

**Description of a New Species of *Notophlebia* from India
and Reassignment of the Ascribed Nymph of *Nathanella*
(Ephemeroptera: Leptophlebiidae)**

by

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SIVARAMAKRISHNAN, K. G. and W. L. PETERS: Description of a New Species of *Notophlebia* from India and Reassignment of the Ascribed Nymph of *Nathanella* (Ephemeroptera: Leptophlebiidae).

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Notophlebia jobi new species is described from imagines and nymphs collected in Tamil Nadu State (= Madras State), India. The nymph originally assigned to *Nathanella* by Peters and Edmunds (1970) is reassigned as the nymph of *Notophlebia*. Phylogenetic relationships of *Notophlebia* are discussed.

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Notophlebia was established by Peters and Edmunds (1970) for the species *Notophlebia hyalina* Peters and Edmunds from Tamil Nadu (= Madras) State, India. Based on additional collections made by one of us (KGS) in Tamil Nadu State, one additional new species *N. jobi* is described herein. The nymph and imagines of *N. jobi* are associated by rearing and the nymph of *N. jobi* is congeneric with the unnamed nymph assigned to *Nathanella* by Peters and Edmunds (1970). Thus, the association of the nymph and imago of *Nathanella* by Peters and Edmunds (1970) is incorrect and the nymph ascribed by them to *Nathanella* is *Notophlebia*. The nymph of *Nathanella* remains unknown. The one nymphal specimen of *Notophlebia* studied by Peters and Edmunds (1970) cannot be assigned to species as the nymph of *N. hyalina* is unknown.

Terminology and procedures used in the description follow those of Peters, Peters and Edmunds (1978).

Genus *Notophlebia* Peters and Edmunds (Fig. 1-17)

Notophlebia Peters and Edmunds, 1970, Pac. Insects, 12:213; Hubbard and Peters, 1978, Oriental Insects Suppl. 9:25.

Nathanella Peters and Edmunds, 1970, Pac. Insects, 12:212 (partim, nymph).

Type species. *N. hyalina* Peters and Edmunds, by original designation.

Species included. *N. hyalina* Peters and Edmunds, 1970; *N. jobi*, new species; *Notophlebia* sp. Peters and Edmunds (as nymph of *Nathanella*).

Distribution. Southern India.

Imago. Length of ♂: body, 7.5-9.0 mm; fore wings, 8.0-9.0 mm. Length of ♀: body, 7.5 mm; fore wings, 11.0 mm. Eyes of ♂ meet on meson of head, lower portion of eyes $\frac{1}{2}$ to $\frac{3}{4}$ length of upper portion, upper portion on short stalk; ♀ eyes separated on meson of head by a length 3 times as great as maximum width of an eye. Fore wings (Fig. 1): maximum width about $\frac{1}{3}$ maximum length; vein Rs forked less than $\frac{1}{6}$ of distance from base to margin; vein MA forked more than $\frac{1}{2}$ of distance from base to margin, fork symmetrical; vein MP_2 attached to MP_1 by a cross vein more than $\frac{1}{4}$ of distance from base to margin; cubital area as in Fig. 1; cross veins few, except basal $\frac{1}{2}$ of cell C without cross veins; anal area enlarged posteriorly (Fig. 1); cilia present on posterior margin of wings. Hind wings absent. Legs: ratios of segments in ♂ fore legs, 0.50:1.00(3.1 mm): 0.03:0.29:0.19:0.10:0.06. Claws of a pair dissimilar, one apically hooked, the other obtuse, pad-like (Fig. 4). Male genitalia (Fig. 2-3): segment 2 of forceps a little longer than length of segment 3, segment 2 of forceps $\frac{1}{7}$ to $\frac{1}{5}$ length of segment 1, apex of segment 3 rounded; base of forceps broad, its inner margin forming an angular bend to a knob-like projection near middle of forceps (Fig. 2); length of styliger plate along median line a little more than $\frac{1}{3}$ maximum width, apex of styliger plate smooth; penes divided, tubular, slender, apex of each penis lobe pointed to inwardly curved and finely serrated (Fig. 3). Ninth sternum of ♀ shallowly cleft apically (Fig. 5). Terminal filament longer than cerci.

