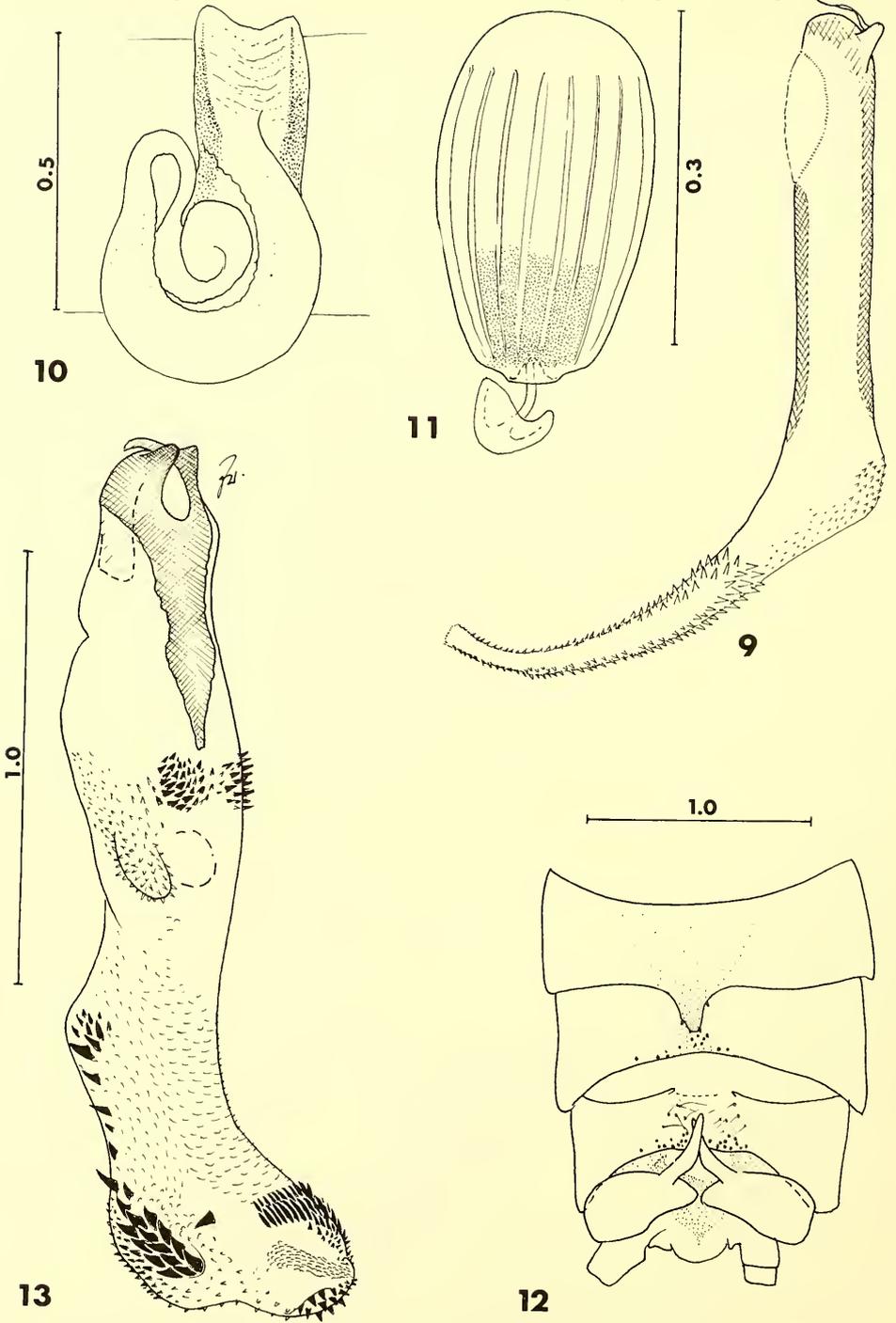
1909 *Ochthopetina minutissima* Enderlein, Stettin. entomol. Ztg. 70: 341, fig. 28.

1982 *Phanoperla minutissima* – ZWICK, Syst. Entomol. 7: 113, figs 19a–c.

