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on a Symbiotic Chironomid**
(Ephemeroptera : Leptophlebiidae)

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Tucson, Arizona

Rustler Park, altitude 8,000 to 9,000 feet on the east side of the Chiricahua mountains of Arizona is the type locality of the adults of *Thraulodes speciosus* Traver. Near there, at an altitude of 5,400 feet at the Southwestern Research Station of the American Museum of Natural History in Cochise County, five miles west of Portal, Arizona, the nymphs of this species were found in abundance and reared as follows: one female imago, 25 June 1960; one male and one female imago, 10 July 1960; two female subimagos, 26 July 1960. They were the most common mayfly nymph in the region.

THRAULODES SPECIOSUS Traver
(Figs. 1-17, 19-25)

NYMPH (fig. 1).—Length: body 8-9 mm; caudal filaments 15-16 mm. General color brown on dorsal surface. *Head*: color brown mottled with dark brown; midline pale; epicranial suture white; ocelli white with wide black crescent at base; area between medial ocellus and lateral ocelli dark brown; dark brown around bases of antennae; first two segments brown, other segments pale yellow basally, brown distally. Antennae twice as long as width of head. *Mouthparts* (figs. 2-5, 7, 11). Labrum and mandibles prominent from dorsal view. Maxillae with dense, thick brush of bright rust hairs (fig. 11); ventromedially with row of about 14 large, toothed spines, inner margin with long, single row of pale hairs; labrum (fig. 7) with apical margin slightly emarginate, with 5 small crenulations. *Thorax*: pronotum brown with variable pattern of dark brown streaks; posterior border pale yellow with pale area extending anteriorly at midline; pale areas along anterior and lateral borders; anterior border slopes rearward laterally; short hairs along anterior lateral borders. Intersegmental areas of thorax pale yellow. Mesonotum dark brown, darker than pronotum, mottled with lighter brown laterally; long, pale yellow, prominent U-shaped mark at midline (fig. 1); midline pale. Scutellum yellow between wing pads; suture between scutum and scutellum marked with wide dark reddish-brown streak extending on either side of midline laterally and anteriorly to base of each wing pad; large yellow spot on base of each wing pad with black spot at lateral posterior corner; hind wing pads on metanotum covered by forewing pads. Thoracic pleuron sclerites dark brown, some with black borders; unsclerotized areas yellow. Legs paler than body, with fringe of fine, long pale hairs along postero-lateral margins of coxae, and along outer margins of femora and tibiae; femora and tibiae with heavy, reddish-brown spines among marginal hairs; coxae dark brown with small black patch basally and black along posterolateral margin; trochanters brown, paler than coxae; femur I with a gray to black spot dorso-

