NEW SPECIES OF NEW WORLD LEPTOHYPINAE
(EPIHEMEROPTERA: TRICORYTHIDAE)

RICHARD K. ALLEN
California State College at Los Angeles

Abstract
The genera Leptohypus Eaton and Tricorythodes Ulmer are confined to the New World, and the Nearctic and Neotropical species of Leptohypus have been extended from Texas to Mexico. Useful nymphal characters are presented for both genera, and descriptions and illustrations are included for 22 new species of Leptohypus Eaton, and 7 new species of Tricorythodes Ulmer.

A revision of New World Leptohypinae is in progress, but has been delayed for several reasons: there are a large number of undescribed species involved, the nymphal or adult stages of many described species are not yet known; and new collections are being received at an increasing rate. Since the completion of generic revisions is several years away it seems desirable to publish the names and descriptions of a number of undescribed Leptohypus Eaton and Tricorythodes Ulmer to make them available to other workers, and to reduce the volume of the future revisions. A number of the species are described from nymphs only. The practice of describing new species from immature stages is discussed by Edmunds and Allen (1965), and their philosophy is expressed in this paper. Traver (1958a) reviewed and keyed the genera of Leptohypinae.

Leptohypus Eaton

Leptohypus is confined to the New World and has previously been reported only as far north as San Antonio, Texas (Burks 1953). New species described herein extend the Nearctic limits of this largely Neotropical genus to Montgomery


(Received 24 October 1966)

Traver (1956b) characterized the adult stage and summarized the characters of the described species of the genus occurring north of the Amazon River. The nymph of Leptobyphes was first reported by Needham and Murphy (1924), and subsequent descriptions were published by Traver (1944) and Burks (1953). The characters most useful in distinguishing the species in the nymphal stage are: (1) the shape of the femora, and the relative lengths of the fore and hind femora; (2) the shape and length of the fore femoral spines; (3) the number and arrangement of denticles on the tarsal claws; (4) the shape of the abdominal segments; and (5) the shape and coloration of the operculate gills on segments 2. Other characters such as abdominal color pattern, and the possession of spines, tubercles, or setae are also useful in distinguishing certain species.

**Leptobyphes dolani n. sp.**

**Nymph.**—Length: body 3.0-4.0 mm; caudal filaments 1.5-2.5 mm. General color brown with black markings. Head brown; occiput black; head with a row of long setae along lateral margins and across clypeal-labral suture; ocelli small; maxillary palpi two-segmented. Thoracic nota brown with black markings; pronotum with a median longitudinal row of short setae; pronotum and mesonotum margined with long setae; legs brown with black markings; femora with irregular black maculae; femora with moderately long spines (Fig. 2b); fore femora nearly as broad as long; fore femoral band of spines as in Fig. 2d; hind femora 30% longer than fore femora; ventral (leading) margin of middle and hind femora with long setae; dorsal margin of hind femora with moderately long spines set in elevated sockets, and with long setae; dorsal margin of hind tibiae with a few long spines and long setae; tarsal claws with two to three marginal denticles (Fig. 2c). Abdominal terga brown with black markings; terga 1 with a row of six black maculae; terga 2-5 with paired submedian and sublateral black maculae; terga 7-10 with paired submedian longitudinal black stripes (Fig. 3); terga with long setae; operculate gills pale with black maculae; segments 7-9 with distinct postero lateral projections (Fig. 1); abdominal sternae brown with paired sublateral black dots on sternae 2-9. Caudal filaments brown.


**Remarks.**—This species is named in honor of Thomas Dolan, IV, Consulting Biologist, Philadelphia, Pa. Leptobyphes dolani and L. robacki n. sp. are the only species in the genus known to occur in eastern North America.

