

Two new species of *Centroptella* (Ephemeroptera, Baetidae) from Vietnam, with a description of adult stages of the genus

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Abstract. *Centroptella liebenauae* sp. n. (adult male and female, subnago, mature nymph) and *C. colorata* sp. n. (subimago female, mature nymph) are described from Vietnam. Adults of *Centroptella* are described for the first time. Critical characters distinguishing the above species from other species of *Centroptella* are illustrated and keyed. Basic data on their biology are presented.

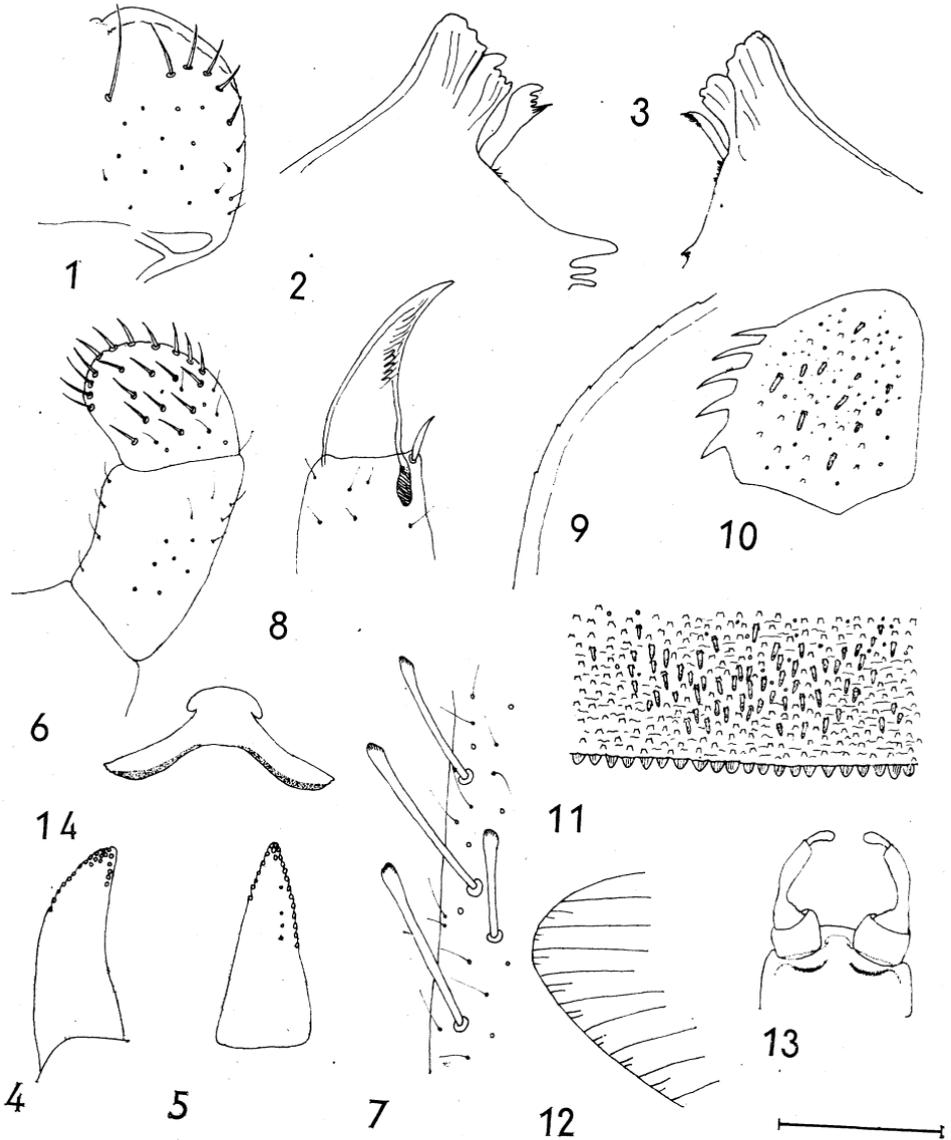
The genus *Centroptella*, phenetically intermediate between *Notobaetis* MORIHARA & EDMUNDS and *Centroptilum* EATON, was proposed for a single species known only in the nymphal stage from China (BRAASCH & SOLDÁN, 1980). Since then three new species apparently belonging to *Centroptella* have been discovered in material from Sri Lanka (MÜLLER-LIEBENAU, 1983). Amongst mayfly material collected at several localities in Vietnam in 1982 and 1984 two additional undescribed species, one of which was reared to the adult stage, were discovered and identified as belonging to this originally monotypic genus. This paper deals with their description and intergeneric relationships, and also completes the original description of the genus with adult characters.

