Proceedings of the 8th International Symposium on Trichoptera, 1997, pages 157-165

The caddisfly (Trichoptera) family Atriplectididae in the Neotropics

RALPH W. HOLZENTHAL

Department of Entomology, University of Minnesota, 1980 Folwell Ave, St. Paul, Minnesota 55108 USA

Abstract. The caddisfly family Atriplectididae is recorded from the Neotropics for the first time. The male and female of a new species from Peru and Bolivia are described and illustrated and assigned to a new genus. The larva of a second, unnamed species is described from Brazil and compared to previously described larvae from Peru and Ecuador. The Brazilian species was found in a shallow, slack water area of a stream flowing through *Araucaria* forest. The distribution of the family in South America probably represents a relictual, pre-drift, Gondwanan fauna.

In 1966, Roback described a very unusual caddisfly larva, based on a single specimen collected from the Río Bella, near Tingo Maria, Peru (Roback 1966). He was unable to place this "extremely aberrant" larva in a known caddisfly family and referred it to "unknown family 1." He noted that one of the most interesting features of this larva was the elongate mesonotum, with its 4 dorsal plates, which Roback beleived allied the specimen with the helicopsychid–calamoceratid line of Ross' (1956) phylogeny. However, he also noted that the larva had a small fore trochantin and an odontocerid-like metanotum, indicating a close relationship to the "odontocerid–sericostomatid" line.

Not until 1978 were other such unusual larvae described, these by Neboiss and Marlier, both in the Proceedings of the 2nd International Symposium on Trichoptera. Neboiss described the larva and pupa of *Atriplectides dubius* Mosely (1936) from Tasmania and Australia. This larva, too, was unusual in that the head, pro- and mesonota were narrow, elongate and retractile. Mosely's species was first assigned to the Leptoceridae: Triplectidinae, but was later transferred by Mosely and Kimmins (1953) to the Odontoceridae.

At the same time, Marlier (1978) described a remarkably similar larva, again with very narrow, retractile anterior segments, from the Seychelles, which he provisionally assigned to *Hughscottiella auricapilla* Ulmer (1910) and placed in the Odontoceridae.

In his 1978 paper Neboiss noted the dissimilarity in both adult and immature characters between *Atriplectides* and "typical" Odontoceridae and erected a new family, Atriplectididae, for the Australian species *A. dubius*. He also noted the close similarity between the adult male genitalia and wing venation between *Atriplectides* and *Hughscottiella* and transferred the latter species to his new family as well.

Not until recently did another unusual larva appear, this one from southeastern Brazil. It was brought to my attention by Dr. O.S. Flint, Jr., Smithsonian Institution, in material received from the Museum of Zoology in São Paolo. This larva is very similar to the ones described previously from Peru, the Seychelles, and Australia. In March, 1996, I had the pleasure of traveling to Brazil, where I visited Campos do Jordão, the locality where the Brazilian specimen was collected. I was fortunate to collect a second larval specimen at this locality and also observed its habitat. A third larval specimen from the Neotropics, this one from Ecuador, was sent to me, via Dr. Flint, from Kieran Monogham of the University of Birmingham, United Kingdom.

In addition to these South American larval specimens, I have on loan from the Smithsonian Institution two adult specimens, a male from Peru and a female from Bolivia, that share the same features described for the family by Neboiss. I describe these specimens below using the morphological terminology of Schmid (1980) for adults and Wiggins (1996) for larvae, and assign them to a new genus and species. The widespread distibution of the family Atriplectididae is thus firmly established in the Neotropics.

