The metamorphosis of *Symposiocladius lignicola* (Kieffer) n.gen., n.comb., a wood-mining Chironomidae (Diptera)

P. S. CRANSTON


The female and larva are described and the male and pupa redescribed for *Orthocladius lignicola* Kieffer. A lectotype is designated for a pupa belonging to the syntypic series. *O. tryoni* Soponis, 1977 is synonymized with *O. lignicola*. A new genus, *Symposiocladius*, is erected for the species, and a systematic placement close to *Orthocladius*, *Synorthocladius* and *Stackelbergina* is postulated. The larval habit of mining in submerged wood is discussed in relation to a brief review of previous records.

KEY WORDS: Diptera, Chironomidae, wood-mining, Holarctic.


A distinctive *Orthocladiinae* larva with a characteristic mentum has been found in several lotic sites in Britain and North America, and is believed to be conspecific with larvae from the Amur River, U.S.S.R. described as *acutilabis* by Konstantinov (1948) and from Romania as *xylophila* by Botnariuc & Cure (1956). Neither of these authors reared the larva and in view of several aberrant features both refrained from placing the species generically, thus rendering the names invalid under the International Code for Zoological Nomenclature, Article 11 g (ii).

Frequent routine invertebrate monitoring over several years in a southern English stream revealed small numbers of this larva, particularly in winter months, but it was not until April 1980 that sufficient live larvae were found in submerged wood to enable rearing to adult. Independently similar wood-mining larvae have been reared in Canada. The pupa is recognizable as that of *Orthocladius lignicola* described by Potthast (1915), although the description of the adult by Kieffer in the same publication, is inadequate for recognition. Characters in all life-history stages, particularly the larva, indicate that a new genus is required for the species, although there is a clear relationship with *Orthocladius* Wulp.

**Symposiocladius** n. gen.

*Type species:* *Orthocladius lignicola* Kieffer., here designated.

*Etymology:* From symposios (Gr.)—a collection of works by different authors on a common topic (referring to present description prior to inclusion in collaborative keys to Chironomidae) and kladios (dim. Gr.)—a small branch.

*Generic diagnosis:* *Symposiocladius* adult males closely resemble *Orthocladius* as keyed and redefined by Brundin (1956). The wing is more coarsely punctate than normal, and together with the evenly tapering, distally bare anal point, this enables separation from *Orthocladius* in the keys of Brundin (1956) and Pinder (1978). In Sæther (1977) the female will key to *Orthocladius* (subgenera *Orthocladius* or *Euorthocladius*) but differs in the virtually straight gonocoxapodeme and the shapes of both the seminal capsules and dorsomesal lobe of the genitalia.

Keys to the pupae and larvae of presently defined genera are in preparation, and these include *Symposiocladius*. The pupae are separable from *Orthocladius* only with difficulty, but in the larva the combination of simple SI seta, abdominal seta 4 developed as a setal brush, and distinctive mentum without a beard is unique in the Chironomidae.

*Generic description* (All terminology follows Sæther 1980)

**Male**

Eyes bare, verticals extending to mid-line of head. Antenna with 13 flagellomeres without
apical spine, plume well-developed. Antennal ratio about 1.5. Antepronotum collar-like with both lobes well-developed and meeting medially. Numerous acrostichals start at antepronotum; dorsocentrales erect and arising from pits; scutellars in a single row. Pulvilli absent, empiumum small, all claws terminally toothed. Tarsal pseudospurs on tarsomeres 1 and 2 of PI and tarsomere 1 of PHI. Hind tibia with comb, inner spur weakly sinuous.

Wing coarsely punctate, without microtrichia; costa extending slightly beyond Rt+5; R 2'3 terminates about 1/3 of the distance between RI and Rtl5 with few or no setae. Squama fringed, anal lobe well developed and rounded.

Hypopygium with anal point well-developed, without setae distally, and evenly tapering to a point. Inferior volsella of gonocoxite well-developed, superior volsella with numerous microtrichia, some brush-like, others stout. Gono stylus without crista dorsalis.