**Leptobyphes robacki n. sp.**

**Nymph.**—Length: body 3.0-4.2 mm; caudal filaments 1.0-2.0 mm. General color yellow to light brown with black markings. Head yellow to light brown; ocelli small; maxillary palpi one-segmented with an apical seta. Thoracic nota light brown to light brown; legs yellow to light brown; femora with long, bifurcated spines (Fig. 3b); fore femoral band of spines as in Fig. 5a; hind femora 20% longer than fore femora; ventral (leading) margin of femora generally concave; ventral margin of middle and hind femora with an occasional long spine; dorsal margin of hind tibiae with long spines; tarsal claws with six to eight marginal
denticles (Fig. 5c). Abdominal terga light brown with black markings; terga 1-8 with paired submedian and sublateral black maculae; terga 9 with paired submedian maculae; terga 10 with a median and paired submedian maculae (Fig. 4); operculate gills yellow with scattered black maculae; segments 7-8 with distinct posterolateral projections (Fig. 4); abdominal sternum yellow to light brown with black markings. Caudal filaments yellow to light brown.


Remarks.—Distinguished from L. dolani, the other eastern North American species, by narrower femora (Figs. 2a and 5a), long bifurcated femoral spines (Figs. 2b and 1b), and by the shape and coloration of the abdomen (Figs. 3 and 4). The species L. robucki is named after Selwyn S. Robuck, Academy of Natural Sciences, Philadelphia, Pa., the collector of the holotype.

Leptophyes apache n. sp.

Nymph.—Length: body 5.5–6.5 mm; caudal filaments 4.0–5.0 mm. General color light brown to brown with dark brown markings. Head brown with dark brown markings; occiput brown with irregular dark brown markings; a black band on frons from compound eyes and around bases of antennae; ocelli small; head with fine spicules; maxillary palpi three-segmented. Thoracic nota brown with irregular dark brown markings; nota with fine spicules; legs light brown femora with moderately long spines (Fig. 6a); fore femoral band of spines as in Fig. 6c; hind femora 65¢ longer than fore femora; anterior surface of middle and hind femora with a median elevated ridge and scattered short spines; ventral (leading) margin of hind femora with short spines; base of middle and hind femora with a transverse row of short spines; dorsal margin of hind tibiae with long spines; tarsal claws with four to eight marginal denticles (Fig. 6c). Abdominal terga light brown with an even irregular brown marking on segments 1–5; brown marking often interrupted medially with a pale longitudinal stripe; segments 1–9 light brown along posterior margin; terga 10 light brown with a dark brown median macula (Fig. 7); operculate gills brown, pale apically; abdominal sternum light brown; sternum 1–7 often with a median dark brown macula. Caudal filaments light brown, usually with a dark brown basal annulation.

Leptobyphyes minus n. sv.

Male nymph.—Length: body 4.0–5.0 mm; caudal filaments 2.5–3.5 mm. General color light brown to brown, occasionally with dark brown markings. Head broad, compound eyes large (Fig. 10); ocelli large, maxillary palp one-segmented. Thoracic nota light brown to reddish brown, occasionally with irregular dark brown markings; legs brown; middle and hind femora with black spots; femora with short spines (Fig. 9b); fore femoral band of spines as in Fig. 9a; hind femora 20%; longer than fore femora; anterior surface of middle and hind femora with small scattered spines; ventral (leading) margin of hind femora with short spines; tarsal claws with 10–14 marginal denticles (Fig. 9c). Abdominal terga light brown to brown, often with a dark brown transverse band; operculate gills brown; segments 7–9 with distinct posterior projections (Fig. 9); abdominal sternum brown. Caudal filaments brown.

Female nymph.—Length: body 6.0–7.0 mm; caudal filaments 3.0–4.0 mm. Compound eyes small (Fig. 11); ocelli small. Other characters as in male, except for sexual differences.

Type.—Holotype: male nymph, Rio Blanco, Arizona, 1–IV–37, J. G. Needham, in collection University of Utah, Salt Lake City. Allotype: female nymph, same data as holotype. Paratypes: 1 male and 5 female nymphs, same data as holotype, 1 male and 1 female nymph in collection California State College at Los Angeles, others in collection University of Utah.

Remarks.—Leptobyphyes minus is unique in the genus as the nymphal stages exhibit secondary sexual dimorphism. The male nymphs have large compound eyes (Fig. 10) and are small in size (4–5 mm), whereas the females are longer (6–7 mm) and have small compound eyes (Fig. 11).

Leptobyphyes musceti n. sv.