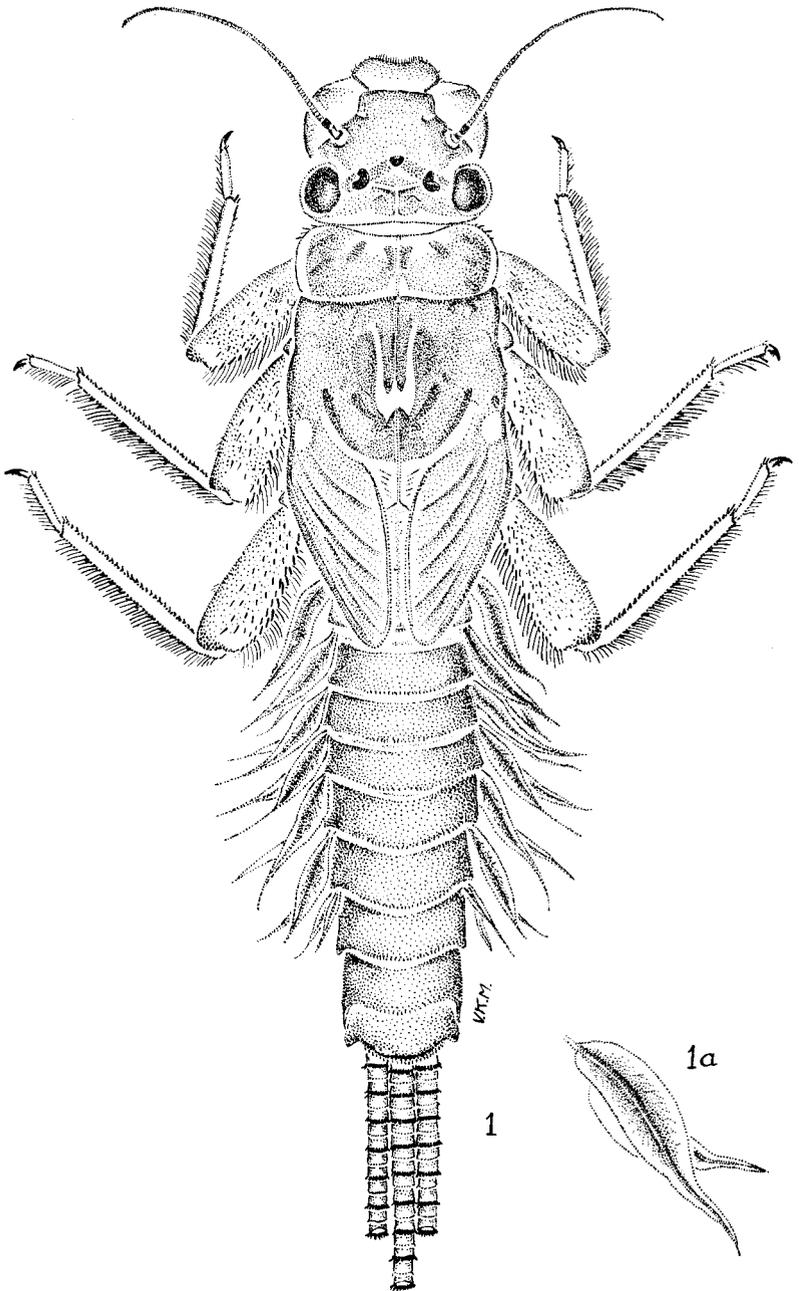
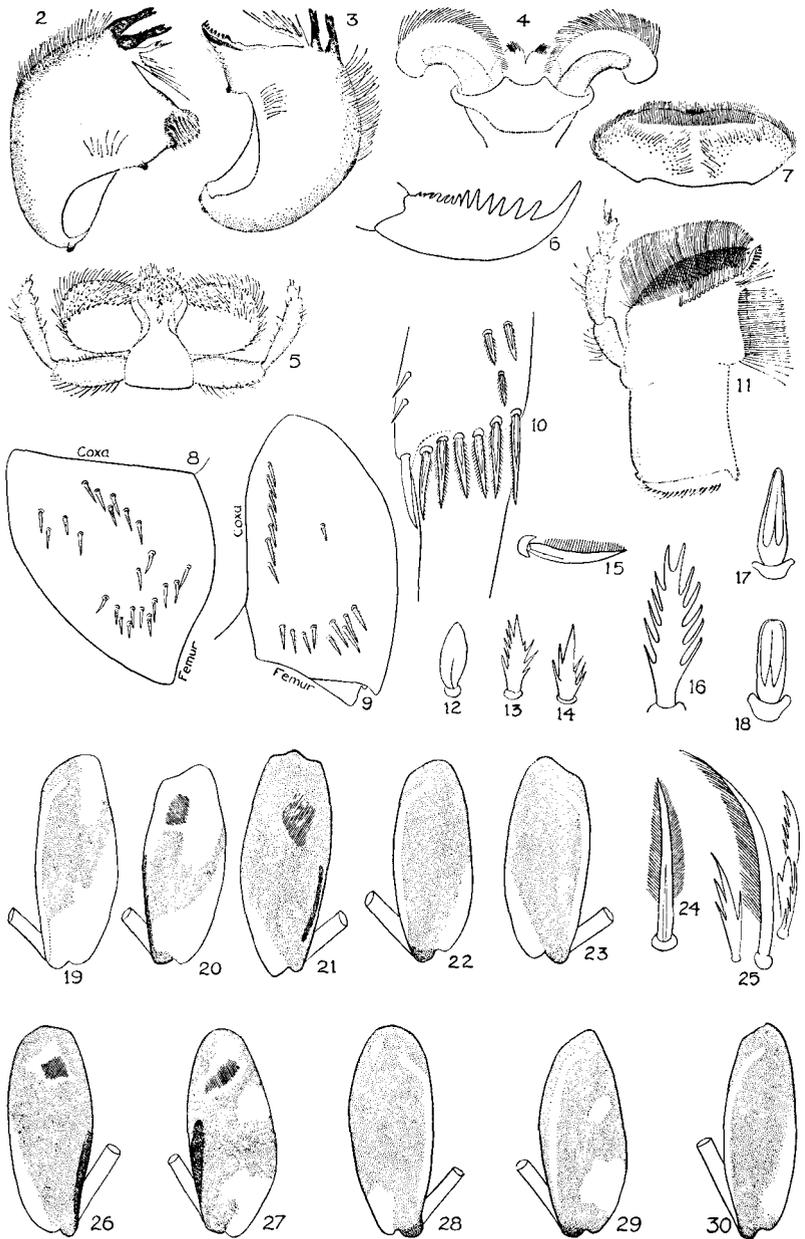