Neoatriplectides new genus

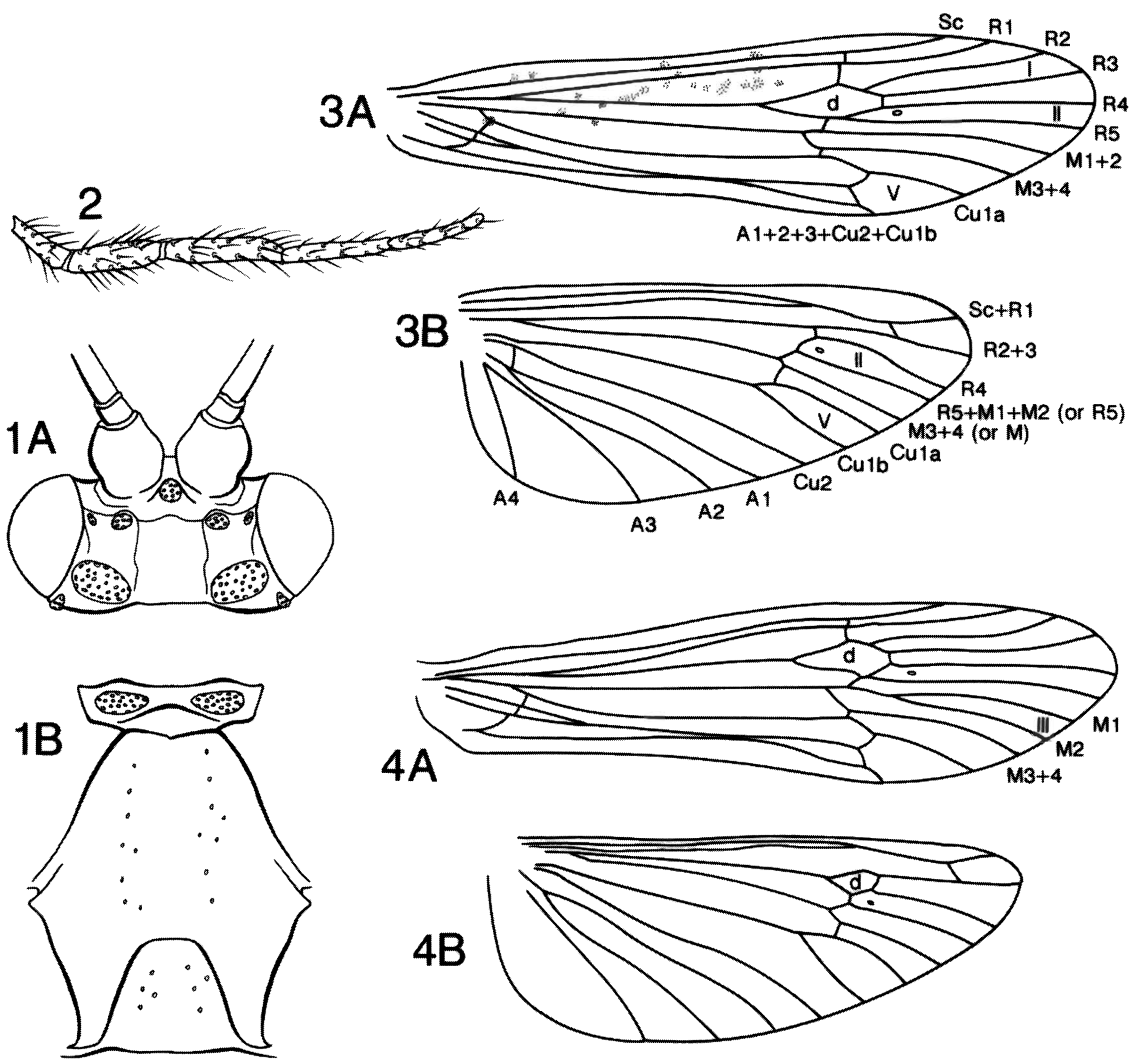
Roback 1966: 256, figs. 248-253, as "unknown family 1."

Type species: *Neoatriplectides froehlichi* new species, by present designation.

The genus is easily distinguished from its two Old World relatives by the male genitalia, especially the single segmented inferior appendages of the New World species.

Generic description

Ocelli absent. Maxillary palps 5 segmented, slender, similar in both sexes. Antennae longer than forewing, scape short, bulbous. Head with anterior setal warts small, posterior setal warts large, heavily setose. Pronotal setal warts transversely elongate. Mesoscutum with 2 longitudinal bands of setae. Scutellum with a single, sparsely setose wart. Spurs 2-4-4, outer spur of each pair less than half length of inner spur; spurs on foreleg much smaller than those on mid- and hindlegs. Forks I, II, and V present in male forewing; forks I, II, III, and V in female forewing. Forewing discoidal cell small, present in both sexes; hind wing discoidal cell small (not discernable in male from Peru). Anal veins of forewing and part of cubitus fused medially along their lengths and emerging at arculus as a single vein A1+2+3+Cu2+Cu1b. Exocrine glands of abdominal sternum V not apparent on either sex. Male genitalia with inferior appendages one segmented, preanal appendages broad, tergum X with spinose projections, phallic apparatus short, stout. Female genitalia simple, with lyre shaped vaginal apparatus sclerites.



FIGS. 1–4. *Neoatriplectides froehlichi* new species. 1A.—Head, dorsal. 1B.—Thorax, dorsal. 2.—Maxillary palp. 3.—Male wings: A. forewing, B. hind wing. 4.—Female wings: A. forewing, B. hind wing.