Female

As male, except: antenna with five flagellomeres; R 4 and R 4+5 with continuous rows of setae; tarsal claws simple. Genitalia with tergite IX clearly divided into two setigerous lobes; gonapophysis VIII divided into three lobes of which the ventrolateral lobe covers most of the other two; membrane well-developed, bases of the labia strongly sclerotized. Two seminal capsules have no strongly developed neck region; spermathecal ducts more or less straight with distal bulbs before spermathecal opening. Cerci large.

Pupa

Thoracic horn long and narrow, covered with spines. Thorax with two median and one basal antepronotal setae; three precorneal setae in a row and four dorsocentral setae; one of which is anterior to the group of three. Thorax more or less smooth along eclosion line. wing sheaths smooth. Tergite I without shagreen or spines, the remainder with a pattern of spines and/or shagreen. Sternites with shagreen on II–VII. Pedes spurii A present. B weak. No filamentous lateral setae. Anal lobe with three macrosetae, no short or filamentous setae; lobe terminates in a spinose point. Genital sac of male ends near apex of anal lobe with short apical protuberance.

Larva

Antenna 5-segmented with segments 3–4 subequal or the fourth longer than the third. Lauterborn organs well-developed, longer than segments. Blade subequal to the flagellum. All S setae of labrum simple and strong, labral lamellae absent. Pecten epipharyngis of three large strongly sclerotised scales and chaetulae laterales absent (or possibly scales of pecten epipharyngis fused to a single plate and one pair of chaetulae laterales). Premandible with a single tooth and no brush. Mandible with apical tooth shorter than the combined width of the three inner teeth; outer margin weakly crenulate, inner margin with indications of a spine in some specimens; seta subdentalis simple and small, seta interna with 6–7 weakly serrate branches. Maxilla with strongly developed sensillae and setae; appendix present; pecten galearis absent. Mentum with elongate median area and two pairs of weak, basal, outer teeth. Ventromental plates indistinct, no beard.

Anterior parapods separate and bearing apically simple and toothed claws; posterior parapods short, separate and with simple claws. Pro cerci well developed with 6–7 setae; lateral setae well developed. Anal tubules longer than posterior parapods. 1 5 seta developed as a setal brush on abdominal segments I–V, remaining setae simple.

Systematics

Although the difficulties of generic placement of the larva of 'acutilabis' and 'xylophila' are understandable, the development of the fourth lateral seta (1 5) as a setal brush on some abdominal segments is of some importance. This development is characteristic of few Orthocladiinae genera, namely Synorthocladius Thienemann, Stackelbergina Shilova & Zelentzov and above all Cricotopus (although 1 5 may be simple in a few species). In Synorthocladius the 1 5 seta may be similarly developed, and in Stackelbergina all four 1-setae are developed as setal brushes on some segments. Sether (1977) proposed that
Symposiocladius + Orthocladius was the sister group of Cricotopus and its allies, and the possible placement of Stackelbergina close to Orthocladius (Shilova & Zelentzov, 1978) implies that the development of 1, as a setal brush is restricted to this monophyletic grouping of Symposiocladius to Cricotopus. The distribution of this character state within the grouping suggests that it must be an unique inside parallelism, termed an underlying synapomorphy by Sæther (1977, 1979), within this group.

The female genitalia have proved most valuable in determining the relationships of the new genus. The division of the tergite IX into two distinct lobes, together with the size of the ventrolateral lobe of gonapophysis VII, covering all of the apodeme lobe and much of the orally rounded dorsomesal lobe, are features shared only with Orthocladius. The shape of the seminal capsules, spermathecal ducts and dorsomesal lobe are in conflict with a subgeneric placement in either Orthocladius or Euorthocladius (Sæther 1977: 93), while the virtually straight gonocoxapodeme is dissimilar to any Orthocladius examined.