Nymph.—Length: body 5.0–7.0 mm; caudal filaments 6.0–7.0 mm. General color yellow with black markings. Head yellow with brown and black markings; ocellus yellow; a narrow black stripe from posterior margin of head to mesal along posterior margin to near epicranial suture; a black stripe often present on frons between lateral oceli; frons usually brown with black spot; ocelli small; maxillary palp three-segmented. Thoracic nota yellow with variable black markings; nota with fine spicules; legs yellow with black tarsi; fore femora with a subapical black macula; middle and hind femora with basal and subapical maculae; ridge with a brown band near base; femora with short spines (Fig. 12b); fore femoral band of spines as in Fig. 12a; hind femora 55%; longer than fore femora; anterior surface of middle and hind femora with a pronounced ridge and scattered short spines; ventral (leading) margin of hind femora with short spines; base of middle and hind femora with a transverse row of short spines; tarsal claws with four to six marginal denticles (Fig. 12c). Abdominal terga yellow to light brown with variable black markings; terga 1–5 usually with a black transverse band, and a dark median macula; terga 6–9 usually with a median black macula and submedian and subapical maculae (Fig. 11); terga with short spines; operculate gills pale, black at base, and anal sternum pale. Caudal filaments pale with black annulations.

Type.—Holotype: mature nymph, Soloth, Panama (150 m elev.), Guatermala, 21–VI–52, G. G. Masser, in collection University of Utah, Salt Lake City. Paratypes: 44 nymphs, same data as holotype, 2 nymphs each in the following collections: California Academy of Sciences, San Francisco; Canadian National Collection, Ottawa, British Museum (Natural History), London; J. R.
Traver, Amberst, Mass. Five nymphs in collection California State College at Los Angeles, remainder in collection University of Utah.

Remarks.—This species is named in honor of G. G. Mesner, University of Michigan, Ann Arbor.

Nymphex packeri n. so.

Nymph.—Length: body 3.5–4.5 mm; caudal filaments 3.0–4.0 mm. General color brown with pale markings. Head brown; horns with a triangular macula; epicranium often with a transverse row of pale spots; ocelli small, maxillary palpi three-segmented. Thoracic nota brown with pale spot; pronotum with distinct submedian macula and pale laterally; mesonotum with distinct pale submedian rascule; legs yellow brown with brown markings; femora with a subapical brown macula; tibiae and tarsi with a brown band above base; femora with moderately long spines (Fig. 15b); fore femoral band of spines as in Fig. 15a; hind femora 35%; longer than fore femora; ventral (leading) margin of middle and hind femora with short spines; dorsal margin of middle and hind femora with moderately long spines; dorsal margin of hind tibiae with moderately long spines; tarsal claws with six to eight marginal denticles and a palliade of four to six subapical denticles (Fig. 15c). Abdominal terga unicolorous brown; terga with long setae; operculate gills brown with pale macula (Fig. 14); abdominal sterna brown. Caudal filaments brown.

Types.—Holotype: mature nymph, stream, 6.5 mi from junction of Highways #1 and #7 on Highway #7, Dept. Francisco Moza, Honduras, 7-XI-64, J. S. Packer, in collection University of Utah, Salt Lake City. Paratypes: 1 nymph, same data as holotype, in collection California State College at Los Angeles. Paratypes: 2 nymphs, 1 mi W. Campanarios on Highway #7 at bridge, Dept. Olancho, Honduras, 7-XI-64, J. S. Packer, in collection University of Utah.

Remarks.—This species is named in honor of J. S. Packer, Escuela Agricola Panamericana, Tegucigalpa, Honduras.

Lepidophyes castanea n. so.

Nymph.—Length: body 5.0–7.0 mm; caudal filaments 5.5–6.5 mm. General color light brown, often with brown markings. Head light brown with irregular brown markings; occiput light brown, often with a median brown circular marking, and a brown line from the posterior margin of the head to the circular marking; from dark brown; head with fine spicules; ocelli small; maxillary palpi three-segmented. Thoracic nota brown with variable brown markings; nota with fine spicules; tegs brown; femora with moderately long spines (Fig. 16d); femoral band of spines as in Fig. 16e; hind femora 65%; longer than fore femora; anterior surface of middle and hind femora with an elevated ridge and scattered short spines; ventral (leading) margin of hind femora with short spines; base of middle and hind femora with a transverse row of short spines; dorsal margin of hind tibiae with long spines; tarsal claws with four to six marginal denticles (Fig. 16c). Abdominal terga unicolorous brown; tegra with short spines; operculate gills pale, brown at base; abdominal sterna brown. Caudal filaments light brown, often with brown basal annulations.