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Figs 1–8. 1: *Etrocorema nigrogeniculatum*, egg. 2, 3: *Phanoperla* spec. G, centre of S8 and egg. 4–6: *Phanoperla simplex*, Sumatran specimens, egg and variation of collar. 7, 8: *Phanoperla minutissima*, egg and vagina with part of S8. Scales in mm.





Figs 9–13. 9: *Neoperla vesperi*, everted penis. 10, 11: *Neoperla inutilis*, vagina and egg. 12, 13: *Neoperla flavicincta*, male abdominal tip and everted penis, dorsolateral view. Scales in mm.

Material: 2♀, Dolok Merangir, Ebene, 50 m, VI.–IX.1983; 1♀ without abdomen, Berge, 1000 m, 12. III.–6. VII.1983 (PMS and LFS).

This species is externally completely similar to Sumatran *P. simplex*, except for its small ocelli which are about two diameters apart. The inner female genitalia and the egg are here described for the first time.

Vagina membranous, dorsal side with wide, semicircularly curved stalk of receptacle. It bears very delicate pale long spicules on its inside.

Egg ca. 0.35 mm long, oval, opercle bluntly rounded, collar constricted at base, with reflexed rim and few longitudinal crests. Chorion completely smooth, thin. Micropyles few, single, simple.

## Genus *Neoperla* Needham

### The *clymene*-group

#### *Neoperla aliqua* Zwick

1983 *Neoperla aliqua* Zwick, *Spixiana* 6: 177, figs 7a–m.

Material: Dolok Merangir, Berge über 1000 m, 1♂, 8. X.–31. XII.1982; 1♂, 2♀, 12. III.–6. VII.1983; Dolok Merangir, niedere Lagen: 2♀, 15. VI.1982–4. I.1983. 1♂, Sitahoane, 1400 m, 1. VIII.1981 (LFS and PMS).

Most of the present specimens have completely dark tibiae, but the females from Dolok Merangir have the center of middle and hind tibiae pale. The males from Dolok Merangir have dark or medially slightly paler pronota, process of T7 entire, hemitergites and penis like figs 7d, f of ZWICK (1983), respectively. The male from Sitahoane has a less modified HT (intermediate between figs 7c, d of ZWICK, 1983), dorsal lobe of penis large (like fig 7b, ZWICK, 1983). The ♀♀ have a yellow band on the pronotum.

#### *Neoperla spec. AsK*

1983 *Neoperla spec. AsK*, ZWICK, *Spixiana* 6: 180, figs 9a–e.

Material: Dolok Merangir: Berge über 1000 m: 3♀, 12. III.–6. VII.1983; Ebene, 50 m: 1♀, 8. X.–31. XII.1982; 1♀, VI.–IX.1983 (LFS and PMS).

#### *Neoperla spec. AsM*

1983 *Neoperla spec. AsM*, ZWICK, *Spixiana* 6: 181, figs 9h, i.

Material: Dolok Merangir, Berge über 1000 m, 1♀, 8. X.–31. XII.1982; 1♀, 12. III.–6. VII.1983 (LFS and PMS).

#### *Neoperla jacobsoni* Klapálek

1910 *Neoperla jacobsoni* Klapálek, *Notes Leyden Mus.* 32: 38, fig. 3.

1983 *Neoperla jacobsoni* – ZWICK, *Spixiana* 6: 184, figs 11a–c.

Material: 2♂, Dolok Merangir, Ebene, 50 m, VI.–IX.1983 (PMS).

#### *Neoperla vesperi* Zwick (Fig 9)

1983 *Neoperla vesperi* Zwick, *Spixiana* 6: 185, figs 12a–c.

Material: 1♂, 7♀, VI.–IX.1983, Dolok Merangir, Ebene, 50 m (PMS); 3♀, niedere Lagen: 15. VI.1982–4. I.1983 (LFS).

The banded sclerotization of the penis tube is distinctive. The everted penis sac had not yet been described. It is as long as the tube and gently curved ventrad. Basally, there is a dorsal patch of small teeth connected by very delicate spinules to main armature. This consists of bands of triangular teeth along dorsal and ventral sides of sac, bases of bands meeting on sides.

