

## Four New Genera of Leptophlebiidae (Ephemeroptera: Atalophlebiinae) from Southern South America

by

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### ABSTRACT

Four new monotypic genera of Leptophlebiidae, *Archethraulodes*, *Demoulinellus*, *Rhigotopus*, and *Secochela* are established. Four new species are described. Three, *Archethraulodes spatulus*, *Rhigotopus andinensis* and *Secochela illiesi*, are described from imagines. One, *Demoulinellus coloratus*, is known from both imagines and nymph. Descriptions of the eggs of genera are included.

This paper represents Part II of a series revising the cool-adapted Leptophlebiidae in southern South America. Part I (Pescador and Peters, 1980) included discussions and descriptions of the monotypic genera *Dactylophlebia* and *Magallanella*.

The method for gut analysis is the same as used in Part I and the technique of Towns and Peters (1978) was followed to prepare structures for the imagines, Pescador and Peters (1980) for the nymphs, and Koss (1968) for the eggs.

### *Archethraulodes* gen. n.

Genus D Pescador and Peters (1980)

Imago. Length: ♂ body 7.0-8.0 mm, fore wings 7.0-8.5 mm. Eyes of male separated on meson of head by a length subequal to maximum width of median ocellus, lower portion of eyes 0.6 times length of upper portion. Wings (Fig. 1-2): Vein *Rs* of fore wings forked slightly less than quarter distance from base to margin; vein *MA* forked a little more than half distance from base to margin, fork symmetrical; distal portion of vein *MA* strongly sagged (Fig. 1); vein *MP*<sub>2</sub> moderately recurved, attached at base to vein *MP*<sub>1</sub> with a cross vein a third distance from base to margin; vein *ICu*<sub>1</sub> free or weakly attached at base by a cross vein to vein *CuA* and *CuP* and distally divergent from vein *CuA* (Fig. 1). Costal margin of hind wings convex, with concavity located approximately half distance from base, apex obtuse; vein *Sc* 0.75 times maximum length of wing (Fig. 2). Legs: Fore legs broken off and missing; meso- and metathoracic with claws of a pair alike, apically hooked

with an opposing hook (Fig. 4). Male genitalia (Fig. 3): Segments 2 and 3 of genital forceps subequal in length, segment 2 less than one quarter length of segment 1; base of segment 1 broad, inner margin forming an angular bend (Fig. 3). Maximum length of styliiger plate along median line approximately a third to half maximum width. Penis lobes fused in basal half, remainder divided, tubular (Fig. 3); apices spatulate, each with a thick long subapical spine (Fig. 3). Terminal filament longer than cerci.

Female imago and nymph unknown.

Etymology, arche, Gr., meaning beginning; and genus *Thraulodes*, thraulos, Gr., meaning brittle. Masculine.

Type-species. *Archethraulodes spatulus* sp. n.

Discussion. *Archethraulodes* can be distinguished from all other genera of Leptophlebiidae by the following combination of imaginal characters: (1) vein *Sc* of hind wings is at least three quarters of maximum length of hind wings (Fig. 2); (2) claws of a pair are similar, each apically hooked with an opposing hook (Fig. 4); (3) base of segment 1 is broad with inner margin forming an angular bend (Fig. 3); and (4) penis lobes are fused in basal half and each lobe has a long thick subapical spine (Fig. 3).

Pescador and Peters (1980) placed *Archethraulodes* in the phyletic lineage with *Atalonella*, *Rhigotopus* new genus and *Zephlebia* (*Neozephlebia*), but it can be distinguished from them by the apically spatulate penes and a well developed sharp-pointed spine on each penis lobe (Fig. 3).

#### *Archethraulodes spatulus* sp. n. (Fig. 1-6)

Male imago (in alcohol). Length: Body 7.0-8.0 mm, fore wings 7.0-8.5 mm. Head brown. Antennae pale yellow. Ocelli white, base blackish-red. Upper portion of eyes orange-yellow, lower portion black. Thorax: Not a dark yellow, median suture, and inner and outer parapsidal furrows dark brown; pronotum with a pair of longitudinal submedian black stripes. Pleura yellow, coxal sutures reddish-brown. Sterna dark yellow, mesobasisternum paler. Wings: Membrane of fore wings hyaline, pterostigma cloudy white; longitudinal veins shiny brown, veins *C*, *Sc* and *Rs* darker; cross veins pale yellow, except those on pterostigma light brown. Membrane of hind wings hyaline; longitudinal veins pale yellow, darker toward base; cross veins pale white. Fore legs broken off and missing; mesothoracic and metathoracic legs pale yellow, subcoxae and coxae darker, joints of femora and tibiae dark brown. Abdomen: Terga translucent yellow, terga 7-9 darker and opaque; terga with brown maculae covering almost entire segment, except small area near anterior margin of each segment (Fig. 5); lateral margins of terga 2-7 bordered with dark brown, progressively darker posteriorly (Fig. 6). Sterna yellow, faintly washed with brown; externally visible abdominal ganglia yellow, ringed with dark brown. Genitalia (Fig. 3): Forceps yellow, segments 2 and 3 paler. Styliiger plate yellow, darker on margin. Penes yellow, darker along lateral margins. Caudal filaments pale yellow.

Female imago, male and female subimago, and nymph unknown.

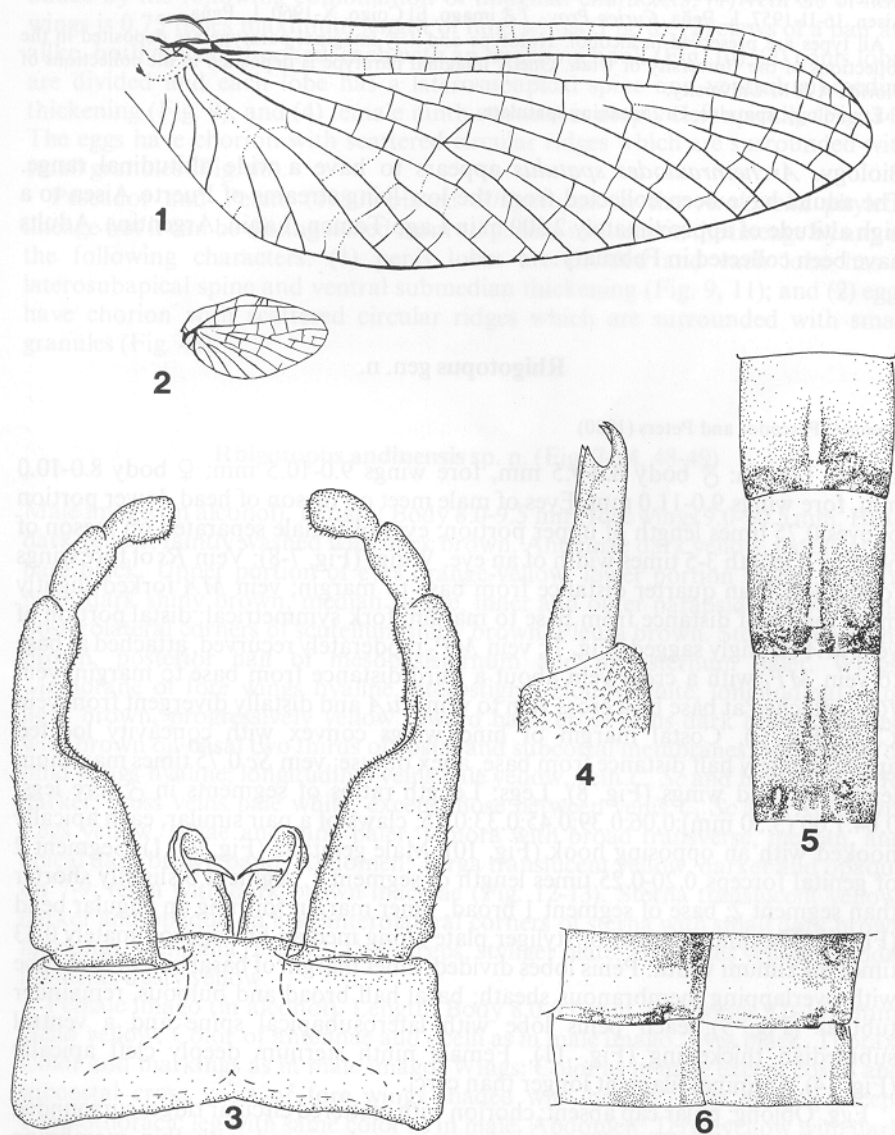


Fig. 1-6. *Archethraulodes spatulus*, ♂ imago: 1, fore wing; 2, hind wing; 3, genitalia, ventral; 4, fore claw; 5, abdominal terga 4-6; 6, abdominal pleura 5-6.