Types.—Holotype: mature nymph, Solola, Panajachel, Guatemala, 21-VIII-62. G. G. Mesner, in collection University of Utah, Salt Lake City. Paratypes: 8 nymphs, same data as holotype; 2 nymphs, in collection California State College at Los Angeles, remainder in collection University of Utah.
Remarks.—Leptobytes castaneus has a brown abdomen similar to that described by Uliker (1919) for the adult of L. costaniceus and may eventually be found to be the nymph of that species.

Leptobytes murdochii n. sp.

Nymph.—Length: body 5.5 mm; caudal filaments 6.0 mm. General color dark brown with numerous minute pale spots. Head brown with minute pale spots; a black band on frons between compound eyes; ocelli small; maxillary palp three-segmented. Thoracic nota brown with irregular light brown markings and minute pale spots; legs unicolorous brown with minute pale spots on femora; femora with short spines (Fig. 17b); fore femoral band of spines as in Fig. 17a; hind femora 95% longer than fore femora; marginal spines of middle and hind femora set in elevated sockets; ventral (leading) margin of middle and hind femora concave in apical one-half; dorsal margin of hind tibiae with heavy spines set in elevated sockets; tarsal claws with two to three marginal denticles (Fig. 17c). Abdominal terga dark brown; posterior margins of segments 2-9 light brown; segments 2-5 with a pale median longitudinal stripe; operculate gills dark brown with a pale margin; abdominal sternae dark brown, suffused with black and with irregular pale markings. Caudal filaments brown with a black basal annulation.

Type.—Holotype: mature nymph, Rio Tocarcana, Darien Prox., Panama, 30-V-61, W. P. Murdoch, in collection University of Utah, Salt Lake City.

Remarks.—This species is named in honor of its collector, W. P. Murdoch, Fort Anadark, Canal Zone.

Leptobytes nanus n. sp.

Nymph.—Length: body 3.0-4.0 mm; caudal filaments 2.0 mm. General color yellow with black markings. Head yellow; a black band between lateral ocelli, bases of antennae margined with black; lateral ocelli large as in Fig. 16; maxillary palp two-segmented. Thoracic nota yellow with black markings, pronotum suffused with black; legs unicolorous yellow; femora with moderately long spines (Fig. 16b); fore femoral band of spines as in Fig. 16c; hind femora 35% longer than fore femora; ventral (leading) margin of middle and hind femora without spines; dorsal margin of hind tibiae with long spines; tarsal claws with four to seven marginal denticles, and a pulvillus of four to seven submarginal denticles (Fig. 16c). Abdominal terga yellow, lightly suffused with black; terga with a few scattered setae; operculate gills black, pale apically; abdominal sternae pale. Caudal filaments pale with a black basal band.

Type.—Holotype: nearly mature nymph, Rio Pedro Niguel, Green Park on Madden Road, Canal Zone, 1-IX-61, W. L. Peters and C. M. Keenan, in collection University of Utah, Salt Lake City. Paratype: 1 nymph, Rio Camaron, N. edge Fort Clayton on Chiva-Chiva Road, Canal Zone, 9-IX-61, W. L. Peters and C. M. Keenan, in collection California State College at Los Angeles.

Leptobytes planamani n. sp.


Nymph.—Length: body 5.0-7.0 mm; caudal filaments 5.5-6.5 mm. General color brown with dark brown and black markings. Head brown with irregular black markings; a black band on frons between compound eyes; head with fine spicules; ocelli small; maxillary palp three-segmented. Thoracic nota brown, often with variable black markings; nota with fine spicules; legs brown; femora often suffused with black; tarsi with brown bands; femora with short spines (Fig. 1c); fore femoral band of spines as in Fig. 1; hind femora 95% longer than fore
femora; anterior surface of middle and hind femora with short spines; base of middle and hind femora with a transverse row of short spines; dorsal margin of middle and hind tibiae with short spines; tarsal claws with three to five marginal denticles. Abdominal terga brown, usually with variable dark brown and black markings; terga 2-9 often black; terga 6-9 often with a pale median stripe; segment 10 often with a median and paired sublateral maculae; terga with scattered short spines on dorsal surface and moderately long paired spines on posterior margin of terga 1-9; operculate gills brown with a pale margin; abdominal sterna brown. Caudal filaments light brown, often with one or more dark brown basal annulations.

