

Review of the original material of the
baetid genera *Baetis* and *Pseudocloeon*
from the Sunda Islands and the Philippines
described by G. ULMER, with some
general remarks (Insecta: Ephemeroptera)

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(With 5 figures and 1 plate)

Abstract

The baetid genera *Baetis* and *Pseudocloeon* from the Sunda Islands and the Philippines which were described by ULMER (1913, 1924 and 1939) are examined. These include: *Baetis javanicus*, *B. sumatrana*, *B. olivascens*, *Acentrella fulmeki*, *Pseudocloeon kraepelini*, *Ps. obscurum*, *Ps. boettgeri*, *Pseudocloeon* sp. 1, *Pseudocloeon* sp. 2. Based on detailed study *Acentrella fulmeki* is transferred to the genus *Baetis*, and also the nymph of *Pseudocloeon* sp. 2 is transferred to the genus *Baetis* and named *B. novatus* sp. n. Two males, which are signed by ULMER „*Pseudocloeon Kraepelini* KLAP.“ belong to two different species of the genus *Baetis* and are closely related to the European *atrebatinus* group. They are described and named *Baetis ulmeri* sp. n. and *B. necopinatus* sp. n. The genus *Acentrella* BENGTTSSON, 1912, is reestablished.

A review of the Baetid species described by ULMER (1913, 1924, 1939) from the Sunda Islands and the Philippines makes it possible to give some additional morphological data and interpretation to the original descriptions. This will be important for future study of material from this geographical region. The original material is stored in the Zoological Museum of the Zoological Institut, University Hamburg (WEIDNER 1962, 1964). More modern microscopic equipment than was available to ULMER in his time allows correction of small differences in ULMER's drawings and to complete his nymphal descriptions. Therefore new drawings of ♂ genitalia and hind wings as well as morphological details of the nymphs are added. The nymph of "*Pseudocloeon* sp. 2" is described, and based on its morphological characters transferred into the genus *Baetis*. No imagines are available. 1 vial in the collection contains 2 different males which are labeled by ULMER "*Pseudocloeon Kraepelini* KLAP.?" These two males belong to two different species of the genus *Baetis*; both are closely related to the European *atrebatinus* group. They are labeled: X. 1925, Pangkalang, Kota Baru, Central Sumatra. The name of the collector is not mentioned, but probably it was Prof. FULMEK, who collected other species at the same place at the same time.

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Baetis javanicus ULMER, 1913

(Fig. 1, 2a, b; Plate 1: figs 1, 4)

ULMER 1913: 110–111, Fig. 8–9, ♂ and ♀

ULMER 1924: 52–53, Fig. 25, ♂

ULMER 1939: 523–524, ♂; 643–645, Fig. 345–352, nymph

Material: 29 nymphs, 1 subimago ♂, 1 ♂, 1 subimago ♀. 1 slide preparation of a nymph; 1 slide preparation of ♂ hind wing.

Additional description

Imago ♂: The single available ♂ of this species shows a deformation on the last segment of the left forceps (Fig. 2a, ventral). ULMER (1913) mentions that in the hind wing only 2 veins are present. But actually 3 longitudinal veins are developed; the 3rd vein follows close to the hind margin of the wing (Fig. 2b).

Nymph: Morphological details as in Fig. 1. Surface and hind margin of terga as on Plate 1, Fig. 1; pronotum and color pattern as on Plate 1, Fig. 4. Hind wing pads of normal size. – Gills: 7 pairs, gills of 1st pair considerably smaller than the following gills.

Distribution: Java, Sumatra.

Baetis sumatrana ULMER, 1939 (Fig. 2c, d)

ULMER, 1939: 524–525, Fig. 89–91, ♂

Material: 2 ♂♂ „Typen“; 3 ♂♂; 2 subimago ♂♂; 1 subimago ♀ (dubium); 1 ♀ (dubium). 1 slide preparation: forceps, front wing, hind wing.

♂ Imago: In his Fig. 91 of the forceps of *B. sumatrana*, ULMER (1939) did not point out the chitinous, caudally directed prolongation between the forceps bases (Fig. 2c). Hind wing as in Fig. 2d.

Nymph: not known.

Distribution: Sumatra.

Baetis olivascens ULMER, 1939 (Fig. 2e, f)

ULMER 1939: 525–526, Fig. 92–95, ♂.

Material: 1 ♂ Imago, 2 ♂♂ subimago, 1 ♀ subimago. 1 slide preparation: 1 hind wing and forceps of ♂.

Distribution: Java

Baetis fulmeki comb. nov. (Fig. 2g, h, i)= *Acentrella fulmeki* ULMER 1939

ULMER 1939: 526–528, Fig. 96–101, ♂, ♀.

Material: 7 ♂♂, 5 subimago ♂♂ and 7 subimago ♀♀. 2 slide preparations of ♂ forceps, front wings, hind wings and upper surface of turbinate eyes; hind wings of subimago ♂ and subimago ♀.

Nymph: not known

The male genitalia, male hind wing and hind wings of subimagines of both sexes show that this species is more closely related to the *atrebatinus* group of the genus *Baetis* rather than *Acentrella*. In the genus *Acentrella* the hind wings of both sexes are comparatively long and narrow and obviously longer (about twice) in ♂ than in ♀. For comparison of the hind wings of *A. fulmeki* ULMER, Fig. 2i shows hind wings of subimago ♂ and subimago ♀, because the Imago ♀ is not available. *Acentrella fulmeki* ULMER 1939 is herein transferred to the genus *Baetis*.