Mature nymph. Head prognathous. Antennae 2 times as long as maximum length of head. Mouthparts (Fig. 13-17): dorsal hair on labrum as in Fig. 14; submedian, anterior and lateral areas of hair ventrally; anterior margin without denticles. Left mandible as in Fig. 13. Lingua of hypopharynx with well developed lateral processes, anterior margin shallowly cleft; superlingua of hypopharynx as in Fig. 16, with a row of hair along anterior margin. Maxillary palpi greatly elongated; segment 2 of maxillary palpi slightly longer to $1\frac{1}{2}$ times length of segment 1; segment 3 of palpi equal in length to segment 2, triangular; long hair in rows on apical half of segment 3 ventrally and apical $\frac{1}{4}$ dorsally; a large projection on inner anterior margin of maxillae; remainder of hair on maxillae as in Fig. 15. Labium as in Fig. 17; labial palpi greatly elongated; segment 2 of palpi a little shorter than $\frac{1}{2}$ length of segment 1; segment 3 of palpi 4 times length of segment 2, triangular; paraglossae ventral to glossae. Dorsum of abdomen with profuse long hair. Legs (Fig. 7-12): apex of claws (Fig. 12) hooked and narrow, a row of nearly equal sized denticles on claw, apical denticle much larger, basal 3-4 denticles set apart from remaining denticles. Gills (Fig. 6) on segments 1-6 alike, both portions of lamellae plate-like, tracheae branched. Posterolateral spines on abdominal

segments 7-9, those on segment 9 larger. Abdominal segments 7-9 greatly elongated. Terminal filament longer than cerci.

***Notophlebia jobi* sp. n. (Figs. 1-17)**

Male imago (in alcohol). Length: body 9.0 mm; fore wings 9.0 mm. Upper portion of eyes reddish-yellow, lower portion black. Head dark brown. Antennae light brownish-yellow. Ocelli pale, base of ocelli darker. Thorax: brownish-yellow with dark brown streaks; carinae darker, sutures paler. Legs: coxae, trochanters, femora and base of tibiae of prothoracic legs brownish-yellow, remainder of legs pale; meso- and metathoracic legs brownish-yellow, except tarsi pale. Fore wings (Fig. 1): longitudinal veins and cross veins yellowish-brown; membrane light brownish-yellow, except basal $\frac{1}{2}$ of cell Sc dark brown; cross veins near fork of vein Rs and middle of R_1 surrounded by narrow, dark brown clouds. Abdomen: segments 1-2 translucent light brownish-yellow, segments 3-7 hyaline, and segments 8-10 opaque, brownish-yellow; terga 3-7 with a posterior transverse, narrow, brownish-yellow band, faded medially. Genitalia (Fig. 2-3): forceps pale, penes brownish-yellow; margin of genital forceps forming a knob-like projection; apex of each penis lobe inwardly curved (Fig. 4). Basal 3 segments of each caudal filament dark violet, remainder pale violet with darker violet annulations at articulations.

Female imago. Unknown.

Female subimago (in alcohol). Length: body 7.5 mm; fore wings 11.0 mm. Head brownish-yellow. Antennae light brownish-yellow. Ocelli pale, base of ocelli black. Eyes black. Thorax: dark brownish-yellow. Legs brownish-yellow. Fore wings: longitudinal veins and cross veins chestnut brown; membrane translucent whitish except basal $\frac{1}{2}$ of cell Sc chestnut brown. Abdomen: opaque, brownish-yellow, posterior margin of terga darker. Caudal filaments brownish-yellow, darker annulations at articulations.

Mature nymph (in alcohol). Length 10.0-12.0 mm. Head brown. Antennae pale yellow. Thorax brown; lateral edges of pronotum dark brown. Legs (Fig. 7-12): dark brownish-yellow; tibiae of prothoracic legs interspersed with plumose spines and hair laterally, tibiae of remaining legs profusely hairy; basal 4 denticles on claws distinctly set apart from remaining denticles (Fig. 12). Abdomen brownish-yellow. Gills pale violet, tracheae pale. Caudal filaments dark brownish-yellow, markings as in ♂ imago and ♀ subimago.

Paired submedian dark brown maculae are found on meso- and metanota of some nymphs.