Types.—Holotype: mature nymph, Ariranha River, Nova Teutonia, Brazil, XI-61, F. Plummer, in collection University of Utah, Salt Lake City. Paratypes: 23 nymphs, same data as holotype, 2 nymphs each in the following collec-
tions: California Academy of Sciences, San Francisco; Canadian National Collection, Ottawa; British Museum (Natural History), London; J. R. Tavner, Amherst, Mass. Paratypes: 1 nymph, Cachimbo, L.q. Carangueira, Brazil, XII-59, F. Plaumann, in collection University of Utah; 12 nymphs, Nova Teutonia, Brazil, III-62, XI-63, F. Plaumann; 5 nymphs in collection California State College at Los Angeles, others in collection University of Utah; 1 nymph, Rio de Janeiro, Brazil; 1 nymph, Agua de Prata, Brazil, 23-VI-58, J. Illies, in collection California State College at Los Angeles.

Remarks.—This species is named in honor of F. Plaumann, Nova Teutonia, Brazil, who collected the holotype.

Lepotaphyes cornutus n. sv.

Nymph.—Length: body 3.0 mm; caudal filaments 3.0 mm. General color black with pale markings. Head black; occiput with paired tubercles (Fig. 20); ocelli small; maxillary palpi three-segmented. Thoracic nota black with irregular pale markings; pronotum and mesonotum with paired tubercles; legs pale with black markings; femora pale with a large black macula near apex; tibiae pale with a large black macula; tarsi pale with a black band along (Fig. 19a); mesothoracic leg with a long cecal tubercle; femora with short spines (Fig. 29b); fore femoral band of spines as in Fig. 19a; hind femora 50%, longer than fore femora; dorsal femoral spines set in elevated sockets; anterior surface of middle and hind femora with an elevated median ridge and scattered spines; base of middle and hind femora with a transverse row of short spines; dorsal margin of middle and hind tibiae with short spines; tarsal claws with four to six marginal denticles (Fig. 19c). Abdominal terga black with pale markings; terga 3-9 with a pale median stripe; terga 1-9 with a submedian row of short spines; operculate gills black; abdominal sternum black with irregular pale markings. Caudal filaments brown.

Types.—Holotype: immature nymph, Rio Irany, Brazil, IV-63, F. Plaumann, in collection University of Utah, Salt Lake City.

Lepotaphyes undulatus n. sv.

Nymph.—Length: body 2.5-3.5 mm; caudal filaments 1.5-2.5 mm. General color brown with dark brown to black markings. Head brown with dark brown to black markings; occiput with irregular black markings; sub black band on front between compound eyes; ocelli small; maxillary palpi one-segmented, palpi usually with an apical seta. Thoracic nota light brown to brown, with variable black markings; legs unicolorous brown; coxae with a variable projection, largest on fore leg (Fig. 21a) and smallest on hind leg; femora with short spines (Fig. 21b); fore femoral band of spines as in Fig. 21a; hind femora 20%, longer than fore femora; anterior surface of middle and hind femora with an oblique row of spines; ventral (leading) margin of middle and hind femora with heavy spines; tarsal claws with five to seven marginal denticles, often with a single submarginat denticle near apex (Fig. 21c). Abdominal terga brown, occasionally with a suffusion of red and black markings; posterior margins of terga 7-8 with a median protuberance (Fig. 22); segments 8-9 with undulating lateral margins and with distinct posteroventral projections. Setae of segments 7-9 (Fig. 22); operculate gills brown with a pale transverse line near apex (Fig. 23); abdominal sternum brown. Caudal filaments light brown with one or more dark brown basal annulations.