Neoatriplectides froehlichi new species
Figs. 1–6

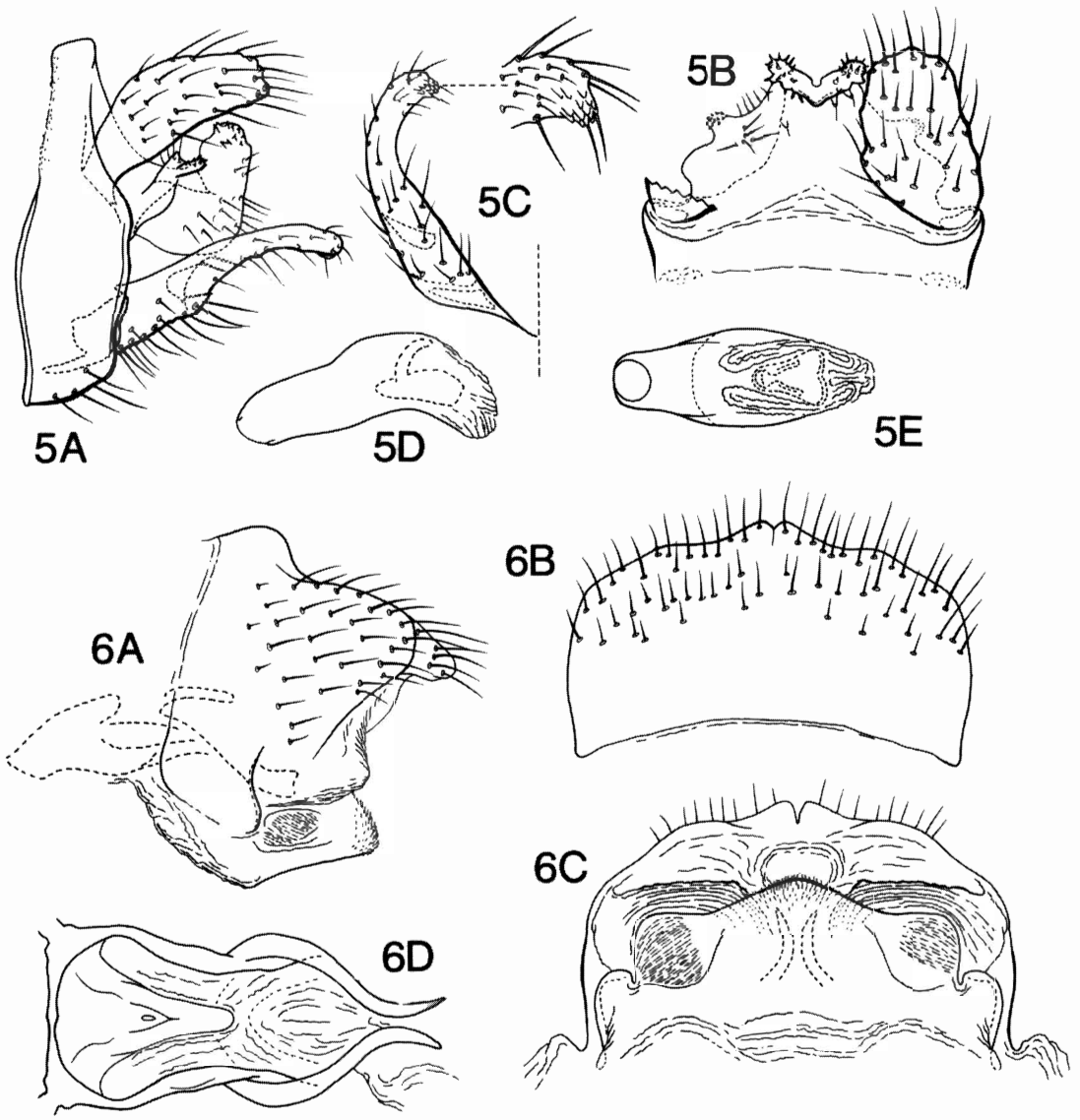
Diagnosis

Among the known species in the family, *N. froehlichi* is the only one with single segmented inferior applendages in the male genitalia. It is perhaps most similar to *Atriplectides dubius* in having broad preanal appendages and spinose lobes on tergum X.

Description

Adult (Figs. 1-4).—Head and thoracic features as in generic description. Forewing length 10 mm (♂), 12 mm (♀). Color stamineous (♂ specimen [teneral and in alcohol] and ♀ specimen [pinned] both badly denuded). Wing venation as in generic description, male with scattered maculations in wing membrane basally along anterior edge (Fig. 3A).

Male genitalia (Fig. 5).—Abdominal segment IX narrow, especially dorsally; posterior edge with minute papillae dorsally. Preanal appendages short,



FIGS. 5, 6. *Neoatriplectides froehlichi* new species, adult genitalia. 5.—Male genitalia: A. segments IX, X, lateral. B. same, dorsal. C. inferior appendage, ventral; inset, detail of apex. D. phallic apparatus, lateral. E. same, ventral. 6.—Female genitalia: A. segments IX, X, lateral. B. same, dorsal. C. same, ventral. D. vaginal apparatus, ventral.

broad, densely setose. Segment X broad, with several spinose lobes, apical spinose lobe rounded, upturned, slightly cleft mesally; lateral spinose lobe terete to knoblike; segment X ventrally broadly rounded, setose; dorsally with small setose patch. Inferior appendages elongate, digitate, single segmented, setose; in lateral view, wide basally, narrow mesally and apically, slightly deflexed apically and mesally curved; mesally with crescentric excavation; apicomesally with short, blunt, spines and longer setae. Phallic apparatus short, stout; apex with convoluted membranes; phallotremal sclerite indistinct, with dorsal projection.