Distribution: Sumatra

As mentioned before ULMER's collection contains 2 undetermined males from Central Sumatra. The label in this vial is signed "*Pseudocloeon kraepelini* KLAP.?" Both ♂♂ belong to different species of the genus *Baetis* and are closely related to the European *atrebatinus* group. Both species are described as follows.

Baetis ulmeri sp. n. (Fig. 2j, k, l)

Material: 1 ♂

Holotype: 1 slide preparation of male genitalia, 1 front wing and 1 hind wing: Pangkalang, Kota Baru, Central Sumatra. October 1925; det. I. MÜLLER-LIEBENAU 1981. Zool. Inst. Mus. Hamburg.

Description: Male genitalia, front wing and hind wing as in Fig. 2j, k, l. Until now no species of the *atrebatinus* group in the genus *Baetis* is known with highly reduced hind wings as in the new species *B. ulmeri* sp. n. The baetid material collected by Dr. J. E. BISHOP in the River Gombak in Malaysia which I have studied (in manuscript) contains nymphs of 6 *Baetis* species which are closely related to the European *atrebatinus* group. Two of them have hind wing pads of the usual size, two have highly reduced hind wing pads, and in two nymphs the hind wing pads are completely lacking, indicating the respective imagines either have hind wings of normal size, very small ones (as in *B. ulmeri* sp. n.) or no hind wings at all, which is the case in the next new species *B. necopinatus* sp. n.

On the evidence of the male genitalia *B. ulmeri* sp. n. is placed in the *atrebatinus* group. It differs from all other members of this group by the very small hind wings (Fig. 2k). To judge from the male genitalia this species is closely related to *B. propinquus*.

Nymph: not known.

Distribution: Central Sumatra.

Baetis necopinatus sp. n. (Fig. 2m, n)

Material: 1 ♂.

Holotype: 1 slide preparation of male genitalia, 1 front wing: Pangkalang, Kota Baru, Central Sumatra. October 1925; det. I. MÜLLER-LIEBENAU 1981. Zool. Inst. Mus. Hamburg.

Description: Male genitalia and front wing as in Fig. 2m, n. Hind wings not developed.

The complete absence of hind wings indicates a close relationship of *B. necopinatus* sp. n. to *B. ulmeri* sp. n. of the *atrebatinus* group. The lack of hind wings is also the most striking difference between *B. necopinatus* sp. n. and all other species of this group.

Nymph: not known.

Distribution: Central Sumatra.

Pseudocloeon kraepelini KLAPALEK, 1905 (Fig. 3a)

KLAPALEK 1905: 105-106, ♂ (no Fig.)

ULMER 1913: 111, ♀ (no Fig.)

ULMER 1924: 66-68, ♂, Fig. 32-33

ULMER 1939: 533-534, ♂, Fig. 102-104

Material: 4 specimens pinned: 3 ♂♂, 1 subimago ♂, KLAPALEK 1905, Java, Buitenzorg, 24. 2.-12. 3. 1904, syntypes. - 3 ♂♂, 2 subimago ♂♂, 2 ♀♀, 1 subimago ♂ and 1 subimago ♀ in alcohol. - 1 slide preparation of ♂ forceps and front wings.

Lectotype: ♂ in alcohol, Bellevue, Buitenzorg, IX. 1928, THIENEMANN leg. - I. MÜLLER-LIEBENAU det. 1981. Zool. Inst. Mus. Hamburg.

Nymph: unknown.

Distribution: Java.

With regard to this species ULMER (1913:111) points out that he has examined the type material, 3 ♂♂ and 1 subimago ♂, det. KLAPALEK 1905, Buitenzorg, Java, 24. II.–12. III. 1904 (leg. KRAEPELIN). These syntypes are stored in the Zoological Museum in Hamburg (pinned). In a later paper (1924:66) ULMER's determination of *Pseudocloeon kraepelini* also is based on a dry male specimen. ULMER was not able to confirm his earlier determinations of *Ps. kraepelini* until he received fresh material from the German Limnological Sunda Expedition 1928–1929 through Prof. THIENEMANN (ULMER 1939: 533–524). Thus we can be sure that all determinations of the above mentioned material are correct and authentic.

Pseudocloeon obscurum ULMER 1913 (Fig. 3b)

ULMER 1913: 111–112, ♂, Fig. 10–11

ULMER 1924: 68–70, ♂, Fig. 34–36

ULMER 1939: 534

Material: 2 ♂♂, 2 subimago ♂♂, 1 ♀, 1 subimago ♀. Male genitalia as in Fig. 3b.
Nymph: not known.

Distribution: Java, Sumatra.

Pseudocloeon boettgeri ULMER 1924 (Fig. 3c)

ULMER 1924: 70–72, Fig. 37–38, ♂.

ULMER 1939: 534–535, ♂ (no Fig.)

Material: 7 males pinned. 17 ♂♂, 1 ♀ in alcohol; 2 ♂♂ on slide preparations (forceps and front wings). This material is not in good condition, the forceps of all males are deformed, so the male genitalia in Fig. 3c might be not fully correct.