Geographical Distribution (Fig. 47). Holotype ♂ imago, ARGENTINA: *Neuquen Prov.*, Lago Tomen, 9-11-1962, 2,500 m, I. Rottmann, Paratypes, CHILE: *Aisen Prov.*, 1 ♂ imago, Puerto Aisen, 16-11-1957, L. Peña. *Curico Prov.*, 1 ♂ imago, El Coigo, X-1960, L. Peña.

All types are preserved in alcohol. Holotype and 1 ♂ imaginal paratype are deposited in the collections of the University of Utah. One ♂ imaginal paratype is deposited in the collections of Florida A & M University.

Etymology. *spatulus*, Gr., meaning spatulate.

**Biology.** *Archethraulodes spatulus* appears to have a wide altitudinal range. The adults have been collected from the low-lying streams of Puerto Aisen to a high altitude of approximately 2,500 m in Lago Tomen, Lanin, Argentina. Adults have been collected in February.

### Rhigotopus gen. n.

Genus C Pescador and Peters (1980)

**Imago.** Length: ♂ body 8.0-9.5 mm, fore wings 9.0-10.5 mm; ♀ body 8.0-10.0 mm, fore wings 9.0-11.0 mm. Eyes of male meet on meson of head, lower portion of eyes 0.75 times length of upper portion; eyes of female separated on meson of head by a length 3-5 times width of an eye. Wings (Fig. 7-8): Vein *Rs* of fore wings forked by a length 3-5 times distance from base to margin; vein *MA* forked slightly more than half distance from base to margin, fork symmetrical; distal portion of vein *MA* strongly sagged (Fig. 7); vein *MP*<sub>2</sub> moderately recurved, attached at base to vein *MP*<sub>1</sub> with a cross vein about a third distance from base to margin; vein *ICu*<sub>1</sub> attached at base by a cross vein to vein *CuA* and distally divergent from vein *CuA* (Fig. 7). Costal margin of hind wings convex with concavity located approximately half distance from base, apex obtuse; vein *Sc* 0.75 times maximum length of hind wings (Fig. 8). Legs: Length ratios of segments in ♂ fore legs, 0.64:1.00 (3.30 mm):0.06:0.39:0.45:0.33:0.15; claws of a pair similar, each apically hooked with an opposing hook (Fig. 10). Male genitalia (Fig. 9, 11): Segment 2 of genital forceps 0.20-0.25 times length of segment 1, segment 3 slightly shorter than segment 2; base of segment 1 broad, inner margin forming an angular bend (Fig. 9). Maximum length of styliger plate along median line approximately 0.33 times maximum width. Penis lobes divided, inner margin of basal half of each lobe with overlapping membranous sheath; basal half broad and bulbous, remainder tubular (Fig. 9); each penis lobe with laterosubapical spine and a ventral submedian thickening (Fig. 11). Female ninth sternum deeply cleft apically (Fig. 14). Terminal filament longer than cerci.

Egg. Oblong; polar cap absent; chorion with scattered circular ridges surrounded by small granules (Fig. 48); 1 oval sperm guide ringed with thin membrane (Fig. 49).

Nymph unknown.

Etymology. *rhigos*, Gr., meaning cold; *topos*, Gr., meaning place. Masculine.

Type species. *Rhigotopus andinensis* sp. n.

Discussion. *Rhigotopus* can be distinguished from all other genera of Leptophlebiidae by the following combination of imaginal characters; (1) vein *Sc* of hind wings is 0.75 times maximum length of hind wings (Fig. 8); (2) claws of a pair are alike, both apically hooked, each with an opposing hook (Fig. 10); (3) penis lobes are divided and each lobe has a laterosubapical spine and ventral submedian thickening (Fig. 9); and (4) female ninth sternum is deeply cleft apically (Fig. 14). The eggs have chorion with scattered circular ridges which are surrounded with small granules (Fig. 48).

Pescador and Peters (1980) placed *Rhigotopus* in the *Atalonella* phyletic lineage but it can be distinguished from all genera included in the lineage by any of the following characters: (1) penis lobes are divided and each lobe has a laterosubapical spine and ventral submedian thickening (Fig. 9, 11); and (2) eggs have chorion with scattered circular ridges which are surrounded with small granules (Fig. 48).

#### ***Rhigotopus andinensis* sp. n. (Fig. 7-14, 48-49)**

Male imago (in alcohol). Length: Body 8.0-9.5 mm, fore wings 9.0-10.5 mm. Head dark yellow, faintly washed with dark brown. Antennae dark yellow. Ocelli white, base black. Upper portion of eyes orange-yellow, lower portion black. Thorax: Nota dark shiny brown, median suture, inner and outer parapsidal furrows and posterolateral corners of scutellum shiny brown. Pleura brown. Sterna dark shiny brown, posterior half of mesobasisternum and metasternum paler. Wings: Membrane of fore wings hyaline, pterostigma cloudy white; longitudinal veins light brown, progressively yellow toward base; cross veins dark brown, shaded with brown on basal two thirds of costal and subcostal membranes. Membrane of hind wings hyaline; longitudinal veins pale yellow, vein *C*, *Sc* and basal half of *R*<sub>1</sub> darker; cross veins pale white, except those between veins *C*, *Sc* and *R*<sub>1</sub> brown. Legs yellow, tibiae and tarsi paler, femora with broad transverse, median, and apical dark brown band. Abdomen: Terga translucent yellow, darker and opaque on 7-9; terga with dark brown maculae (Fig. 12-13). Sterna translucent yellow, darker and opaque on 8-9; anterolateral corners of sterna with small dark brown markings. Genitalia (Fig. 9, 11). Forceps, styliger plate, and penes yellow. Caudal filaments dusty yellow.

Female imago (in alcohol). Length: Body 8.0-9.0 mm, fore wings 9.0-11.0 mm. Head yellow. Color of antennae and ocelli as in male imago. Eyes black. Thorax: Color and markings as in male imago. Wings: Color as in male except costal and subcostal cross veins of fore wings shaded with brown. Legs missing except I mesothoracic leg with same color as in male. Abdomen: Terga yellow with dark brown maculae as in male imago. Sterna yellow, paler on 7-9, markings of sterna as in male. Caudal filaments pale yellow.

Male and female subimago, and nymph unknown.

