

## GENERIC REVISION OF *CLOEODES* AND DESCRIPTION OF TWO NEW GENERA (EPHEMEROPTERA: BAETIDAE)

R. D. WALTZ AND W. P. McCAFFERTY

Department of Entomology, Purdue University, West Lafayette, Indiana 47907.

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**Abstract.**—The genus *Cloeodes* is redefined to include species with hindwings and species without hindwings. *Notobaetis* Morihara and Edmunds (1980) and certain species previously assigned to *Centropptella* Braasch and Soldán (1980), including the type species, are congeneric with *Cloeodes*, necessitating the following recombinations: *Cloeodes penai* (Morihara and Edmunds) n. comb., *Cloeodes longisetosus* (Braasch and Soldán) n. comb., and *Cloeodes soldani* (Müller-Liebenau) n. comb. A new Neotropical genus, *Bernerius* n. gen., and its type species, *B. incus* n. sp., from Peru are described. *Bernerius* is a sister genus of *Cloeodes*. Species previously assigned to the *ceylonensis-similis-pusilla* species group of *Centropptella* are a monophyletic cluster unrelated to *Cloeodes* (= *Centropptella* Braasch and Soldán, in part) and are therefore placed in *Chopralla* n. gen. that includes: *Chopralla ceylonensis* (Müller-Liebenau) n. comb. (= type species), *Chopralla similis* (Müller-Liebenau) n. comb., and *Chopralla pusilla* (Müller-Liebenau) n. comb.

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*Cloeodes* was erected by Traver (1938) to include several Puerto Rican species of Baetidae with adults very similar to Nearctic species assigned to *Pseudocloeon* Klapálek (both having paired marginal intercalaries of the forewings and no hindwings) and larvae distinct from any known Nearctic species assigned to *Pseudocloeon* (*Cloeodes* having a well-developed median terminal filament). Our revisionary study of Baetidae has shown *Cloeodes* to be a distinct genus possessing several apomorphic character states. We redefine and describe it herein along with describing a new sister genus of *Cloeodes*. The revision of *Cloeodes* has necessitated the revision, and hence dissolution, of the genus *Centropptella* Braasch and Soldán because certain of those species, including the type species of *Centropptella*, are actually *Cloeodes*. Other unrelated *Centropptella* are placed in an additional new and distinctive genus that is also described herein.