FIG. 1. *Thraulodes speciosus* Traver, female nymph. FIG. 1a. Gill.

medially near base (figs. 20, 21); some specimens with light brown area medially with yellow area anterior and posterior to this spot, other specimens with light brown area over entire femur except for pale strip along posteriorapical border; femora II and III lacking black spot near base, with yellow strip along anterior border extending medially near base, and yellow area along posterior border as in femur I (figs. 19, 22, 23); some specimens with two more extensive yellow areas separated by light brown medially; specimens with more extensive brown areas most common; pale areas variable from side to side on some nymph; tibia I yellow with black band apically, narrowly margined with reddish-brown; tibiae II and III yellow, narrowly penciled with reddish-brown dorsobasally; all tarsi pale to dark brown except for pale yellow basal one-fifth, narrowly margined with reddish brown at base; denticles and tips of all claws reddish-brown. *Spines on legs*: dorsal surface of trochanters with three groups of grooved spines (figs. 8, 9): longitudinal row on side that attaches to femur, oblique row parallel to posterior margin that attaches to coxa, and a group near dorsal margin; all grooved spines probably pinnate; trochanter I with from 6-10 spines in longitudinal row, from 7-8 in oblique row and from 0-4 in group near dorsal margin; trochanter II with from 4-9 in longitudinal row, from 4-7 in oblique row, and from 1-4 in dorsal margin group (figs. 8, 9); trochanter III with from 4-8 in longitudinal row, 0-1 in oblique row, 0-1 in dorsal margin group. All femora with short, grooved fairly blunt-tipped spines (fig. 17) irregularly spaced over dorsal surface, except femur I with spineless area near base; outer border with long spines among hairs, some spines slightly narrowed near tip, spine tips widened and somewhat spoon-shaped or spatulate, some long spines appear sharper at tips, not spatulate; femur I with fewer spines along outer border than femora II and III, with single row of pinnate spines on dorsobasal one-third near outer border, some specimens show these among hairs; without spines on ventral surface; ventral surfaces of femora II and III, between midline and inner border with small comb-like pinnate spines slightly curved with spinelets on inner side only (fig. 15) occurring in irregular rows about 3-5 deep, all spines curved and pointed uniformly. Tibiae and tarsi, leg I: tibia with 3-4 irregular rows of many coarsely pinnate spines crowded together (fig. 16) along entire inner border, with even row of long pinnate spines (fig. 24) dorsoposteriorly, apical inner corner of tibia with cluster of both types of spines with pinnate spines longer than border spines and curved inward (fig. 25); ventral surface of tarsus near midline with 5-7 short pinnate spines and one coarsely pinnate spine; ventral apical margin of tarsus with blade-like spine (fig. 12), claw with 6-7 large denticles and 4-5 minute basal ones (as in fig. 6); tibiae and tarsi leg II: tibia with one long pinnate spine on ventral apical margin and eight smaller pinnate spines along midline; tarsus with three nonpinnate spines; claws with seven large denticles and six minute basal ones; (one specimen tibia with one long and one short pinnate spine on apical margin near inner border); four pinnate spines along midline, seven nonpinnate spines along inner border; tarsus with blade-like spine (fig. 12) on apical border and five additional small nonpinnate spines; tibiae and tarsi, leg III: tibia with five to seven pinnate spines across ventral apical margin (fig. 10), thirteen specimens with five spines across, two with six, and one with seven, one long nonpinnate sturdy spine in same row at one end, one specimen with twenty eight long pinnate spines along two-thirds of shaft from near midline to outer border on one specimen, not in rows, but irregular;

