

## New Species and Life Stages of *Atopophlebia* (Ephemeroptera: Leptophlebiidae: Atalophlebiinae)

by

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The nymph and female subimagines of *Atopophlebia fortunensis* are described for the first time and two new South American species, *A. obrienorum* and *A. yarinacocha* are described from male imagines. Nymphal morphology shows that *Atopophlebia* represents an evolutionary intermediate between the relatively plesiomorphic Pan-Austral leptophlebiid fauna and the genus *Thraulodes* of the warm Neotropics.

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*Atopophlebia* was established by Flowers (1980) from two male imagines collected in Panama. Since publication of the original description, additional members of this genus have been found in collections from northern South America. In addition, a nymph of *Atopophlebia fortunensis* was collected from a small stream in northwestern Panama. These fresh discoveries allow a more complete characterization of this genus and further discussion on the phylogenetic position within the Leptophlebiidae.

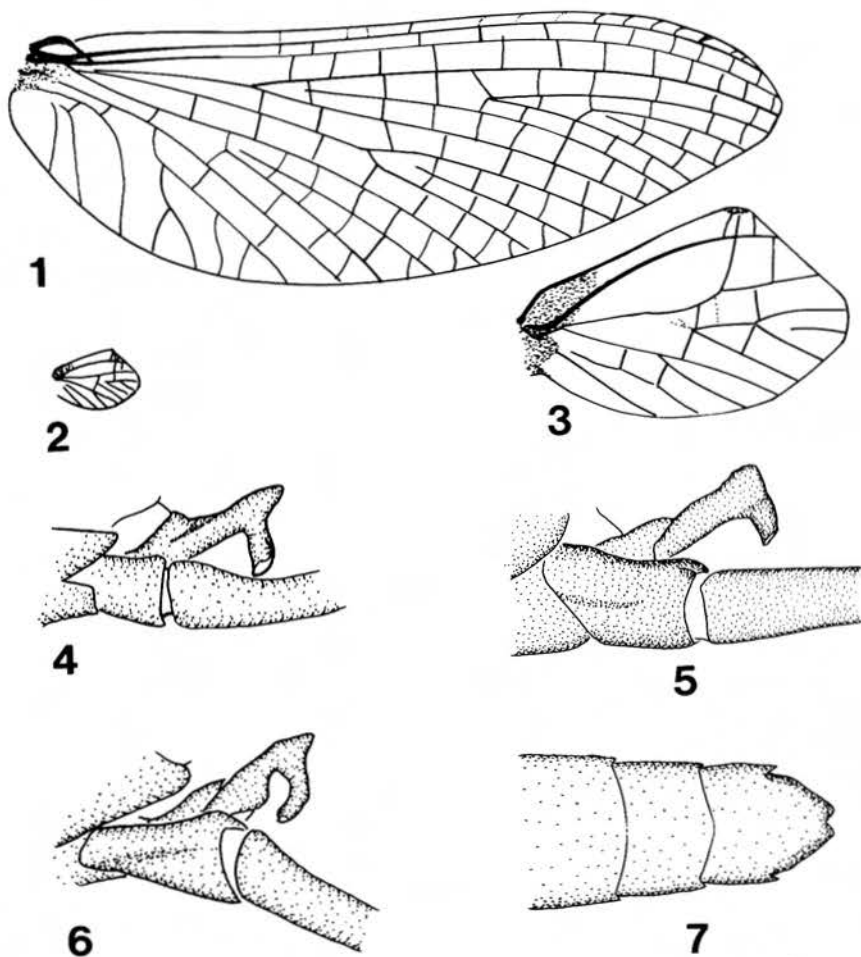
### *Atopophlebia* Flowers

1976 "*Ulmeritus* ally" Edmunds *et al.*, Univ. Minn.: 239, Fig. 141.

1980 *Atopophlebia* Flowers, Florida Ent. 63: 162-165, Figs. 1-10 (holotype).

