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THE GENUS *TROGLOSIRO* AND THE NEW FAMILY TROGLOSIRONIDAE (OPILIONES, CYPHOPHTHALMI)

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ABSTRACT. The cyphophthalmid genus *Troglosiro* Juberthie, known only from New Caledonia, is made the type of a monobasic new family Troglosironidae, the plesiomorphic sister group of [Pettalidae + Sironidae]. Five new species, *raveni*, *juberthei*, *ninqua*, *tillierorum* and *platnicki*, are described.

Juberthie (1979) described *Troglosiro* as a new genus of cyphophthalmid based on the single species *Troglosiro aelleni* Juberthie, from d'Adio Cave (also known as Grotte de Ninrin-Reu) on the island of New Caledonia. Despite its generic name and the characterization of the species as "cave-dwelling" in the paper's title, *T. aelleni* has no detectable morphological adaptations for a troglobitic existance. Juberthie (1979, 1989) and Shear (1980, 1985) were unable to place the genus in the classification of cyphophthalmids but agreed that it was related to the clade Sironidae + Pettalidae, and while zoogeographically allied to the latter, had more characters in common with the former. In addition, *T. aelleni* has at least three autapomorphies: some of the male abdominal sterna have small, median exocrine gland orifices, the apical setae of the penis are greatly enlarged and basally fused, and the movable fingers of the penis are very large, roughened, and have fimbriate outer margins.

Recent collecting for soil animals on New Caledonia by A. and S. Tillier, and by Norman Platnick and Robert Raven, resulted in the discovery of five new species sharing these apomorphies. Study of this new material has convinced me that *Troglosiro* constitutes the sister-group of Sironidae + Pettalidae, and thus should be placed in its own family, named and diagnosed below.

I am grateful to Drs. Platnick and Tillier for allowing me to study their material, and to Dr. B. Hauser, Natural History Museum, Geneva, Switzerland, for the loan of type material of *Trogolosiro aelleni*. All primary types have been deposited in the Musée National d'Histoire Naturelle (MNHN), Paris. Secondary types, where available, have been deposited in the American Museum of Natural History (AMNH), New York.

Specimens were observed, measured, and drawn using a dissecting microscope. The right chelicera, pedipalp, first and fourth legs, and penis were then mounted in glycerine on a microscope slide and examined with a compound microscope outfitted with Nomarski Interference Contrast optics, and measured with an ocular micrometer. All measurements are in millimeters; in the descriptions, measurements of appendage segments are given in order from basal to distal (beginning with trochanter for pedipalps, femora for legs), lengths first, separated from widths by a diagonal stroke. Length/Width ratios, if significant, follow in parentheses.

Family Troglosironidae, new

Diagnosis.—Distinct from all other cyphophthalmids in the following combination of characters. Penis with apical setae enlarged and fused, movable fingers of penis enlarged and with dentate/fimbriate lateral margins (Figs. 15, 16, 24–28, 43), and sterna of males with 2–4 median exocrine gland pores (Fig. 30).

Type genus.—*Troglosiro* Juberthie 1979, by present designation and monotypy.

Distribution.—New Caledonia.

Remarks.—The new family is named because the genus it contains cannot be placed in any of the existing monophyletic families of cyphophthalmids, and because an integration of the characters of its type genus into the cladistic analysis by Shear (1980) causes it to appear in the cladogram as the sister group of the two families Pettalidae and Sironidae, thus indicating at least a family-level rank for the taxon. The new family is supported by the autapomorphies given in the diagnosis.

Genus *Troglosiro* Juberthie

Troglosiro Juberthie, 1979:222; type species *T. aelleni* Juberthie.

Description.—Coxae 1, 2 free, 3, 4 fused. Eyes absent. Ozophores type 2. Chelicerae (Figs. 2, 10, 18, 31) robust, basal article with (Fig. 18) or without (Fig. 10) dorsal crest. Cheliceral fingers with regular or irregular teeth (Figs. 18, 38). Abdominal sternites 8 and 9, and tergite 9 fused as corona analis. Tarsus 4 entire. Tarsal claws 1, 3, 4 smooth, 2 toothed (Fig. 34). Male secondary sexual modifications: adenostyle lamellar, not curved, acute-triangular, at base of tarsus 4 (Figs. 5, 6, 37, 42). Sternites with 2, 3, or 4 small, median exocrine gland pores (Fig. 30) variously located; anteriormost pore often bilaterally paired; sternites sometimes deeply depressed in midline. Anal opercula of males unmodified, anal glands absent, tergite 9 not modified. Penis (Figs. 7, 8, 15, 16, 24–28, 43) distinctive, with four apical setae fused in pairs and their bases much thickened, movable fingers enlarged, middle pair of dorsal setae sometimes reduced or absent.

Key to Species

1a. Dorsum with a distinct color pattern of black and brown (Fig.1); males with 4 sternal pores ..... ***raveni***, n. sp.
1b. Dorsum uniformly colored ..... 2.
2a. Body length about 2.5 mm ..... 3.
2b. Body length about 2.0 mm, usually less ..... 4.
3a. Males with 4 sternal pores; penis (Fig.16) with 4 ventral setae, their bases contiguous . ***tillierorum***, n. sp.
3b. Males with 2 sternal pores; penis (Fig. 26) with 2 ventral setae, their bases widely separated ..... *aelleni* Juberthie.
4a. Body length about 1.75 mm; males with 2 sternal pores (a third pore present in a minority of specimens from one locale), sternites deeply depressed; penis (Fig. 24) with 1 ventral seta, median dorsal setae (Fig. 25) as large as other dorsal setae ..... ***juberthiei***, n. sp.
4b. Body length 2–2.15 mm; males with 3 sternal pores, sternites deeply depressed (Fig. 30) or not, penis with more than 1 ventral seta, median dorsal setae reduced in size or absent ..... 5.
5a. Male sternites deeply depressed (Fig. 30); penis (Fig. 28) with 6 dorsal setae, the median pair reduced ..... ***platnicki***, n. sp.
5b. Male sternites not depressed; penis (Fig. 43) with 4 dorsal setae, the median pair absent ... ***ninqua***, n. sp.