Centroptella liebenauae sp.n.

(Figs 1—14)

Mature nymph (holotype): Body length 4.9 (4.6—5.9) mm, length of cerci 1.2 (1.0—1.5) mm, paracercus slightly longer. Head pale, occiput light brown, antennae brownish, eyes dark grey. Labrum slightly broader than long, with 1 + 4—5 bristles; incisors of right mandible only slightly cleft, prostheca relatively wide, not plumose; prostheca of left mandible as broad as 1/4 of incisor width, with rounded teeth; maxilla with 4 teeth at apex. Maxillary palps about as long as galea-lacinia, apical segment shorter by 1/3 than basal one and bluntly pointed at apex. Glossae and paraglossae equal in width, paraglossae with a submarginal mesal row of 8—10 bristles; segment 3 of labial palps rounded, slightly tapered medially.

Pronotum brownish or olive brown, with large diffuse spots and a pair of apparent medial tubercles; meso- and metanotum of the same colour with bright pale strips and smudges, forewing pads usually dark yellowish, uni-



Figs 1-14: *Centroptella liebenauae* sp. n. 1 - nymph, labrum. 2 - nymph, left mandible. 3 - nymph, right mandible. 4 - nymph, paraglossa. 5 - nymph, glossa. 6 - nymph, labial palpus. 7 - nymph, posterior margin of femur. 8 - nymphal claw. 9 - nymph, margin of gill 3. 10 - nymph, paraproct plate. 11 - nymph, posterior margin of tergum III. 12 - adult, apex of forewing with paired intercalaries. 13 - adult, forceps. 14 - adult, penis cover. Scales: Figs 1-6, 8, 10, 14 - 0.4 mm; 7, 9, 11 - 0.1 mm; 12, 13 - 1.0 mm.

colourous, hindwing pads minute, colourless but well recognisable. Legs pale yellowish, tarsi and claws dark brownish; femora with numerous submarginal triangular scales near inner margin, outer margin with a row of 8—10 bristles as long as $\frac{2}{3}$ femur width and rounded at apex; tibiae of all legs with long, fine setae forming dorsal arc near base, course of arc different on tibiae of each leg pair, no seam recognisable on fore tibiae. Similar fine setae well apparent also on tarsi but shorter. Claws pointed, with two rows of 3—4 denticles.

Abdominal terga I and VIII usually pale, other terga dark brownish with pale markings, consisting of two pairs of spots and a pair of diffuse smudges near posterior margin; surface of terga densely covered with long, pointed or bluntly pointed scales, posterior margin with rounded triangular spines on anterior abdominal segments or elongated pointed spines on posterior ones. Gills 1—7 elongated, rounded and slightly asymmetric, about 3.5 times longer than broad. Paraprocts with pointed scales and minute microtrichia, their margins with stout pointed spines. Cerci brownish, paler near base, every fourth segment with 2—3 large pointed spines on outer margin.

Adult male (paratype No. 1): Body length 4.2 (4.0—4.3) mm, length of cerci 8.5 (7.5—9.0) mm. Head yellowish brown, an inconspicuous pair of paler spots on occiput; antennae yellowish white, scape and pedicel slightly darker, three times longer than head. Eyes dark grey, ocelli whitish, black bordered; turbinate eyes dark reddish brown, pitch brown near base up to the level of normal eyes; shaft with divergent margins, faceted surface convex, nearly circular in dorsal view, without conspicuous dark rim. Thorax brown, mesonotum darker. Fore wings colourless, pterostigma slightly milky transparent, longitudinal veins slightly yellowish; base of *c* and *sc* dark brown, with paired intercalaries progressively diminishing towards anal region; intercalaries missing in cubital and anal membranes; about 5 imperfect but not forked cross-veins in pterostigma. Legs whitish, unicolorous, tarsi of fore legs twice longer than femora; claws dissimilar. Abdominal segments I—VI whitish translucent, unicolorous, only stigmatic area slightly marked with black; segments VII and VIII yellowish brown, tergum X lighter. Forceps base with straight posterior margin, inconspicuous rounded projections near bases of forceps segments 1. Forceps whitish, segment 1 wide, approximately quadrate, segment 3 long nearly as long as $\frac{1}{3}$ of segment 2. Cerci whitish, unicolorous.