## **Neoperla spec. AsJ**

1983 *Neoperla* spec. AsJ, ZWICK, Spixiana 6: 187.

Material: 3♀♀, Dolok Merangir, niedere Lagen, 15. VI. 1982–4. I. 1983 (LFS).

## **Neoperla distincta** Zwick

1983 *Neoperla distincta* Zwick, Spixiana 6: 186, figs 13a–c.

1983 *Neoperla* sp. E, STARK, Aquatic Insects 5: 106, figs 20, 21, 54–56.

Material: Sumatra: Dolok Merangir: Ebene, 50 m: 1♀, VI.–IX. 1983 (PMS); niedere Lagen: 2♂♂, 7♀♀, 15. VI. 1982–4. I. 1983; 1♀, 8.–25. I. 1983; 1♀, Berge, 8. X.–31. XII. 1982 (LFS). Malaysia: 1♀, Kuala Lumpur, at light, 17. I. 1933 (Pendlebury) 1♀, Selangor, 7th M. Chenas Rd., light, 4. IV. 1924 (Seismund) (both ex Federated Malay States Museum in BMNH, as *Phanoperla* or *Neoperla minutissima* [End.]). 3♀♀, Pahang, Kuala Tahan, 15.–16. XII. 1958 (Quate; BPBM). Thailand: 1♀, Banna Chawang nr Nabon, 700 m, 5. IX. 1958 (Gressitt; BPBM); 5♀♀, Trang Prov., Khaophapha, Khaochang, 200–400 m, XII. 1963–I. 1964, light (Samuelson; BPBM); 11♀♀, Krachong Forest nr Trang, 100 m, 2. VII. 1962 (Ross and Cavagnaro; Jewett det. *N. nitida* Kimmins; CAS). Note that males from several of the same collections have already been listed by ZWICK (1983).

Of the small yellow Sumatran *Neoperla* with simply forked Rs (the present species, and the *primitiva*-complex, see below), *N. distincta* has the larger, less widely separate ocelli, being only about one diameter apart in males, about 1.5 diameters in females. Dark ocellar rings do not fuse medially, the space between the ocelli remains light or is at most slightly infuscate. It is the only species of the *chymene*-group known to occur on Sumatra as well as on the mainland, but at the time of the species' description, Sumatran females had not yet been recorded.

Males are easily recognized by their curved, pilose hemitergites. Females are exceptional in that their receptacular stalk is long and describes 2–3 complete rings, where the armature increases from 2 or 3 lines of spinules basally to a wide band occupying half the stalk's width distally. The egg has about 11 straight blunt ridges. According to STARK (1983) the chorion is impunctate. However, all eggs we have seen are finely and irregularly punctate on the entire chorion, including the in other species bare ribs, but not on the collar.

## **Neoperla primitiva** Geijskes, s. str.

1952 *Neoperla primitiva* Geijskes, Arch. Hydrobiol., Suppl. 21: 292, fig. 8.

1983 *Neoperla primitiva primitiva* – ZWICK, Spixiana 6: 182, figs 10a, b, f, g.

Material: Dolok Merangir: niedere Lagen: 4♂♂, 3♀♀, 15. VI. 1982–4. I. 1983; 2♂♂, 8.–25. I. 1983; Ebene, 50 m, 2♂♂, 6♀♀, VI.–IX. 1983; Berge, 1♂, 1♀, 8. X.–31. XII. 1982 (LFS and PMS).

Among *Neoperla* distinguished by a longitudinally striate section at the tip of the penis tube and the base of the eversible sac, ZWICK (1983) recognized three related but distinct morphs. Because in the material then available, these morphs had never been taken together and because only a single type of female was available, he treated them as allopatric subspecies of one single species, *primitiva*. The present material, however, contains all three morphs from a single locality, Dolok Merangir. Also, a second evidently related but distinct female has now been found. It appears, therefore, that the three taxa are in fact specifically distinct. In males, ocelli are almost two diameters apart, even more in females.