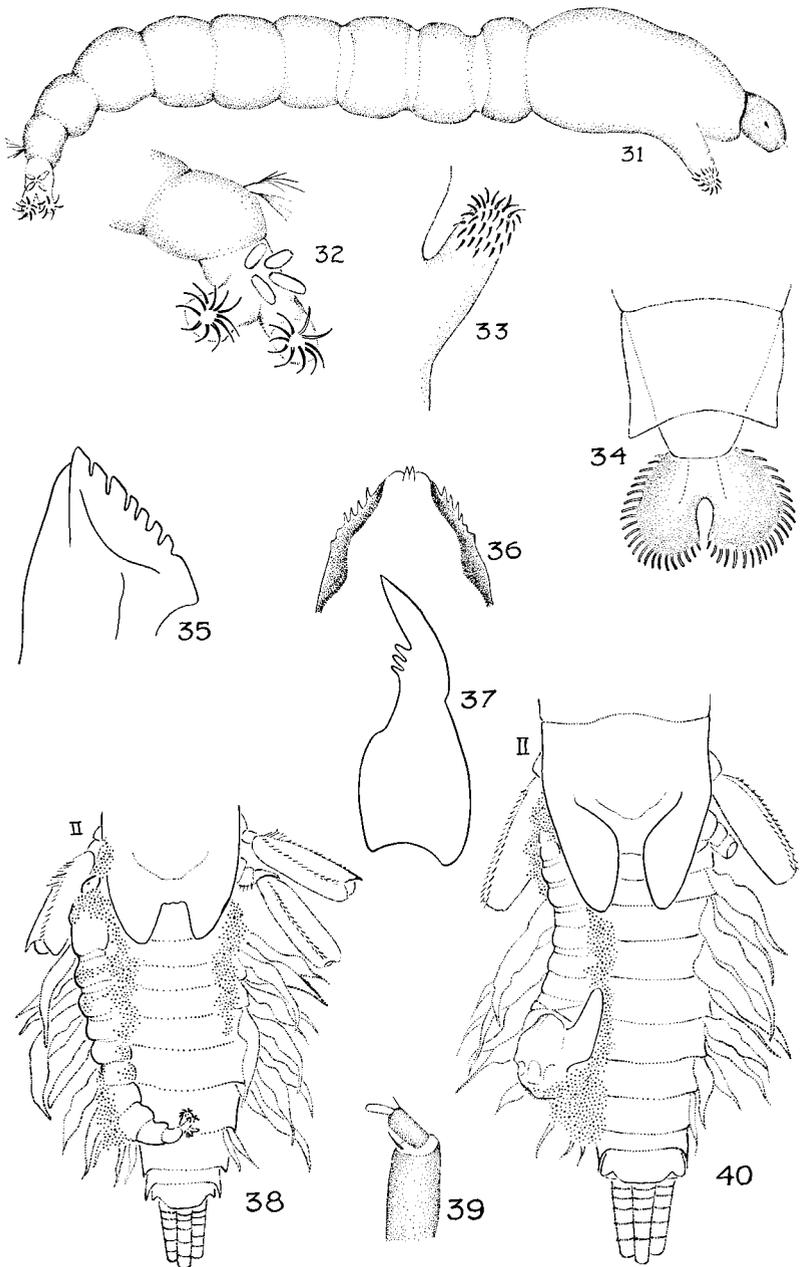


FIGS. 2-17. *Thraulodes speciosus*. FIG. 2. Left mandible. FIG. 3. Right mandible. FIG. 4. Hypopharynx. FIG. 5. Labium. FIG. 6. Claw from leg III. FIG. 7. Labrum. FIG. 8. Trochanter, leg I. FIG. 9. Trochanter, leg II. FIG. 10. Ventral

eighteen specimens with from thirteen to thirty pinnate spines along two-thirds of shaft, tarsus with five small nonpinnate spines and one long blade-like spine at apical ventral border (fig. 12); claws with average of seven large denticles and six minute ones nearer base; of twenty seven specimens: four with five denticles, eight with six, eleven with seven, four with eight, all with three to seven minute denticles near base. *Abdomen*: few specimens with abdominal tergite 1 yellow to pale brown, some specimens with tergites 1-3 yellow to pale brown; most specimens with tergites brown except for tergites 4-5 and 9; tergites 4-5 of most specimens with variable yellow triangular area at midline, with base of triangle along posterior border, in some specimens with pale areas on either side of midline, and absent from a few specimens; tergite 9 with yellow area at midline; tergite 10 narrowly yellow along anterior margin, rimmed with black along posterior border. Some specimens with dark brown spots near base of gills on tergites 1-7; pale streak under gills extending from posterior margin to two-thirds distance to anterior margin, very close to medial side of gill attachment. Minute spines present on posterior borders of abdominal tergites; intersegmental areas pale with diffuse, transverse, penciled streaks. Posterolateral spines on tergites 2-9, those on 2-8 small; spine projects rearward laterally on tergite 9, length equal to depth of tergum at midline. Gills double, lanceolate, widest on segments 1 and 2, decreasing in size rearward with edges white; main tracheae dark gray with delicate branches obscured by the gray pigmentation (fig. 1a). Ventral surface of body pale yellow. Ganglia