The adult male and pupa also resemble Orthocladius s.str. although the distally bare, evenly tapered anal point and coarsely punctate wing is distinctive, and the weak pedes spuri B is unusual. Following the scheme of phylogenetic argumentation outlined by Sæther for Orthocladiinae (1977: 77-85), Symposiocladius is found to belong with Synorthocladius and Orthocladius as the sister group of Cricotopus and its allies, and, furthermore, to be synapomorphic for trend 58 with Orthocladius. The simple larval SI seta, I, developed as a setal brush, the weak pedes spuri B on the pupa and the straight gonocoxapodeme of the female may all be considered to be apomorphic character states in Symposiocladius relative to Orthocladius, although some of these trends may be paralleled in Synorthocladius. Unfortunately the female genitalia of Stackelbergina were not described and the exact sister group relationships in this group cannot be elaborated until the females of Stackelbergina can be examined.

It is possible that, after closer re-examination of the genera involved, the ranking of subgenera in Orthocladius (s.l.) may be altered, and with this, an alteration of the ranking of Symposiocladius, Synorthocladius and Stackelbergina.

Symposiocladius lignicola (Kieffer in Potthast, 1915) n.comb.

Fig. 1−19.


Species diagnosis: See generic diagnosis.

Description
Male imago

Description as for Orthocladius tryoni Soponis, 1977: 100, 101, tab. ZZ except in British material there are fewer acrostichals (9−20, mean 14, against 18−30, mean 24.7). For all other measurements ranges fall within those cited by Soponis and means are very similar. Figures are given for the male wing (Fig. 1), thorax (Fig. 2), tentorium, cibarial pump, stipes and maxilla (Fig. 3) and hypopygium (Fig. 4).

Female imago

(n=7, plus 4 dissected from pupae.) Body length 3.5 (2.6−4.6) mm, wing length 2.06 (1.9−2.4) mm (both n=7); Yellow-brown with dark brown vittae, postnotum and episternum; halteres brown. abdomen and legs darker brown.

Head: Antennal pedicel (measurements in µm)
The metamorphosis of *Symposiocladilus lignicola* 423

74 (58–85) wide by 47 (27–58) high; flagellomeres 74 (53–92); 44 (32–51); 51 (37–61); 51 (37–64); 150 (132–172). Antennal ratio 0.69 (0.59–0.83). Temporal setae 14 (11–20), comprising 3–6 outer verticals, 3–4 postorbitals and 4–14 inner verticals; the postorbitals and outer verticals in a single row, the inner verticals in a group extending to the midline of the head. Clypeus with 12 (6–16) setae. Palp lengths 44 (37–53); 50 (42–64); 134 (111–170); 117 (106–132); 184 (164–201). Tentorium 143 (122–169) long.

**Thorax** with 19 (13–31) acrostichals, 13 (9–16) dorsocentrals, 5 (4–7) prealars, 6 (4–8) antehumerals, 10 (6–12) scutellars. Acrostichals more or less in a single row, dorsocentrals erect and arising from distinct pits, scutellars in a single row.

**Wing** with 16 (12–21) squamal setae: 1. rarely 2, on brachiolum. 19 (14–26) on R, 16 (10–18) on R); 30 (23–38) on R. Venarum ratio 1.23 (1.1–1.3).

**Legs** (n=7):

<table>
<thead>
<tr>
<th>T_h</th>
<th>T_h</th>
<th>T_h</th>
<th>T_h</th>
<th>BR</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_1</td>
<td>759 (672–903)</td>
<td>931 (819–1134)</td>
<td>631 (525–756)</td>
<td>409 (367–483)</td>
</tr>
<tr>
<td>P_2</td>
<td>796 (682–945)</td>
<td>811 (703–966)</td>
<td>384 (325–462)</td>
<td>232 (201–262)</td>
</tr>
<tr>
<td>P_3</td>
<td>816 (714–966)</td>
<td>957 (840–1102)</td>
<td>543 (493–651)</td>
<td>306 (262–367)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T_h</th>
<th>T_h</th>
<th>T_h</th>
<th>T_h</th>
<th>BV</th>
<th>SV</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_1</td>
<td>300 (262–315)</td>
<td>201 (168–241)</td>
<td>114 (95–136)</td>
<td>2.1 (1.8–2.7)</td>
<td></td>
</tr>
<tr>
<td>P_2</td>
<td>186 (157–220)</td>
<td>121 (105–157)</td>
<td>103 (84–115)</td>
<td>1.9 (1.3–2.5)</td>
<td></td>
</tr>
<tr>
<td>P_3</td>
<td>249 (220–294)</td>
<td>156 (136–189)</td>
<td>111 (94–136)</td>
<td>2.3 (1.4–3.7)</td>
<td></td>
</tr>
</tbody>
</table>