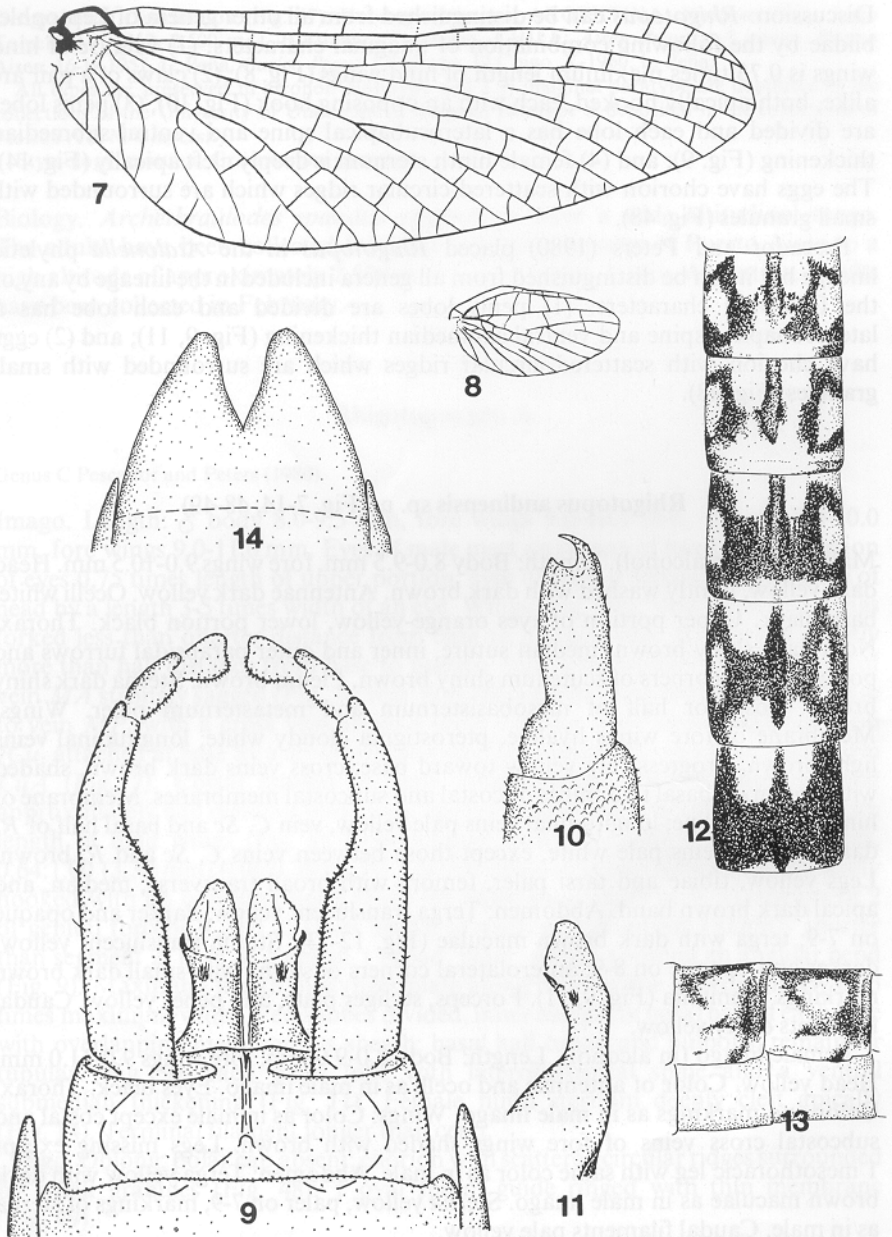


Fig. 7-14. *Rhigotopus andinensis*. — Fig. 7-13, ♂ imago: 7, fore wing; 8, hind wing; 9, genitalia, ventral view; 10, fore claw; 11, penis lobe, lateral; 12, abdominal terga 3-7; 13, abdominal pleura 5-6. Fig. 14, 9th sternum of ♀ imago.

Geographical Distribution (Fig. 47). Holotype ♂ imago, ARGENTINA: *Chubut Prov.* small streams near Bariloche, 29-IX-1958, 700 m., J. Illies; Allotype ♀ imago, same data as holotype. Paratypes, ARGENTINA: 5 ♂ imagines same data as holotype; *Chubut Prov.*, 3 ♂ imagines, small stream near Bariloche, 31-X-1955, J. Illies; 6 ♂ imagines, small streams near Bariloche, 27-VII-1955, J. Illies; 1 ♂ imago Pucara 1/10-IV-1957, L. Peña. CHILE: *Cautin Prov.*, 16 ♂ imagines, Lago Villarica, 19-IV-1958, W. Besch. *Llanquihue Prov.*, 8 ♂ and 2 ♀ imagines, Lake shore, 2-III-1958, J. Illies; 6 ♂ imagines, Lago Llanquihue, 6-VI-1958, W. Besch.

All types are preserved in alcohol. Holotype, allotype, 35 ♂ imaginal paratypes are deposited in the collections of the University of Utah. 10 ♂ imaginal, and 2 ♀ imaginal paratypes are deposited in the collections of Florida A & M University.

Etymology. Species is named for the Andes Mountains.

Discussion. One marked variation observed among the specimens studied is the presence of a narrow short longitudinal brown line on sterna 2-6 of few male imagines. Such variation occurs among the specimens collected in Lago Villarica, Cautin Prov., and Lago Llanquihue, Llanquihue Prov., Chile.

Biology. The adults of *R. andinensis* have been collected from early September to late July.

### *Secochela* gen. n.

Genus E Pescador and Peters (1980)

Imago. Length: ♂ body 6.5-8.0 mm, fore wings 6.5-8.5 mm; ♀ body, 7.0-8.0 mm, fore wings 7.0-8.5 mm. Eyes of male meet on meson of head, lower portion of eyes 0.75 times length of upper portion; eyes of female separated on meson of head by a length 3.0-4.0 times width of eye. Wings (Fig. 17-18): Vein *Rs* of fore wings forked approximately one quarter distance from base to margin; vein *MA* forked slightly more than half distance from base to margin, fork symmetrical; distal portion of *MA* moderately sagged (Fig. 17); vein *MP*<sub>2</sub> moderately recurved, attached at base to vein *MP*<sub>1</sub> with a cross vein more than one quarter distance from base to margin; vein *ICu*<sub>1</sub> attached at base by a cross vein to vein *CuA* and *CuP* and distally divergent from vein *CuA* (Fig. 17). Costal margin of hind wings convex with concavity located approximately half distance from base, apex obtuse; vein *Sc* 0.9 times maximum length of hind wings (Fig. 18). Legs: Length ratios of segments in ♂ fore legs, 0.75:1.00(2.75 mm):0.07:0.40:0.40:0.34:0.12; claws of a pair dissimilar, one apically hooked, other obtuse, pad-like (Fig. 22). Male genitalia (Fig. 19-21): Segments 2 and 3 of genital forceps subequal in length, segment 2 less than one quarter length of segment 1; base of segment 1 broad, forming an angular bend on inner margin (Fig. 19). Maximum length of styliiger plate along median line half maximum width. Penis lobes fused in basal half, remainder divided and tubular; each lobe with apical spine and setae (Fig. 19-20) and subapically serrated membranous inner surface (Fig. 21). Female ninth sternum apically entire (Fig. 23). Terminal filament longer than cerci.

Subimago. Morphologically similar to imago except eyes slightly smaller and ocelli less prominent. Fore legs and genital forceps not fully extended, wings translucent, dull color with long unbranched marginal hairs. Caudal filaments hairy.

Egg. Oblong; polar cap absent; chorion smooth with pad-like circular disc (Fig. 50); 1-2 round sperm guides (Fig. 51).

Nymph. Unknown.

Etymology. *secus*, L., meaning different; *chela*, L., meaning claw. Feminine.  
Type species. *Secochela illiesi* sp. n.

Discussion. *Secochela* can be distinguished from all other genera of Leptophlebiidae by the following combination of imaginal characters: (1) vein Sc of hind wings is 0.9 times maximum length of hind wings (Fig. 18); (2) claws of a pair are dissimilar, one is apically hooked while the other is obtuse and pad-like (Fig. 22); (3) penis lobes are fused in basal half and each lobe has a short apical spine and setae (Fig. 20); and (4) female ninth sternum is apically entire (Fig. 23). The eggs have smooth chorion with pad-like circular discs (Fig. 50).

Pescador and Peters (1980) placed *Secochela* in the *Meridialaris* phyletic lineage but it can be distinguished from all genera included in the lineage by any of the following characters: (1) hooked claws have no opposing hook (Fig. 22); (2) each penis lobe has apical spine and setae, and subapically serrated membranous inner lining (Fig. 21); and (3) eggs have smooth chorion with pad-like circular disc (Fig. 50).