Types.—Holotype: mature nymph, Rio Irany, Parana, Brazil, IV-62, F. Plaumann, in collection University of Utah, Salt Lake City. Paratypes: 1 nymph, Campos de Palmu, Loj. do Taipa (1200 m), Parana, Brazil, III-63, F. Plaumann; 5 nymphs,
Leptothyphes jodiannae n. sp.

**Nymph.**—Length: body 4.0–5.0 mm; caudal filaments 4.0–5.0 mm. General color brown to dark brown with dark brown and black markings. Head usually brown with dark brown and black markings; vertex with irregular black markings; often with a black band on frons between compound eyes; head with fine spinules; lateral ocelli small; maxillary palpi three-segmented. Thoracic nota brown and usually with irregular black markings; nota with fine spinules; thoracic sterna brown; legs dark brown with pale markings; tibiae with pale apical and basal maculae; tarsi pale at apex and base; femora with long spines (Fig. 24b); femoral band of spines as in Fig. 24a; hind femora 65% longer than fore femora; marginal spines of middle and hind femora set in elevated sockets; anterior surface of middle and hind femora with an elevated median ridge and a row of parallel spines; ventral (leading) margin of middle and hind femora with a double row of long spines; base of middle and hind femora with a transverse row of spines; outer margin of middle and hind tibiae with heavy spines; tarsal claws with four to five marginal denticles (Fig. 24c). Abdominal terga brown to dark brown, often with parallel submedian black longitudinal stripes; terga with long spines on posterior margin of segments 1–9; operculate gills brown at base, pale at apex; abdominal sternum brown, often purplish brown. Caudal filaments brown.

**Types.**—Holotype: mature nymph, Rio Supe Grande, 10 km E. Tingó Maria, San Martin Province, Peru, 26–VI–63, W. L. Peters, in collection University of Utah, Salt Lake City. Paratypes: 17 nymphs, same data as holotype, 5 nymphs in collection California State College at Los Angeles, 1 nymph in each of the following collections: California Academy of Sciences, San Francisco; Canadian National Collection, Ottawa; British Museum (Natural History), London; J. R. Traver, Aberneth, Mass.

**Remarks.**—This species is named in honor of my daughter, Jody Anne Allen.

*Leptothyphes gibbus* n. sp.

*Leptothyphes* sp. B. Traver 1944: 16.
brown, light brown basally and apically; femora with short spines (Fig. 25b); fore femoral band of spines as in Fig. 25a; hind femora 35%; longer than fore femora; anterior surface of middle and hind femora with scattered spines; ventral (leading) margin of middle and hind femora with short spines; tarsal claws with three to five marginal denticles, and a palisade of two to three submarginal denticles near apex (Fig. 25c). Abdominal terga yellow with variable black markings; tergites 1-9 with median tubercles; tubercles well developed on tergite 1-8, small of tergii 9; oecopelae gills yellow, black at base, abdominal sterna yellow. Caudal filaments yellow.

Type.—Holotype: mature nymph, Novo Tutoina, Brazil, XI-63, F. Plaumann, in collection University of Utah, Salt Lake City. Paratypes: 2 nymphs, same data and deposition as holotype. Paratype: 1 nymph, Cachoeirinha Brook, Ouritiro, Minas Gerais, Brazil, 22-VIII-60, H. Kleszczekop, in collection J. R. Traver, Amherst, Mass.

Remarks.—The ecology of this species is described by Traver (1944).

Leptophlebius maculatus n. sp. Male nympha (in alcohol).—Length: body 4.0 mm, forewing 4.0 mm. Head light brown, a thin black line between lateral ocelli, bases of antennae black. Pronotum light brown with black markings, and a pale median macula; mesonotum brown with black markings; pleurae brown with black markings; thoracic sternum yellow; wings opaque; venation pale (crossveins indistinct); legs pale with black maculae; coxae with a black macula; trochanters with an apical black spot; femora with apical and basal black maculae; tibiae and tarsi pale. Abdominal terga pale, suffused with black; tergites 2-10 with a median black macula (Fig. 29); abdominal sterna pale. Penes of the petraeoid-type. Caudal filaments pale.