| P_1 | 0.68 (0.64–0.69) | 2.27 (2.25–2.37) | 2.68 (2.62–2.84) |
| P_2 | 0.48 (0.46–0.49) | 3.10 (2.97–3.18) | 4.19 (4.06–4.26) |
| P_3 | 0.57 (0.54–0.59) | 2.82 (2.76–2.86) | 3.27 (3.15–3.35) |

**Genitalia** (Figs. 5–9). Cerci 140 (111–175) long, by 57 (26–80) wide. Gonocoxite IX well-developed and bearing 2–4 long setae and 3–6 shorter setae.

Gonapophysis VIII divided into three lobes, the ventrolateral lobe (Fig. 9a) covering all of the apodeme lobe (Fig. 9c) and most of the dorsomesal lobe (Fig. 9b). The apodeme lobe is well sclerotised and the dorsomesal lobe has an oral rounded projection. Gonocoecapodeme VIII virtually straight, or with weak median bend. Membrane around vagina well-developed although weakly sclerotised: labia strongly sclerotised towards the point of fusion posterior to the spermathecal eminence (Fig. 8). Two more or less pear shaped seminal capsules (Fig. 7), 95 (84–111) long by 68 (60–75) wide, without microtrichia, with apical 2/3 to 3/4 darkened and without well-developed neck. Spermathecal ducts range from virtually straight to moderately convoluted, with separate openings after distinct bulbs: ducts with distal hairlike structures. Notum 138 (117–159).

**Pupa** (n=11)

Total length 4.6 (4.0–5.8) mm, variably but weakly sclerotized.

**Cephalothorax**: Thoracic horn (Fig. 11) covered in spinules. 258 (190–349) long. Longest (posterior) precalcarial seta 165 (106–220) long. Suture weakly rugulose. Two median, one lateral antehumeral setae, three precorals and four dorsocentrals, the anteriormost separated from the posterior group of three. Wings without pearl row and with a smooth margin.

**Abdomen** (Fig. 10). Pedes spurii A present on sternites IV–VI, weak pedes spurii B may be present on segment II. The row of recurved spines on the posterior margin of tergite II convoluted, with separate openings after distinct bulbs: ducts with distal hairlike structures. Notum 138 (117–159).

extends for 1/3 of the tergite width and comprises 1-3 rows of hooks. Posterior (intersegmental) crescent shaped band of spines on III-V variably developed, broader in the female pupae examined. Remaining tergital spine and shagreen pattern as in Fig. 10. Sternites I and VIII without shagreen. II and III with weak shagreen in anterior half, IV with median shagreen, V and VII with posterior band. Anal lobe 340 (304-367) long, with spinose points extending beyond basal insertion of three anal macrosetae of maximum length 299 (262-336) (Fig. 12). In several specimens there is a tendency for one or two of the macrosetae to be singly or multiply branched.
Larva (n=16, except where stated)

Body length 5–6.5 mm (n=5), head capsule 569 (530–650) μm, yellow-brown with occipital margin scarcely darkened and mentum and mandible nearly black.

Antenna (Fig. 13). Five segmented; lengths 40 (32–48); 9 (7–11); 7 (5–10); 8 (7–11); 5 (4–6). Antennal ratio 1.38 (1.19–1.75). Antennal blade 36 (27–43), sometimes overreaching the flagellum; subsidiary blade 8 (5–9) long, inserted subapically on segment 2. Ring organ 7 (5–8) from base of antennal segment 1. Lauterborn organs very distinct, extending to mid-point of segment 4, and with striations distinct. On the dorsolateral side of the head capsule, external to the base of the antenna is a heavily sclerotised extension of the head capsule.