Nymph: not known.

Distribution: Philippines (Mindanao), South Sumatra.

ULMER (1924: 72 and 1939: 532) presented two keys for the males of *Pseudocloeon boettgeri*, *Ps. kraepelini* and *Ps. obscurum*.

Pseudocloeon sp. 1 (Fig. 4; Plate 1: figs 2, 5)

ULMER 1939: 645–648; Fig. 353–356, Fig. 357–364, nymph.

Material: 4 immature nymphs in alcohol, 1 mature and 1 immature nymph on slide preparations.

A detailed study of the nymphs of *Pseudocloeon* sp. 1 in ULMER's collection enables an additional description.

Description: For morphological details see Fig. 4. – Body length: ca. 4,5 mm, cerci about 4,5 mm; terminal filament reduced to about 14 segments. – Pronotum and color pattern as on Plate 1: fig. 5; surface and hind margin of terga as on Plate 1: fig. 2. – Hind wing pads minute (Fig. 4h and Plate 1: fig. 5). – Gills: 7 pairs, smooth gill margin. – Antennae: Inner margin of all segments serrated (Fig. 4g). – Legs (Fig. 4i): femur of 1st leg wider at base than at apex, femora of 2nd and 3rd legs nearly parallel-sided. Tibia and tarsus longest on 1st leg, shortest on 3rd leg. Apex of tarsi of all three legs dilated. Bristles on outer margin of femora finely feathered bilateral. Tibia on all three legs with two rows of bristles: on 1st pair of legs one row with very long and finely feathered bristles and other row with very short bristles. 2nd leg also with one row of long and fine bristles, and other row with short bristles, but longer than analogous row on 1st leg. 3rd leg (Fig. 4i) with two rows of long, fine bristles, one of these on ventral side. A conspicuous bristle near apex on inner margin of tarsus (Fig. 4j) was overlooked by ULMER.

Distribution: South Sumatra.

Baetis novatus sp. n. (Fig. 5. Plate 1: figs 3, 6)= "*Pseudocloeon* sp. 2" ULMER 1939

ULMER 1939: 648–650, Fig. 365–375, nymph.

Material: 5 nymphs; 1 slide preparation.

Holotype: Slide preparation of nymph, W. Java Gedeh Tjiboda, 1400 m, 22.–30. XII. 1930. M. A. LIEFTINCK. I. MÜLLER-LIEBENAU det. 1981. Zool. Inst. Mus. Hamburg.

The nymph of this species has heavily reduced hind wing pads (Fig. 5 h), and the terminal filament is reduced to only a few segments (Fig. 5 m). Thus it is not surprising, that ULMER placed this species in the genus *Pseudocloeon*. However recent studies revealed that these nymphs do not belong to the genus *Pseudocloeon*. Reduced hind wing pads and a reduced terminal filament are not typical characters for the genus *Pseudocloeon*. Both characters occur singly or together in combination with other generic characters in the genus *Pseudocloeon* as well as in the genus *Baetis* and other baetid genera (MÜLLER-LIEBENAU, 1971). In "*Pseudocloeon* sp. 2" most morphological characters of the nymph apply to the genus *Baetis*. Therefore this species is redescribed and transferred to the genus *Baetis*. It is named *Baetis novatus* sp. n.

Description of the nymph: For morphological details see Fig. 5. – Body length: 4–5 mm, cerci shorter than the body, terminal-filament reduced to about 4 segments. Pronotum and color pattern bleached out because of the long preservation in alcohol. Fig. 6 on Plate 1 gives an impression of the patterns caused by the muscle insertions on the dorsal surface of abdomen. – Hind wing pads reduced (Fig. 5 h). Gills (Fig. 5 g): As already mentioned by ULMER (1939: 650) only six pairs of gills are present (on segments II–VII). – Legs: comparatively stout (Fig. 5 i). Femur of 1st leg wider near base than femur of 2nd and 3rd legs. Claws with one (possibly two) fine, short bristle near apex (Fig. 5 k). – For surface and hind margin of terga see Plate 1: fig. 3. The scale bases on the surfaces are comparatively small.

Distribution: Java.

Discussion

This review again reveals the uncertainty in our knowledge of a correct definition of the genus *Pseudocloeon*. A partly solution probably can be found with help of the nymph of ULMER'S (1939) *Pseudocloeon* sp. 1 from South Sumatra (see p. 200). The nymph of this species (the male is not known) assembles a number of characters which give rise to confine the true genus *Pseudocloeon* to the Oriental Region. As EDMUNDS et al. (1976: 155) point out, "the genus *Pseudocloeon* was established from a species from Java, and it is not certain, that the American species are congeneric with the Javanese species". In my opinion this is true not only for the American species but also for all "*Pseudocloeon*" from outside the Oriental Region. These have to be studied carefully and than possibly gathered into one or more new genera.