The present specimens agree with the description of ZWICK (1983). It is assumed that the females with ca. 15 ribs per egg and a brush of delicate filaments on a long stalk instead of a normal anchor are females of *N. primitiva*. Females tentatively assigned to the various presumed subspecies by ZWICK (1983) require checking. *N. primitiva* (s. str.) is known only from Sumatra.

## **Neoperla inutilis** Zwick, spec. propr. (Figs 10, 11)

1973 *Neoperla inutilis* Zwick, Annls Zool., Warszawa 30: 499 (replacement name for *N. sumatrana* Klapálek 1909 [not 1923!; not ENDERLEIN 1909]).

1983 *Neoperla primitiva inutilis* – ZWICK, Spixiana 6: 182, figs 10c, d.

Material: Dolok Merangir: 1♂, 17.–20. XII. 1981; niedrige Lagen: 1♂, 2♀♀, 15. VI. 1982–4. I. 1983; 1♀, 8.–25. I. 1983; Ebene, 50 m, 6♀♀, VI.–IX. 1983; Berge über 1000 m, 5♂♂, 12. III.–6. VII. 1983 (LFS and PMS).

Known from Sumatra and west Java. Males agree with the description of ZWICK (1983).

Presumed female: Vagina with two long pointed lateral sclerites absent in *N. primitiva*. Stalk of receptacle wide, short, forming not even one complete ring. Its armature consists of very fine spinules. They are not growing larger distally, as is the case in *N. primitiva*. Egg about 0.33 mm long, with ca. 19 straight impunctate ribs between wide opercle and a distinct short collar surrounding deeply concave anchor attachment. Chorion finely and irregularly punctate, except on ribs. Anchor mushroom-shaped, on relatively short stalk.

### ***Neoperla separanda* Zwick, stat. nov.**

1983 *Neoperla primitiva separanda* Zwick, *Spixiana* 6: 182, fig. 10e.

Material: Sumatra, Dolok Merangir, niedere Lagen, 15. VI. 1982–4. I. 1983, 1♂ (LFS).

The present male agrees with the west Javan holotype by the ventrally curved everted penis sac, the dorsobasal patch of fine spinules, and in the longitudinal striation which extends far onto the ventral side of the eversible sac. The present male differs, however, by the shortness of the striate section of the penis tube proper.

The female remains unknown.

The *montivaga*-group

### ***Neoperla simplicior* Navás**

1932 *Neoperla simplicior* Navás, *Mem. Pont. Accad. Sci. Nuov. Linc.* (2) 16: 953, fig. 66.

1983 *Neoperla simplicior* – ZWICK, *Spixiana* 6: 190, figs 15a–d.

Material: 1♂, Dolok Merangir, 10.–31. I. 1970 (PMS).

### ***Neoperla fallax* Klapálek**

1910 *Neoperla fallax* Klapálek, *Notes Leyden Mus.* 32: 44.

1983 *Neoperla fallax* – ZWICK, *Spixiana* 6: 191, figs. 16a–i.

Material: Dolok Merangir: 1♂, 12. IV.–7. V. 1970; 1♀, Berge über 1000 m, 12. III.–6. VII. 1983 (PMS).

### ***Neoperla affinis* Zwick**

1983 *Neoperla affinis* Zwick, *Spixiana* 6: 193, figs 18a–d.

Material: Dolok Merangir: 1♂, 1♀, 10.–16. XII. 1981; 2♂♂, 2♀♀, Berge über 1000 m, 12. III.–6. VII. 1983. Sitahoane, 1400 m, 1. VIII. 1982, 2♂♂, 1♀ (PMS).

### ***Neoperla illiesi* Zwick**

1983 *Neoperla illiesi* Zwick, *Spixiana* 6: 197, figs 21a–f.

Material: Dolok Merangir, Berge über 1000 m: 7♂♂, 7♀♀, 8. X.–31. XII. 1982, 15♂♂, 1♀, 12. III.–6. VII. 1983. Sitahoane: 1♀, 1400 m, 30. VII. 1981; 2♀♀, 1. IX. 1981; 2♀♀, 2. IX. 1981; 1♀, 24. XII. 1981–2. I. 1982 (LFS and PMS).

The new collections confirm the presumed conspecificity of sexes.

