https://doi.org/10.24199/j.mmv.1976.37.05 30 June 1976

SYMBIOCLADIUS AURIFODINAE sp. nov. (DIPTERA, CHIRONOMIDAE), A PARASITE OF NYMPHS OF AUSTRALIAN LEPTOPHLEBIIDAE (EPHEMEROPTERA)

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Summary

Symbiocladius aurifodinae sp. nov., an orthoclad chironomid parastic on nymphs of the mayfly genus *Atalophlebioides*, is described from mountain streams in Victoria. Descriptions are based on mature pupae and larvae collected during the summer. It is concluded that there is probably only one generation per year. This is the first record of *Symbiocladius* from Australia, and it is shown that this species is closely related to *S. wygodzinskyi* Roback from Argentina.

Introduction

Fontaine (1964) and Arvy and Peters (1973) have reviewed the literature on the larvae of Chironomidae that are found in association with mayfly nymphs. It appears that the only species which actually feed on the tissues of their hosts are members of the genus *Symbiocladius*, and most records are from the flattened nympths of the Heptageniidae of the Northern Hemisphere. There is, however, one record of larvae on a species of Leptophlebiidae from North America (Mayo 1969), and careful description of another type of larva from a flattened leptophlebiid from southern South America (Roback 1965). It may be noted here that flattened leptophlebiid nymphs replace the Heptageniidae in the Southern Hemisphere.

The larvae found by Mayo (1969) on nymphs of *Thraulodes* were identified as *Symbiocladius*, but it is clear from her description and figures that they differ considerably from the other described species. The larvae, for instance, seem not to be parasitic, they have well-formed head capsules and they retain eyespots, caudal bristles and anal gills. They seem, in fact, to be not unlike the phoretic genus *Plecoteracoluthus*, which occurs on perlid stoneflies (Steffan 1965) and Megaloptera (Hilsenhoff 1968).

The specimens from Argentina, on the other hand, are clearly parasitic and damaging to their hosts, which were tentatively identified as *Thraulodes*. It was intriguing therefore, especially in view of the similarity of the biotas of southern South America and Australia, to find a very close relative on nymphs of the leptophlebiid *Atalophlebioides* in streams on the Great Dividing Range in Victoria.

THE MATERIAL

The specimens were obtained during monthly collections (June 1971 to June 1972) of the fauna of several streams that were used in the study of the life histories of stoneflies. The methods used are described by Hynes and Hynes (1975), where more information on the streams is given. Mayfly nymphs carrying larvae or pupae of Chironomidae were found in only three of the 11 stream stations that were intensively studied.

These were:

Crown Creek above Woods Point (map reference 424367), 2300 ft, a cool (max. 16¼°C), swift stream 5-10 m wide and up to 40 cm deep, with a stable bed of rocks and shingle.

Godfreys Creek below Frenchman's Gap (421374), 2500 ft, a cool (max. 13¾°C), fairly swift shallow stream 2-3 m wide, with a stable stony and gravelly bed containing some silt.

Delatite River below Sawmill Settlement (434423), 1900 ft, a cool (max. 16¾°C), swift, turbulent river about 15 m wide and up to at least 1 m deep, with a stable bed of boulders, stones and coarse sand.

No specimens of *Atalophlebioides*, which is a common genus in stony streams, were seen with chironomid larvae in any of the many other streams that we visited in Victoria. How-

ever, one pupa was taken, and unfortunately lost in an attempt to breed it out, in Leatherbarrel Creek, N.S.W. (615491) on January 8, 1974.

Two larvae were first noticed in the collection made on October 26, 1971, in Delatite River, one was found on November 24 in Crown Creek, and several were found in Godfreys Creek on December 28. They persisted in small numbers until February and March in the two creeks; in December there were many pupae, and in January and February only pupae (one pre-pupa in March) were obtained. In Delatite River only pupae were found on December 28 and no specimens were collected on or after January 25. These findings possibly indicate only a single generation per season for the chironomid. It seems that at least some species of the host mayfly, which is present at all times, are univoltine (Duncan 1972). Thirty-seven larvae and pupae were collected in total, 20 from Godfreys Creek and 12 from Delatite River, and four mayflies carried empty shrouds from which, presumably, pupae had emerged.