All nymphs belonging to this "*Pseudocloeon*-complex" which I examined, i. e. from ULMER'S Material (1 species), from Malaysia (1 species), the Philippines (1 species), Ceylon (2 species), have the following characters in common: 1) color pattern on pronotum (Plate 1, fig. 5), very similar to that of "*Acentrella*" or the two species of the European *Baetis lapponicus* group (MÜLLER-LIEBENAU 1969, Fig. 43–44); 2) hind wing pads reduced to small appendages about 2–3 times longer than wide (Fig. 4; Plate 1, Fig. 5); 3) one conspicuous bristle near inner margin near apex of tarsus (Fig. 4 j) on all three legs in most species (also shown in DEMOULIN 1969, *Pseudocloeon* sp. 1 and *Ps.* sp. 2, Fig. 3 g and 4 f, Bismarck Archipelago). – Differences between species are mostly seen

in the mouth parts, surfaces of terga, bristling on margins of leg segments (although all of them have very long and fine bristles on outer margin), and claws.

Three variations of bristling on tibia of 3rd leg are possible: a) two dense rows of long and fine bristles of equal length plus one conspicuous bristle near inner margin near apex of tarsus (Fig. 4i und j), b) two such rows of bristles and no conspicuous bristle on tarsus (then lacking on all three legs; 1 undescribed species from India), c) only one row of long and fine bristles plus conspicuous bristle on tarsus (on all three legs; 1 undescribed species from the Philippines).

Thus I have the impression that all the above mentioned species belong to the same genus, which is the true genus *Pseudocloeon* KLAPALEK, 1905, from Java, and which is confined to the Oriental Region. All "*Pseudocloeon*" species known from other parts of the world should be looked at as more distantly related and not as *Pseudocloeon* KLAPALEK itself. A careful study of all species could lead to interesting consequences in the generic classification of baetine Mayflies.

Concerning the genus *Acentrella* BENGTTSSON, which I (1969) synonymised with the genus *Baetis* in the revision of the European species of the genus *Baetis* LEACH, I now am of the opinion that this genus is more closely related to the *Pseudocloeon*-complex than to the genus *Baetis* and has to be reestablished. BENGTTSSON (1912) based his original description on imagines with hind wings which are comparatively long and narrow, without costal projection and with two longitudinal veins. The hind wing of the male is considerable longer than hind wing of the female. Only two species of the genus *Acentrella* are described, which correspond in all known characters to the original description of the genus by BENGTTSSON: *A. lapponica* and *A. sinaica*. At present it seems that *A. lapponica* is holarctic and occurs in the northern parts of Europa and in the north of Canada (COBB & FLANNAGAN, 1980), whereas *A. sinaica* is restricted to the south-western, southern and eastern parts of Europe.

ULMER's *Acentrella fulmeki* from Sumatra is herein transferred to the genus *Baetis* (see p. 198) mainly judging from its male genitalia and the hind wing; the nymph is not known.

The genus *Pseudocloeon* was established by KLAPALEK (1905) based on imagines without hind wings, and with two intercalaries in the front wings. Many nymphs of "*Pseudocloeon*" which I have seen from Europe have small remainders of reduced hind wing pads on the metatergum, but the males never develop hind wings. On the other hand also the nymphs of some species of the genus *Baetis* are known to me (mostly from the Oriental region) which have reduced hind wing pads or no hind wing pads at all (MÜLLER-LIEBENAU 1973). But in both genera, the combination of additional characters easily separates the nymphs.

Therefore, according to our present knowledge of this difficult situation, the following preliminary concept of the herein discussed baetid genera seems to be acceptable:

1. *Baetis* LEACH, 1815: with a wide range of specific combinations of morphological characters; nymphs either with "normal", reduced (comparatively short and broad near base, Fig. 5h) or without hind wing pads, and with the terminal filament either shorter than cerci or slightly reduced. How far it will be necessary or at least convenient to establish new genera or subgenera in the present genus *Baetis* will be seen in future study. *Baetis* occurs worldwide.

2. *Acentrella* BENGTTSSON, 1912: hind wings of imago comparatively long and narrow and with two longitudinal veins, without costal projection, narrower than "normaly" in *Baetis*, and longer in male than in female. Nymphal

body more flattened than in *Baetis*, with reduced terminal filament. Specific color pattern on pronotum (as on Plate 1, fig. 5, and in MÜLLER-LIEBENAU, 1969, Fig. 43–44); hind wing pads narrower than in *Baetis* with “normal” sized hind wing pads; hind wing pads in male nymph considerable longer than in female nymph (corresponding in ♂ and ♀ imago and subimago, without costal projection); no conspicuous bristle on inner margin of tibia as in the next genus. – *Acentrella* is known from Europa and the north of Canada. The American species *propinquus* WALSH and *ephippiatus* TRAYER belong to the genus *Baetis*.

3. Oriental *Pseudocloeon* (sensu KLAPALEK): color pattern and pronotum similar to that of *Acentrella*; hind wing pads lacking or reduced, if reduced, about two or three times longer than broad (Fig. 4; Plate 1, fig. 5); legs similar to *Acentrella*, but mostly the rows of bristles on outer margin of leg segments are more dense, and two rows of bristles of equal length can be present on tibia of 3rd leg; a conspicuous bristle near apex near inner margin of tarsus (Fig. 4j) present in most species (see p. 200). Distribution: Oriental Region.

The nymph of *Pseudocloeon kraepelini* KLAPALEK remains still unknown. For absolutely certain identification it is indispensable to receive reared material, which means adult males reared from the nymph. At present it is impossible to make any statement about the true nymph of *Pseudocloeon* sensu KLAPALEK before this condition is filled.