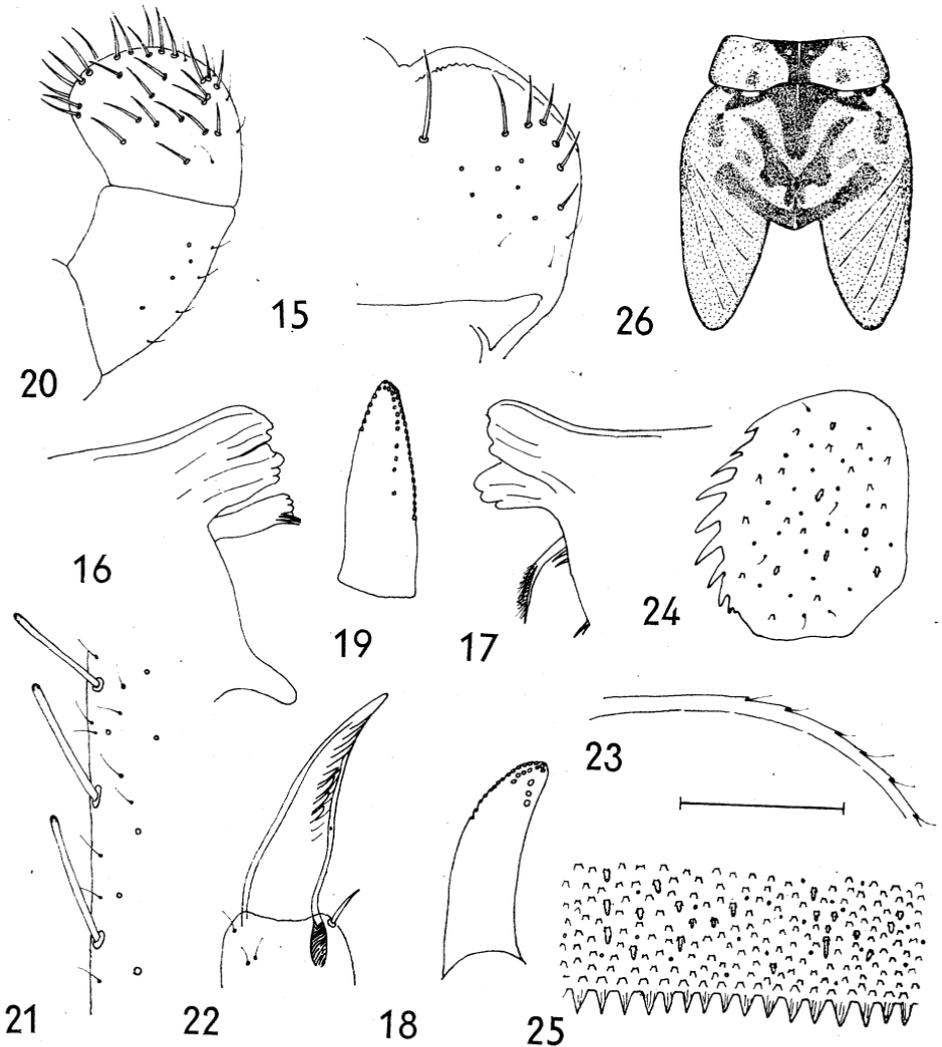
Adult female (paratype No. 2): Body length 3.7 mm, cerci broken. Head whitish yellow, unicolorous, eyes black, ocelli grey; antennae pale, scape and pedicel slightly darker. Thorax brownish yellow, unicolorous, ventral side paler. Wings transparent, longitudinal veins yellowish brown. Legs yellow, tarsi slightly darker. Abdominal segments whitish yellow, terga with a pair of large darker diffuse smudges on the sides.