Troglosiro raveni, new species
Figs. 1–8

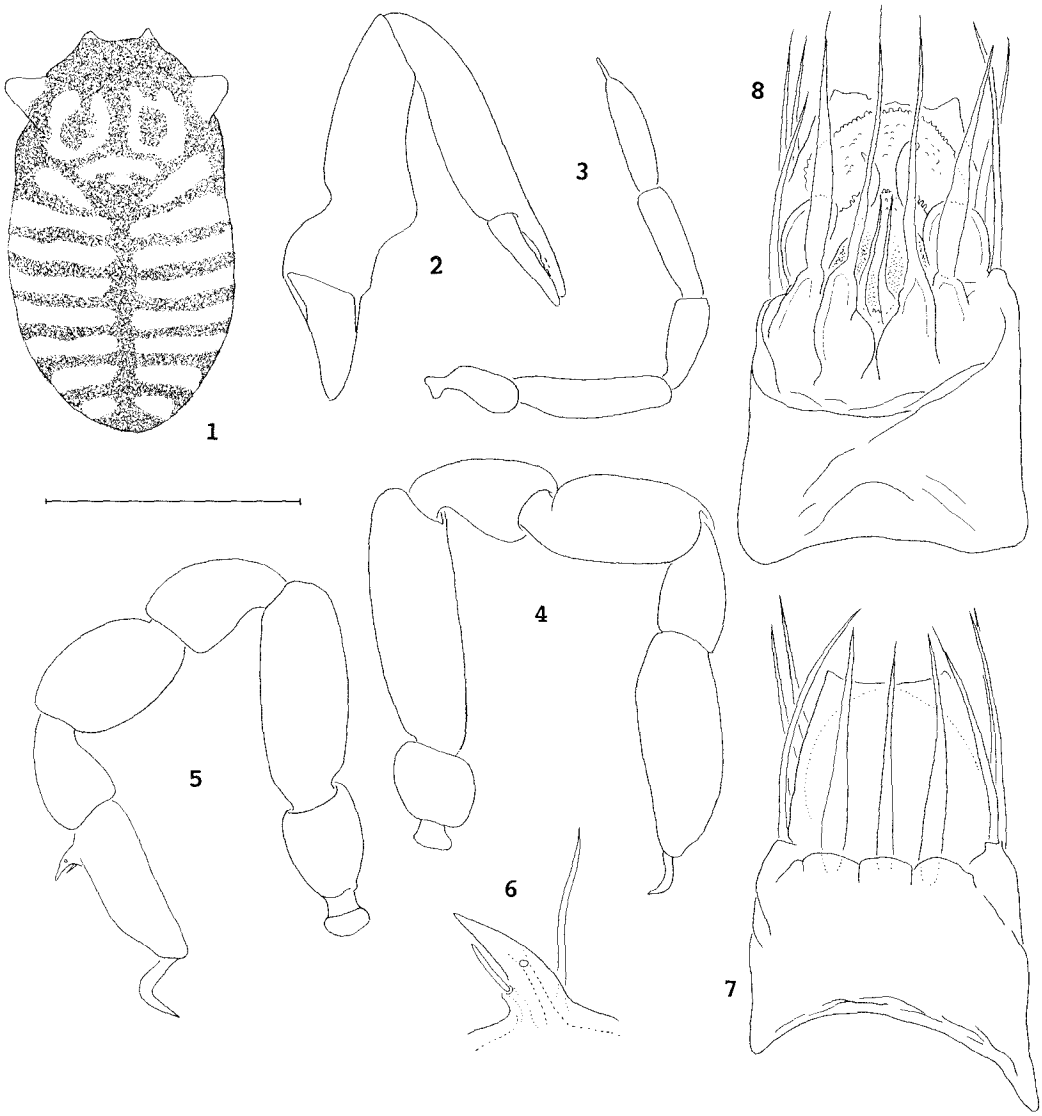
Type data.—Holotype male and paratype female (MNHN) from Berlese sample of dry forest litter, Col des Rousettes, 490 m elevation, New Caledonia, collected 29 May 1987 by Robert Raven and Norman Platnick.

Etymology.—The name honors one of the collectors, a noted Australian arachnologist.

Distribution.—Known only from the type locality.

Diagnosis.—Distinct from its congeners in the color pattern.

Description.—*Male:* Total length 2.03, width across ozophores 1.13, greatest width (gW) 1.2, L/gW = 1.69. Body (Fig. 1) generally egg-shaped, widest at posterior part of cephalothorax. Dorsum shining, with pebbled microsculpture. Ozophores close to cephalothorax margin, directed laterally. Cephalothoracic sulcus indistinct; abdominal sulci scarcely visible. Posterior end of body evenly rounded. Abdominal sternites with 4 gland pores in midline; anteriormost in posterior margin of sternite 2+3, appears as pair of pores at high magnification; following 3 pores single, at anterior margins of sternites 4, 5, 6. Pebbled ornamentation absent from sternal midline, sterna not depressed. First cheliceral segment (Fig. 2) 0.83 long, 0.19 wide, low dorsal crest present. Second cheliceral segment 0.71 long, 0.14 wide, straight, evenly tapered, fixed finger 0.23 long, 32% length of second cheliceral segment. Cheliceral teeth regular. Palpal segments (Fig. 3) 0.21, 0.33/0.08 (4.13), 0.22, 0.26/0.08 (3.25), 0.26. Legs robust, with heavily pebbled ornamentation. Leg 1 (Fig. 4) segments 0.55/0.19 (2.9), 0.34/0.17, 0.32/0.19 (1.68), 0.14/0.23, 0.49/0.18. Leg 4 (Fig. 5) segments 0.45/0.19 (2.37), 0.31/0.19, 0.32/0.21 (1.52), 0.26/0.16, 0.38/0.14. Adenostyle (Fig.6) slightly curved, acutely tri-