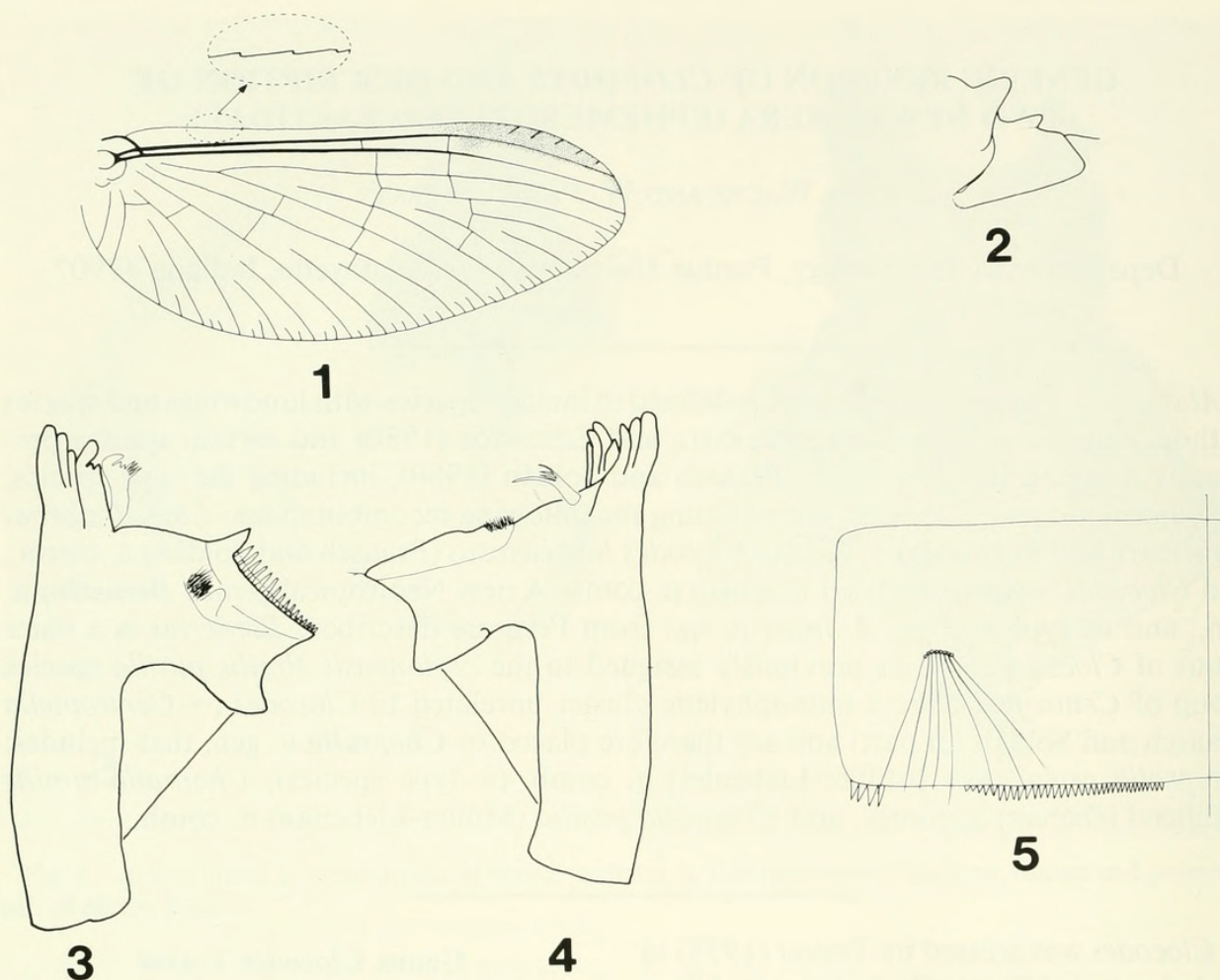
### Genus *Cloeodes* Traver

*Cloeodes* Traver, 1938: 32. Type species *Cloeodes maculipes* Traver, by original designation.

*Notobaetis* Morihara and Edmunds, 1980: 606. Type species *N. penai* Morihara and Edmunds, by original designation. n. syn.  
*Centropptella* Braasch and Soldán, 1980: 123. (in part). Type species *C. longisetosa* Braasch and Soldán, by monotypy. n. syn.

Larva.—Labrum slightly broader than long, clearly emarginate and with marginal shelf anteriorly. Left mandible (Fig. 3) with incisors fused apically; prostheca stout, digitate; no tuft of setae between incisors and molar area; thumb of molar area triangulate and elevated above plane of incisor base. Right mandible (Fig. 4) with incisors separated apically; prostheca reduced, slender, and variably furcate. Labium with 3-segmented palps; terminal segment rounded to oblique; segment 2 with weakly developed





Figs. 1–5. *Cloeodes* spp. 1, Forewing. 2, Metascutellar hump. 3, Left mandible. 4, Right mandible. 5, Ventral setal tuft.

inner apical lobe; glossae subequal to paraglossae; paraglossae with subparallel margins.

Femora parallel sided, without ventral setal patch and with short, dorsal bristles and similarly shaped distal bristles. Tibiae with subproximal arc of long, fine setae; no fine setae adjoining tibial seam. Foreleg with subtending bristle and tibial seam and with subproximal arc of long, fine setae. Claws (Fig. 17) ca.  $0.33\times$  tarsal length, with or without microspines.

Abdominal terga with broadly pointed, rectangulate-based scales and fine setae; scales with median length subequal to basal width; posterior marginal spines present on all terga; ventrally abdomen with scales and fine setae, with prominent tufts (i.e. with contiguous setal bases) of long, fine setae on

segments 2–6 (Figs. 5, 18). Gills (similar to Fig. 13) 1–7, asymmetric, broadly pointed, without marginal spination or ciliation; each gill often  $2\times$  or more length of associated tergum. Median terminal filament subequal to cerci.