Subimago male (paratype No. 3): Body length 4.2 mm, cerci broken. Head whitish, antennal flagellum with brownish stippling, eyes grey; turbinate eyes more rounded, dark brown, shaft darker than faceted surface. Thoracic nota light brown, ventral side of thorax pale. Wings brownish grey, unicolorous. Legs and abdomen white, without markings.

Specimens examined: Mature nymph (holotype), adult male (paratype No. 1), adult female (paratype No. 2), subimago male (paratype No. 3), 18 nymphs, 2 ♂♂ (reared) (further paratypes), Vietnam, Vinh Phu Prov., Suoi Bac stream, Tam-Dao, 23.—25. v. 1982; 41 nymphs

(further paratypes), same locality, 10.–16. x. 1984; 3 nymphs (further paratypes), Vinh Phu Prov., Song Dan riv., 17. x. 1984 leg. T. Soldán. Holotype in alcohol, parts of paratypes on slides (Canada balsam with Cellosolve), deposited in the Institute of Entomology, Czechoslovak Academy of Sciences, České Budějovice. Some paratypes in the collections of junior authors.

Etyymology: This species is dedicated to Dr I. Müller-Liebenau, Plön, BRD, an outstanding expert in the taxonomy of the family Baetidae.



Figs 15–26: *Centroptella colorata* sp. n., nymph. 15 – labrum. 16 – left mandible. 17 – right mandible. 18 – paraglossa. 19 – glossa. 20 – labial palpus. 21 – posterior margin of femur. 22 – claw. 23 – margin of gill 3. 24 – paraproct plate. 25 – posterior margin of abdominal tergum III. 26 – colour patterns of pro- and mesonotum. Scales: Figs 15–20, 22, 24 – 0.4 mm; 21, 23, 25 – 0.1 mm; 26 – 1.0 mm.

Centroptella colorata sp. n.

(Figs 15–26)

Mature nymph (holotype): Body length 4.0 (3.8–4.0) mm, length of cerci 1.6 mm. Head whitish yellow, diffuse darker smudges on occiput; ocelli grey; antennae with conspicuous brownish stippling. Labrum distinctly broader than long with 1 + 7–8 bristles. Incisors of right mandible apparently cleft with rounded teeth, prostheca plumose but not branched, about twice longer than incisors; prostheca of left mandible as long as incisors with rounded outer and pointed inner apical teeth. Maxilla with 4 teeth at apex; maxillary palps as long as galea-lacinia, 2-segmented; basal segment as long as $\frac{2}{5}$ of distal one, distal segment pointed at apex with several short hairs. Distal segment of labial palps rounded, evidently tapered mesally, evenly covered with stout pointed bristles. Glossae as wide as paraglossae with submarginal row of 10–12 bristles.

Pronotum smooth, without tubercles, predominantly pale with darker smudges; mesonotum with bright longitudinal strips, forewing pads pale yellow, slightly darker apically; metanotum whitish yellow, unicolorous, minute hindwing pads well apparent. Legs whitish yellow, unicolorous, femora sometimes with diffuse darker smudge and a row of 6–8 bristles as long as $\frac{1}{3}$ of femur width on outer margins; tibiae of all legs with fine setae arising from sockets forming dorsal arc near bases; inner row of setae nearly perpendicular to the leg axis in middle and hind legs; claws pointed, with two rows of 3–4 triangular denticles.

Abdominal terga I and VII–IX pale yellowish, nearly without markings; terga II–VI and X dark brownish, with large diffuse pale spots and a pair of small rounded spots in middle; abdominal sterna pale, unicolorous, without markings. Surface of terga sparsely covered with short plumose scales and semilunar impressions; posterior margin of terga I–III with irregular row of scales, that of terga IV–X with stout pointed triangular teeth arranged into a simple row. Gills elongated, evidently asymmetrical, with indistinct tracheization; gill 1 present, very slender, more than 5 times longer than broad; gills 2–5 apically rounded or bluntly pointed with several teeth on outer margin, about 2.5–3.5 times as long as broad. Paraproct plate with similar row of spines on its posterior margin and a group of plumose scales in middle. Cerci whitish yellow with brownish stippling in apical half; posterior margin of individual segments with scales.