#### *Secochela illiesi* sp. n. (Fig. 15-23, 50-51)

Male imago (in alcohol). Length: Body 6.5-8.0 mm, fore wings 6.5-8.5 mm. Head yellow to orange-yellow. Antennae blackish-brown, flagellum yellow. Ocelli pale white, black at base. Upper portion of eyes orange-yellow, lower portion black. Thorax: Nota dark yellow to shiny brown, pronotum paler; outer parapsidal furrows and posterolateral corners of scutellum shiny brown to dark reddish-brown; pronotum with a pair of narrow longitudinal, submedian dark brown stripes. Pleura yellow to shiny brown; margins of katapisterna and anepisterna washed with black. Sterna yellow to shiny brown, probasisternum, median of mesofurcasternum and metasternum paler. Wings: Membrane of fore wings hyaline, pterostigma cloudy white; longitudinal veins yellow, cross veins white, weakly developed except those on pterostigma developed. Membrane of hind wings hyaline, longitudinal and cross veins white. Legs yellow, tibiae and tarsi paler. Abdomen: Terga translucent yellow, opaque yellow on 1 and 7-9; terga with broad dark brown maculae (Fig. 15-16). Sterna translucent yellow, slightly darker on sterna 7-9; small black anterolateral spot on sterna 2-7. Genitalia (Fig. 19-21): Forceps yellow, inner margins of segment 1 reddish-brown. Styliger plate yellow with a broad shallow U-shaped posteromedian emargination. Penes yellow, apex of penis lobes each with 3 setae (Fig. 20). Caudal filaments pale yellow with a narrow brown annulation at articulations, annulations progressively faded apically.

Female imago (in alcohol). Length: Body 7.0-8.0 mm, fore wings 7.0-8.5 mm. Head pale yellow to dark yellow. Color of antennae and ocelli as in male imago.



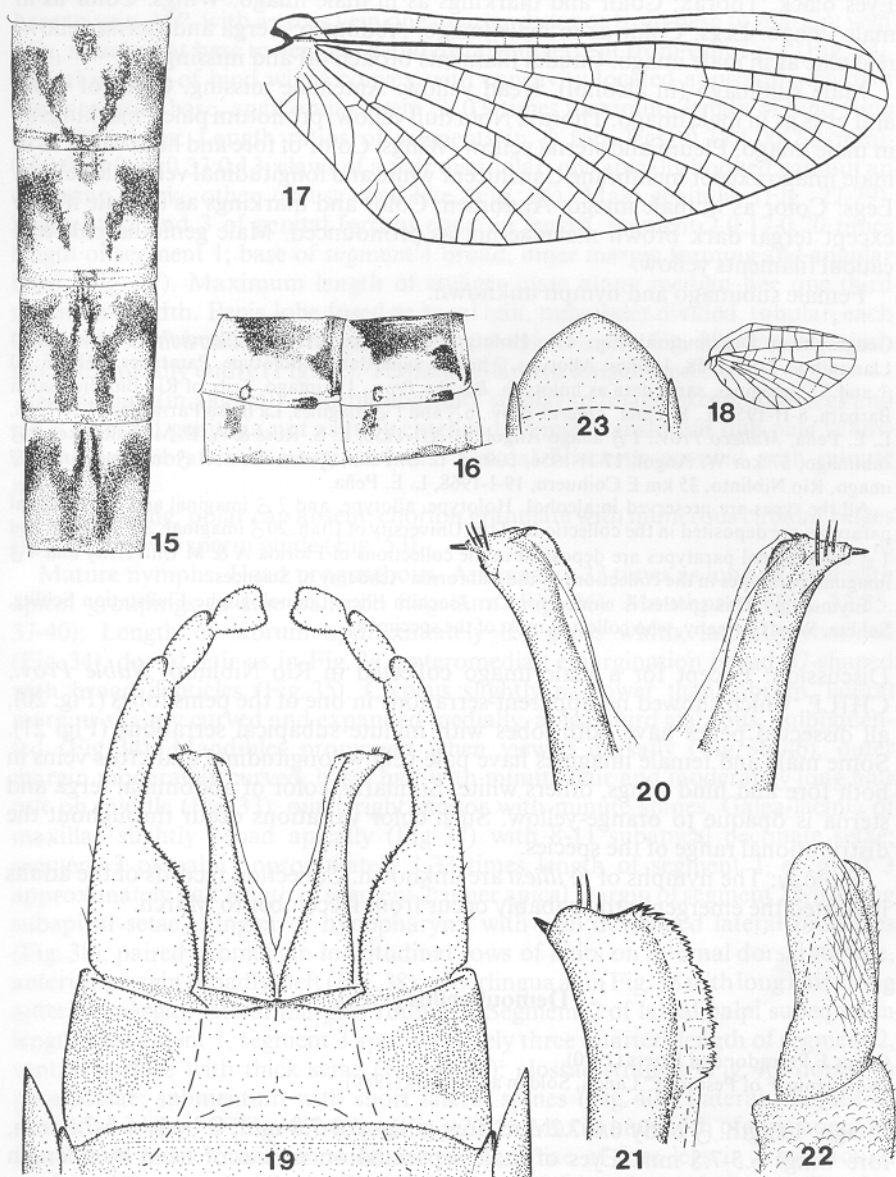


Fig. 15-23. *Secochela illiesi*. — Fig. 15-22, ♂ imago: 15, abdominal terga 4-7; 16, abdominal pleura 5-6; 17, fore wing; 18, hind wing; 19, genitalia, ventral; 20, variation in apex of penes, dorsal; 21, apex of penis lobe enlarged, ventral; 22, fore claw. Fig. 23, 9th sternum of ♀ imago.

Eyes black. Thorax: Color and markings as in male imago. Wings: Color as in male imago. Legs: Color as in male imago. Abdomen: Terga and sterna yellow, maculae as in male imago. Caudal filaments broken off and missing.

Male subimago (in alcohol). Head yellow. Antennae missing. Color of ocelli and eyes as in male imago. Thorax: Nota dull yellow, pronotum paler, markings as in male imago. Pleura and sterna yellow. Wings: Color of fore and hind wings as in male imago except membrane translucent white and longitudinal vein pale yellow. Legs: Color as in male imago. Abdomen: Color and markings as in male imago except tergal dark brown maculae not as pronounced. Male genitalia pale and caudal filaments yellow.

Female subimago and nymph unknown.

Geographical Distribution (Fig. 47). Holotype ♂ imago, CHILE: *Llanquihue Prov.*, Lago Llanquihue, 2-III-1958, J. Illies; Allotype, ♀ imago, same data as holotype. Paratypes, CHILE: 20 ♂ and 5 ♀ imagines, same data as holotype. *Bio Bio Prov.*, 1 ♂ imago, Trib. of Río Bio Bio, Santa Barbara, 8-II-1959, L. E. Peña. *Linares Prov.*, 6 ♂ and 1 ♀ imagines, La Balsa Parral 25/27-II-1956, L. E. Peña. *Malleco Prov.*, 1 ♂ imago Angol, 31-XII-1950, E. S. Ross & A. E. Michelbacher; 1 ♂ subimago, 57 km W. Angol, 17-II-1956, 600 m, L. E. Peña; *Nuble Prov.*, 3 ♂ imagines and 1 ♀ imago, Río Niblinto, 35 km E Coihueco, 19-I-1968, L. E. Peña.

All the types are preserved in alcohol. Holotype, allotype, and 7 ♂ imaginal and 5 ♀ imaginal paratypes are deposited in the collections of the University of Utah. 20 ♂ imaginal, 2 ♀ imaginal and 1 ♂ subimaginal paratypes are deposited in the collections of Florida A & M University and 4 ♀ imaginal paratypes in the collections of the California Academy of Sciences.

Etymology: This species is named for Dr. Joachim Illies, Limnologische Flußstation Schlitz, Schlitz, West Germany, who collected most of the specimens.

Discussion: Except for a male imago collected in Río Niblinto, *Nuble Prov.*, CHILE, which showed no apparent serrations in one of the penis lobes (Fig. 20), all dissected penes have both lobes with minute subapical serrations (Fig. 21). Some male and female imagines have pale yellow longitudinal and cross veins in both fore and hind wings, others white. Similarly, color of abdominal terga and sterna is opaque to orange-yellow. Such color variations occur throughout the distributional range of the species.

Biology: The nymphs of *S. illiesi* are unknown. Collection records of the adults indicated the emergence to probably occur from December to March.

### Demoulinellus gen. n.

Genus F Pescador and Peters (1980).