Female genitalia (Fig. 6).—Abdominal sternum VIII with broad, rounded posterior excavation and sclerotized apicomesal "scale" (this may be an abnormality of the specimen). Tergum IX broad, heavily setose, slightly cleft apically; IX ventrolaterally with sinuate, sclerous ridge, possibly serving as receptacle for male inferior appendage; sternum IX apicolaterally with oval, finely striated, lightly sclerotized plate; sternum IX broad, mesally bearing fine microsetae. Segment X membranous, indistingishable from highly folded membranes surrounding anovaginal opening; appendages of X broad, heavily setose, broadly fused to segment IX+X. Vaginal apparatus sclerotized posteriorly, as shown in Fig. 6D, with prominent, apical, lyre-shaped sclerites.

Material examined

Holotype.—♂ [teneral]: **PERU**. **Cuzco**: Paucartambo, Puente San Pedro, ca. 50 km NW Pilcopata, km 152, 13°09'S, 71°26'W, 1430 m, 30-31.viii.1989, N. Adams, et al. (NMNH).

Paratype.—♀: **BOLIVIA**. **Yungas La Paz**: Circuata to Cajuata, 2400 m, 3.5.xii.1984, L.E. Peña (NMNH).

Other material examined

ECUADOR. exact locality not known, 1 larva (University of Birmingham). **PERU**. **Huanuco**: Río Bella, trib. of Monzón river on Sindicata Monzón, nr. Tingo Maria, 3-4.x.1955, S.S. Roback, 1 larva (ANSP).

Etymology

Named in honor of Professor Claudio Gilberto Froehlich, Universidade do São Paulo, in recognition of his pioneering research on the Plecoptera and other aquatic insects of southern South America. Dr. Froehlich collected the larva described herein from Campos do Jordão, Brazil, and facilitated my visit to this locality, where we collected a second larval specimen.