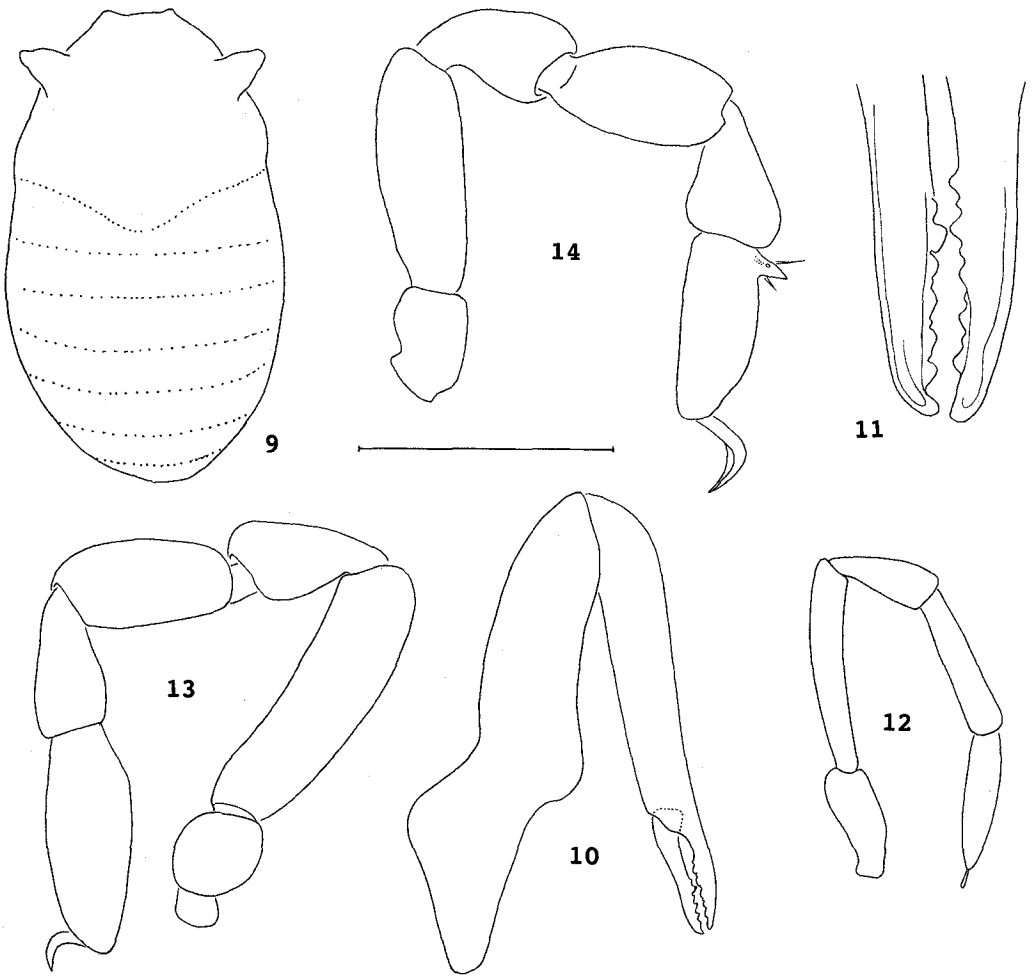


Figures 1–8.—***Troglosiro raveni***, new species, male: 1, dorsum; 2, chelicera; 3, pedipalp; 4, first leg; 5, fourth leg; 6, adenostyle; 7, penis, ventral view, tip of ventral plate broken off; 8, penis, dorsal view, tip of ventral plate broken off. Scale line: 1.5 mm for 1; 0.6 mm for 2–5; 0.3 mm for 6; 0.15 mm for 7, 8.

angular. Penis in ventral view (Fig.7) with three ventral setae; in dorsal view (Fig.8) with three lateral setae on each side and three pairs of dorsal setae, median dorsal setae much reduced, lateral two bladelike. Apical setae broken off in holotype (and only) male, probably typical for genus. Gonopore structures: ventral plate large, with toothed semicircular margin; movable fingers with very large basal lobes, fingers with toothed lateral margins; gonopore lip with fine teeth. Color pattern as illustated (Fig. 1).

Female: Total length, 2.00 mm. Closely resembling male in all nonsexual characters.

Remarks.—Though the characteristic large apical setae are broken off in the only male, they were clearly present at one time, and the other characters of this species argue for its inclusion in *Troglosiro*. Color patterns are rare in cyphophthalmids; usually the dorsum is evenly colored black to light yellowish tan, with differences in surface texture marking segmental limits. Often the legs are a lighter color than the dorsum, or



Figures 9–13.—***Troglosiro tillierorum***, new species, male: 9, dorsum; 10, chelicera; 11, cheliceral teeth; 12, pedipalp; 13, first leg; 14, fourth leg. Scale line: 1.5 mm for 9; 0.6 mm for 10, 12, 13, 14; 0.15 for 11.

have light-colored distal segments. Forster (1948), however, described several species of the New Zealand genus *Rakaia* Forster with distinctive color patterns not unlike that of *Troglosiro raveni*. All the known species of *Rakaia* lack sternal glands in the males and have very well-developed modifications of the anal plate and posterior tergites.