4. “*Pseudocloeon*” auct.: color pattern on pronotum as in *Acentrella* and in the preceding genus; hind wing pads as in preceding genus (Fig. 4h); legs similar to *Acentrella* and the preceding genus, tibia of 3rd leg with only one row of long and fine bristles; no conspicuous bristle near apex near inner margin of tarsus. – Members of this complex genus are described from all geographical regions.

Continued study of the baetine Mayflies probably will lead to a better concept of this extremely confusing family. It seems important to me, to mention once more, a subject that has been discussed before and has been pointed out by EDMUNDS et al. (1976: 156) concerning this family: “The generic classification in the Baetidae is almost certain to be based largely on nymphs; new adult characters must be sought for assigning the species to genus.” This is opposite to the situation found in most of the other families in the Ephemeroptera and in most of the other orders of insects, where usually genera and species are based on imaginal characters. Therefore the way studying baetine Mayflies well be unusual, but indispensable.

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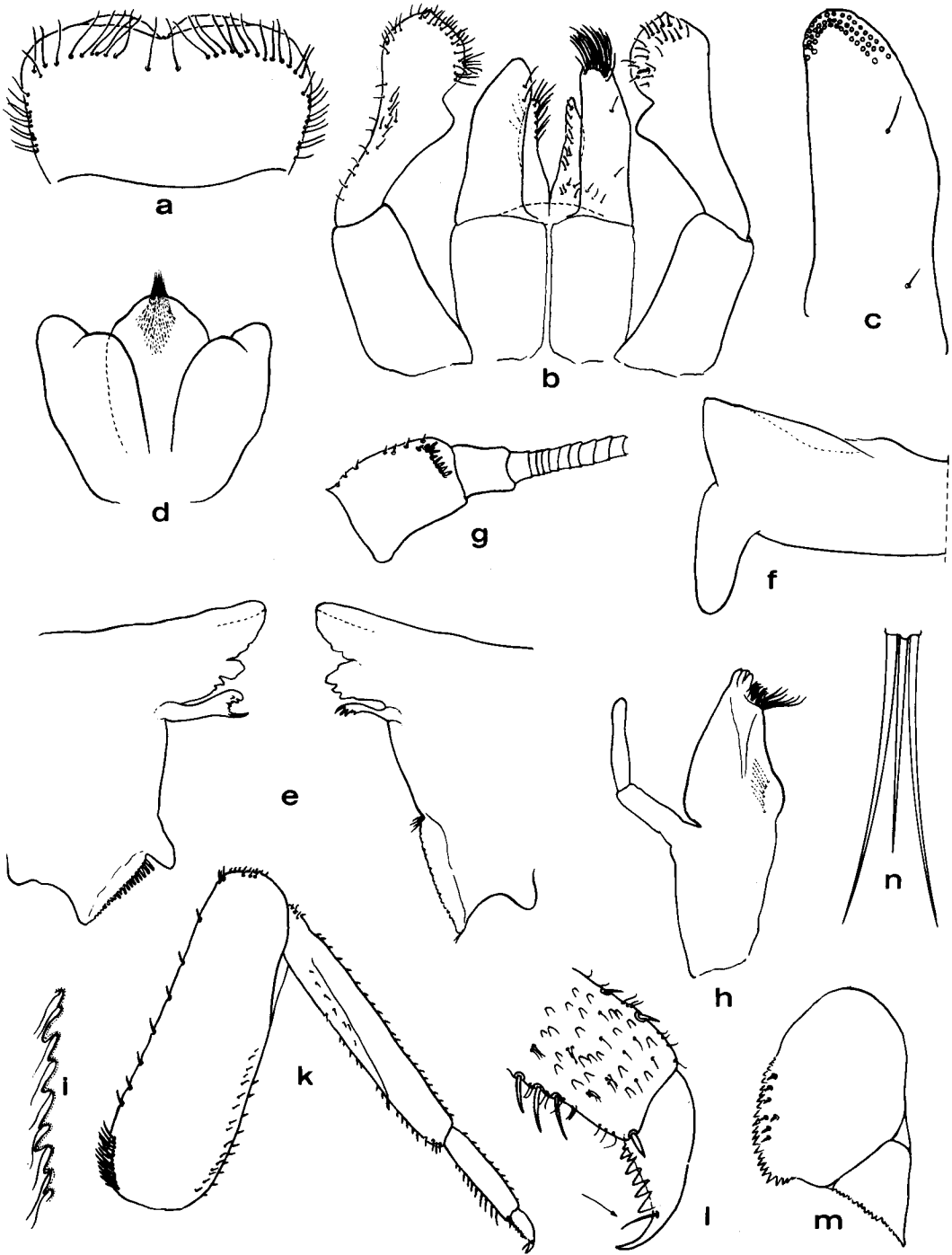


Fig. 1: *Baetis javanicus* nymph: a) labrum; b) labium (left half dorsal, right half ventral); c) glossa; d) hypopharynx; e) canine and molar area of left and right mandible; f) left half of metatergum with hind wing pad; g) base of antenna; h) maxilla; i) part of outer margin of a gill; k) leg; l) claw; m) paraproct; n) caudal filaments.