Labrum and dorsal surface of head capsule (Figs. 14, 15). All S setae simple. SI arising from distinct tubercles, 34 (32–43) long. SII 33 (28–37) long, SIII 32 (29–34) long and with a median bend, SIVa and b present. Two simple labral chaetae present. Pecten epipharyngis either of three broad scales, or one median fused scale and one pair of chaetulae laterales. No chaetulae basales visible. Premandible 100 (90–108) long with one apical tooth and a broad inner tooth, without a brush.

Mandible (Fig. 16). 171 (148–191) long. Seta subdentalis 11 (9–16) long; seta interna with 6 or 7 finely serrate branches. Outer margin with weak crenulations, inner margin weakly sclerotised and sometimes with a few weak spines.

Mentum (Fig. 17). 147 (138–159) wide at base of outer teeth on flattened mentum.

Maxilla (Fig. 19). Sensillae and setae on palpiger well developed, with few lamellae on palpiger base. Few weakly developed lamellae on galea. Maxillary setae well-developed and simple. A long but weak appendix is present. Pecten galear is absent.

Abdomen (n=5). Supra-anal seta 80 (53–100) long. Posterior parapods 138 (127–148) long with dark brown simple claws. Anterior parapods with yellow-brown claws; all but the shortest claws with internal serrations. Anal tubules 170 (160–180) long, without constrictions. Lateral seta 1₄ developed as a setal brush (Fig. 18) on abdominal segments I–VI, up to 160 μm long. Remaining body setae simple and short.

Additional material examined


Variation

There are some differences between British reared specimens and those from Canada. The 8–14 inner vertical setae in a group in British females is considerably higher than the 4–6 in a single row in Canadian females. In the pupae the weak pedes spurii B are more distinct in Canadian specimens. However no differences have been found between Nearctic and British larvae. If, as appears possible, Symposiocladus lignicola is distributed throughout regions of temperature, perhaps only deciduous, forests of the northern hemisphere, the Canadian and British adults may represent the extremes of a continuous cline. For this reason, and because of the absence of material from the vast areas of the Soviet Union to study patterns in variation, it is
The metamorphosis of Symposiocladus lignicola
unwise to ascribe specific status to the two groups examined.

**Distribution**

*S. lignicola* is known as an adult from Britain, West Germany, Finland and Sweden in Europe, and in addition larvae have been described and figured from Romania and the U.S.S.R. (Amur River). In North America there are records from Canada (Manitoba, Quebec, British Columbia and Yukon) and the U.S.A. (Alabama, Alaska, California, Florida, Maryland, Minnesota, New Hampshire, New York State, Oregon, Pennsylvania, Virginia & Wisconsin). Additional records from larvae include South Carolina, Georgia and Tennessee (Suponis, pers. comm.).

**Ecology**

*S. lignicola* (as *xylophila*) larvae were found by Botnariuc & Cure (1956) in immersed wood in a backwater of the River Sebesului in Romania and, although a few larvae have been taken in benthic samples and drift nets, the greatest numbers have been found in submerged wood. In Crowborough Warren stream (southern England) larvae were found in submerged alder (*Alnus glutinosa*) and hazel (*Corylus avellaria*), while Borkent (pers. comm.) found larvae in *Acer* (Quebec) and in *Alnus* (British Columbia). Physico-chemical parameters of the stream in Crowborough Warren, measured between February 1977 and October 1978 are: depth 0.02–1.60 m, velocity 0–0.3 m/s, discharge 0.0004–0.04 m³/s; pH 5.4–6.5 (mean 6.1); stream temperature 6–16°C; soluble iron 0.005 p.p.m. – 0.17 p.p.m.; total iron 0.17 p.p.m. – 0.63 p.p.m.; calcium 47–50 p.p.m.; nitrate/nitrite variable. The benthos is clay with sandstone boulders and gravel, and there is a small sewage works 400 m upstream from the site.