on cervix, one on prosternum, two on mesosternum and one on abdominal sternite 7 prominent dark gray, other ganglia on abdomen faint, on some specimens not apparent. Mesosternum lateroposteriorly with wide, light brown longitudinal streaks. Abdominal sternites 2-8 laterally with light brown streaks about midway between anterior and posterior borders, slightly diagonal to pleural fold (apparent on most specimens). Caudal filaments predominantly light brown, with dark brown on alternate segments basally, every fourth segment medially, with apical third entirely light brown; spines on posterior border of each segment in basal half; apically with fine white hairs in place of spines; terminal filament more stout than cerci.

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apical margin tibia, leg III. FIG. 11. Maxilla. FIG. 12. Blade-like spine on tarsus, leg I. FIG. 13. Coarsely pinnate spine on tarsus, leg I. FIG. 14. Coarsely pinnate spine on tarsus, leg I. FIG. 15. Comb-like spine on ventral surface femora II, III. FIG. 16. Coarsely pinnate spine on leg I. FIG. 17. Spine on dorsal surface femur. FIG. 18. Oak Creek Canyon specimen, spine on dorsal surface femur. FIGS. 19-25. *Thraulodes speciosus*. FIG. 19. Pattern on dorsal surface femur, leg II. FIG. 20. Pattern on dorsal surface femur, leg I from same specimen as fig. 19. FIG. 21. Pattern on dorsal surface femur, leg I showing variation from fig. 20. FIG. 22. Pattern on dorsal surface femur, leg III. FIG. 23. Pattern on dorsal surface femur, leg II. FIG. 24. Pinnate spine on ventral surface tibia, leg III. FIG. 25. Group of pinnate spines on tibia I. FIGS. 26-30. Oak Creek Canyon specimens. FIG. 26. Pattern on dorsal surface femur I. FIG. 27. Pattern on dorsal surface femur I showing variation from fig. 26. FIG. 28. Pattern on dorsal surface femur leg II, left side. FIG. 29. Pattern on dorsal surface femur leg II right side same specimen as fig. 28. FIG. 30. Pattern on dorsal surface femur leg III.