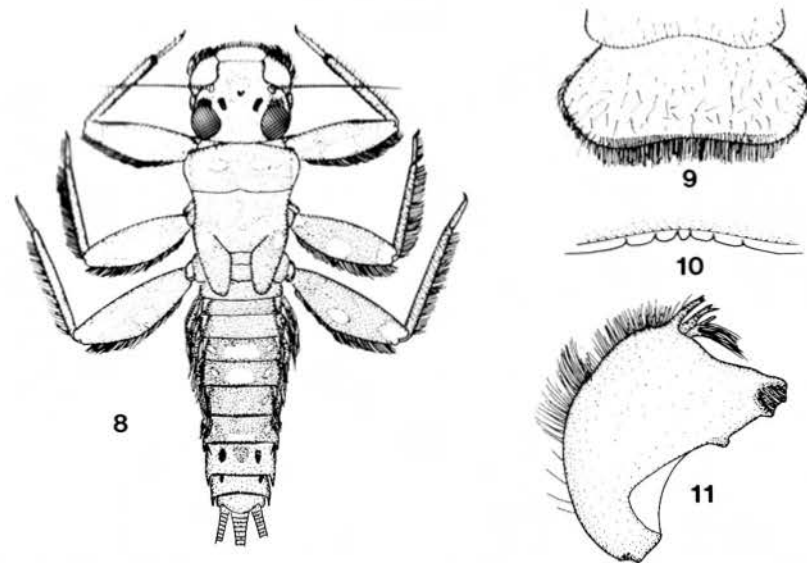
Female Subimago: Length: body 10.4 mm; fore wings 10.6 mm. Eyes separated on meson of head by a length 2.75 times maximum width of eye. Maximum width of fore wings  $2/5$  their maximum length;  $MP_2$  attached at base to veins  $MP_1$  and CuA with a cross vein, attachment of vein  $MP_2$  to  $MP_1$  approximately  $1/3$  the distance from base to margin; IMP shorter than  $MP_2$  and not attached at base (as in Fig. 1); other veins of fore and hind wings as in male imago. Ninth sternum shallowly emarginate apically (Fig. 7).

Nymph: Head prognathous. Antennae  $1\ 1/3$  times maximum width of head. Mouthparts (Fig. 9-15): labrum as in Fig. 9; anteromedian emargination with 5 broad-based denticles (Fig. 10). Clypeus as in Fig. 9. Left mandible as in Fig. 11. Lingua of hypopharynx with well developed lateral processes, submedian lobes with a small interior row of hairs, anterior margin deeply cleft (Fig. 13). Segments 1 and 2 of maxillary palpi subequal; segment 3 less than  $1/3$  length of segment 2, triangular; hair on maxillae as in Fig. 12. Labium as in Fig. 14, 15;



Figs. 1-7. 1-4, *Atopophlebia obrienorum*: 1, fore wing; 2, hind wing; 3, hind wing enlarged; 4, male genitalia, side view. 5-6, male genitalia, side view. 5, *A. fortunensis*; 6, *A. yarinacocha*. 7, *A. fortunensis*, ventral aspect of segments 7-9 of female subimago.

segment 2 of palpi equal to segment 1; segment 3 less than  $1/2$  length of segment 2, triangular, narrow, lacking spines on dorsal surface. Legs (Fig. 16): tibiae in cross section round, flattened on inner margin; ventral side of femora indented along apical third for reception of tibiae; claws as in Fig. 17. Gills: gills on segments 1-6 alike, decreasing in size; dorsal and ventral lamellae with fringes of slender filaments on posterior margin; tracheae palmate (Fig. 18); gill on segment 7 reduced to a pair of filaments less than  $1/4$  length of segment 8. Posterolateral spines on abdominal segments 2-9, progressively larger poste-



Figs. 8-11. *A. fortunensis*: 8, nymph. 9-11, mouthparts of nymph; 9, labrum; 10, anteromedian emargination of labrum, enlarged; 11, left mandible.

riorly. Cerci broken off and missing, basal segments with whorls of spines at articulations.

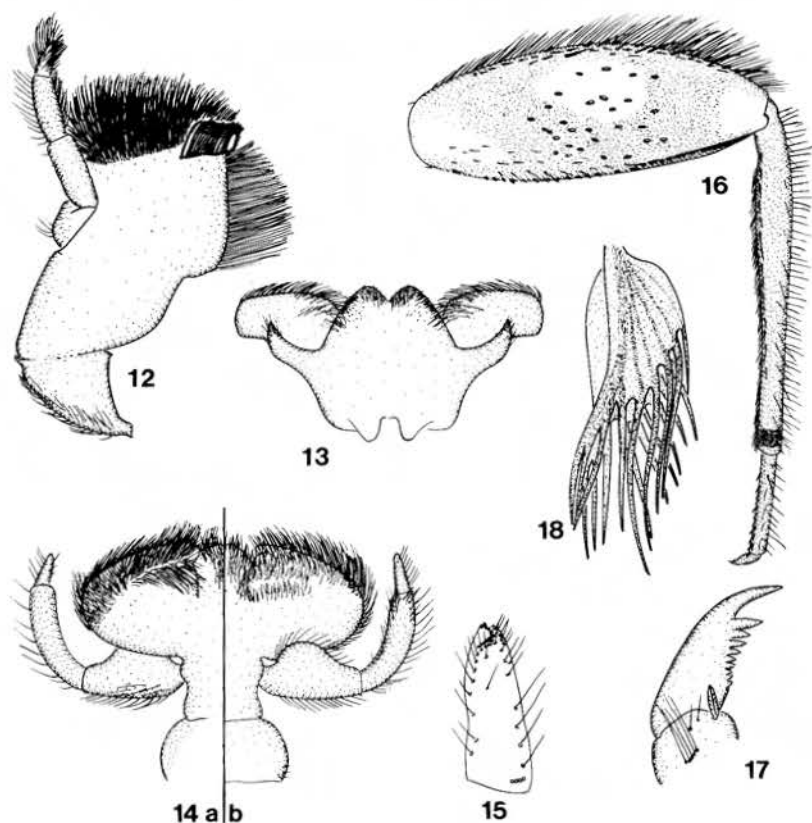
Discussion. The nymph of *Atopophlebia* can be distinguished from the other leptophlebiid nymphs of the northern Neotropics by the following combination of characters: (1) gills 1-6 fringed on posterior margin (Fig. 18), gill 7 reduced, filamentous; (2) outer margin of mandibles curved, fringed with long setae which are most dense at bend (Fig. 11); (3) labrum with distinct broad-based denticles (Fig. 10); and (4) abdomen with postero-lateral spines on segments 2-9. Imagines and subimagines of *Atopophlebia* can be distinguished from all other Neotropical Leptophlebiidae by their yellow color with black or dark brown maculae on the tibiae and apical segments of the abdomen. This general pattern holds true not only for the species in this paper but also for additional undescribed species from Ecuador and Venezuela known only from female subimagines. The position and size of these maculae are species specific characters.