Subimago female (dissected from mature nymph): Body pale whitish, pronotum and antennae slightly darker. Eyes black, ocelli grey. Forewings brownish grey, unicolorous; hindwing absent. Abdominal terga without markings.

Material examined: Mature nymph (holotype), subimago female (dissected from mature nymph, paratype No. 1), 2 nymphs (further paratypes): Vietnam, Lam Dong Prov., Da Nhim river, Duc Trong, 27. x. 1984 leg. T. Soldán. Holotype in alcohol, parts of paratypes on slides (Canada balsam with Cellosolve), deposited in the Institute of Entomology, Czechoslovak Academy of Sciences, České Budějovice.

Etymology: Named after the bright and contrasting abdominal colour pattern.

Differential diagnosis and discussion

Centroptella liebenauae sp. n. occupies a quite independent position among other known species of this genus. It is distinguished mainly by "normal"

baetid right prostheca, only slightly cleft mandibular incisors, tubercles on pronotum and by the unique occurrence of stout spines on the cerci. A closely related species was described by MÜLLER-LIEBENAU (1984: 272 — 283, Figs 15, 30, 32, 33, 48) from the river Gombak in West Malaysia, and referred to as "Genus No. 2 sp. 1". Despite the unique arrangement of right mandible, additional morphological characters (antennae, labrum, scales on terga, paraproct and especially the arrangement of tibial bristles) show the relationship of both these species to *Centroptella*, and also in certain respects to *Notobaetis* and *Centroptilum*. As pointed out by MÜLLER-LIEBENAU (1984) the different arrangement of prostheca need not be a contradiction since a similar situation occurs in certain other baetid genera, e.g. *Baetis* and *Centroptilum*. That is why we classify both these closely related species in the genus *Centroptella*. Also MÜLLER-LIEBENAU (1984) states that "... Genus No. 2 from Malaysia appears to be very closely related, if not synonymous to *Centroptella* BRAASCH & SOLDÁN". Distinguishing characters between *C. liebenauae* sp. n. and the unnamed species are apparent from the key presented below.

Centroptella colorata sp. n. appears to be closely related to *C. ceylonensis* MÜLLER-LIEBENAU from Sri Lanka. The main critical distinguishing characters of known species of *Centroptella* are keyed as follows:

- 1 (4) Right mandibular incisors only slightly cleft, prostheca wide with apical pointed or rounded teeth; group of conspicuous stout spines on outer margin of each fourth cerci segment.
- 2 (3) Labrum with 1 + 5–6 bristles; basal segment of maxillary palps as long as 2/3 of segment 2; bristles on femora longer than 1/2 femur width; gills 1 and 7 oval, similar to others; pronotum with pair of distinct tubercles (Vietnam) *C. liebenauae* sp. n.
- 3 (2) Labrum with 1 + 3 bristles; basal segment of maxillary palps as long as 1/4–1/3 of segment 2; bristles on femora as long as 1/4–1/3 of segment 2; bristles on femora as long as 1/3 femur width; gills 1 and 7 very narrow, much smaller than others; pronotum without tubercles (W. Malaysia)
..... *Centroptella* sp. (Genus No. 2 sp. 1 of MÜLLER-LIEBENAU, 1984)
- 4 (1) Right mandibular incisor apparently cleft, prostheca narrow, plumose or branched, without teeth; cerci with small spines or scales similar on all segments.
- 5 (6) Maxillary palpus small, half length of galea-lacinia; gills 3–5 with strongly asymmetrical apex produced into obtuse point; paraproct with numerous well developed teeth on posterior margin (China) *C. longisetosa* BRAASCH & SOLDÁN, 1980
- 6 (5) Maxillary palpus about same length as or reaching beyond galea-lacinia; gills 3–5 slightly or moderately asymmetrical, rounded or bluntly pointed; paraproct with only several teeth or teeth imperfect on posterior margin.
- 7 (10) Minute hindwing pads well developed; claws with two rows of denticles; abdominal terga with bright and contrasting colour pattern.
- 8 (9) Prostheca of right mandible 2-branched, about as long as incisors; 5 spines between prostheca and molar part; submarginal row of bristles on paraglossa consisting of 8–9 bristles; 11–15 bristles on margins of femora; gills rounded, tracheization distinct (Sri Lanka) *C. ceylonensis* MÜLLER-LIEBENAU, 1983
- 9 (8) Prostheca of right mandible not branched, about twice longer than incisors; 1–2 spines between prostheca and molar part; submarginal row of bristles on paraglossa consisting of 10–12 bristles; 6–9 bristles on margins of femora; gills elongated, tracheization indistinct (Vietnam) *C. colorata* sp. n.
- 10 (7) Hindwing pads completely absent; claws without denticles; abdominal terga with diffuse colour pattern.
- 11 (12) Posterior margins of terga I–III without scales, with regular row of spines; scales on surface of terga short, regularly triangular; posterior margin of segment 3 of labial palps straight or slightly concave (Sri Lanka) *C. soldani* MÜLLER-LIEBENAU, 1983
- 12 (11) Posterior margins of terga I–III without spines, with irregular row of scales; scales on surface of terga elongated, rounded; posterior margin of segment 3 of labial palps convex, rounded (Sri Lanka) *C. similis* MÜLLER-LIEBENAU, 1983

The adults of *C. liebenauae* sp. n. cannot be compared to those of other species of *Centroptella* since more of the latter are available. Nevertheless, adult characters of this single known species allow the completion of a differential diagnosis of the genus. *Centroptella* can be distinguished from other genera of the family Baetidae by the following combination of characters: (1) turbinate eyes prominent, well developed; (2) posterior margin of metanotum emarginated medially, metascutellar hump projected dorsoposteriorly; (3) forewings with paired intercalaries; (4) intercalaries absent in most anal and cubital membranes; (5) hindwings completely absent, and (6) forceps 3-segmented, apical segment relatively very long. These characters approach *Centroptella* to the Neotropical genus *Notobaetis* MORIHARA & EDMUNDS, 1980 which shares the characters (1–3). Adults of *Notobaetis* can be distinguished by well developed hindwings, complete intercalaries and different arrangement of forceps.

The relationships to the *Centroptilum-Cloeon-Procloeon* phyletic line are, especially owing to paired intercalaries, very remote (eg. MÜLLER-LIEBENAU, 1983). Also some unnamed Ethiopian nymphs of *Centroptilum* possess cleft right mandible and branched prostheca (DEMOULIN, 1970).

Notes to biology and distribution

The species from Sri Lanka are known to inhabit stony streams and rivers of average depth 5–100 cm and width 3–20 m (see MÜLLER-LIEBENAU, 1983, also for hydrochemical data of the collecting sites). Nymphs were collected mostly in partially shaded water running through tea plantations or forest (COSTA & STARMÜHLNER, 1972). Mature nymphs occurred in November–December.

The unnamed species from W. Malaysia seems to prefer places with slow or no current in the river Gombak (for details see Station II of BISHOP, 1973).

In Vietnam nymphs of *Centroptella* were found at two different habitats. Nymphs of *C. colorata* sp. n. were collected in a large river at places with big boulders and moderate current (10–40 cm.s⁻¹). They are extremely rare at the type locality, probably not inhabiting tributaries of the Da Nhim near Duc Trong. Nymphs of *C. liebenauae* sp. n. were collected in a montane stream (about 1–3 m wide). They evidently prefer places with a slow current and stony bottom, but do not inhabit pools without current. They live together with *Baetis*, *Centroptilum*, *Thalerosphyrus*, *Bleptus*, *Cinygmima*, *Habrophleboides*, *Isca* and *Caenis* nymphs. Their quantitative presentation was about 2–4 % of the total mayfly standing crop. Mature nymphs were found in May and in October at the same locality, indicating at least two generations a year. Emergence seems to be, owing to apparently different size cohorts found in May, continual from spring to autumn.