### ***Neoperla flavicincta* Zwick spec. nov. (Figs 12, 13)**

Material: ♂ holotype, Dolok Merangir, niedere Lagen, 15. VI. 1982–4. I. 1983 (LFS).

Wings 10 mm long. Anterior branch of Rs with 1 or 2 distal forks, posterior branch from anastomosis simple. Ocelli little more than one diameter apart. Yellow; narrow half ring between ocelli black,

Male: Process of T7 slender, triangular. T8 flat, midline indistinctly sclerotized, some scattered granules. T9 little modified, with weak setose spinuliferous paramedian swellings. HT10 simple, anterior processes little curved, obliquely pointed, median face flat.

Penis about 1 mm long, typical of *montivaga*-group, with a pair of spiny bulbous projections on sides and two patches of stiff spines next to tip of dorsal penis sclerite. Everted penis sac plump, with two ventral humps and dorsally curved tip. Most of sac covered with delicate scales arranged transversely on dorsal side, longitudinally on ventral side. Major armature consists of ventrolateral bands of spines between humps, a subterminal ventral patch of spines, and two subterminal transverse rows dorsally across tip of sac. A narrow band of fine, closely placed scales on each side near apex.

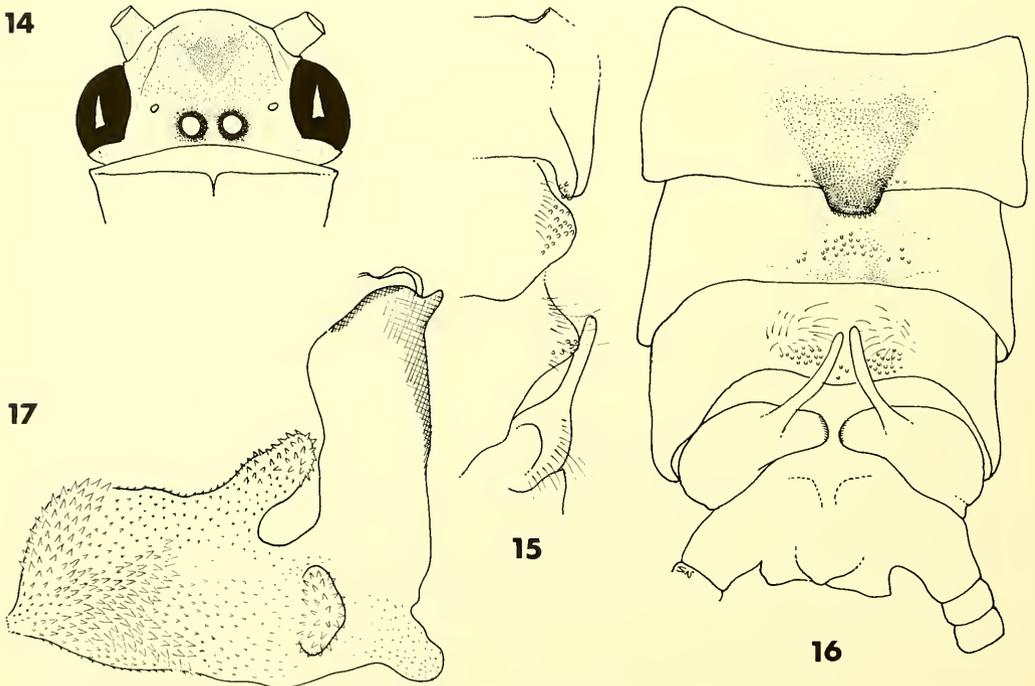
Female: Unkown.

Notes: *N. flavicincta* belongs to the *variegata*-subgroup of the *montivaga*-group. The related species occur on Borneo, several of them have patterned wings. None agrees closely with the present species.