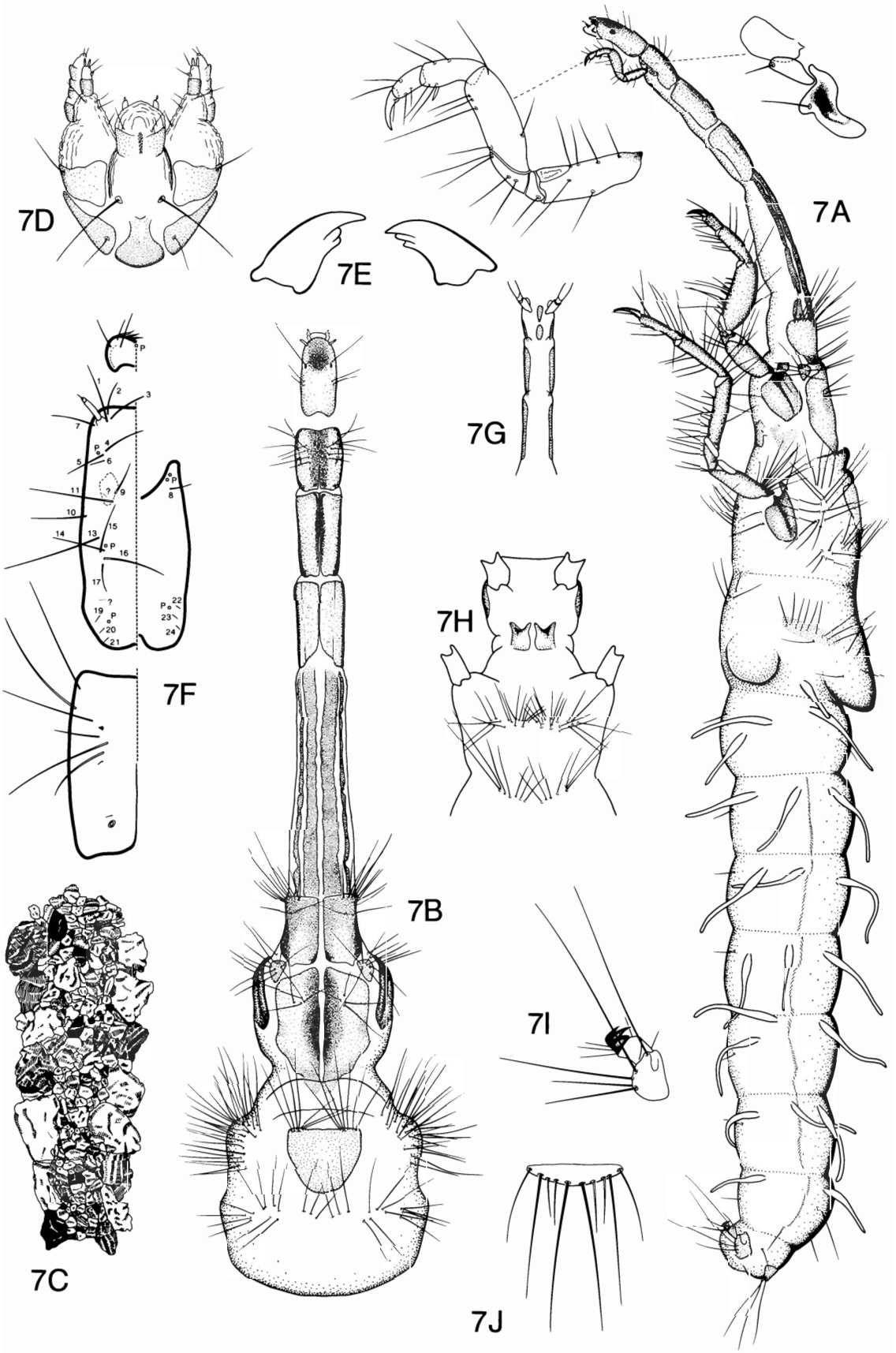
Neoatriplectides sp.
Figs. 7-9

I am here describing the larvae of the Brazilian species in detail. These specimens are very similar in overall morphology to the one from Peru described by Roback (1966). The larval specimen from Ecuador is identical to the Peruvian specimen and both are probably conspecific with the adults described herein as *N. froehlichi*. However, the Brazilian specimens have single abdominal gill filaments, whereas the northern specimens have branched gills. Also, the Peruvian/Ecuadorian and Brazilian specimens differ slightly in the distribution of thoracic setae. The Brazilian specimens certainly represent a second, undescribed species.

Description

Larva.—Length of larva 20 mm (fully extended), 12 mm (fully retracted). Head (Figs. 7A, B, F): pale brown, with darker pigmentation on frons; small, elongate, lacking visible sutures, ventral apotome apparently obliterated; head setal pattern as in Fig. 7F, most head setae long, slender, especially setae 11 and 13; antennae long; eyes small; labrum simple; mandibles slightly elongate, with prominent apical tooth and smaller subapical teeth; maxillolabium as in Fig. 7D, sparsely setose; labial palps reduced, maxillary lobes and maxillary palps elongate; cardo, stipes, submental and mental sclerites well developed. Pronotum (Fig. 7B, F) brown, darker dorsomesally, with scattered muscle scars; longer than wide, with median suture developed only posteriorly; pronotal setae long, slender. Mesonotum (Fig. 7B) complex, with two pairs of dorsal plates anteriorly, these

FIG. 7. *Neoatriplectides* sp., larva. A.—Larva, lateral; right inset, propleural sclerites, enlarged; left inset, foreleg, enlarged. B.—Head and thorax, dorsal. C.—Case, dorsal. D.—Maxillolabial complex, ventral. E.—Mandibles, dorsal. F.—Head and pronotal setal pattern, dorsal on left, ventral on right. G.—Forethorax, ventral. H.—Meso- and metathorax, ventral. I.—Anal claw and lateral sclerite, lateral. J.— Dorsal sclerite, segment IX, dorsal.