Troglosiro tillierorum, new species
Figs. 9-16

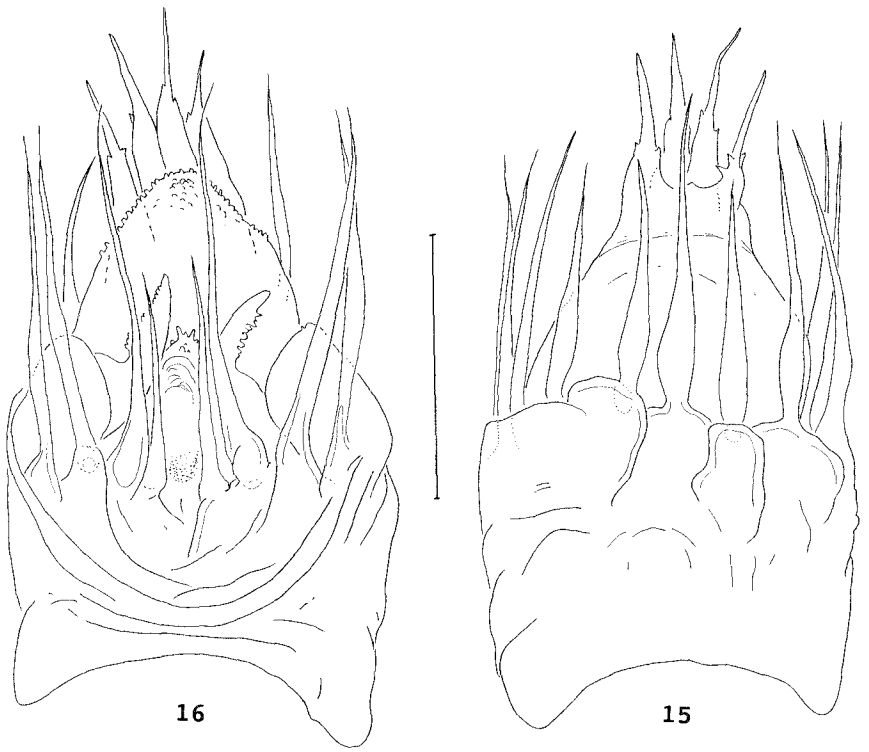
Type data.—Holotype male (MNHN) from Berlese sample from humid forest, Bobeitio (Tillier station 16a; 165°01′01″E, 20°57′13″S), 350 m elevation, New Caledonia, collected 17 November 1988 by A. and S. Tillier.

Etymology.—The name honors the collectors, diligent students of the New Caledonian fauna.

Distribution.—Known only from the type locality.

Diagnosis.—Closest in size and appendage proportions to *T. aelleni*, but with 4, rather than 2, ventral penial setae, and 4, rather than 2, sternal pores. Distinct from the other species of the genus in its larger size.

Description.—*Male:* Total length 2.5, width across ozophores 1.33, greatest width (gW) 1.33, L/gW = 1.88. Body (Fig. 9) generally egg-shaped, widest at posterior part of cephalothorax. Dorsum shining, with pebbled microsculpture. Ozophores close to cephalothorax margin, directed laterally, slightly constricted apically. Cephalothoracic sulcus distinct; abdominal sulci less so. Posterior end of body evenly rounded. Abdominal sternites with 4 gland pores in midline; anteriormost in posterior margin of sternite 2+3,



Figures 15, 16.—***Troglosiro tillierorum***, new species, male: 15, penis, ventral view; 16, penis, dorsal view. Scale line: 0.15 mm.

second near midlength of sternite 4, third near midlength of sternite 5, fourth in sulcus between sternites 6 and 7. Pebbled ornamentation absent from sternal midline, sterna not depressed. First cheliceral segment (Fig. 10) 1.08 long, 0.21 wide, dorsal crest absent. Second cheliceral segment 0.99 long, 0.13 wide, straight, evenly tapered, fixed finger 0.21 long, 21% length of second cheliceral segment. Cheliceral teeth (Fig. 11) somewhat irregular, perhaps due to wear. Palpal segments (Fig. 12) 0.26, 0.48/0.07 (6.8), 0.26, 0.32/0.07 (4.5), 0.30. Legs robust, with heavily pebbled ornamentation. Leg 1 (Fig. 13) segments 0.63/0.19 (3.1), 0.37/0.18, 0.40/0.19 (2.1), 0.32/0.17, 0.48/0.19. Leg 4 (Fig. 14) segments 0.53/0.19 (2.8), 0.37/0.20, 0.34/0.20 (1.7), 0.31/0.21, 0.41/0.17. Adenostyle not curved, acutely triangular. Penis in ventral view (Fig. 15) with 4 ventral setae; in dorsal view (Fig. 16) with 3 lateral setae on each side and 6 dorsal setae, median dorsal setae much reduced. Apical setae typical for genus. Gonopore structures: ventral plate large, with toothed semicircular margin; movable fingers with very large, laterally protruding basal lobes, fingers with toothed lateral margins; gonopore lip with small, blunt teeth.

Female: not collected.