FIGS. 31-40. *Symbiocladius* sp. FIG. 31. Larva. FIG. 32. Caudal end, larva. FIG. 33. Anterior proleg larva. FIG. 34. Caudal end, pupa. FIG. 35. Lateral view

VARIATIONS.—In male pale yellow of posterior border of head extends anteriorly between dark red turbinate eyes; area between anterior border of eyes dark brown; in female area between eyes mottled with brown near midline.

The description of the nymph was based on 220 nymphs taken by V. K. Mayo 4 June 1959, 25 and 26 June 1960, 9 and 10 July 1960, and 10 September 1960 from a stream that runs through the American Museum Research Station near Portal, Arizona; in entomological collection University of Utah, Salt Lake City, and 6 nymphs in collection of Jay R. Traver, Amherst, Mass.

Nymphs which were taken at Oak Creek Canyon near Sedona, Coconino County, Arizona 23 June, 1951 were tentatively described by Traver (1967) as belonging to the species *Thraulodes arizonicus* McDunnough. These are very similar to the nymphs of *T. speciosus* and the following are the differences between the two series. The only difference between the spines of the two series seems to be between the small grooved spines on dorsal surfaces of femora. The tips of these spines on Oak Creek Canyon specimens (fig. 18) are more blunt than those of *T. speciosus* (fig. 17) and are nearly as wide as the base and slightly flattened across the end. On femur II of two specimens of *T. speciosus*, one blunt tipped spine like those on Oak Creek Canyon specimens was found and on Oak Creek Canyon specimens there was an occasional spine more pointed, somewhat resembling those on *T. speciosus*. There seem to be more spatulate spines among hairs on the outer margin of Oak Creek Canyon specimens than on *T. speciosus*. The color pattern of abdominal terga differs with more yellow on Oak Creek Canyon specimens: tergite 7 with faint yellow area close to posterior margin at midline; tergite 8 with yellow area at posterior margin extending midway to anterior margin, with a narrow brown streak along midline. Tergites of *T. speciosus* 7–8 are brown. Laterally on either side of the gill attachment, abdominal terga of Oak Creek Canyon specimens are yellow; *T. speciosus* has only a pale streak under the gill. Posterior margins of tergites 7–10 of Oak Creek Canyon specimens are narrowly rimmed with dark brown; only tergite 10 of *T. speciosus* is rimmed with black posteriorly. Caudal filaments of Oak Creek Canyon specimens dark brown; those of *T. speciosus* are yellowish-brown.

A symbiotic relationship was found between a large number of nymphs of *T. speciosus* and a chironomid larva belonging to the genus

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labial plate of larva. FIG. 36. Labial plate of larva, dorsal view. FIG. 37. Mandible, larva. FIG. 38. Larva on nymph of *Thraulodes speciosus*. FIG. 39. Antenna, larva. FIG. 40. Pupa on nymph of *T. speciosus*.

Symbiocladius Kieffer (Kieffer, 1925). The chironomid larvae and some pupae were found attached along the sides of the abdominal tergum of the nymphs of *T. speciosus*, medial to the bases of the gills. A few specimens had two larvae attached, one on either side. On one nymph a larva was found attached along the abdominal sternum ventral to the bases of the gills. In some cases the chironomid larvae had prevented the gills from developing and some nymphs were found on which the gills were atrophied on one side. The larvae and pupae are encased in a yellowish granular membrane, and where this is attached to the nymph there is a deposit of silt; figs. 38, 40 show the larva and pupa on the abdomen of the nymph, the coarse stippling representing the silt. In fig. 38, a large larva is shown attached to an immature nymph: head lies along side of wing pad between second and third legs; a thick crumpled deposit with silt extends beyond head and is firmly attached along side of wing pad close to second coxa; the silt is cemented down side of tergum; caudal end of larva has broken out of case and is slightly raised. The drawings were made from specimens that had been in alcohol for some time and parts of membranous cases had been broken. On the same specimen there is evidence that a second larva had been attached to the right side where part of the membrane with silt is deposited near the bases of the gills on tergites 1-5. The specimen was collected at the Southwestern Research Station on 9 July 1960. Chironomid larvae were found attached to 9 additional nymphs.