The genus *Centroptella* is apparently Oriental, with species occurring in China, Sri Lanka, Vietnam and W. Malaysia. The origin of the generic complex *Notobaetis-Centroptella* (and Genus No. 2 of MÜLLER-LIEBENAU, 1984) seems to be most likely Gondwanian. The distribution of *Notobaetis* (Argentina), and *Centroptella* (Oriental with extension to East Palaearctic-China) including a branched-prostheca *Pseudocloeon* species described DEMOULIN (1970) from Natal provides an indication to this Gondwanian origin.

REFERENCES

- BISHOP J. E. 1973: Limnology of a small Malayan River, Sungai Gombak. Dr W. Junk B. V. Publishers, 485 pp, The Hague.
- BRAASCH D. & SOLDÁN T. 1980: *Centroptella* n. gen., eine neue Gattung der Eintagsfliegen aus China (Baetidae, Ephemeroptera). *Reichenbachia*, **18** : 123—127.
- COSTA H. H. & STARMÜHLNER F. 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 Vidyalakara University of Ceylon, Kelaniya. Part I. Preliminary Report: Introduction and description of the stations. *Bull. Fish. Res. Stn, Sri Lanka*, **23** : 43—76.
- DEMOULIN G. 1970: Ephemeroptera des faunes éthiopienne et malgache. *South Afr. Anim. Life*, **14** : 24—170.
- MORIHARA D. K. & EDMUNDS G. F. 1980: A new genus of Baetidae (Ephemeroptera) from South America. *Int. Rev. Ges. Hydrobiol.*, **65** : 605—610.
- MÜLLER-LIEBENAU I. 1983: Three new species of the genus *Centroptella* Braasch & Soldán, 1980, from Sri Lanka (Insecta: Ephemeroptera). *Arch. Hydrobiol.*, **97** : 486—500.
- MÜLLER-LIEBENAU I. 1984: New genera and species of the family Baetidae from West-Malaysia (River Gombak) (Insecta: Ephemeroptera). *Spixiana*, **7** : 253—284.

Два новых вида *Centroptella* (Ephemeroptera, Baetidae) из Вьетнама и описание взрослой стадии данного рода

Таксономия, ориентальная область, взрослый самец, нимфы, определитель, биология

Резюме. Дается описание новых видов *Centroptella liebenauae* sp. n. (взрослые самец и самка, субимаго, нимфа) и *C. colorata* sp. n. (субимаго самки, зрелая нимфа) из Вьетнама. Впервые дается описание взрослых особей рода *Centroptella*. Отличительные признаки от других видов *Centroptella* изображены и приведены в виде определителя. Приведены основные данные по биологии новых видов.

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REVIEW

Gewecke M. & Wendler G. (eds): *INSECT LOCOMOTION*. Proceedings of Symposium 4.5 from the 17th International Congress of Entomology, 254 pp., 170 figs, 5 tables. Verlag Paul Parey, Berlin and Hamburg 1985.

The book is based on the lectures and allied poster and film sessions presented at the symposium on insect locomotion held at the University of Hamburg as a part of the 17th I.C.E. in August 1984. The meeting offered a rare opportunity to learn about the work of physiologists and others investigating various forms of insect locomotion, namely terrestrial, aquatic and aerial. The main research emphasis of the contributors was focussed on the question, how does sensory feedback from the moving body or its appendages interact with a centrally generated programme of motor control to produce the well coordinated and

well adapted behaviour (walking, jumping, swimming, flying) that can be observed in the intact animal. The coordination of leg and wing movements, as well as the movements of the whole animal in space are dependent on metabolism, respiration, internal transport, muscle contraction, neural, hormonal and sensory control, and mechanical, hydro- or aerodynamic mechanisms. Aspects of these topics are also reflected in articles contained in this book. The analyses span from the cellular to the system level and from physiological principles to applied problems. Since the papers give a topical synopsis of current problems in this field of research and of new perspectives for the future, it should prove to be a useful and indispensable guide to all invertebrate behavioural physiologists.

J. Žďárek