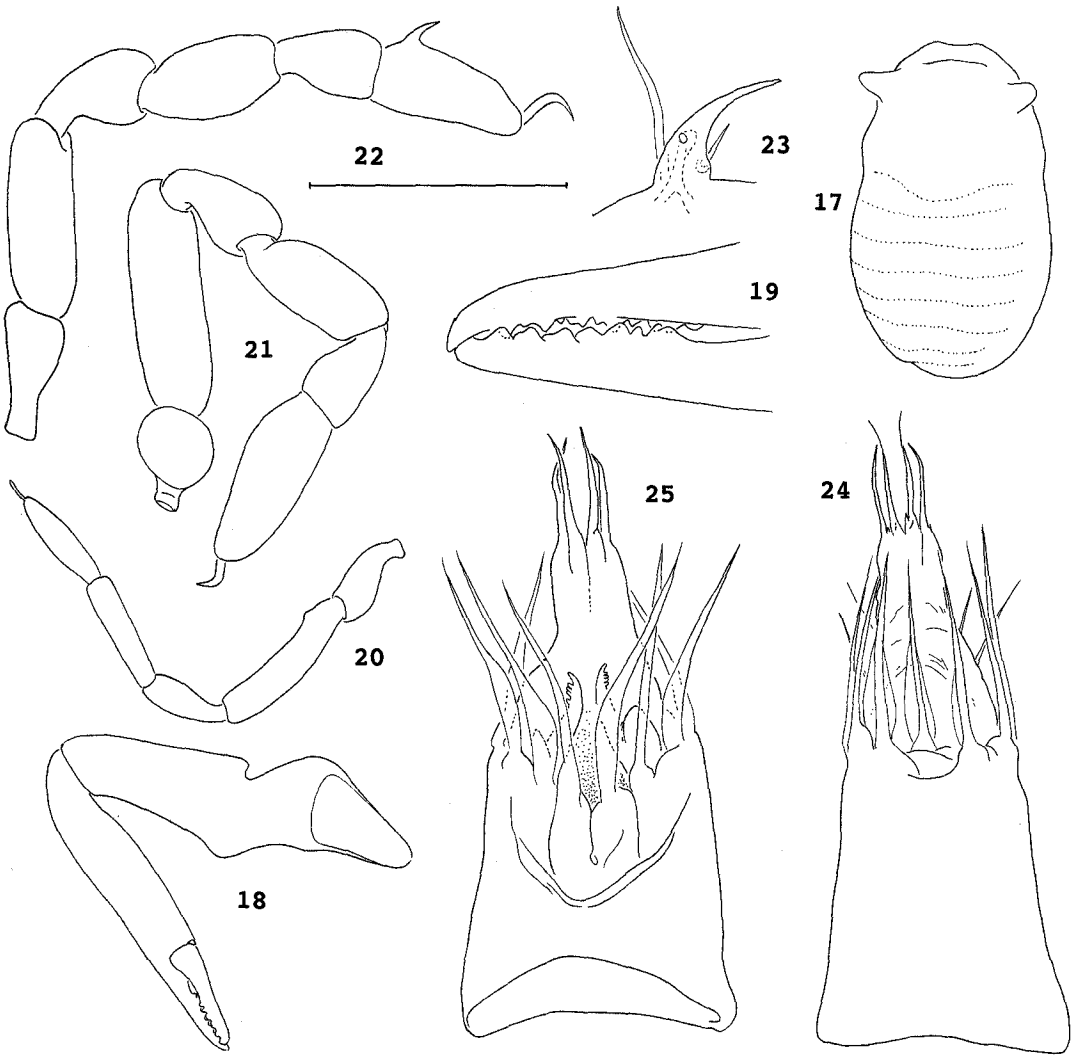
Remarks.—This species is nearly identical in size and appendage measurements to the type specimen of *T. aelleni*, but the penis and the sternal pores are quite different. With only the single male of *T. tillierorum* available, and only two males of *T. aelleni* known, it is difficult to assess the range of variation in either population. However, previous experience in other genera suggests that differences of this magnitude constitute species distinctions.

Troglosiro aelleni Juberthie
Fig. 26

Troglosiro aelleni Juberthie, 1979:222 (male holotype and male paratype from Grotte d'Adio (Ninrin-Reu), near Poya, Mt. Adio, 200 m altitude, collected by Aellen and Strinati, 2 April 1977; in Muséum d'Histoire naturelle de Genève, Switzerland, examined).

I examined the holotype slides and specimens and found Juberthie's 1979 description entirely accurate. Juberthie did not illustrate a ventral view of the penis, supplied here as Fig. 26. There are 2 ventral setae.

Surprisingly, no additional specimens of this species turned up in the Tillier and Platnick-



Figures 17–25.—***Troglosiro juberthiei***, new species, male: 17, dorsum; 18, chelicera; 19, cheliceral teeth; 20, pedipalp; 21, first leg; 22, fourth leg; 23, adenostyle; 24, penis, ventral view; 25, penis, dorsal view. Scale line: 1.5 mm for 17; 0.6 mm for 18, 20-22; 0.3 mm for 23; 0.15 mm for 19, 14, 25.

Raven collections. It is possible that the species is limited to the cave at the type locality.

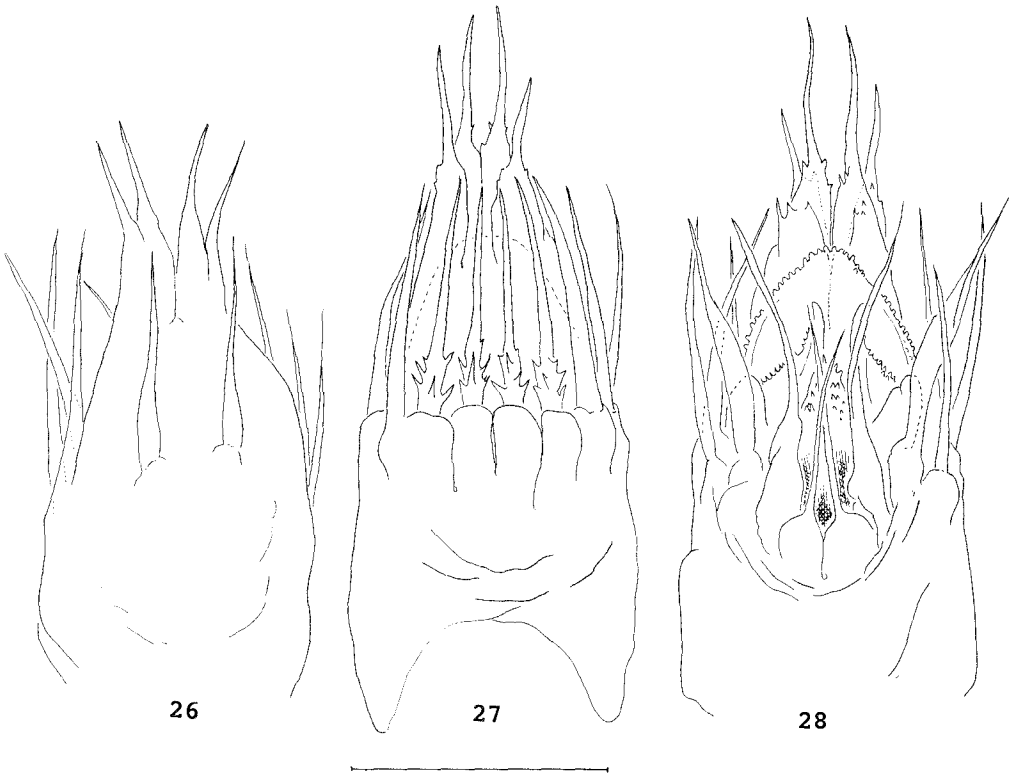
Troglosiro juberthiei, new species
Figs. 17–25

Type data.—Holotype male, paratype female (MNHN) and six additional male and one additonal female paratypes (AMNH) from Berlese sample of montane forest litter, Riviere Bleue, 280 m elevation, collected 21 May 1987, by N. I. Platnick and R. J. Raven.