Material. Holotype ♂ imago, INDIA: Tamil Nadu State, Tiger Falls stream, Courtallam, 180 m, 30.X.1975, K. G. Sivaramakrishnan; allotype ♀ subimago, same data as for holotype; paratopotypes: 12 nymphs, same data as for holotype; paratypes: 19 nymphs, Tamil Nadu State, stream near Manjalar Dam, Subramania Iyer Estate, Kombai village, 150 m, 8.X.1981, K. G. Sivaramakrishnan. All types are in alcohol. Association of the nymph and imagoes is by rearing. Holotype, allotype, 4 paratopotypes and 9 paratypes are deposited in K. G. Sivaramakrishnan collections at

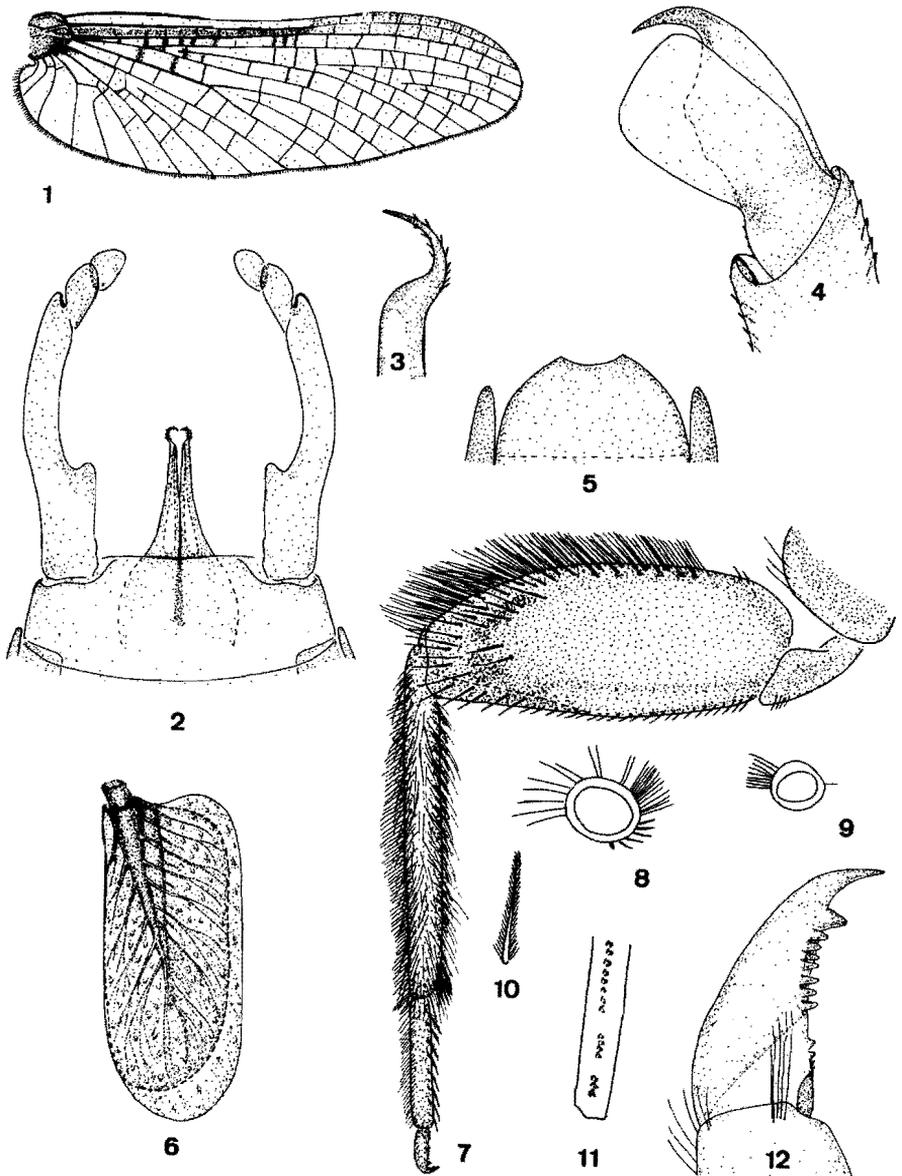


Fig. 1-12, *Notophlebia jobi*. Fig. 1-4, ♂ imago: 1, fore wing; 2, genitalia, ventral view; 3, apex of penis lobe; 4, fore claw. Fig. 5, 9th sternum of ♀ subimago. Fig. 6-12, nymph: 6, gill 4; 7, fore leg; 8-9, cross section of tibia and tarsus of fore leg; 10, plumose spine on tibia of fore leg; 11, apex of tibia of fore leg, ventral view; 12, fore claw.