Borkent found the larvae in branches firmly lodged against the shore of a 3 feet deep stream. He also confirms that the larvae are only found in chambers in the outer wood layer, in branches of no more than 6 cm in diameter and without a bark layer. Larvae have only been found in firm wood, not in water logged branches.

Larval gut contents from all British localities contained numerous wood fibres, and larvae kept in the laboratory were observed to ingest wood particles. It is not clear however if fungi or bacteria associated with the decomposition of immersed rotting wood are the source of nutrition, or if there is a symbiotic gut fauna responsible for the degradation of cellulose.

Borkent observed the larvae to cut a ragged flap at the end of the larval chamber, a flap through which the pupa emerged. Where the pupal exuvium remained partially in the chamber the dorsal side was always in contact with the wood and the ventral surface pointing away from the wood. The pupal exuvium remained in the wood only when emergence took place from a tube above the water line.

Mining in leaves of aquatic plants is a well documented phenomenon (e.g. Gripekoven 1914; Wesenberg-Lund 1943; Thienemann 1954) but burrowing in wood is less frequently recorded. Gripekoven (1914) mentions the worn mental teeth of *Tendipes* (now *Glyptotendipes*) *gripekoveni* (Kieffer) in larvae found in hard wood, while Burtt (1940) found *Glyptotendipes glaucus* (Meigen) (= *pallens* (Meigen)) mining occasionally in rotting submerged timber. The most frequently recorded genus mining in submerged wood, *Stenochironomus*, has several species apparently restricted to this substrate (Borkent pers. comm.).

In the newly formed Lake Kariba (Zimbabwe) McLachlan (1970) found many species of *Chironominae* to be associated with submerged trees, although it is not clear how many of these species were miners. Zvereva (1950) described five larval species associated with submerged wood substrates in the genera *Smittiia*, *Brillia*, *Psectrocladius*, *Glyptotendipes* (possibly belonging to *Polypedilum*). Again most of these larvae appear to be adventitious and not mining in the wood.

In Crowborough Warren stream the following larvae were found either on the surface, or in the space below loose bark on submerged branches: *Brillia modesta* (Meigen), *Brillia longifurca* (Kieffer), *Metriocephalus cfr hygropetricus* (Kieffer), *Polypedilum pedestre* (Meigen), *Polypedilum* sp., *Thienemanninitia* sp. Tubes of *Microspectra notescens* (Walker) were found on the surface and beneath loose bark, particularly where the wood was anchored in slow flowing areas. None of these species made mines, although in an adjacent stream undetermined *Stenochironomus* larvae were mining in similar...
wood to that used by S. lignicola, which was absent at the site.

It is evident from this brief review that mining by larval Chironomidae is not a widespread phenomenon, although the use of submerged wood as a substrate is common.

Soponis (1977: 103) citing pupal exuvial evidence from Coffman (1973) as well as her own data, suggests that S. lignicola (as O. tryoni) is bivoltine, with emergence in spring to summer and again in September. The evidence presented here does not contradict this view.

Acknowledgements: I am very grateful to A. Borkent (Biosyst. Res. Inst., Ottawa, Canada) for the loan of reared material and for permission to cite his ecological observations. I also wish to thank Dr. D. R. Oliver of the same Institution and Dr. F. Reiss, Zoologische Staatsammlung, Munich, for the loan of type material. I have also borrowed larval material from Drs. D. R. Oliver, D. Morris, L. C. V. Pinder and A. R. Soponis, and I particularly wish to thank Ms J. Francis for the loan of specimens, assistance with field work and provision of physico-chemical data on Crowborough Warren stream, one of a number of research streams in the Ashdown Forest area of East Sussex. Discussions with my colleagues at symposia in Dublin and Bergen have proved valuable in the production of this paper.

References


Manuscript received July 1980.
Revised October 1980.


Journal and subscription to reprints of particular groups to be ordered from: Publishing House of the Swedish Research Councils, P.O. Box 6710, S-113 85 Stockholm, Sweden