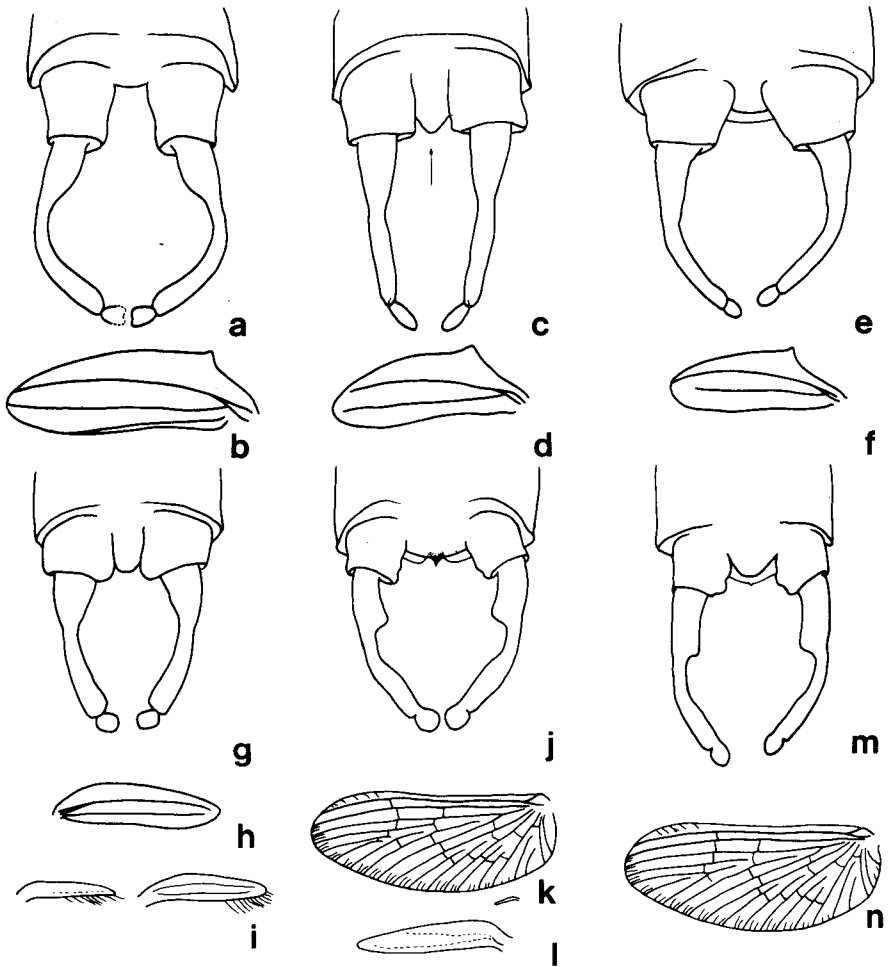


Fig. 2: a) *Baetis javanicus* ♂, genitalia, ventral view; b) *Baetis javanicus* ♂, hind wing; c) *Baetis sumatrana* ♂, genitalia, ventral view; d) *Baetis sumatrana* ♂, hind wing; e) *Baetis olivascens* ♂, genitalia, ventral view; f) *Baetis olivascens* ♂, hind wing; g) *Baetis fulmeki* ♂, genitalia, ventral view; h) *Baetis fulmeki* ♂, hind wing; i) *Baetis fulmeki* Subimago ♀, hind wing (left), Subimago ♂, hind wing (right); j) *Baetis ulmeri* sp. n. ♂, genitalia, ventral view; k) *Baetis ulmeri* sp. n. ♂, front wing and hind wing (same magnification); l) *Baetis ulmeri* sp. n. ♂, detail of hind wing; m) *Baetis necopinatus* sp. n. ♂, genitalia, ventral view; n) *Baetis necopinatus* sp. n. ♂, front wing.

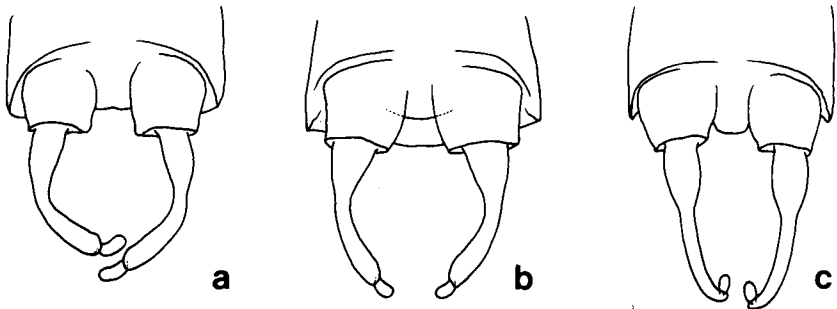


Fig. 3: a) *Pseudocloeon kraepelini* ♂, genitalia, ventral view; b) *Pseudocloeon obscurum* ♂, genitalia, ventral view; c) *Baetis boettgeri* ♂, genitalia, ventral view.