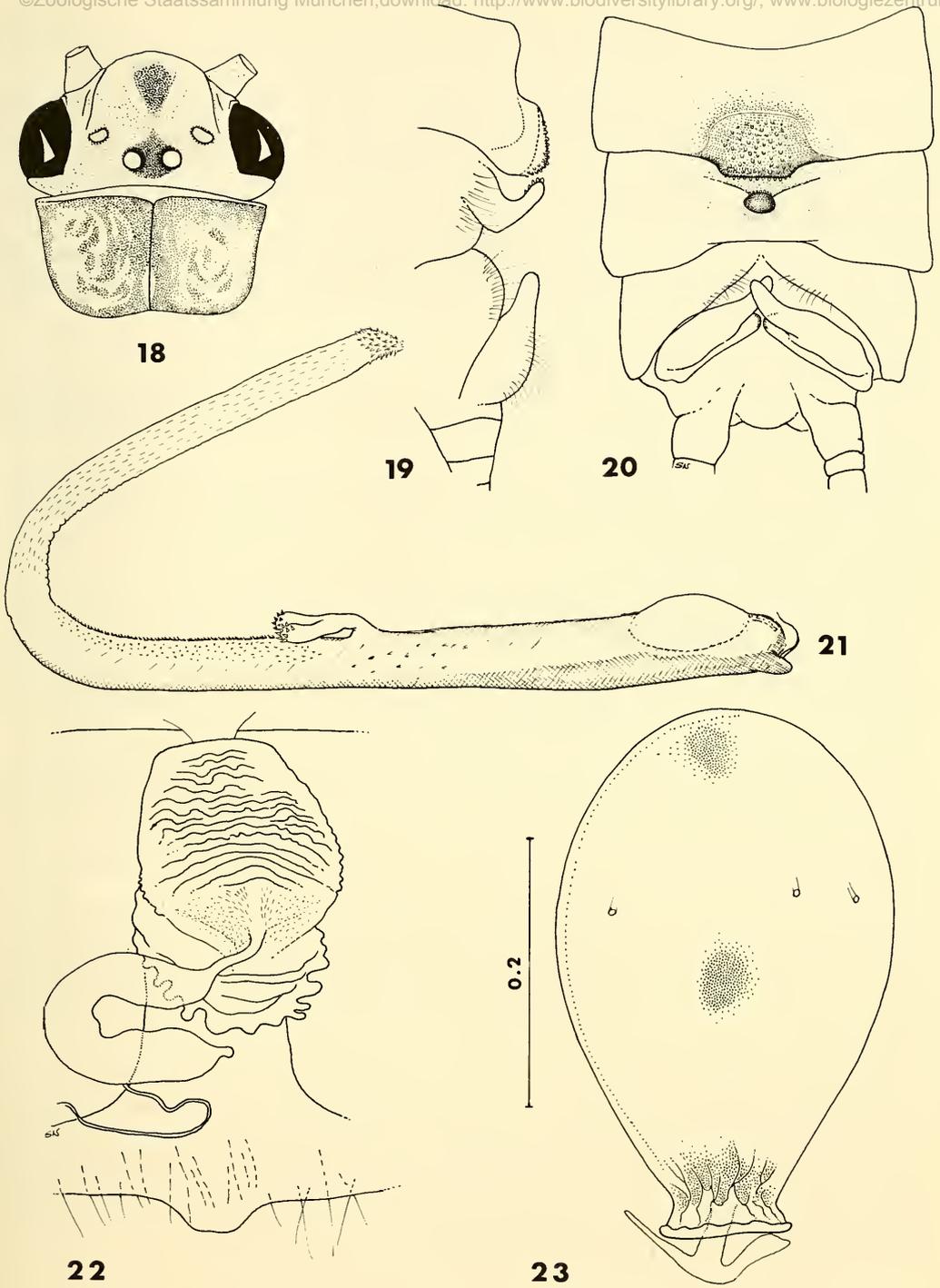
### *Neoperla sitahoanensis* Sivec, spec. nov. (Figs 14–17)

Material: ♂ holotype, 1♂ paratype, Sumatra, Sitahoane, 24. XII. 1981–2. I. 1982 (holotype in PMS, paratype in LFS).

Front wings 15 mm long. Anterior branch of Rs forked 1, 2 or 3 times; posterior branch from anastomosis simple. Ocelli large, about one diameter apart. Tentorial calluses very small. Brownish species without pronounced pattern, except ocellar rings. Cerci relatively pale.