#### *Atopophlebia fortunensis* Flowers (Figs. 5, 7, 8-18)

1976. "*Ulmeritus* ally" Edmunds et al., Univ. Minn.: 239, Fig. 141.

1980. *Atopophlebia fortunensis* Flowers, Florida Ent. 63: 162-165, Figs. 1-10 (holotype).

Female subimago: Length: body 10.4 mm; fore wings 10.6 mm. Color and



Figs. 12-18. *A. fortunensis*, nymph: 12, right maxilla, ventral; 13, hypopharynx; 14, labium, (a) dorsal, (b) ventral; 15, apical segment of labial palp, ventral; 16, fore leg; 17, claw; 18, abdominal gill 3.

markings as in male imago except: eyes black, head yellow; apex of profemora lacking brown spot, tarsi entirely yellow.

**Nymph:** Head brown, venter lighter, dorsal markings as in Fig. 8. Thorax brown, venter pale yellowish brown; dorsum with pale markings as in Fig. 8. Legs (Fig. 16) yellowish brown, anterior (dorsal) side of femora with darker brown markings, black spot at apex of tibiae. Abdominal terga 1-7 brown with yellowish brown markings as in Fig. 8; terga 8, 9 yellow with black markings of imago visible; tergum 10 yellow basally, brown apically. Caudal filaments light brown.

**Material:** 1 female subimago: Panama, Chiriqui Province, Cuenca Fortuna, Quebrada Hondo, 1082 m. 16-V-1985, 7:30 PM, at light. R. W. Flowers; 1 nymph: Panama, Bocas del Toro Province, Oyo de Agua, small stream, 150 m. 24.5 C. 4-V-1985. R. W. Flowers; 1 nymph: Costa Rica, Cartago, 1116 m. 24-VI-1962. G. G. Musser. Association of subimago and nymphs is by abdominal and leg color patterns.

The adult color pattern of *A. fortunensis* clearly distinguishes this species from all other known Central American Leptophlebiidae. This pattern is clearly visible on the abdomen and legs of both the nymphs studied. Edmunds et al. (1976) figured the nymphal gill as that of an "*Ulmeritus* ally".

**Biology.** The nymph from Panama was collected from a stream in a steep forested ravine next to a small pasture. The stream was heavily shaded and contained small pools and short riffles. Quebrada Hondo, where the female was collected, is a medium sized stream which empties into the lake at Presa Fortuna. The collecting site was at an area with riffles and deep pools next to primary forest. Rains cause rapid fluctuation of the water level in this stream.

#### *Atopophlebia obrienorum*, sp. n. (Fig. 1-4)

**Male subimago** (imaginal characters developed and visible inside subimaginal exuviae): Length: body, 7.5 mm; fore wing, 9 mm. Eyes contiguous at meson of head, upper portion creamy yellow, lower portion greyish-black; base of ocelli greyish-black. Head yellow, washed with brown; a black spot at apex of frontal carina and a pair of black spots ventrally below each compound eye. Thorax yellow. Legs yellow; prothoracic tibiae dark brown. Wings (Fig. 1-3): veins of fore and hind wings yellow; membrane of fore wings hyaline; membrane of hind wings hyaline, washed with smoky brown at base. Veins MP, IMP and CuA as in generic description of female subimagine. Abdomen yellow, posterior margins of terga 5-7 dark brown at middle; tergum 8 brown, darker brown at base, yellow at lateral margins; terga 9-10 brown. Sterna 1-7 yellow; 8 and 9 brown. Subgenital plate and forceps washed with smoky brown. Penes (fully expanded inside subimaginal exuviae) fused in basal third, lobes narrow, widely separated in apical 2/3, each lobe with a ventro-lateral projection near apex (Fig. 4); styliger plate washed with brown. Basal segment of forceps washed with brown, apical segments yellowish-white. Caudal fillaments yellowish brown, darker at base.