7D
7E
7A
7G
7H
7F
7B
7C
7I
7J

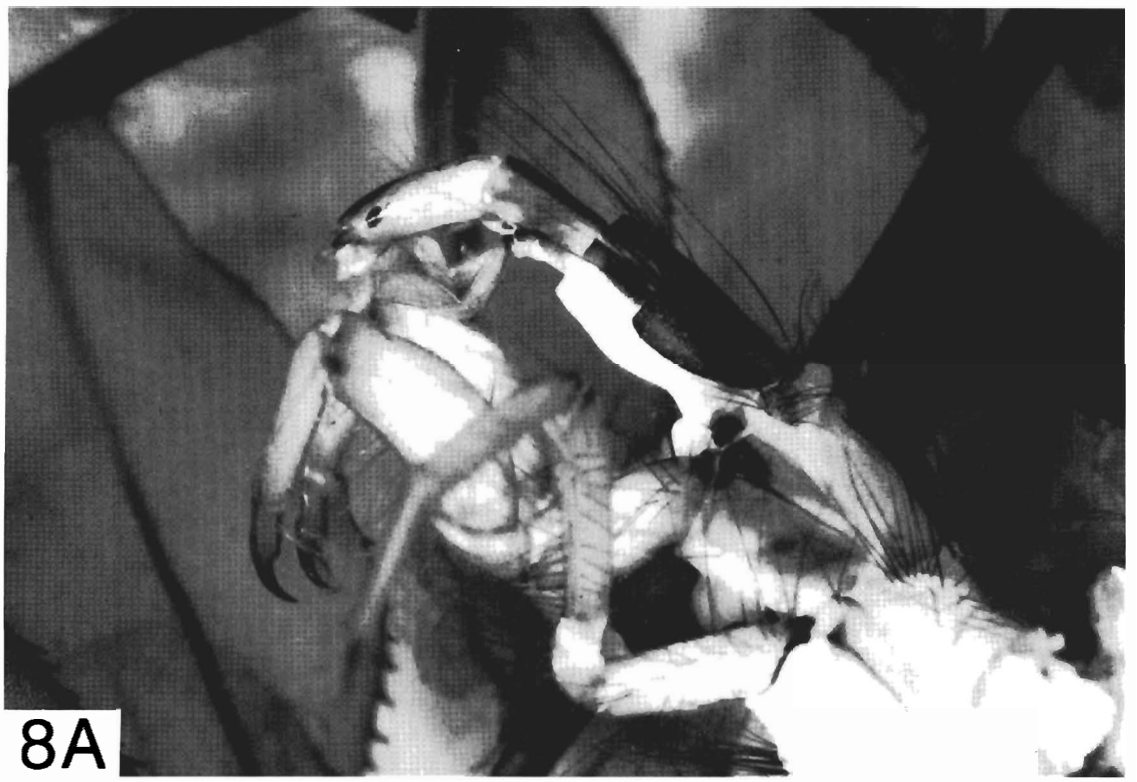


FIG. 8. *Neoatriplectides* sp., larva. A.—Larva, with forethorax retracted. B.—Same, with forethorax extended.

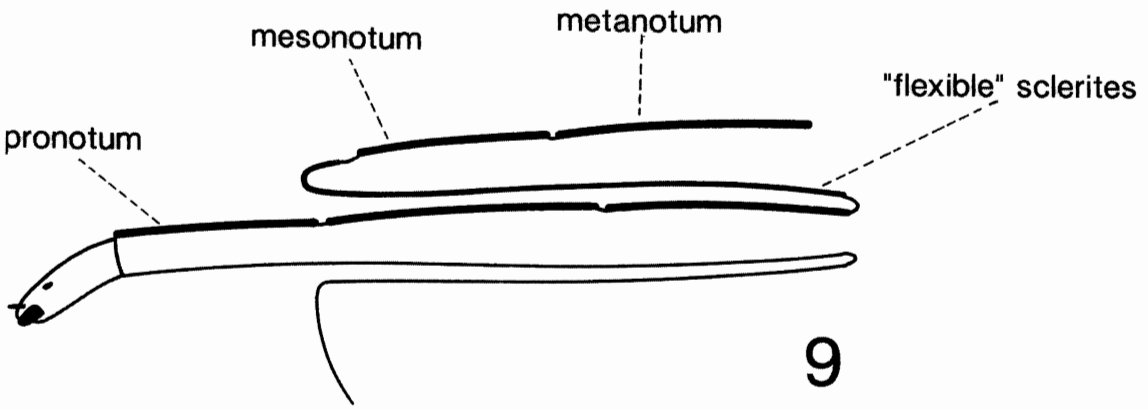


FIG. 9. *Neoatriplectides* sp., larva. Diagramatic longitudinal section of larval thoracic sclerites in retracted position.

elongate, without setae; anterior pair darkly pigmented, much longer than wide, posterior pair dark, with slight longitudinal ridges; mesonotum at midlength very elongate and capable of retraction into body by invagination (partially invaginated position as in Figs. 7A, B; fully extended condition as in Fig. 8B); membranous, bearing two pairs of dorsal, elongate, pigmented, flexible sclerites [anatomy of retracted part of thorax as illustrated in Fig. 9]; posterior portion of mesonotum large, largely covered by sclerites, anterior pair of sclerites quadrate, darkly pigmented, anterolateral corners rounded and extending ventrally over pleural region, anterior margins heavily setose; behind these are a pair of small, rounded setose sclerites; posterior part of mesonotum with pair of large, roughly semicircular scerites, these darkly pigmented along meson and with anteromesal patch of 4 long setae. Metanotum large, membranous, heavily setose dorsolaterally and along midlength; with single dorsal semicircular sclerite, bearing row of ca. 14 long setae anteriorly. Prosternum with small, oval anterior and posterior sclerites mesally; mesosternum with pair of quadrate sclerites, their anterior margins excavate; metasternum with 2 more or less linear rows of elongate setae. Prothoracic legs very small, situated toward anterior half of pronotum, leg setation as in Fig. 7A (left inset); propleural sclerites small, separate (Fig. 7A, right inset); foretrochantin indistinguishable from pleural sclerites; mesothoracic legs large, robust, bearing long setae; femur especially robust and bearing row of short, stout setae along ventral margin (but femur not as stout as in Old World species); metathoracic leg elongate, slender, with long setae; meso- and metapleural sclerites large, oval. Abdominal segment I with prominent dorsal and lateral humps; dorsal hump with few long setae at its base; lateral sclerite elongate-oval, bearing ca. 10 long setae. Lateral fringe present on segments III-VII; segment VIII with lateral spicules. Unbranched abdominal gills distributed as follows: single, lateral gill on I, single dorsal, ventral and lateral gills on II-VII, dorsal and ventral gills only on VIII. Pair of ventral setae present on II-VIII, in addition VIII with dorsal and lateral setae. Abdominal segment IX with setose dorsal sclerite (Fig. 7J); anal proleg as is Fig. 7I, anal claw with strong dorsal accessory hook and short dorsal setae; ventral sole plate with a few short setae; lateral sclerite with elongate setae; each anal proleg with tiny spines adjacent to anal opening.