The Hosts

The host mayflies appear to be all of the same species of *Atalophlebioides* (Figure 1), which it is possible may later become specifically identifiable by its comb-like tarsal claws and by the peculiarly thickened distal margins of two of the segments near the bases of the three tails (Figures 1, C and D). No counts of uninfected specimens were made, but it is estimated that only about 1% carried the chironomid.

Infected nymphs are all middle-sized, 3½ to 6½ mm long, whereas fully developed nymphs were 8-8½ mm long. There was good evidence that the chironomid caused stunting rather than that smaller nymphs were selected for infestation. The larvae were attached laterally to the thorax, indifferently as to side: 18 out of 41 were on the right. When wing pads were present the one nearest to the parasite was always reduced (Figures 1, A and B) and the entire development of the nymph seems to have been retarded. For instance, the uninfected nymph of which the mesonotum is shown in Figure 1, F, was the same size and, as judged by the developing male eyes, in the same instar (probably the penultimate) as the specimen shown in Figure 1, B. Also, the most fully developed infected nymph, a 6½ mm male that still carried an empty pupal shroud, seemed to be physiologically near emergence in that its better developed wing pad enclosed a folded structure; but its wings were tiny and distorted (Figure 1, E) as compared with normal specimens in late instars (Figure 1, G and H). It may also be significant that the only chironomid collected on March 29 was a pre-pupa 1·75 mm long, which is shorter than the smallest formed pupa that was collected, and it was taken on one of the two smallest infected mayflies (3½ mm). It was also the only larva collected after the end of December. One may suppose that it infested a nymph that was too small or too unhealthy for ordinary development to occur.

The parasite larvae were completely enclosed in a tough membranous shroud, as has been described for other species of *Symbiocladius* (Codreanu, 1939; Roback, 1965), and they lay alongside the nota, sometimes with the tail tucked under the wing pad as shown in Figure 1, A. The larval head was directed forward or backward, apparently indifferently (13 out of 25 were forward), but I could find no trace of lesions on the nymphs. It seems clear, however, that, as with the European species (Codreanu, 1939), the host must supply the food.

The pupae were all attached as shown in Figure 1, B, with their heads over the mayfly abdomen, and it appears from the empty shrouds that they leave by a dorsal rip. There was no relationship between the sex of the host and that of the pupal parasites; all four possible combinations were found among the 12 pupae collected.

THE PARASITE

Six specimens, two larvae and four pupae, were used for the preparation of microscope slides for comparison with the clearly closely similar Argentinian species *S. wygodzinskyi* (Roback, 1965). The mountant was Euparal.