**Female and nymph:** Unknown.

**Etymology:** This species is named for Drs. Charles W. and Lois B. O'Brien, who collected both this species and the genotype of *Atopophlebia*.

**Material:** Holotype ♂ subimago: Ecuador, Pastaza Province, 25 km W. Puyo. 27-IV-1978. L. & C. W. O'Brien, G. B. Marshall. Holotype deposited in the collections of Florida A&M University.

This species can be distinguished from other known *Atopophlebia* by the entirely dark brown protibiae and apical two segments of the abdomen. Although it is not my usual practice to erect new species on the basis of subimagines only, I do so in this case because the subimago was on the point of moulting and important imaginal characters such as wing venation and genitalia were clearly visible and fully developed. Furthermore, *Atopophlebia* is known from so few specimens that including this species is important to an understanding of the genus. As noted below, study of the specimen of *A.*

*obrienorum* helped reveal that the original description of *Atopophlebia* was based on specimens with atypical wing venation.

***Atopophlebia yarinacocha*, sp. n. (Fig. 6)**

Male imago: Length: body, 7.1 mm; fore wings, 9.5 mm. Head and thorax shrivelled, details not clear but apparently similar to *Atopophlebia fortunensis* and *A. obrienorum*. Thorax amber yellow. Fore legs yellow, apical third of fore tibiae brown. Middle and hind legs broken off and missing. Wings hyaline, veins amber; fore wing with vein IMP free at base and shorter than  $MP_2$  (as in Fig. 1). Subcostal area of hind wing stained amber in basal 1/2. Abdomen amber yellow; posterior margins of terga 1-8 brown, this brown band becoming wider and darker on terga 7 and 8; terga 1, 8 and 9 with a pair of anterolateral black maculae. Genitalia amber, penes fused in basal third, separated in apical 2/3, a curved ventrolateral projection near apices (Fig. 6). Cerci yellow with brown dots at articulations.

Female and Nymph: Unknown.

**Etiology:** Yarinacocha, noun in apposition, a pre-colombian site (Laguna Yarinacocha) near Pucallpa.

**Material:** Holotype ♂ imago: Peru, Loreto Province, Pucallpa. 15-20-IV-1962. J. Schunke. Paratypes: 2 ♂ subimagines; same data as holotype. Holotype and paratypes deposited in the collections of Florida A&M University.

This species can be distinguished from *A. fortunensis* and *obrienorum* by the anterolateral black maculae on abdominal tergum 1. The penis lobes of both *A. obrienorum* and *a. yarinacocha* have longer ventro-lateral extensions than *A. fortunensis* (Figs. 4-6).

**Discussion.** In the original generic description of *Atopophlebia*, an unusual configuration of veins IMP and  $MP_2$  in the fore wings was noted (Flowers 1980). Imaginal and subimaginal material subsequently studied showed that condition to be atypical not only for *Atopophlebia* in general but also for *A. fortunensis*. The typical condition is as illustrated for *A. obrienorum* (Fig. 1). The degree of separation of the eyes on the meson of the head in the male appears to be variable: in *A. fortunensis* the eyes are separated while in *A. obrienorum* they are contiguous, at least in the subimago.

*Atopophlebia* is one of the most plesiomorphic examples known among the Leptophlebiidae from the northern Neotropics. The nymph and imago of *Atopophlebia* share generalized characters scattered widely among Southern Hemisphere leptophlebiids: moderately curved mandibles with setae on the outer margin, labrum not strongly widened, stigmatic veins in fore wings curved and anastomosed, and fork of vein MA of the fore wings symmetrical. However, *Atopophlebia* also appears to be a sister group to the apomorphic *Thraulodes* complex. Synapomorphies between *Atopophlebia* and *Thraulodes* include the broad central denticles of the labrum, the general structure of the

labium, and the chaetotaxy of the labial palpi. Also, some *Thraulodes* have the anastomosed costal cross-veins in the fore wing characteristic of *Atopophlebia*. However, the genitalia of *Thraulodes* is quite different and in some features more derived than that of *Atopophlebia*. It appears that *Atopophlebia* evolved from a pre-*Thraulodes* ancestor before the breakup of Gondwanaland.

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