Following are descriptions of pupae in relationship to nymphs: in fig. 40 a pupa is shown attached to the left side with head rearward; caudal end is between second and third coxae and a thick membranous deposit with silt extends along side of wing pad nearly to second coxa; there is a deposit of silt along the tergum with a thickened deposit extending beyond head to middle of ninth tergite; head of pupa lies on posterior border of seventh tergite; head has broken away from tergum and appears in fig. 40 to be on gills but is not attached to them. The specimen was collected on 26 June 1960. On another nymph a chironomid pupa adheres by posterior end to side of wing pad near second coxa; rest of pupa is extended out laterally from tergum of nymph; head extends to middle of seventh tergite over to one side above gills. One specimen broken away from nymph collected 26 June 1960; ventral surface of head and thorax not covered by membrane which covers caudal end and tergum up to third segment where it is broken away; membrane covers thoracic tergum; extends beyond head with crumpled area and much silt for a length equal to length of head and thorax combined. Same yellowish granular membrane as on larvae; ventrally

the membrane covers head capsule of larva of which the two halves are flattened out on fourth abdominal sternite with tips bearing claws of prolegs lying in center on unsclerotized area between fourth and fifth sternites; membrane does not seem to cover the abdominal sternites below fourth segment but envelopes caudal end.

A pupa in an early stage of development was collected 26 June 1960; entirely encased in a colorless membrane except for head of larva which is still free; there is no silt in membrane but a small patch on one side of caudal end where it had probably attached to nymph. Nymph on which pupa had been attached with evidence of larvae having been on both sides. Pupa with wings and legs developed in early stage; abdomen widened out. Claws of anterior and posterior prolegs are in membrane covering pupa.

There is no hole in chitin of nymphs. The larvae have apparently not fed on nymphs and are therefore not parasitic, but symbiotic. Pennack (1953 : 650) states that "*Symbiocladius* and some species of *Spaniotoma* are commensals on mayfly and stonefly nymphs." The term symbiotic is preferred in this paper. Other examples of symbiotic relationships between chironomid larvae and mayfly nymphs are cited by Johannsen (1937) as follows: larvae of *Spaniotoma* sp. E. group *Epoieocladius* Zavrel were found clinging to the legs and gills of an ephemerid nymph, *Hexagenia recurvata*. The larva of a European species, *Spaniotoma ephemerae* has been described as living in symbiotic relation with *Ephemera vulgata*. *Spaneotoma (Dactylocladius) brevipalpis* (Goetg.) of Europe has been found living under wing covers of mayflies. Another symbiotic relationship is mentioned by Claassen (1922) in which the larvae and pupae are carried under the wing pads of mayfly nymphs belonging to the genus *Rhithrogena*.

Traver sent to the writer a *Thraulodes* nymph collected by F. Plauermann from Rio Jacutinga, Brazil, April 1962. This had a chironomid pupa attached to the abdominal tergum. After being preserved in alcohol the pupa dropped off, but it was evident that it had been attached on the right side adjacent to the midline. It appears to have been cemented to the abdomen with traces of cement still adhering to tergites 1-9. This does not resemble the silt deposited on the tergites of *T. speciosus* where the larvae and pupae had been attached; neither does it correspond in position on the abdomen to that of the larvae and pupae on *T. speciosus*. The pupa does not appear to be encased in a membrane, but a small amount of fine silt remains on head.

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