Etymology.—The name honors Dr. C. Juberthie, Laboratoire souterrain du C. N. R. S., Moulis, St. Girons, France, who described the genus *Troglosiro*, and who has contributed more than anyone else to our understanding of cyphophthalmid Opiliones.

Distribution.—In addition to the type locality: NEW CALEDONIA: Plot VI I, Station 250 d, Riviere Bleue (166°39′16″E, 22°06′13″S), moist forest Berlese, 4 December 1986, A. and S. Tillier, 1 male.

Diagnosis.—Closest in size and appendage proportions to *T. platnicki* and *T. ninqua*, but with 1, rather than 3 or 4, ventral penial setae, and usually with 2, rather than 3, sternal pores. The median dorsal penial setae are of normal



Figures 26–28.—Penes.–26, *Troglosiro aelleni* Juberthie, ventral view; 27, 28, ***Troglosiro platnicki***, new species: 27, ventral view; 28, dorsal view. Scale line: 0.15 mm.

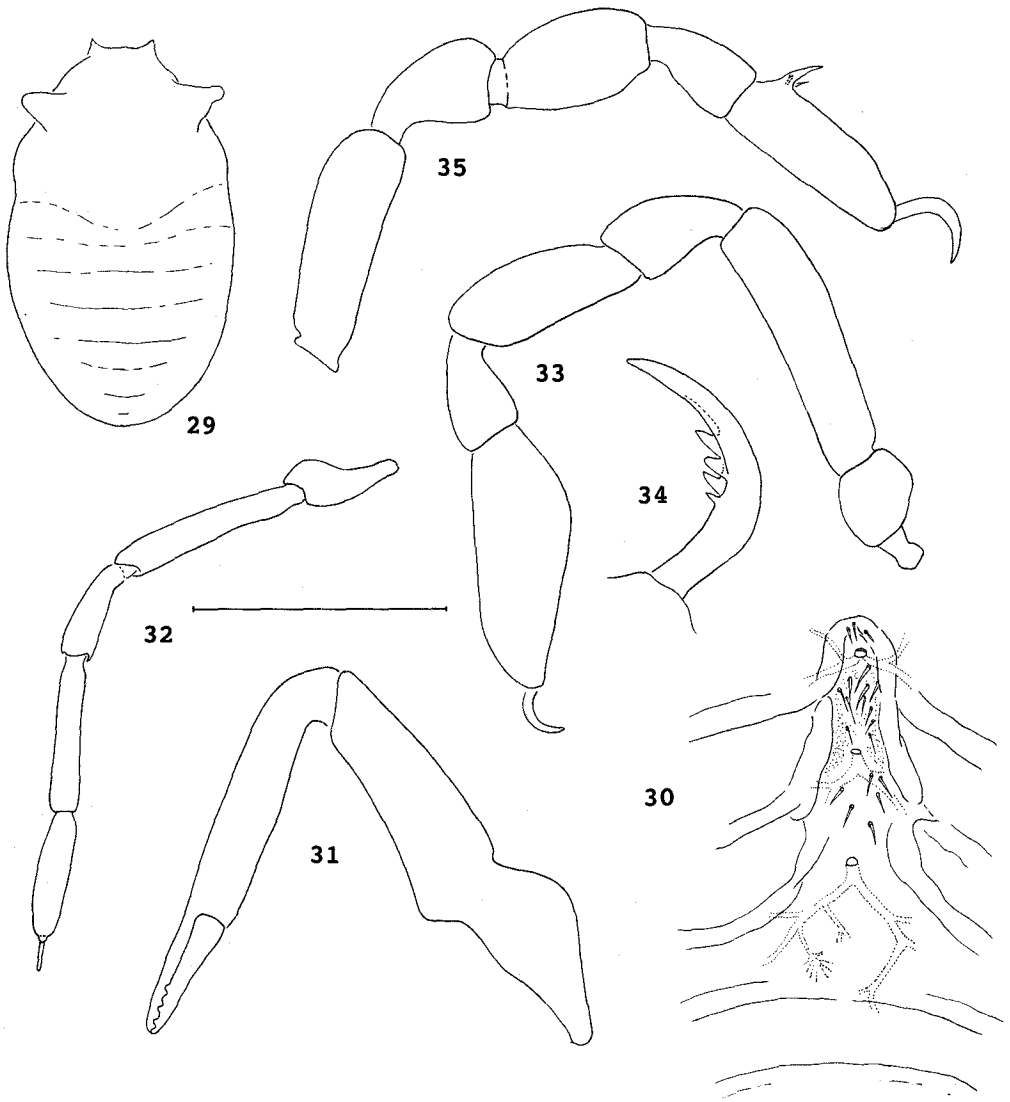
size, rather than reduced. Distinct from the other species of the genus in its smaller size.

Description.—*Male:* Total length 1.77, width across ozophores 1.00, greatest width (gW) 1.10, L/gW = 1.61. Body (Fig. 17) generally egg-shaped, widest at posterior part of cephalothorax. Dorsum shining, with pebbled microsculpture. Ozophores close to cephalothorax margin, directed laterally, slightly constricted apically. Cephalothoracic sulcus rather indistinct; abdominal sulci even less so. Posterior end of body evenly rounded. Abdominal sternites with 2 gland pores in midline; anteriormost in posterior margin of sternite 2+3, second near midlength of sternite 4; in two of seven males from the type series a third near midlength of sternite 5. Pebbled ornamentation absent from sternal midline, sterna 4 and 5 depressed. First cheliceral segment (Fig. 18) 0.82 long, 0.18 wide, with pronounced dorsal crest. Second cheliceral segment 0.75 long, 0.12 wide, straight, scarcely tapered, fixed finger 0.24 long, 32% length of second cheliceral segment. Cheliceral teeth (Fig. 19) irregular. Palpal segments (Fig. 20) 0.22, 0.36/0.07 (5.14), 0.19, 0.25/0.06 (4.2), 0.23. Legs robust, with heavily pebbled ornamentation. Leg 1 (Fig. 21) segments 0.50/0.16 (3.1), 0.28/0.15, 0.30/0.15 (2.0), 0.24/0.13, 0.40/0.17. Leg 4 (Fig. 22) segments 0.40/0.15 (2.7), 0.29/0.17, 0.28/0.17 (1.65), 0.23/0.15, 0.34/0.15. Adenostyle (Fig. 23) curved, acuminate. Penis in ventral view (Fig. 24) with 1 ventral setae, 3 lateral setae on each side; in dorsal view (Fig. 25) with 6 dorsal setae, median dorsal setae not reduced. Apical setae somewhat more gracile than typical for genus. Gonopore structures: ventral plate large, with toothed semicircular margin; movable fingers with very large, laterally protruding basal lobes, fingers with toothed lateral margins; gonopore lip with small, blunt teeth.