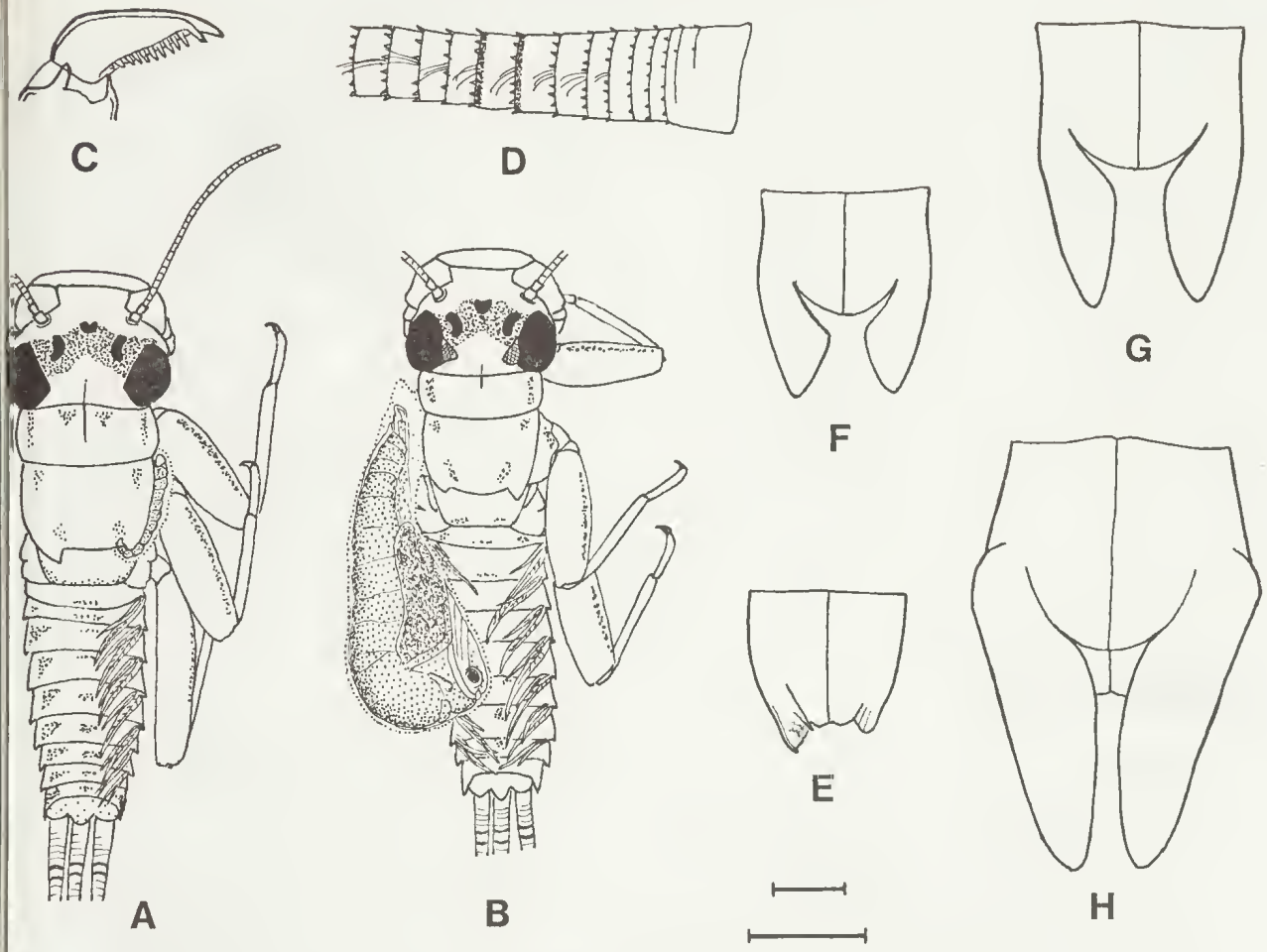

Fig. 1—A and B, Nymphs of *Atalophlebioides* with a larva and pupa of *Symbiocladius aurifodinae* (larger scale line 1 mm): C and D, claw and base of filum terminale of *Atalophlebioides* (upper scale line 0·1 mm): E-H, mesonota of *Atalophlebioides* (larger scale line 1 mm), E, an infected specimen 6½ mm long, F-H, uninfected specimens 6½, 7½ and 8¼ mm long. H, from Delatite River December 28, 1971, E, Godfreys Cr. February 25, 1972, rest from Godfreys Cr. December 28, 1971.

Genus Symbiocladius Kieffer
Subgenus Acletius Roback

1965 *Entomol. News* 76: 114-115.

The Australian material agrees in most respects with Roback's definition of *Acletius*. These include the haired eyes of the adult (Figure 2, E and H), the subequal tibial spurs (Figure 2, D), the long pectinate empodium, the three long basal spines on the claws (Figure 2, G), the latero-dorsal position of the larvae on the host (Figure 1, A), the five lateral teeth on the labial plate (Figure 3, B and E) and the two teeth on the mandibles (Figure 3, C).

There are, however, small differences. The antennae of the female have seven segments, rather than six (Figure 2, H), and the two mandibular teeth of the larva are subequal rather than being one robust and one accessory (Figure 3, C). I was unable to observe the palpal segments of the adult.

Symbiocladius (Acletius) aurifodinae sp. nov.