"New genus F of Pescador" Landa, Soldan and Peters (1980)

Imago. Length: ♂ body 6.0-7.2 mm, fore wings 6.0-7.0 mm; ♀ body 6.5-7.5 mm, fore wings 6.5-7.5 mm. Eyes of male separated on meson of head by a length approximately 0.75 times maximum width of median ocellus, lower portion of eyes 0.75 times length of upper portion; eyes of female separated on meson of head by a length 4-4.5 times width of an eye. Wings (Fig. 24-25): Vein *Rs* of fore wings forked approximately one fifth distance from base to margin; vein *MA* forked slightly more than half distance from base to margin, fork symmetrical; distal portion of

vein *MA* moderately sagged (Fig. 24); vein *MP*<sub>2</sub> moderately recurved, attached at base to vein *MP*<sub>1</sub> with a cross vein one quarter distance from base to margin; vein *ICu*<sub>1</sub> attached at base to vein *CuA* and distally divergent from vein *CuA* (Fig. 24). Costal margin of hind wings convex with concavity located approximately half distance from base, apex obtuse; vein *Sc* 0.9 times maximum length of hind wing (Fig. 25). Legs: Length ratios of segments in ♂ fore legs, 0.75:1.00(2.2 mm): 0.60:0.38:0.38:0.33:0.13; claws of a pair dissimilar, one apically hooked without an opposing hook, other obtuse, pad-like (Fig. 26). Male genitalia (Fig. 27-29): Segments 2 and 3 of genital forceps equal in length, segment 2 0.17-0.20 times length of segment 1; base of segment 1 broad, inner margin forming an angular bend (Fig. 27). Maximum length of styliiger plate along median line one third maximum width. Penis lobe fused at basal half, remainder divided, tubular, each lobe with semicircularly arranged dorsal subapical hairs (Fig. 28). Female ninth sternum apically entire (Fig. 32). Terminal filament longer than cerci.

Subimago (in alcohol). Morphologically similar to imago except, fore legs and male external genitalia not as fully extended. Wings translucent dull pale yellow with long unbranched marginal hairs. Caudal filaments covered with minute hairs.

Egg. Oblong; polar cap absent; chorion granulate with numerous circular ridges (Fig. 52); 1 oval sperm guide (Fig. 53).

Mature nymphs. Head prognathous. Antennae 1.33 times as long as head with apical groupings of fine hairs on flagellum (Fig. 56). Mouthparts (Fig. 33-35, 37-40): Length of labrum approximately 0.4 times width, laterally rounded (Fig. 34), dorsal hair as in Fig. 34, anteromedian emargination broad, U-shaped with broad denticles (Fig. 35). Clypeus slightly narrower than labrum, lateral margins slightly curved and expanded medially, apical third glabrous, unpigmented (Fig. 34). Mandibles prominent when viewed dorsally (Fig. 36, 46), outer margin moderately curved, basal half with minute hair and moderately long hair tuft on middle (Fig. 33), outer right incisor with minute spines. Galea-lacinia of maxillae slightly broad apically (Fig. 37) with 8-11 subapical pectinate setae; segment 2 of palpi approximately 1.33 times length of segment 1, segment 3 approximately half length of segment 2; inner apical margin of segment 2 with long subapical setae. Lingua of hypopharynx with well developed lateral processes (Fig. 38), paired submedian longitudinal rows of hairs on internal dorsal surface, anterior margin broadly cleft (Fig. 38); superlingua as in Fig. 38 with long hair along anterior margin, lateral margins rounded. Segment 2 of labial palpi subequal in length to segment 1, segment 3 approximately three quarters length of segment 2, ventral surface with thick setae (Fig. 39-40); glossae straight (Fig. 40) dorsal to paraglossae; submentum with short lateral spines (Fig. 40). Lateral margins of pronotum glabrous (Fig. 46). Legs (Fig. 42-45): Maximum width of tarsi approximately 0.8 times maximum width of tibiae; tibiae of fore legs in cross section rounded (Fig. 43), tarsi oval (Fig. 44); femora with fringed spatulate setae (Fig. 54); denticles on claws progressively larger apically (Fig. 45). Gills (Fig. 41, 46): Gills on segments 1-7 alike, dorsal and ventral lamellae slender, tapered at apex (Fig. 41), main tracheal trunk along median line with no tracheoles (Fig. 41). Posterolateral projections on abdominal segments 6-9; terga with minute wedged shaped setae, most

abundant near posterior margin (Fig. 55), lateral and posterior margins glabrous. Terminal filament longer than cerci; caudal filaments with minute apical denticles and groupings of fine hair (Fig. 57).

**Etymology.** Genus named for Dr. Georges Demoulin, Brussels, Belgium in honor of his significant contribution to the study of Ephemeroptera. Masculine.

**Type species.** *Demoulinellus coloratus* sp. n.

**Discussion:** *Demoulinellus* can be distinguished from all other genera of Leptophlebiidae by the following combination of characters. In the imago: (1) vein *Sc* of hind wings is 0.9 times maximum length of hind wings (Fig. 25); (2) claws of a pair are dissimilar, one is apically hooked and the other is obtuse and pad-like (Fig. 26); (3) penis lobes are fused in basal half and each lobe has dorsal, semi-circularly arranged, subapical hairs (Fig. 28); and (4) female ninth sternum is apically entire (Fig. 32). The eggs have granulate chorion with several circular ridges (Fig. 52, 53). In the nymph: (1) clypeus is slightly narrower than labrum, lateral margins are smoothly curved (Fig. 34); (2) labrum is approximately 0.6 times as long as wide (Fig. 34); (3) outer margin of mandibles is curved with minute hairs on basal half, and a tuft of median hair (Fig. 33); (4) claws have denticles which are progressively larger apically. (Fig. 45); (5) posterolateral projections occur on abdominal segments 6-9; and (6) abdominal gills 1-7 are alike, dorsal and ventral portions of lamellae are slender and apically tapered (Fig. 41, 46).

Pescador and Peters (1980) recently stated that *Demoulinellus* is a phyletic enigma. Further study of imagines, eggs and nymphs however, indicates the genus is in the same phyletic line as *Zephlebia* and related genera from New Zealand. D. R. Towns and W. L. Peters are presently revising *Zephlebia* and related genera from New Zealand. *Demoulinellus* can be distinguished from *Zephlebia* by any of the following characters. In the imagines: (1) basal halves of penis lobes are fused and each lobe has semi-circularly arranged subapical hair (Fig. 27, 28-29), and (2) claws of a pair are dissimilar, one apically hooked, while the other is obtuse and pad-like (Fig. 26). The eggs have granulate chorion with several circular ridges (Fig. 25). In the nymph: (1) outer apical corner of mandible is produced to a prominent ridge near base of outer incisor (Fig. 33); (2) apical third of labrum is glabrous and slightly membranous (Fig. 34); and (3) segment 3 of maxillary palpi is approximately 2 times the length of segment 2 (Fig. 37).

#### ***Demoulinellus coloratus* sp. n. (Fig. 24-46, 52-57)**

Male imago (in alcohol). Length: Body 6.0-7.2 mm, fore wings 6.0-7.0 mm. Head yellow. Scape and pedicel of antennae yellow, flagellum paler. Ocelli pale white, base reddish-black. Upper portion of eyes orange-yellow, lower portion black. Thorax: Pronotum pale yellow; meso- and metanota dark yellow, outer and inner parapsidal furrows, and margins of mesonotum shiny brown. Pleura yellow. Sterna dark yellow, metasternum paler. Wings: Membrane of fore wings hyaline, pterostigma cloudy white; longitudinal veins white, veins *C*, *Sc*, and *Rs* slightly darker; cross veins weakly developed, hyaline. Legs yellow, profemora dark