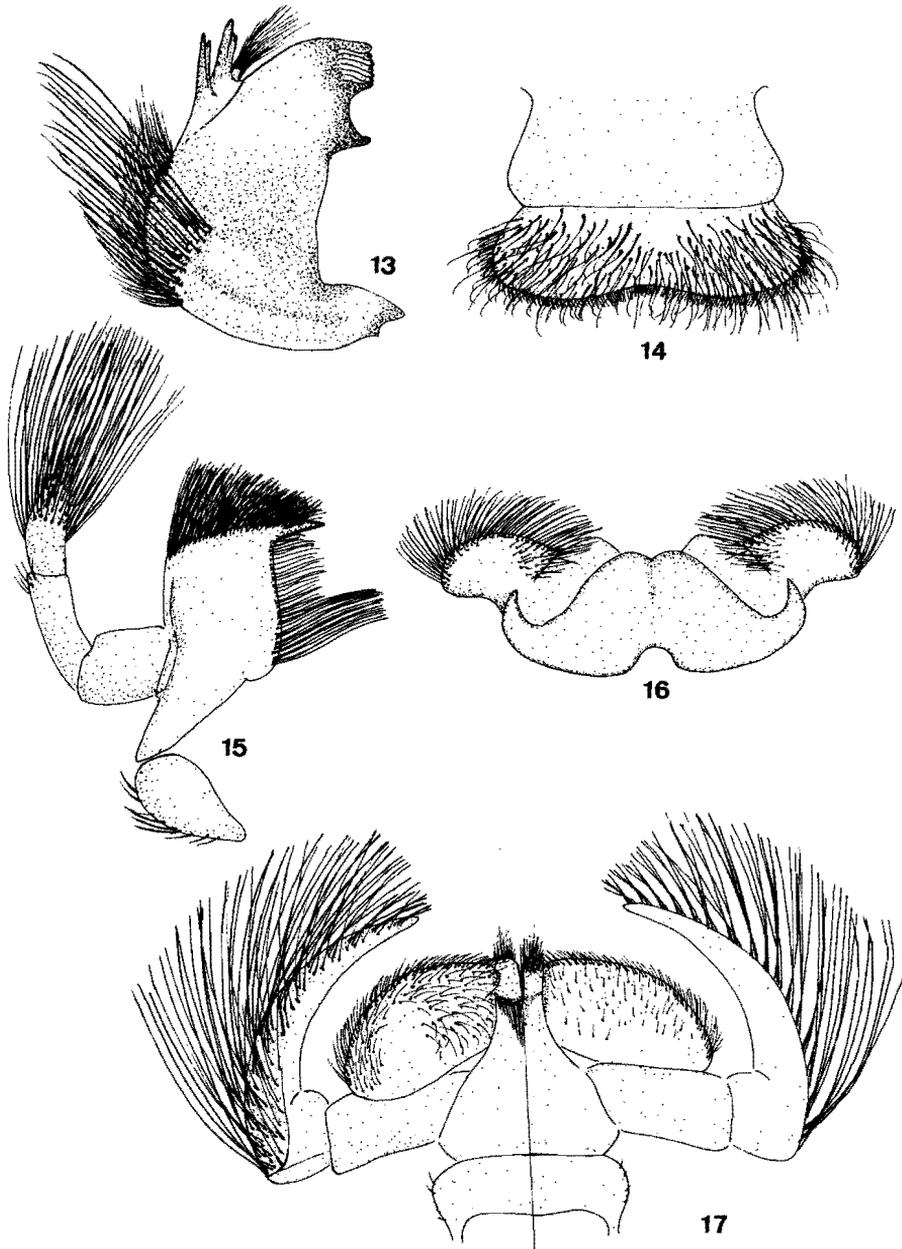


Fig. 13-17, *Notophlebia jobi*, nymph: 13, left mandible; 14, clypeus and labrum; 15, ventral view of right maxilla; 16, hypopharynx; 17, labium, dorsal (left) and ventral (right) views.

Entomology Institute, Loyola College, Madras. 8 paratopotypes and 10 paratypes are deposited in the collections of Florida A&M University.

Etymology. Species is named for Prof. S. V. Job, School of Biological Sciences, Madurai Kamaraj University, Madurai.