Adult male.—Forewings (Fig. 1) with paired marginal intercalaries in most cells; detached base of vein  $MA_2$  extending well beyond  $0.5\times$  distance between distal cross-vein and proximal (=  $MA_1$  to  $MP_1$ ) cross-vein. Hindwings present or absent; when present with acute or distinctly hooked median costal process. Posterior margin of metanotum deeply emarginate; metascutellar hump (Fig. 2) not flattened before apex but projecting dorsoposteriorly. Forceps four-segmented; segments 2 and 3 nearly fused; segment 3 ca.  $2\times$  length segment 2,



segment 2 subequal to segment 1 and with basal bulge bearing fine bristle-like setae; no median spine or protuberance between forceps bases.

Adult female.—Marginal intercalaries of forewing paired or less often single. Posterior margin of metanotum not as deeply emarginate as in male; metascutellar process as in male. Subanal plate not developed.

Material examined.—*Cloeodes maculipes* Traver: Holotype, ♂ adult, Puerto Rico, Ludillo Mtns., camp lab 46 (107), VI-14-1935. J. Garcia-Diaz. in alcohol, genitalia slide mounted in balsam (solvent: xylene); larval exuviae of holotype ♂ slide mounted in euparal (solvent: abs. alc.), C.U. Type No. 1402.1, Cornell University. Paratypes, ♂ adult (genitalia missing), subimago exuviae, larval exuviae (missing), same data and deposition as above; paratype (allotype), ♀ adult, in alcohol; wing slide mounted, Puerto Rico, Trout's pool, El Yunque Trail, VI-12-1935. J. Garcia-Diaz. C.U. Type No. 1402.2, same deposition as holotype. *Cloeodes consignatus* Traver: Holotype, ♀ adult, Puerto Rico, Yunez River, VI-21-1935, J. Garcia-Diaz. Cornell University Type No. 1403.1, in alcohol; one wing slide mounted. *Notobaetis penai* Morihara and Edmunds: Paratypes, ♂ larva, Argentina, Tucuman N.W. of San Miguel de Tucuman, I-25-1969, W. L. and J. G. Peters, slide mounted in balsam (solvent: xylene), Purdue Entomological Research Collection (PERC); ♀ larva, Argentina, Cordoba Prov., Copina (ca. 25 km WNW Alta Garcia), elev. 1650 m, IV-11/14-1969, L. Pena, slide mounted in balsam (solvent: xylene) (PERC); ♀ adult, legs slide mounted in balsam (solvent: xylene), same data as above (PERC); ♂ adult, wings slide mounted, same data as above (PERC); three whole larvae (in alcohol), same data as above, Florida A&M University Collection; two adult ♂ and one subimago ♂ and two associated larval exuviae (in alcohol), same data as above, University of Utah Collection. *Centrop- tella*