Figs 14–17. *Neoperla sitahoanensis*, male; head, abdominal tip in profile and in dorsal view, everted penis in lateral view.



Figs 18–23. *Neoperla diehli*, head and pronotum, male abdominal tip in profile and in dorsal view, everted penis, vagina and egg. Scale in mm.

Male: Process of T7 wide, blunt, tongue-shaped. Sclerotization of T8 broad, diffuse, granules scattered over middle of posterior half of segment. T9 with normal spinulose and setose paramedian swellings. HT10 normal, with slender curved anterior process. Sternites and cerci unmodified. Penis little longer than 1 mm, wide, soft except for long dorsal and short ventrobasal sclerites. The wide everted penis sac stands at right angle on ventral side of penis tube. There are a finely rough dorsal process at its base and a strongly spinose midventral finger. Laterobasally, a transverse spiny swelling on each side. At wide apex, spines that are stronger than general armature of sac form a single wide dorsal, lateral, and ventrolateral bands.

Female: Unkown.

Notes: *N. sitahoanensis* is a close relative of a Bornean species and differs only in details of lobes and armature of the everted penis sac: differences will be discussed in the forthcoming description of the Bornean taxon (ZWICK, in preparation).

### **Neoperla diehli** Sivec, spec. nov. (Figs 18–23)

Material: Sumatra, Sitahoane (near Dolok Merangir): ♂ holotype, 1. IX. 1981; paratypes: Sitahoane: 1♂, 2. IX. 1981; 2♂♂, 1♀, 1400 m, 1. VIII. 1981; Dolok Merangir, Berge, VIII. 1981, 2♂♂, 1♀ (Holotype and most paratypes in PMS, 2 paratypes in LFS).

Front wing of males 13–15, of females 17–18 mm long. Anterior branch of Rs with simple fork or anteriormost vein forked again; posterior branch from anastomosis simple. Ocelli large, hardly one diameter apart. Front wings greyish, veins brown except for yellow C, Sc and c-sc-crossveins, head, pronotum and raised portions of pterothorax brown. A dark heart-shaped mark between ocelli, a triangular one in front of M-line. Sides of pronotum usually lighter than middle, yellowish. Antennae, palpi, tarsi, front tibiae, middle tibiae (except apex) and base of hind tibiae dark brown, remainder yellow.

Male: T7 with dark raised spinulose area forming short square process opposite narrow raised process of T8, which is spinulose in front. T9 retracted, much reduced, without spinules. Anterior process of HT10 short, curved, blade-shaped, narrow edge directed obliquely to outside. Sternites and cerci simple.

Penis almost 2 mm long, narrow, tubular, apex curved gently to ventral side. A forked apically spinose ventral outgrowth near middle of tube. Tube generally fairly well sclerotized, but very long dorsal sclerite still discernible. A narrow bandshaped dorsal sclerite rests on the membraneous base. Ventral side of tube between membrane and outgrowth also somewhat sclerotized; distally from outgrowth soft, with fine rugosities. Sides of tube also with little rugosities. Everted sac shorter than tube, narrow, tubular, with longitudinal scales. The little spiny apex points ventrobasad.

Female: S8 with narrow short median lappet. Vagina membraneous, folded, extensible. Simple receptacle on raised central cone, many narrow concentric folds in front of it, a few wide ones behind it.

Egg ca. 0.40 mm long, drop-shaped, collar narrow, constricted at base, funnel-shaped. Anchor simple, mushroom-shaped. Micropyles near middle of egg. Chorion finely and irregularly punctate except on collar. Smooth, except for some incomplete meshes formed by interconnected crests near and on collar.

Notes: The complete agreement in colour pattern leaves no doubt about conspecificity of sexes. While the female is typical of the *montivaga*-group, the male appeared to belong to the *clymene*-group, in conflict with the group-concepts proposed by ZWICK (1983). However, closer inspection of the penis tube revealed all structures typical of the *montivaga*-group, modified by the poor development of the ventrobasal sclerite and obscured by what appears to be an extended secondary sclerotization of the penis tube. The present species, and a few undescribed South East Asian relatives, appear to form a distinct subgroup of the *montivaga*-group of *Neoperla*.

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