Male described from pupal material; 2·2 mm. Head and thorax dark brown, abdomen

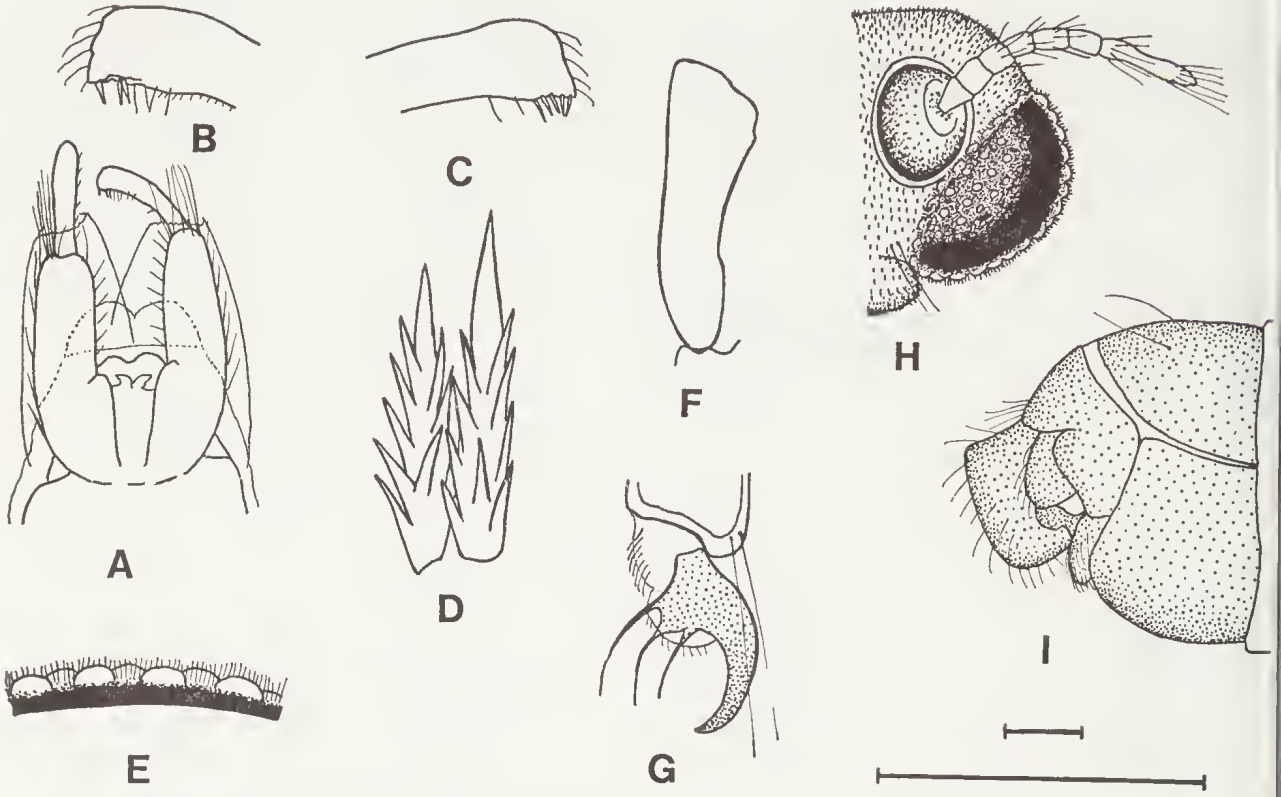

Fig. 2—*Symbiocladius aurifodinae*. A and B, D-G, holotype, H and I, allotype. A, genitalia and part of pupal skin (smaller scale line 0·1 mm): B, tip of dististyle (larger scale 0·1 mm): C, ditto of specimen from Godfreys Cr. December 28, 1971: D, tibial spurs of hind leg (smaller scale line 0·1 mm): E, optical section of eye margin (larger scale line 0·1 mm): F, pupal thoracic respiratory organ (smaller scale line 0·1 mm): G, claw of hind leg (smaller scale line 0·01 mm): H and I, head and abdominal tip of female (smaller scale line 0·1 mm).

brown with paler patches at bases of hairs. Antennae with at least 14 segments; eyes hairy, the hairs about as long as the diameter of the facets (Figure 2, E). Thorax apparently with bristles only on scutellum. Pronotum narrow and collar-like. Legs with subequal tibial spurs and with claws with three basal hairs (Figure 2, D and G); segment ratios as in Table 1. Genitalia as Figure 2, A and B, but note that the number of bristles at the tip of the dististyle is three in the type and five in the other specimen (Figure 2, C).