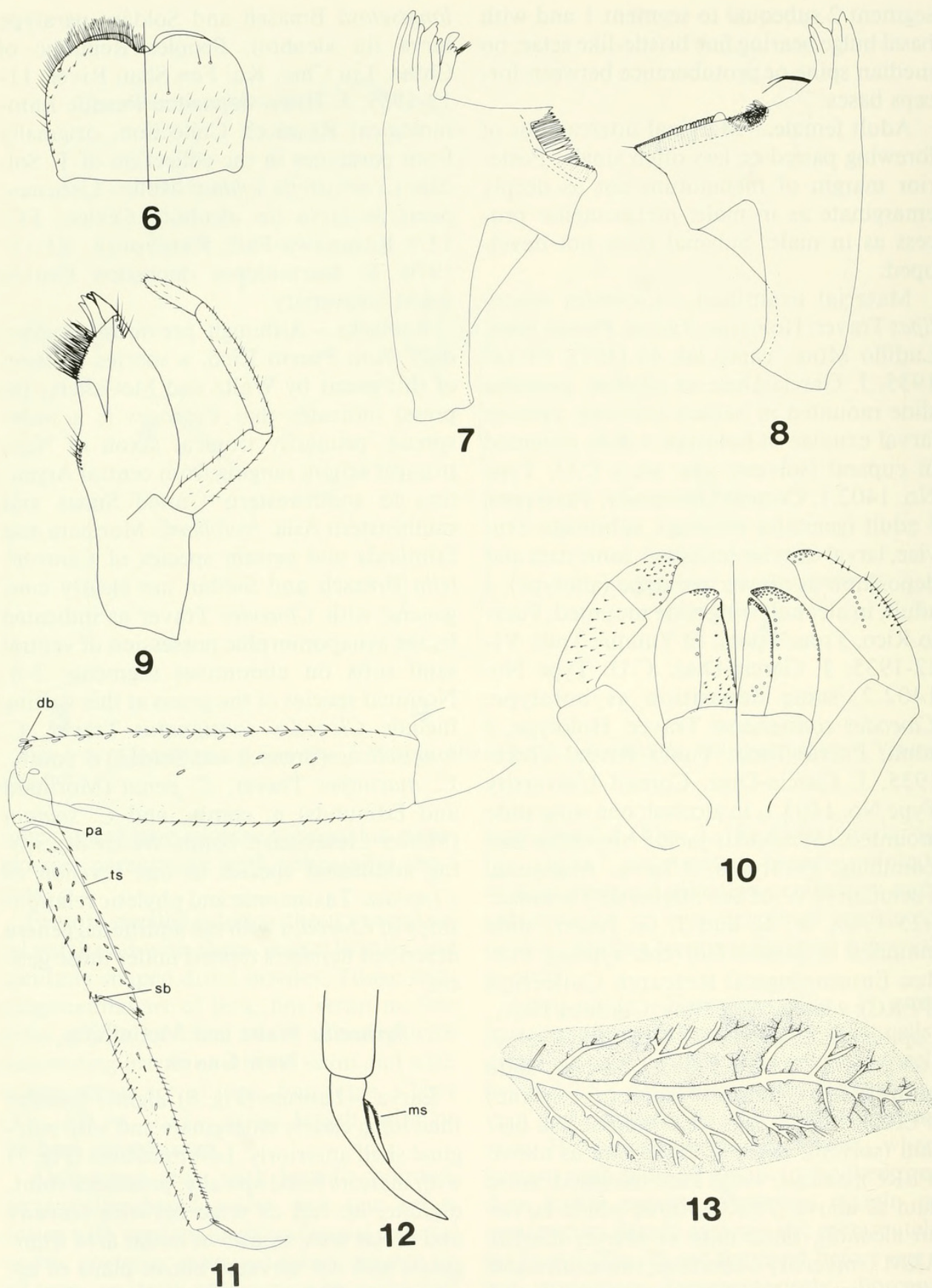
*longisetosa* Braasch and Soldán: paratype larva (in alcohol), Peoples Republic of China, Liu Chui, Kuj Fon Shan River, 11-12-1959, I. Hrdy, deposited Purdue Entomological Research Collection, originally from paratypes in the collection of T. Soldán. *Centrop- tella soldani* Müller-Liebenau: paratype larva (in alcohol), Ceylon, FC/11/c Rasanawa-Fall, Ratnapura, XI-19-1970. F. Starmühlner deposited Florida A&M University.

Remarks.—Although previously known only from Puerto Rico, a species revision of this genus by Waltz and McCafferty (in press) indicates that *Cloeodes* is a widespread, primarily tropical taxon of Neotropical origin, ranging from central Argentina to southwestern United States and southeastern Asia. *Notobaetis* Morihara and Edmunds and certain species of *Centrop- tella* Braasch and Soldán are clearly congeneric with *Cloeodes* Traver as indicated by the synapomorphic possession of ventral setal tufts on abdominal segments 2–6. Nominal species of the genus at this writing include *Cloeodes consignatus* Traver, *C. longisetosus* (Braasch and Soldán) n. comb., *C. maculipes* Traver, *C. penai* (Morihara and Edmunds) n. comb., and *C. soldani* (Müller-Liebenau) n. comb. We are describing additional species in our revision of *Cloeodes*. Taxonomic and phyletic relationships of *Cloeodes* with the additional genera described herein is treated under those genera.