Discussion. *Notophlebia jobi* can be distinguished from *N. hyalina* by the following characters in the ♂ imago: (1) cross veins near fork of vein Rs and middle of cell R_1 of fore wings are surrounded by narrow, dark brown clouds (Fig. 1); (2) abdominal segments 1-2 are translucent light brownish-yellow, segments 3-7 are hyaline, and segments 8-10 are opaque brownish-yellow; (3) inner margin of genital forceps forms a knob-like projection (Fig. 2); and (4) apex of each penis lobe is inwardly curved (Fig. 3).

As discussed, the unnamed nymph originally described as the nymph of *Nathanella* cannot be placed to species as the nymph of *Notophlebia hyalina* is unknown. However, the nymph of *N. jobi* can be distinguished from the unnamed nymph by the following characters: (1) abdominal gills are rectangular in shape (Fig. 6); (2) lateral margins of labrum are angular (Fig. 14); (3) tibiae of prothoracic legs are interspersed with plumose spines and hair laterally (Fig. 7); tibiae of remaining legs are profusely hairy; and (4) basal 4 denticles on claws are distinctly set apart from remaining denticles (Fig. 12).

Biology. The nymphs of *N. jobi* are found in intermittent and perennial streams where water flow is moderate. Nymphs cling to the underside of boulders in swifter current and prefer to aggregate in areas where small twigs and fallen leaves are trapped. Nymphs move slowly or cling tightly to the rock when boulders are disturbed. They can swim slowly with an undulating motion, the femora at the same plane as the body and the tibiae and tarsi at right angles to the femora; the legs do not move or help in swimming.

Gut samples contained filaments of *Spirogyra* sp., members of Cyanophyceae such as *Rivularia* sp., plant spores, Sphaeroraphidae, solitary and colonial diatoms, mineral particles, and organic detritus.

DISCUSSION

The above redescription of *Notophlebia* is based on *N. hyalina*, *N. jobi*, and the unnamed nymph described as the nymph of *Nathanella* by Peters and Edmunds (1970). *Notophlebia* can be distinguished from all genera of the Leptophlebiidae by the following combination of characters. In the imago: (1) hind wings are absent; (2) cilia occur on posterior margin of fore wings (Fig. 1); (3) Cu area of fore wings possesses two long intercalaries (Fig. 1); (4) penes of the ♂ genitalia are divided, tubular, and serrated at apex (Fig. 2-3); and (5) claws of a pair are dissimilar (Fig. 4). In the nymph: (1) plate-like abdominal gills are present on segments 1-6 (Fig. 6); (2) long hair on apical segment of maxillary palpi is in even rows (Fig. 15); (3) maxillary and labial palpi are elongated (Fig. 15, 17) and extend beyond lateral margins of head; and (4) apical denticle on claws is greatly enlarged (Fig. 12).

In Southern India and Sri Lanka, *Notophlebia* resembles *Isca* and *Nathanella* in several characters: absence of hind wings, divided and tubular penes, and two intercalaries in the CuA area of the wings. *Notophlebia* can be distinguished from these genera in the imago by the following characters: (1) the anal area of fore wings is enlarged posteriorly (Fig. 1); and (2) penes of ♂ genitalia are serrated at apex (Fig. 3).

The nymphs of *Notophlebia* are apparently adapted for filter feeding, although extensive field observations are needed to determine the functions of the highly adapted mouthparts (Wallace and Merritt, 1980). Based on the adaptive radiation of the nymphs of *Notophlebia*, phylogenetic analysis of nymphal characters is difficult. Similar mouthpart morphology and feeding mechanisms occur throughout the world within the Leptophlebiidae. Examples include *Choroerterpides* from Southeast Asia, *Hagenulus* from the West Indies, and the *Traverella* complex of genera from South and North America. Based on research by one of us (WLP) the apparent filter feeding mechanism has evolved independently in several lineages within the Leptophlebiidae. It is tempting to place *Notophlebia* and *Choroerterpides* closely together phylogenetically based on nymphal characters, but such characters are convergent. Derived imaginal character states clearly place *Choroerterpides* in the *Choroerterpes* lineage as delineated by Peters and Edmunds (1970), while *Notophlebia* shares derived character states with lineages containing *Thraulius*, *Megaglena*, *Nathanella*, and *Isca* (Peters and Edmunds, 1970).

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