Larval case.—Cylindrical, slightly flattened, made with sand grains, with large mineral fragments laterally. Length of case 16 mm.

Pupa.—Unknown.

Material examined

BRAZIL. São Paulo: Parque Estadual Campos do Jordão, 13.iii.1988, C.G. Froehlich and L.G. Oliveira, 1 larva (NMNH); same, 1st order tributary of Rio Galharada, 22°41.662'S, 45°27.783'W, el. 1530 m, 7.iii.1996, Holzenthal, Rochetti, Oliveira, 1 larva (UMSP).

Biology

Malicky, in this volume (1997) and elsewhere (1994, 1995) has discussed in detail the biology of the Seychelles species, and Chessman (1986) reported on the diet of the species from Australia. Assuming that the Brazilian species was also a feeder on arthropod carcasses, I searched in small (about 20

cm diameter), shallow (< 10 cm) lateral pools of a small, 1st order tributary of the Rio Galharada where dead arthropods might have settled out from the current and accumulated. I did find one larva and one empty case in this microhabitat after about 2 hours of searching. Collecting was difficult due to constant rain and travel up the stream was impeded by overhanging bamboo and fallen logs; had the weather been better, I am sure more larvae would have been found. No larvae were found in the main channel of the stream. The Rio Galharada is small and shallow, about 1-2 m wide and no more than 0.75 m deep in the deepest pools. The substrate consists of sand and small gravel, with rocks and small boulders scattered about the stream bed. Bamboo and ferns border the stream, which is heavily shaded by a canopy of often huge *Araucaria angustifolia* and an understory of *Podocarpus lamberti*, as well as other small trees and shrubs. The forest has a primeval appearence. Efforts at sweeping riparian vegetation (thwarted by wet conditions) for adults and light trapping at night were not successful.

Systematics and Biogeography

While I prefer not to erect a monobasic new genus, I do so here to call attention to both the presence of this taxon in South America and to its distinctness from the Old World genera. The adult male of the South American species (due mainly to similarities in tergum X) is most similar to *A. dubius* from Australia. However, the larvae from Peru and Brazil are almost identical to those of *H. auricapilla* from the Seychelles, except for their less chelate midlegs. The mesothoracic sclerites are quite different between the Australian species and the species from the Seychelles and South America, especially the absence of the long flexible sclerites in *A. dubius* (compare Neboiss' figs. 2 and 11 with Marlier's plate V and Figs. 7A and B in this paper). Also, the mandibles of *H. auricapilla* and *Neoatriplectides* sp. are similar to each other and of a different dentition than in *A. dubius* (compare Neboiss' fig. 6 with Fig. 7E herein).

What, then, are the phylogenetic relationships among the species of Atriplectididae? It appears, based on larval characters, that *H. auricapilla* and *N. froehlichi* are sister species, but adult male genitalic characters of *N. froehlichi* and *A. dubius* are more similar. I have not attempted to assess the evolutionary polarity of these characters for reasons mentioned below. Certainly the atriplectidids are monophyletic. The highly abberrant larval morphology and behavior are unique within the Trichoptera. This leads to the next issue: How is the clade related to the other case making trichopteran families? The family seems to fit within Brevitentoria: Leptoceroidea as defined by Weaver (1984). Weaver (1983) synonymized the atriplectidids with Odontoceridae (Pseudogoerinae), but in the paper by Weaver and Morse (1986) Atriplectididae appears as the sister family of Odontoceridae, yet no synapomorphies were indicated. Resolution of the phylogenetic position of the atriplectidids must involve an assessment of the phylogeny of all of the Leptoceroidea, and perhaps an even broader assessment of relationships within the Brevitentoria.

Resolution of these issues is beyond the scope of this paper. The species level phylogeny will await the description of a second Australian species (Neboiss, pers. comm.) and the hoped for collection of the adults of the Brazilian species. The relationship of Atriplectididae within the Brevitentoria will be adressed in a molecular phylogenetic analysis now underway by Dr. Karl Kjer, Rutgers University (pers. comm.).

Banarescu (1995) regarded the presence of *Hughscottiella* on the Seychelles and *Atriplectides* in Australia as relicts of a pre-drift Gondwanan fauna; the discovery of *Neoatriplectides* in South America supports this assertion.