TABLE 1

Symbiocladius aurifodinae ratios of leg segments of type specimens (100 = 0·7 mm)

	femur	tibia	tarsal segments 1	2	3	4	5
Male							
fore	100	200	130	88	49	16	17
mid	99	146	131	34	27	16	15
hind	134	163	108	60	33	21	21
Female							
fore	161	225	171	64	37	29	29

Female described from pupal material; 3·1 mm. Similar to male, and also to *S. wygodzinskyi* Roback (Figure 2, H and I). It has, however, seven antennal segments, no ventral hair on the antennal pedicel, and it lacks the paler spots at the bases of the abdominal hairs.

Pupa, length, male 2·2 to 2·8 mm (holotype 2·2), female 2·3 to 3·8 (allotype 3·1); small respiratory trumpets present (Figure 2,

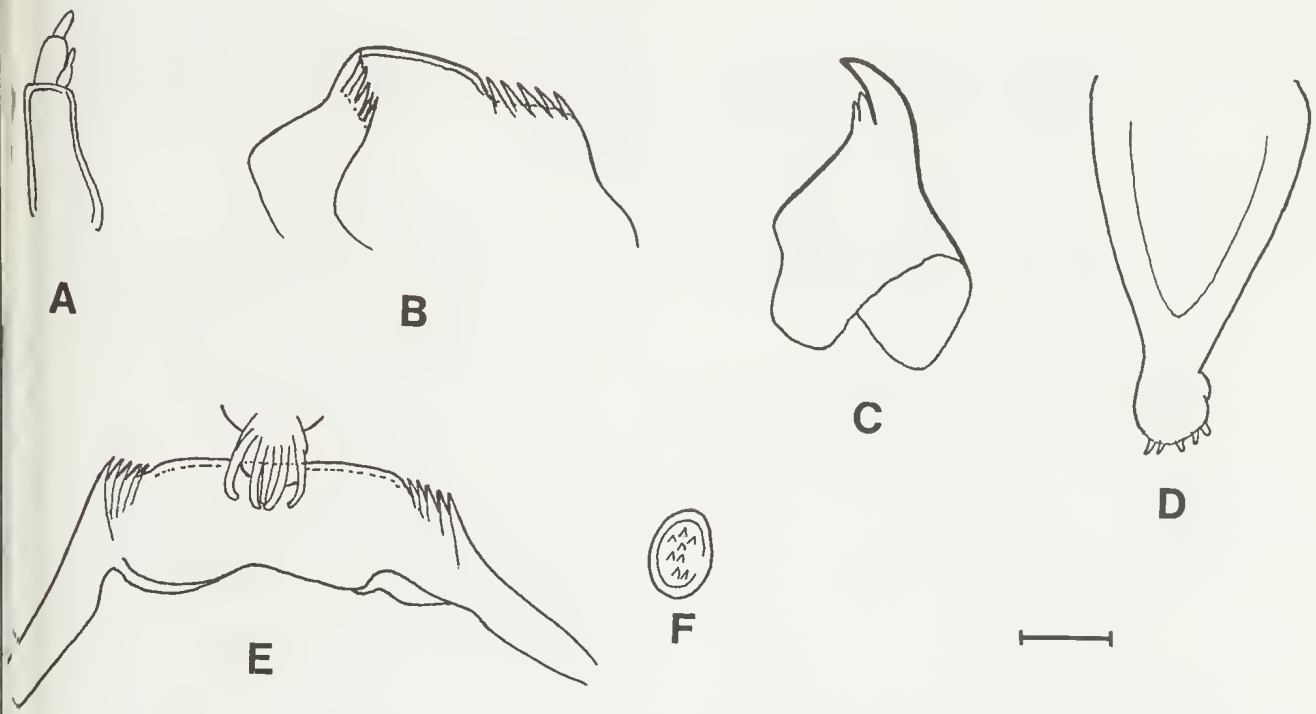

Fig. 3—*Symbiocladius aurifodinae*, larval appendages (scale line 0·01 mm): A, antenna: B, labial plate: C. mandible: D, Labrum: E, labial plate and tip of labrum: F, maxillary palp: A-D, head capsule of holotype: E and F, head capsule from a female pupa from Delatite R. December 28, 1971.