#### ***Bernerius* Waltz and McCafferty, NEW GENUS**

Larva.—Labrum (Fig. 6) slightly broader than long, clearly emarginate and with marginal shelf anteriorly. Left mandible (Fig. 7) with incisors fused apically; prostheca stout, digitate; no tuft of setae between incisors and molar area; thumb of molar area triangulate and not elevated above plane of incisor base. Right mandible (Fig. 8) with incisors separated apically; prostheca reduced, slender and furcate; no tuft of setae between





Figs. 6–13. *Bernerius incus* larva. 6, Labrum (left, ventral; right, dorsal). 7, Left mandible. 8, Right mandible. 9, Maxilla. 10, Labium (left, ventral; right, dorsal). 11, Foreleg (db—distal bristles, pa—proximal arc, ts—tibial seam, sb—subtending bristle). 12, Claw (ms—microspines). 13, Gill 4.



incisors and molar area. Labium (Fig. 10) with three-segmented palps; terminal segment obliquely truncate; segment 2 with weakly developed inner apical lobe; glossae subequal to paraglossae; paraglossae with weakly convex subparallel margins.

Femora (Fig. 11) parallel sided, without ventral setal patch, and with short dorsal bristles and similarly shaped distal bristles. Tibiae with subproximal arc of long, fine setae; no fine setae adjoining tibial seam. Foreleg with subproximal arc of setae, subtending bristle, and tibial seam. Claws (Fig. 12) ca.  $0.33 \times$  tarsal length, excavate and with microspines basally.

Abdominal terga with rectangulate-based scales and fine setae; scales with median length ca.  $2 \times$  basal width; posterior marginal spines present on all terga; ventrally abdomen with scales and fine setae, no setal tufts. Gills (Fig. 13) 1–7 asymmetric, elongate, and broadly pointed apically; without marginal spination or ciliation. Median terminal filament subequal to cerci.

Type species.—*Bernerius incus* Waltz and McCafferty n. sp.

Etymology.—*Bernerius* is of masculine gender and is based on the sur-name of the American ephemeropterist Lewis Berner.

Remarks.—This genus is erected for a Peruvian species previously treated as *Baetis* sp. B by Berner (in Roback et al., 1980) and redescribed as *Bernerius incus* n. sp. below. Adults are presently unknown.

*Bernerius* is a sister genus to *Cloeodes* as demonstrated by the following synapomorphies: the presence of a left mandible (Figs. 3, 7) with incisors fused apically and a stout prosthema; a right mandible (Fig. 4, 8) with incisors partially fused but separated apically and a slender, furcate prosthema; the presence of an arc of long, fine setae subproximally on the tibia (Fig. 11-pa); simple, asymmetrically lamellate, and broadly pointed gills (Fig. 13). *Bernerius* retains the plesiomorphous condition of abundant long, fine setae on the venter of most abdominal segments, which in *Cloeodes* species form

distinct tufts (Figs. 5, 18) on abdominal segments 2–6.

The elevation of the left mandible thumb above the plane of the incisor bases, the presence of clearly defined setal tufts on sterna 2–6, reductionist tendencies in spination of the legs, increased stability in the length of posterior marginal row spines and differences in the degree of convexity of the exterior margin of the paraglossae (toward a more parallel and less convex condition) are phenoclines clearly differentiating larvae of the relatively more derived *Cloeodes* species from *Bernerius*.

The similarity of *Bernerius* especially to plesiomorphic *Cloeodes* species suggests a Neotropical origin for *Cloeodes*. Species of *Cloeodes* we have studied that possess hindwing pads are apparently restricted to South America. Apomorphic species, including those to be described from North America and those transferred herein, *C. longisetosus* (China) and *C. soldani* (Sri Lanka), have lost the hindwings.

### *Bernerius incus* Waltz and McCafferty, NEW SPECIES

*Baetis*(?) sp. B. Berner, 1980: 190.