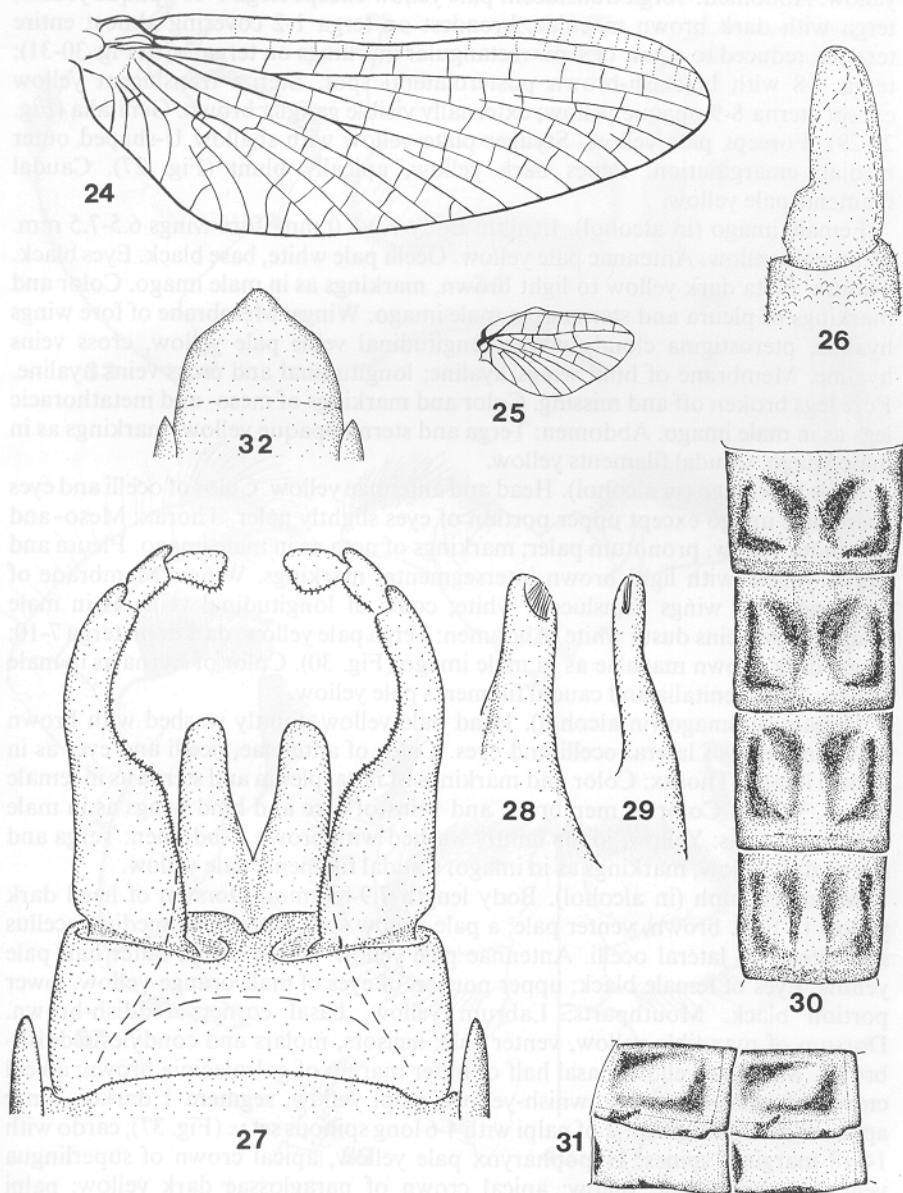


Fig. 24-32. *Demoulinellus coloratus*. — Fig. 24-31, ♂ imago: 24, fore wing; 25, hind wing; 26, fore claw; 27, genitalia, ventral; 28-29, dorsal (28) and lateral (29) views of penis lobe; 30, abdominal terga 4-7; 31, abdominal pleura 5-6. Fig. 32, 9th sternum of ♀ imago.

yellow. Abdomen: Terga translucent pale yellow except terga 9-10 opaque yellow, terga with dark brown maculae, broadest on terga 1-2 covering almost entire tergum, reduced to a pair of semi-rectangular markings on terga 3-10 (Fig. 30-31); terga 1-8 with blackish-brown posterolateral spot. Sterna translucent yellow except sterna 8-9 opaque yellow; externally visible ganglia brown. Genitalia (Fig. 27-29): Forceps pale yellow. Styliiger plate yellow with shallow U-shaped outer median emargination. Penes dark yellow, apically blunt (Fig. 27). Caudal filaments pale yellow.

Female imago (in alcohol). Length: Body 7.0-8.0 mm; fore wings 6.5-7.5 mm. Head pale yellow. Antennae pale yellow. Ocelli pale white, base black. Eyes black. Thorax: Nota dark yellow to light brown, markings as in male imago. Color and markings of pleura and sterna as in male imago. Wings: Membrane of fore wings hyaline, pterostigma cloudy white; longitudinal veins pale yellow, cross veins hyaline. Membrane of hind wings hyaline; longitudinal and cross veins hyaline. Fore legs broken off and missing. Color and markings of meso- and metathoracic legs as in male imago. Abdomen: Terga and sterna opaque yellow, markings as in male imago. Caudal filaments yellow.

Male subimago (in alcohol). Head and antennae yellow. Color of ocelli and eyes as in male imago except upper portion of eyes slightly paler. Thorax: Meso- and metanota yellow, pronotum paler; markings of nota as in male imago. Pleura and sterna yellow with light brown intersegmental markings. Wings: Membrane of fore and hind wings translucent white; color of longitudinal veins as in male imago; cross veins dusty white. Abdomen: Terga pale yellow, darker on terga 7-10; tergal dark brown maculae as in male imago (Fig. 30). Color of sterna as in male imago. Male genitalia and caudal filaments pale yellow.

Female subimago (in alcohol). Head pale yellow, faintly washed with brown between bases of lateral ocelli and eyes. Color of antennae, ocelli and eyes as in female imago. Thorax: Color and markings of nota, pleura and sterna as in female imago. Wings: Color of membrane and veins of fore and hind wings as in male subimago. Legs: Yellow, joints faintly washed with brown. Abdomen: Terga and sterna dull yellow, markings as in imago. Caudal filaments pale yellow.

Mature nymph (in alcohol). Body length 7.9-8.0 mm. Dorsum of head dark yellow to light brown, venter pale; a pale yellow spot anterior to median ocellus and lateral to lateral ocelli. Antennae pale yellow. Ocelli black, outer half pale yellow. Eyes of female black; upper portion of eyes of male orange-yellow, lower portion black. Mouthparts: Labrum yellow, basal corners reddish-brown. Dorsum of mandible yellow, venter pale; incisors, molars and condyles reddish-brown. Maxillae yellow, basal half of outer margin of galealacinia brown; apical crown of galea-lacinia brownish-yellow; palpi yellow, segment 1 darker; inner apical corner of segment 2 of palpi with 4-6 long spinous setae (Fig. 37); cardo with 14-18 marginal spines. Hypopharynx pale yellow, apical crown of superlingua yellow. Labium pale yellow; apical crown of paraglossae dark yellow; palpi yellow. Segment 1 with 17-22 outer marginal spines, 8-12 inner marginal spines. Thorax: Nota dark yellow to light brown with scattered small brown markings. Pleura pale yellow. Sterna pale yellow; externally visible ganglia dark brown. Legs pale to dark yellow; femora with broad transverse basal and median brown bands;