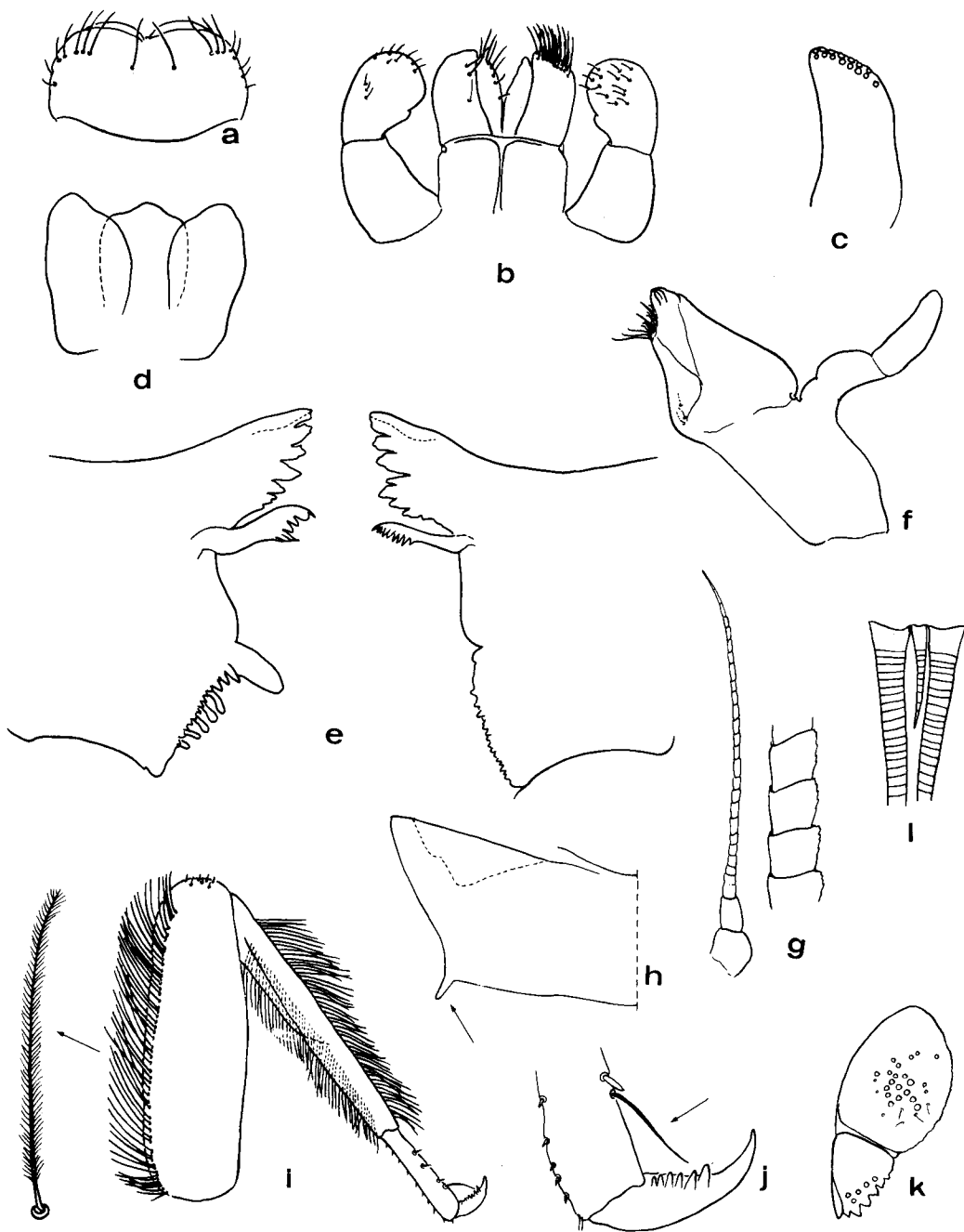


Fig. 4: *Pseudocloeon* sp. 1, nymph: a) labrum; b) labium (left half dorsal, right half ventral); c) paraglossa; d) hypopharynx; e) canine and molar area of left and right mandible; f) maxilla; g) antenna and 4 segments at higher magnification showing serrated inner margin; h) left half of metatergum with reduced hind wing pad; i) 3rd leg and 1 femoral bristle at higher magnification; j) apex of tarsus with conspicuous bristle and claw; k) paraproct; l) base of caudal filaments.