Larva.—Body 10–11 mm long. Head capsule lightly pigmented, pale near oral margin and frontal area below antennal bases. Antennae pale, tapered, ca.  $3 \times$  head capsule in length; scape subequal to pedicel in length; flagellar segments darkened apically. Labrum (Fig. 6) with 1 + 2–3 subapical setae. Maxillary palp (Fig. 9) exceeding galea-lacinia, with evidence of third segment; palp with numerous fine setae. Segment 2 of labial palp (Fig. 10) ca.  $1.25 \times$  length of segment 3 and with 6–8 dorsal setae; apex of segment 3 obliquely truncate with inner marginal stout bristles; paraglossa with 3 apical rows of setae, 4–5 ventral intero-marginal fine setae, and 5–6 dorsal intero-marginal setae medioapically; glossa with ca. 20 stout inner marginal setae.

Prothorax lightly pigmented with medial



dark hourglass marking; meso- and meta-thorax lightly pigmented, without patterning; hindwing pads present. Legs (Fig. 11) lightly pigmented, tibiae and tarsi darker than femora; trochanters with 20 or more laterally serrated blade-like bristles and numerous fine setae, without scales; femora with many pointed, laterally serrate ventral bristles, with fine setae and scales, with short, blunt dorsal bristles, and with 6–7 stout, pointed, distal setae; tibiae with bristle-like setae dorsally and ventrally, (subtending bristle blade-like as other tibial setae); tarsi with scales, fine setae, and many bristle-like stout setae dorsally and ventrally, without dorsal row of fine setae. Claws (Fig. 12) ca.  $0.33 \times$  tarsal length, with basal microspines.

Dorsal abdomen lightly patterned with brown medially; segment 1 uniformly colored; segment 2 with pale brown trapezoidal medial patch; segments 3, 4, and 5 with pale broken coloration; segments 6 and 7 with dark trapezoidal medial patch; segments 8–10 pale to cream. Posterior marginal spines present on all tergites, basally with clear area as in *Centroptilum* sp. No. 4 Demoulin (1970), with base of each ca.  $0.5 \times$  length, subequal, evenly tapered; smaller spines situated randomly throughout series. Abdomen pale ventrally, with scales and long, fine setae randomly scattered over surface, without tufts of setae. Paraproct with spinous posteromedial margin (large and small spines alternating); surface with scales and fine setae.

Type material.—Holotype, ♀ larva, Peru, Llave River at Llave, VII-2-1977. 4000 m. Coll. #21. S. S. Roback, Academy of Natural Sciences of Philadelphia. Slide 1, labium in balsam (solvent: xylene), other mouthparts mounted in euparal (solvent: abs. alc.); slide 2, abdominal segments 4–10 mounted in euparal (solvent: abs. alc.); slide 3, gills 3, 4, 7 mounted in balsam (solvent: xylene); slide 4, foreleg in balsam (solvent: xylene), abdominal segment 3 in euparal (solvent: abs. alc.); slide 5, thorax, abdominal segments 1 and 2 mounted in

euparal (solvent: abs. alc.); head capsule (70% ETOH).

Remarks.—Roback (Roback et al., 1980) described the Llave River where *B. incus* (= *Baetis* sp. B. Berner) was collected as a large river ca. 200 meters wide and organically enriched, presumably with the offal and raw waste from a local slaughter house. Photographs of the habitat indicate the river had slow to moderate current.