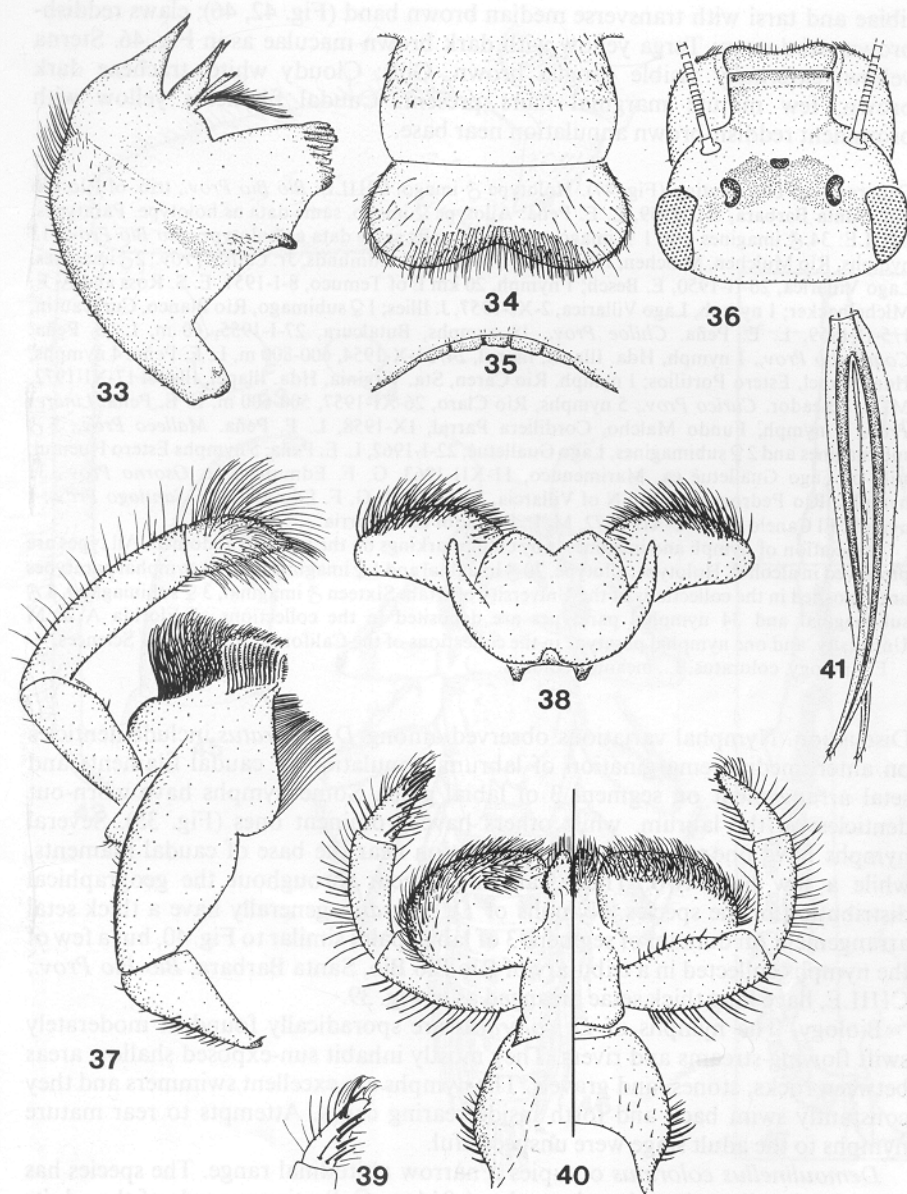


Fig. 33-41. *Demoulinellus coloratus*, mature nymph: 33, left mandible; 34, clypeus and labrum; 35, anteromedian emargination of labrum enlarged; 36, head; 37, right maxilla, ventral; 38, hypopharynx; 39, segment 3 of labial palpi, dorsal view of variation; 40, labium, dorsal (left), ventral (right); 41, gill 4.

tibiae and tarsi with transverse median brown band (Fig. 42, 46); claws reddish-brown. Abdomen: Terga yellow with dark brown maculae as in Fig. 46. Sterna yellow; externally visible ganglia brown. Gills: Cloudy white, tracheae dark brown; few minute marginal hairs present. Caudal filaments yellow with prominent reddish-brown annulation near base.

Geographical Distribution (Fig. 47). Holotype ♂ imago, CHILE: *Bio Bio Prov.*, trib. of Río Bio Bio, Santa Barbara, 8-II-1959, L. E. Peña: Allotype ♀ imago, same data as holotype. Paratypes, CHILE: 34 ♂ imagines and 1 ♀ imago and 12 nymphs same data as holotype. *Bio Bio Prov.*, 13 nymphs, Río Mulchen, Mulchen, 130 m, 8-XII-1963, G. F. Edmunds, Jr. *Cautin Prov.*, 2 ♂ imagines, Lago Villarica, 26-II-1950, E. Besch; 1 nymph, 20 km E of Temuco, 8-I-1951, E. S. Ross and A. E. Michelbacher; 1 nymph, Lago Villarica, 2-XI-1957, J. Illies; 1 ♀ subimago, Río Blanco, Curacautin, 1/5-II-1959, L. E. Peña. *Chiloe Prov.*, 18 nymphs, Butalcura, 27-I-1955, 60 m, L. E. Peña. *Coquimbo Prov.*, 1 nymph, Hda. Illapel, Illapel, 24/31-X-1954, 600-800 m, L. E. Peña: 4 nymphs, Hda. Illapel, Estero Portillos; 1 nymph, Río Caren, Sta. Virginia, Hda. Illapel, Illapel 17-XI-1972, M. L. Pescador. *Curico Prov.*, 5 nymphs, Río Claro, 26-XI-1957, 500-600 m, L. E. Peña. *Linares Prov.*, 1 nymph, Fundo Malcho, Cordillera Parral, IX-1958, L. E. Peña. *Malleco Prov.*, 3 ♂ subimagines and 2 ♀ subimagines, Lago Gualletué, 22-I-1962, L. E. Peña; 5 nymphs Estero Huemul, trib. of Lago Gualletué ca. Marimenuco, 11-XII-1963, G. F. Edmunds, Jr. *Osorno Prov.*, 31 nymphs. Río Pedrogoso, 8 km N of Villarcia, 28-XI-1963, G. F. Edmunds, Jr. *Santiago Prov.*, 1 nymph, El Canelo 30-XI-2-XII-1972, M. L. Pescador & G. Barria.

Association of nymph and imagines is by color markings on the legs and abdomen. All types are preserved in alcohol. Holotype, allotype, 20 ♂ imaginal and 1 ♀ imaginal, and 59 nymphal paratypes are deposited in the collections of the University of Utah. Sixteen ♂ imaginal, 3 ♀ subimaginal, 3 ♂ subimaginal and 34 nymphal paratypes are deposited in the collections of Florida A & M University, and one nymphal paratype in the collections of the California Academy of Sciences.

Etyymology. *coloratus*, L., meaning colored.

Discussion. Nymphal variations observed among *D. coloratus* include denticles on anteromedian emargination of labrum, annulation of caudal filaments and setal arrangement on segment 3 of labial palpi. Some nymphs have worn-out denticles on the labrum, while others have prominent ones (Fig. 35). Several nymphs have one reddish-brown annulation near the base of caudal filaments, while a few have two. These variations occur throughout the geographical distribution of the species. Nymphs of *D. coloratus* generally have a thick setal arrangement on dorsum of segment 3 of labial palpi similar to Fig. 40, but a few of the nymphs collected in a tributary of Río Bio Bio, Santa Barbara, *Bio Bio Prov.*, CHILE, have long thick setae arranged as in Fig. 39.

Biology. The nymphs of *D. coloratus* are sporadically found in moderately swift flowing streams and rivers. They mostly inhabit sun-exposed shallow areas between rocks, stones, and gravels. The nymphs are excellent swimmers and they constantly swim back and forth inside rearing cages. Attempts to rear mature nymphs to the adult stage were unsuccessful.

*Demoulinellus coloratus* occupies a narrow altitudinal range. The species has never been collected at elevations above 914 m. Collection records of the adults indicate the emergence to be from late January to late February.

The nymphs are primarily detritivores. Gut contents were detritus, mineral particles and diatoms. Identified diatoms included *Navicula* and *Eunotia*.