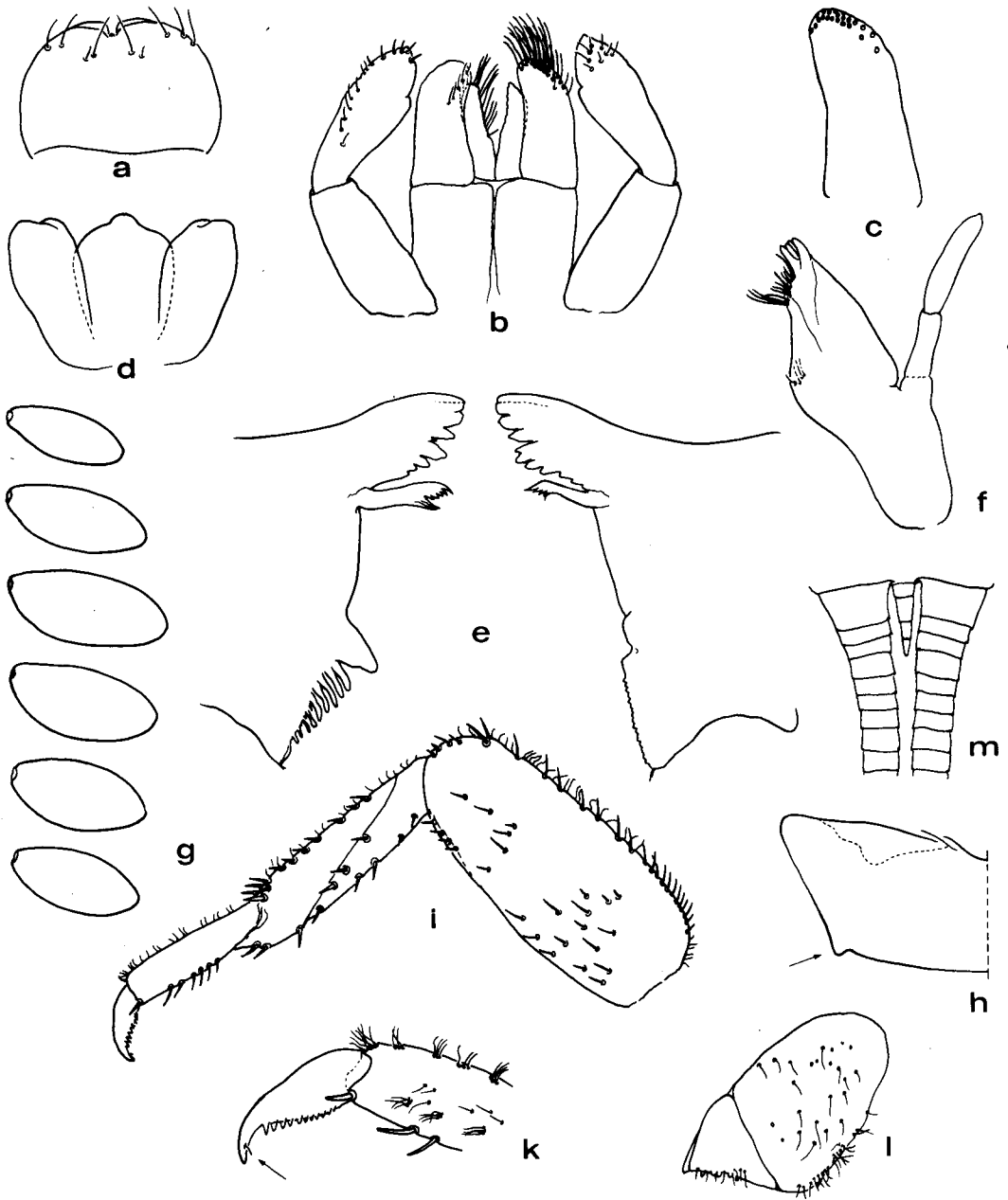
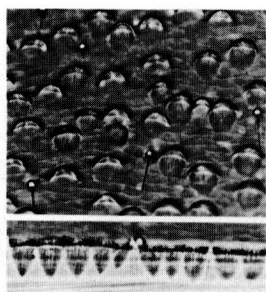
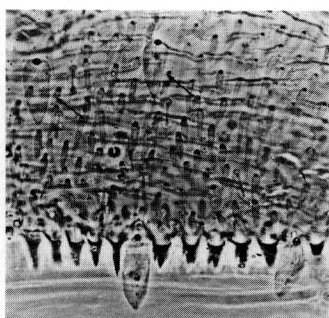


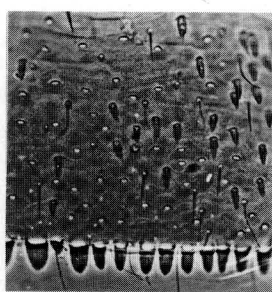
Fig. 5: *Baetis novatus* sp. n., nymph: a) labrum; b) labium (left half dorsal, right half ventral); c) paraglossa; d) hypopharynx; e) canini and molar area of left and right mandible; f) maxilla; g) gills (segment II-VII); h) left half of metatergum with reduced hind wing pad; i) leg; k) claw with very small bristle near apex; l) paraproct; m) base of caudal filaments.



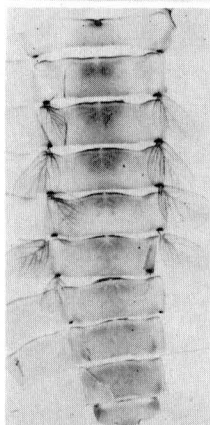
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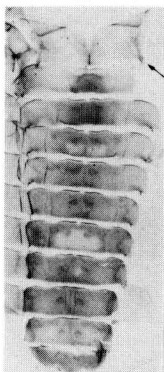
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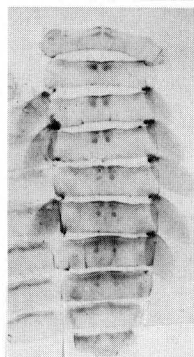
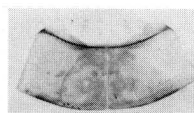
3



4



5



6

Plate 1

1 = *Baetis javanicus*, surface and hind margin of nymphal tergum; 2 = *Pseudocloeon* sp. 1, surface and hind margin of nymphal tergum; 3 = *Baetis novatus* sp. n., surface and hind margin of nymphal tergum; 4 = *Baetis javanicus*, nymphal exuvium (pronotum at higher magnification); 5 = *Pseudocloeon* sp. 1, nymphal exuvium, pointer: hind wing pad (pronotum at higher magnification); 6 = *Baetis novatus* sp. n., nymphal exuvium (pronotum at higher magnification).