Female: Slightly larger (length of paratype 1.83), otherwise similar to male in nonsexual characters.

Troglosiro platnicki, new species
Figs. 27–35

Type data.—Holotype male (MNHN) from Berlese sample from humid forest, Riviere Bleue



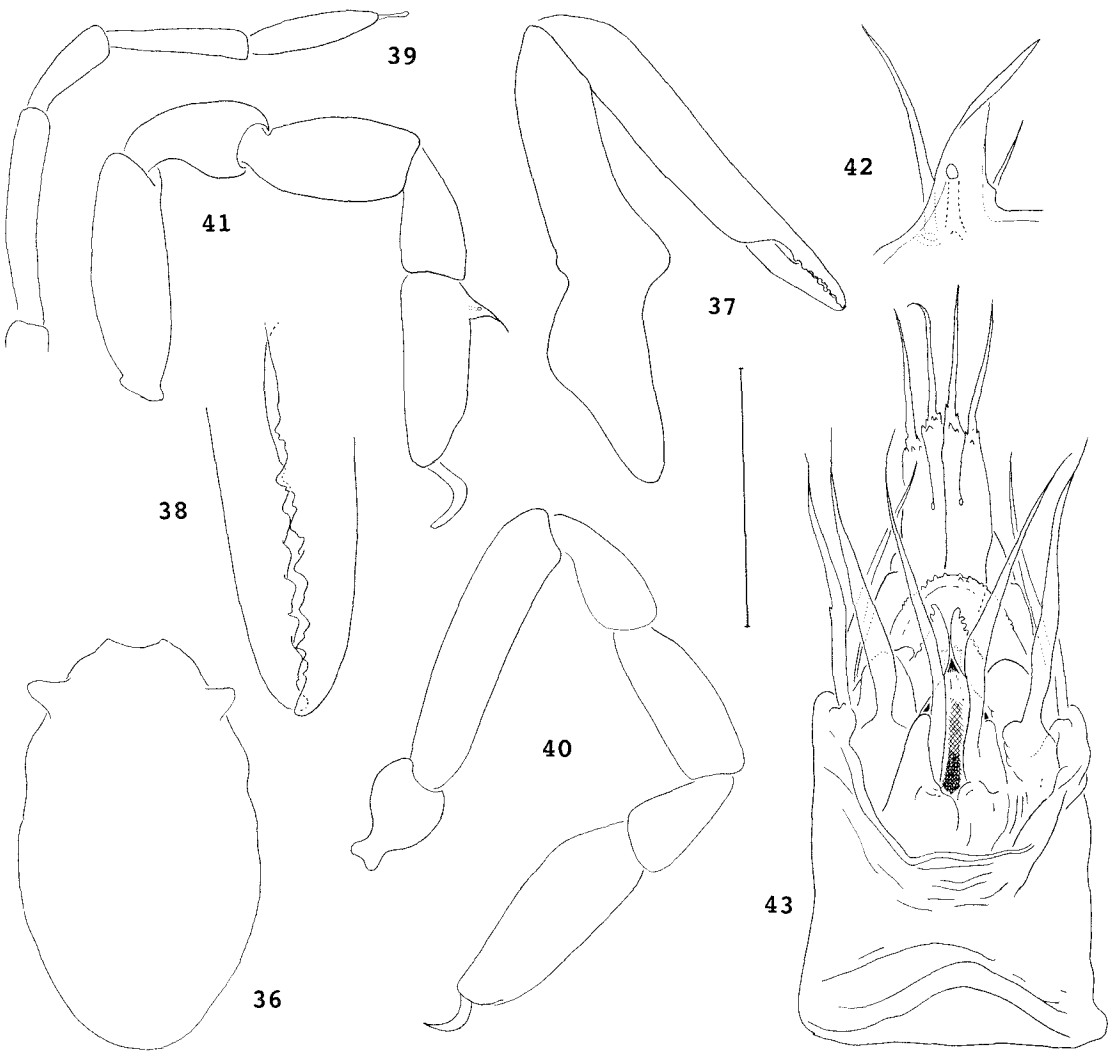
Figures 29–35.—***Troglosiro platnicki***, new species, male: 29, dorsum; 30, ventral view of anterior abdominal segments; 31, chelicera; 32, pedipalp; 33, first leg; 34, claw of second leg; 35, fourth leg. Scale line: 1.5 mm for 29; 0.75 mm for 30; 0.6 mm for 31–33, 35; 0.15 mm for 34.

(Tillier station 250k, plot VI X; 166°39′16″E, 22°06′13″S), 160 m elevation, New Caledonia, collected 7 July 1987 by A. Tillier.

Etymology.—The name honors Dr. Norman I. Platnick, internationally known authority on arachnids.

Distribution.—In addition to the type locality, NEW CALEDONIA: from the following Berlese samples of moist forest litter along Riviere Bleue, same coordinates and altitude as type collection. Tillier Sta. 250c, plot VI 0, A. & S. Tillier, 3 November 1986, 2 males, female (MNHN); Sta. 250h, plot VI 0, A. & S. Tillier, 6 April 1987, 4 males, 2 females (MNHN). Riviere Bleue, Berlese sample from humid forest (Tillier station 251d, plot VII 0; 166°40′01″E, 22°05′59″S), 170 m elevation, A. & S. Tillier, 11 December 1986, male, female (MNHN); wet forest along Riviere Bleue, 280 m elevation, N. Platnick & R. Raven, 21 May 1987, male (AMNH); Berlese of rainforest litter, Mt. Dzumac, N. Platnick & R. Raven, 28 May 1987, male (AMNH).