F). Cuticle thin and pale brown, without spines. In the male a small featureless tail fin (Figure 2, A); genital sacs elongate (Figure 2, A, where the tips of the sacs are missing). Note that Roback (1965) states that in *S. wygodzinskyi* the anal fins are twice the length of the genital sacs, but this does not agree with his figure. In mature female pupae, in which the abdomen is distended with eggs, the anal fin is hardly apparent.

Larva, the larvae range in length from 0·5 to 2·1 mm (two that are certainly last instar, with developing appendages, are 2·0 and 2·1 mm). Head pale yellow with a darkened hind edge; capsule widely open behind, almost a hemisphere. No eyespots. Body light brown with well formed anterior prolegs and small posterior ones; no posterior hairs or gills. Antennae small and little sclerotized; number of segments uncertain (Figure 3, A). Labial plate broad with five lightly sclerotized teeth on each side (Figures 3, B and E). Maxilla shows only a small lightly sclerotized ring with several central conical structures (Figure 3, F). Mandibles conspicuous hooks with two accessory teeth (Figure 3, C). Labrum with an apical swelling bearing about five lightly sclerotized teeth (Figures 3, D and E).

MATERIAL EXAMINED

Descriptions made mostly from the six mounted specimens.

Holotype —mature male pupa, Crown Cr., Jan. 27, 1972.

Allotype —mature female pupa, Godfreys Cr., Jan. 27, 1972.

Paratypes—male pupa and 2 last instar larvae, same data as allotype.

—head capsule of larva extracted from case of female pupa, Delatite R., Dec. 28, 1971.

Other Material

—2 larvae, 1 prepupa, 1 female pupa, Crown Cr., Nov. 24 and Dec. 28, 1971, and March 29, 1972.

—11 larvae, 2 male pupae, 2 female pupae, Godfreys Cr., Dec. 28, 1971, and Feb. 25, 1972.

—9 larvae, 3 female pupae, Delatite R., Oct. 26, Nov. 23 and Dec. 28, 1971.

All the specimens were collected by H. B. N. and M. E. Hynes. The types, paratypes and much of the other material has been presented to the National Museum of Victoria in Melbourne. Two larvae and one pupa from Delatite R., and four larvae and two pupae from Godfreys Cr. remain in the author's collection. The species is named for the goldmines which are still active around Woods Point near to which most of the specimens were collected.

Although in the absence of fully developed specimens, it is difficult to be certain, adults would probably run down to the genus *Crictopus* in Freeman's (1961) key to the Australian Orthocladiinae. The larvae and pupae are, however, very different from those of *Cricotopus*. They are also quite distinct from those of *Trissocladius*, with which the genus *Symbiocladius* has sometimes been combined, as was already pointed out by Saether (1969).

S. aurifodinae is clearly very closely related to *S. wygodzinskyi*, but there are a few differences. The male has more antennal flagellar segments, at least 14 as opposed to 13, and the bristles at the dististyle tip are pointed not ovate. The female has one more antennal segment. The pupa lacks dorsal spines and possesses a small respiratory organ. The larva has, apparently, much less robust lateral labial teeth and a wider central part to the labial plate, and its second mandibular tooth is larger. Also the tip of the labium which carries the spines is more swollen, and there seem to be no lateral spines below it such as are figured for *S. wygodzinskyi* by Roback. These seem to be very small changes after what must be many tens of millions of years of isolation of the two continents.

Acknowledgements

I have previously acknowledged the help from many people and organizations that allowed me so rewarding a sabbatical year in Australia. My principal benefactors were the University of Waterloo, Monash University, and the National Research Council of Canada. I remain in their debt.

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