Acknowledgments

I am particularly grateful to Dr. Oliver S. Flint, Jr., Smithsonian Institution, for providing me with specimens of this most interesting family. Dr. Flint also reviewed the manuscript and offered useful advice as did Dr. Roger Blahnik, University of Minnesota. Dr. Peter Barnard, Natural History Museum, London, kindly lent me specimens of *H. auricapilla* to compare with the South American forms. Dr. Arturs Neboiss, Abbotsford, Victoria, Australia, similarly provided larval and adult specimens of *A. dubius* and his illustrations of a new species in the genus from Australia. Dr. Hans Malicky, Lunz am See, Austria, provided literature and comments on this study. My thanks are also extended to Dr. Don Azuma and Dr. Jon Gelhaus, Academy of Natural Sciences, Philadelphia, for loaning me the specimen collected in Peru by Roback. I am also grateful to Kieran Monaghan, University of Birmingham, UK, for sending me the specimen from Ecuador. Mr. James Hodges, Cumming, Georgia, provided the excellent photographs of the

specimen I collected in Brazil. I offer my most sincere appreciation to Prof. Rosálys Guahyba and Dr. Janira Martins Costa, Museu Nacional, Rio de Janeiro, Dr. Claudio Froehlich, Universidade do São Paulo, Ribeirão Preto, Brazil, and their students and co-workers for organizing and arranging my trip to Brazil during March, 1996. My visit to Brazil was funded by the University of Minnesota Insect Collection, the Institute of International Studies and Programs, University of Minnesota, and the Museu Nacional/Universidade Federal do Rio de Janeiro. This support is gratefully acknowledged. This is paper number 961170102, Scientific Journal Series, Minnesota Agricultural Experiment Station, St. Paul, Minnesota.

Literature Cited

BANARESCU, P. 1995. Zoogeography of fresh waters, volume 3: distribution and dispersal of freshwater animals in Africa, Pacific areas and South America. AULA-Verlag, Weisbaden.

CHESSMAN, B.C. 1986. Dietary studies of aquatic insects from two Victorian rivers. Australian Journal of Marine and Freshwater Research 37: 129-146.

MALICKY, H. 1994. Eine reliktäre Köcherfliegenlarve von den Seychellen mit ungewöhnlicher Ernährungsweise. Natur und Museum 124: 233-238.

MALICKY, H. 1995. The caddisflies (Insecta: Trichoptera) of Seychelles: taxonomy, zoogeography, biology and conservation. Phelsuna 3: 15-22.

MALICKY, H. 1997. What does biologically successful mean? The enigma of Atriplectididae (Insecta: Trichoptera). Pages 289-291 *in* R.W. Holzenthal and O.S. Flint, Jr. (editors). Proceedings of the 8th International Symposium on Trichoptera. Ohio Biological Survey, Columbus.

MARLIER, G. 1978. Les larves et nymphes des Trichoptères des Seychelles. Pages 31-54 *in* I.M. Crichton (editor). Proceedings of the 2nd International Symposium on Trichoptera. Dr W. Junk Publishers, The Hague.

MOSELY, M.E. 1936. A revision of the Triplectidinae, a subfamily of the Leptoceridae (Trichoptera). Transaction of the Royal Entomological Society of London 85: 91-129.

MOSELY, M.E., AND D.E. KIMMINS. 1953. The Trichoptera (caddis-flies) of Australia and New Zealand. British Museum (Natural History), London.

NEBOISS, A. 1978. Atriplectididae, a new caddisfly family (Trichoptera: Atriplectididae). Pages 67-73 *in* I.M. Crichton (editor). Proceedings of the 2nd International Symposium on Trichoptera. Dr W. Junk Publishers, The Hague.

ROBACK, S.W. 1966. Chapter XI–The Trichoptera larvae and pupae. Pages 235-303 *in* R. Patrick (editor). The Catherwood Foundation Peruvian-Amazon expedition: limnological and systematics studies. Monographs of the Academy of Natural Sciences of Philadelphia, Number 14.

ROSS, H.H. 1956. Evolution and classification of the mountain caddisflies. University of Illinois Press, Urbana.

SCHMID, F. 1980. Genera des Trichoptères du Canada et des États adjacents. Les insectes et arachnides du Canada, Partie 7. Publication 1692. Agriculture Canada, Ottawa.

ULMER, G. 1910. No. III.—Trichoptera. *In* The Percy Sladen Trust Expedition to the Indian Ocean in 1905. Transactions of the Linnean Society of London, Series 2 (Zoology) 14: 41-54, plates 3-4.

WEAVER, J.S., III. 1983. The evolution and classification of Trichoptera, with a revision of the Lepidostomatidae and a North American synopsis of this family. Ph.D. dissertation, Clemson University, Clemson, South Carolina.

WEAVER, J.S., III. 1984. The evolution and classification of Trichoptera, Part 1: the groundplan of Trichoptera. Pages 413-419 *in* J.C. Morse (editor). Proceedings of the 4th International Symposium on Trichptera. Dr W. Junk Publishers, The Hague.

WEAVER, J.S., III, AND J.C. MORSE. 1986. Evolution of feeding and case-making behavior in Trichoptera. Journal of the North American Benthological Society 5: 150-158.

WIGGINS, G.B. 1996. Larvae of the North American caddisfly genera (Trichoptera), 2nd edition. University of Toronto Press, Toronto.