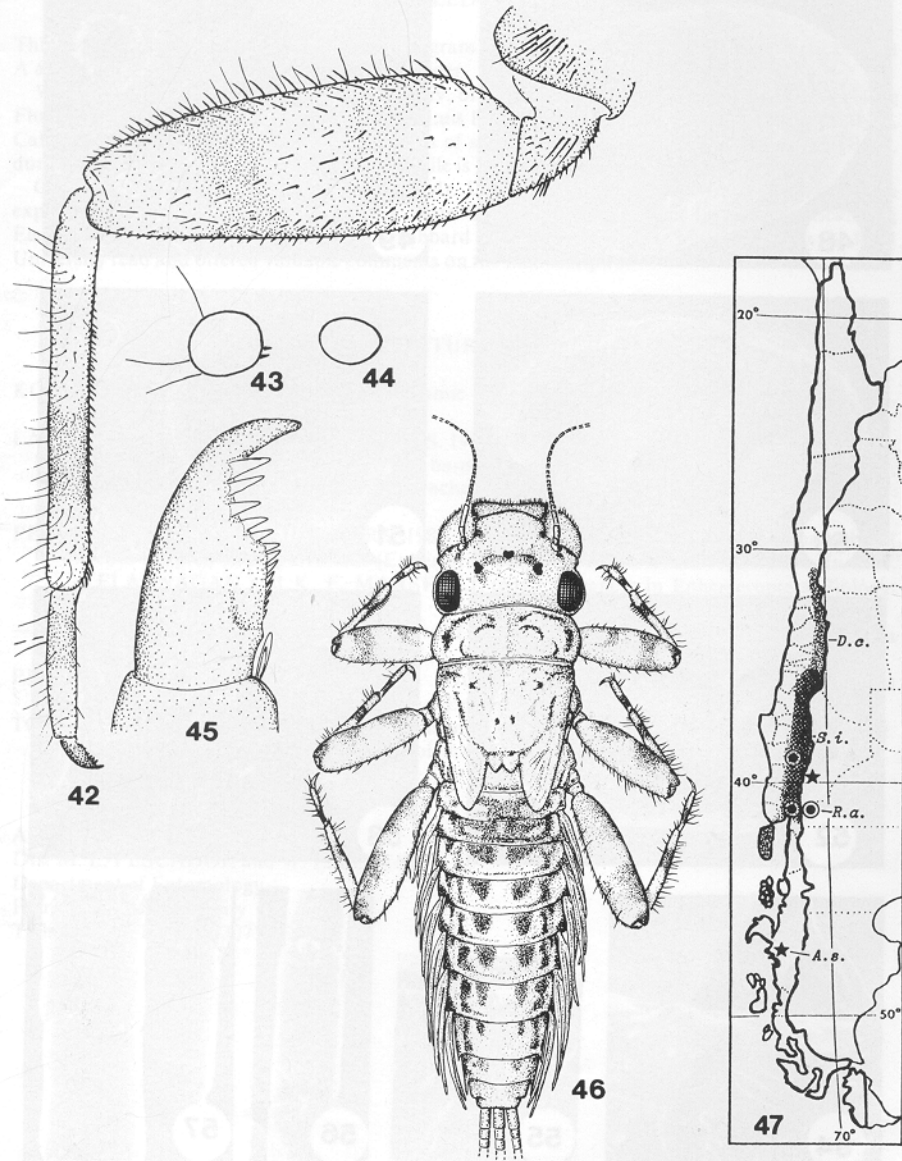


Fig. 42-47. *Demoulinellus coloratus*, mature nymph: 42, fore leg; 43-44, cross section of tibia and tarsus of fore leg; 45, fore claw; 46, ♀ nymph. Fig. 47, geographical distribution of *Archethraulodes spatulus* (A.s.), *Rhigotopus andinensis* (R.a.), *Secochela illiesi* (S.i.), and *Demoulinellus coloratus* (D.c.) in Chile and Western Argentina.

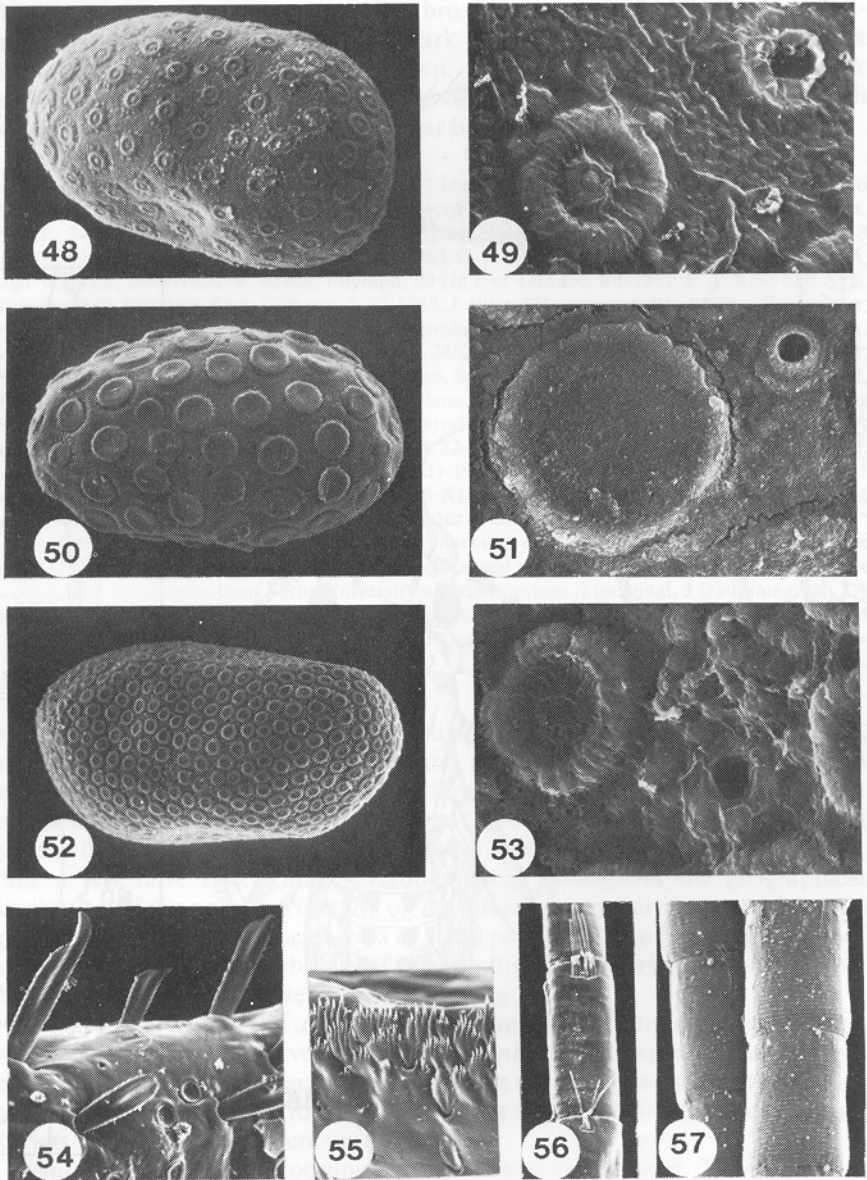


Fig. 48-57. Scanning electron micrographs, — Fig. 48-53, eggs: 48-49, *Rhigotopus andinensis* egg (570X) and micropyle (4650X); 50-51, *Secochela illiesi* egg (560X) and micropyle (3525X); 52-53, *Demoulinellus coloratus* egg (590X) and micropyle (3520X). Fig. 54-57, nymphal setae of *D. coloratus*: 54, femora, dorsal (720X); 55, abdominal terga (500X); 56, antenna (550X); 57, caudal filaments (250X).

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## LITERATURE CITED

- KOSS, R. W. 1968. Morphology and taxonomic use of Ephemeroptera eggs. — *Ann. Entomol. Soc. Amer.* 61: 692-721.
- LANDA, V., T. SOLDAN and W. L. PETERS. 1980. Comparative anatomy of larvae of the family Leptophlebiidae (Ephemeroptera) based on ventral nerve cord, alimentary canal, Malpighian tubulus, gonads and tracheal system. — *Acta Entomol. Bohemoslov.* 17: 169-195.
- PESCADOR, M. L. and W. L. PETERS. 1980. Phylogenetic relationships and zoogeography of cool-adapted Leptophlebiidae (Ephemeroptera) in southern South America. — In: J. F. FLANNAGAN and K. E. MARSHALL (eds.) *Advances in Ephemeroptera Biology*: 43-56. Plenum Press, New York.
- 1980. Two new genera of cool-adapted Leptophlebiidae (Ephemeroptera) from southern South America. — *Ann. Entomol. Soc. Amer.* 73: 332-338.
- PETERS, W. L. and G. F. EDMUNDS, Jr. 1970. A revision of the generic classification of the Eastern Hemisphere Leptophlebiidae (Ephemeroptera). — *Pac. Insects.* 12: 157-240.
- TOWNS, D. and W. L. PETERS. 1978. A revision of the genus *Atalophlebioides* (Ephemeroptera: Leptophlebiidae). — *N.Z. Jour. Zool.* 5: 607-614.

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