### *Chopralla* Waltz and McCafferty, NEW GENUS

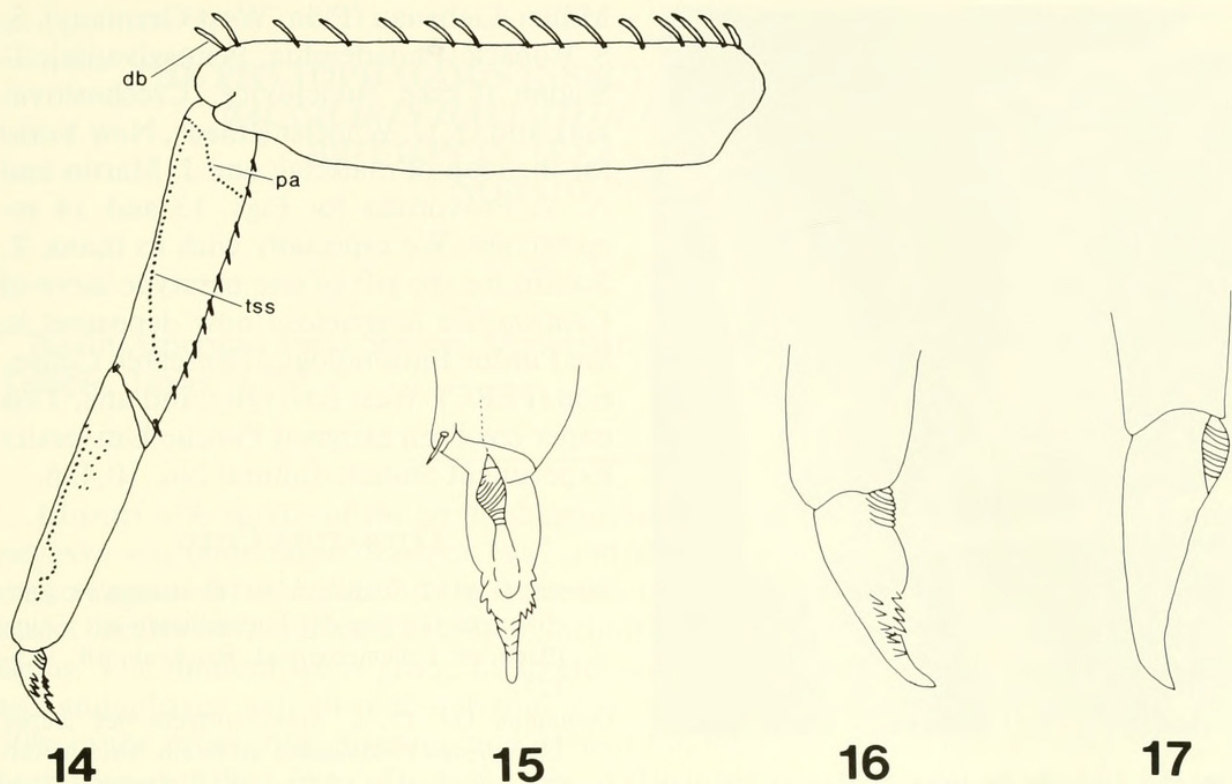
*Centroptella* Braasch and Soldán, 1980: 123 (in part).

*Centroptella*, Müller-Liebenau, 1984b: 96 (*ceylonensis-similis-pusilla* species group). Genus No. 2 sp. 1 Müller-Liebenau, 1984a: 271.

Larva.—Labrum slightly broader than long, clearly emarginate and with marginal shelf anteriorly. Left mandible (similar to Fig. 3) with incisors fused apically; prosthema stout and digitate; no tuft of setae between incisors and molar area; thumb of molar area triangulate and elevated above plane of incisor base. Right mandible (similar to Fig. 4) with incisors separated apically; prosthema stout or reduced and furcate. Labium with 3-segmented palps; terminal segment rounded to broadly rounded apically; segment 2 with weakly developed inner apical lobe; glossae subequal to paraglossae; paraglossae with subparallel margins, not convex.

Femora (Fig. 14) parallel sided, without ventral setal patch, and with long, dorsal bristles and similarly shaped distal bristles. Tibiae with subproximal arc (Fig. 14-pa) of long, fine setae and with long, fine setae adjoining meso- and metatibial seams (Fig. 14-tss). Foreleg with subproximal arc of long, fine setae, subtending bristle, and without tibial seam or with weakly developed seam only and with fine setae adjoining tract of tibial seam. Claws (Figs. 15, 16) ca.  $0.33 \times$  tarsal length, with 3–5 paired medial and apical denticles.





Figs. 14–17. *Chopralla ceylonensis* larva. 14, Foreleg (db—distal bristles, pa—proximal arc, tss—tibial seam setae). 15, Claw (ventral) after Müller-Liebenau (1983). 16, Claw (oblique) after Müller-Liebenau (1983). 17, *Cloeodes longisetosus* larval claw (lateral).