Diagnosis.—Distinct from others species in having 4 ventral setae on the penis, with their



Figures 36–43.—***Troglosiro ninqua***, new species, male: 36, dorsum; 37, chelicera; 38, cheliceral teeth; 39, pedipalp; 40, first leg; 41, fourth leg; 42, adeonstyle; 43, penis, dorsal view. Scale line: 1.5 mm for 36; 0.6 mm for 37, 39–41; 0.3 mm for 42; 0.15 mm for 38, 43.

bases strongly toothed (Fig. 27); the sterna of males are deeply depressed, the depression with pronounced lateral rims (Fig. 30).

Description.—*Male:* Total length 2.0, width across ozophores 1.08, greatest width (gW) 1.23, L/gW = 1.63. Body (Fig. 29) generally egg-shaped, widest at posterior part of cephalothorax. Dorsum shining, with pebbled microsculpture. Ozophores close to cephalothorax margin, directed laterally, slightly constricted apically. Cephalothoracic sulcus indistinct; abdominal sulci less so. Posterior end of body evenly rounded. Abdominal sternites with 3 gland pores in midlines of sternites 2, 3, and 4 (Fig. 30); these sternites deeply depressed, with few scattered setae, depression with distinct lateral rims. First cheliceral segment (Fig. 31) 0.97 long, 0.19 wide, dorsal crest very low. Second cheliceral segment 0.92 long, 0.13 wide, straight, scarcely tapered, fixed finger 0.30 long, 33% length of second cheliceral segment; cheliceral teeth regular. Palpal segments (Fig. 32) 0.23, 0.43/0.075 (6.14), 0.23, 0.33/0.06 (5.5), 0.29. Legs robust, with heavily pebbled ornamentation. Leg 1 (Fig. 33) segments 0.60/0.15 (4.0), 0.32/0.16, 0.39/0.16 (2.4), 0.24/0.14, 0.55/0.21. Leg 4 (Fig. 35) segments 0.52/0.16 (3.3), 0.32/0.19, 0.33/0.20 (1.7), 0.26/0.13, 0.43/0.15. Adenostyle slightly curved, acutely

triangular. Penis in ventral view (Fig. 27) with 4 ventral setae, each toothed at base; in dorsal view (Fig. 28) with 3 lateral setae on each side and 6 dorsal setae, median dorsal setae much reduced. Apical setae typical for genus, but with more coarse teeth basally. Gonopore structures: ventral plate large, with toothed semicircular margin; movable fingers with very large, laterally protruding basal lobes, fingers with lateral margins bearing small rounded teeth; gonopore lip with small, acute teeth.

Females: Somewhat larger (paratype 2.14 long), similar to males in nonsexual characters.

Remarks.—This species is nearly identical in size and appendage measurements to *T. ninqua*, but the toothed ventral setae of the penis and the deeply depressed male sterna of the present species distinguish the two.

Troglosiro ninqua, new species
Figs. 36-43

Type data.—Holotype male and female paratype (MNHN) from Berlese sample from humid forest, Mt. Ninqua (Tillier station 288, 166°09′03″E, 21°44′24″S), 1000 m elevation, New Caledonia, collected 28 October 1986 by A. and S. Tillier.

Etymology.—The name, a noun in apposition, is after the type locality.

Distribution.—Known only from the type locality.

Diagnosis.—Closely related to *T. platnicki*, but differing in lacking median dorsal setae of the penis, and having smooth, not toothed, ventral setae; the sterna of males are only slightly depressed rather than having a deep, rimmed depression as in *T. platnicki*.

Description.—*Male:* Total length 2.12, width across ozophores 1.13, greatest width (gW) 1.3, L/gW = 1.6. Body (Fig. 36) generally egg-shaped, widest at posterior part of cephalothorax. Dorsum shining, with pebbled microsculpture. Ozophores close to cephalothorax margin, directed laterally, slightly constricted apically. Cephalothoracic and abdominal sulci nearly obsolete. Posterior end of body evenly rounded. Abdominal sternites with 3 gland pores in midlines of sternites 2, 3, and 4; these sternites slightly depressed, lacking usual pebbled microsculpture. First cheliceral segment (Fig. 37) 1.02 long, 0.19 wide, dorsal crest very low. Second cheliceral segment 0.91 long, 0.14 wide, straight, scarcely tapered, fixed finger 0.23 long, 25% length of second cheliceral segment; cheliceral teeth complex but regular, each consisting of a main blade and two smaller points (Fig. 38). Palpal segments (Fig. 39) 0.23, 0.46/0.08 (6.13), 0.24, 0.31/0.05 (6.2), 0.33. Legs robust, with heavily pebbled ornamentation. Leg 1 (Fig. 40) segments 0.66/0.14 (4.71), 0.32/0.15, 0.41/0.16 (2.6), 0.29/0.14, 0.50/0.19. Leg 4 (Fig. 41) segments 0.50/0.17 (2.9), 0.26/0.17, 0.38/0.18 (2.1), 0.29/0.14, 0.42/0.15. Adenostyle (Fig. 42) slightly curved, acutely triangular. Penis in ventral view with 4 ventral setae, basally bladelike, set on raised sockets; in dorsal view (Fig. 43) with 2 lateral setae on each side and 4 dorsal setae, median dorsal setae absent. Apical setae typical for genus, bases somewhat more elongate, smoother. Gonopore structures: ventral plate large, with vaguely toothed semicircular margin; movable fingers with moderate, laterally protruding basal lobes, fingers with lateral margins bearing small rounded teeth; gonopore lip narrow, with small, acute teeth.

Female: Somewhat larger (paratype 2.13 long), similar to males in nonsexual characters.

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