Abdominal terga with rectangulate-based and elongate, broadly pointed scales and with fine setae; scales with median length subequal to basal width or with median length ca. 2.0–2.5 × basal width; posterior marginal spines present at least on terga 9 and 10; ventrally abdomen with broadly pointed, rectangulate-based scales and fine setae, no setal tufts. Gills 1–7 asymmetric, simple, and rounded apically; without marginal spination, or ciliation. Median terminal filament subequal to cerci.

Type species.—*Centroptella ceylonensis* Müller-Liebenau, 1983: 486.

Etymology.—*Chopralla* is of feminine gender and is named in recognition of the Indian ephemeropterist B. Chopra.

Material examined.—*C. ceylonensis* (Müller-Liebenau): eight larvae, Sri Lanka, Kitugala, Hal-oya, FC 35/a, XII-27-1970, det. I. Müller-Liebenau, 1983. *Chopralla* sp.: four larvae, Viet Nam, Vinh Phu' Prov., stream nr. Tam-Dao, X-10-1984, T. Soldán

deposited in the Purdue Entomological Research Collection.

Remarks.—Species herein assigned to the genus *Chopralla* are clearly separated from *Cloeodes* (= *Centroptella* in part) species by the absence of ventral tufts of setae on abdominal segments 2–6, the apically rounded gills (versus broadly pointed in *Cloeodes* species), the peculiar claw structure (unlike edentate claws of *Cloeodes*), and the possession of long, fine tibial seam setae (not present in *Cloeodes* species).

Nominal species of *Chopralla* include the Sri Lankan species *Chopralla ceylonensis* (Müller-Liebenau) n. comb. and *C. similis* (Müller-Liebenau) n. comb. and the East Malaysian species *C. pusilla* (Müller-Liebenau) n. comb. The West Malaysian species, Genus No. 2 sp. 1 Müller-Liebenau (1984a) could be placed in *Chopralla* on the basis of the following apparent synapomorphies: possession of *Chopralla*-like claws with paired apical denticles, possession of



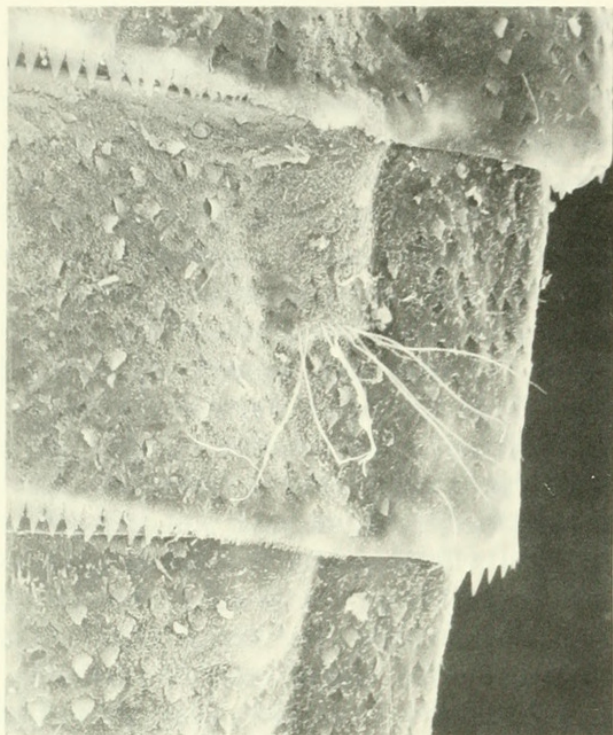


Fig. 18. *Cloeodes* sp. larva. SEM of ventral setal tuft on left side of abdominal segment 4.

long, fine tibial seam setae, asymmetric ovate gills, and fimbriate paraproct scales. This species differs from other known *Chopralla* species, however, by possessing the following inferred plesiomorphic characters: 1) stout prostheca of the right mandible; 2) posterior marginal spines present on segments 1–10; and 3) tergal scales with median length subequal to basal width. Although this latter species appears to clearly belong to *Chopralla*, we do not name the species herein since we have not yet studied the single specimen described.

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