Nymph.—Length: body 4.0-5.0 mm; caudal filaments 4.0-5.0 mm. General color brown with dark brown and black markings. Head brown with dark brown markings; ocellar with irregular black markings; a black band on front between compound eyes; ocelli small; head with long setae; maxillary palps three-segmented. Thoracic nota brown with variable dark brown and black markings; nota with long setae; legs light brown with black and brown markings; fore femora with a subapical black macula; middle and hind femora with variable black markings, usually with basal and subapical black maculae; tarsi with a brown band; femora with moderately long spines (Fig. 27b); fore femoral band of spines as in Fig. 27a; hind femora 25%; longer than fore femora; anterior surface of middle and hind femora with spines and long setae; ventral (leading) margin of middle and hind femora with small spines; tarsal claws with three to five marginal denticles, and often a single submarginal denticle near apex (Fig. 27c). Abdominal terga brown, suffused with black; tergites 2-10 each with a median black macula, maculae most conspicuous on tergites 2-10 (Fig. 28); oecopelae gills brown, pale in middle; abdominal sterna yellow, often suffused with black; sterna 2-9 often with

Fig. 16. Leptophlebius centaurus: 16a, right fore leg; 16b, fore femoral spine; 16c, tarsal claw.
Fig. 17. L. marshalli: 17a, right fore leg; 17b, fore femoral spine; 17c, tarsal claw. Fig. 18. L. nana: 18a, right fore leg; 18b, fore femoral spine; 18c, tarsal claw. Figs. 19-20. L. centaurus: 19a, right fore leg; 19b, fore femoral spine; 19c, tarsal claw; 20a, male nymph. Figs. 21-22. L. marshalli: 21a, right fore leg; 21b, fore femoral spine; 21c, tarsal claw; 22, abdominal terga 7-10, 23, operculae gills. Figs. 24-25. L. fusimagna: 24a, right fore leg; 24b, fore femoral spine; 24c, tarsal claw. Figs. 25-26. L. gibbosa: 25a, right fore leg; 25b, fore femoral spine; 25c, tarsal claw; 26, nymphal head, thorax, and abdomen, lateral view.
A median and paired lateral black macule. Caudal filaments light brown with a basal dark brown annulation.


**Remarks:** The male subimago herein described as *Lepthophyes maculatus* were collected at lights and have not been positively associated with the nymphal stage; however, they were collected at the same locality at the same time as the nymphal types. The black macule on the abdominal tergites of both of these stages also indicates that this association is correct (Figs. 28–29).

**Lepthophyes setatus** n. sp.

Male subimago (in alcohol).—**Length:** body 4.0–5.0 mm; fore wing 4.5–5.5 mm. Head light brown, and a dark black band between ocelli and compound eyes; base of antennae black. Pronotum pale with a thin black line along posterior margin; mesonotum brown; pleuron brown with black markings; thoracic sterna pale; wings opaque; venation pale (crossveins indistinct); hind wing with a long costal projection; legs pale with black macule; coxae with a black macula; trochanters with an apical black spot; femora with apical and basal black maculae; tibiae and tarsi pale. Abdominal terga 1–4 black with a pale median longitudinal stripe; terga 5–9 pale with submedian and sublateral black maculae; terga 10 with a median and sublateral black maculae (Fig. 32); abdominal sterna pale; sterna 7–9 with black lateral margins. Penes of the *petersoni*-type. Caudal filaments pale.

**Nymph.**—**Length:** body 5.0–6.0 mm; caudal filaments 3.0–4.0 mm. General color yellow with brown and black markings. Head yellow with black markings; a thin black line along posterior margin of head from compound eyes to epicalar suture. Terga and sternae often with paired sublateral black macules; a black band on frons between compound eyes; head with short setae; maxillary palp three-segmented. Thoracic nota yellow with variable black markings; thoracic nota with short setae; legs yellow with black and brown markings; fore femora with a subapical black macula; middle and hind femora usually with basal and subapical black maculae; tarsi with a brown band; femora with short spines (Fig. 30b) and long setae; fore femoral band of spines as in Fig. 30a; hind femora 45° longer than fore femora; anterior surface of middle and hind femora with long setae; ventral (leading) margin of hind femora with a row of spines in apical two-thirds, basal
one-third with long setae; tarsal claws with three to five marginal denticles, and a palisade of five to six submarginal denticles near apex (Fig. 34c). Abdominal terga 1–4 black with a pale median longitudinal stripe; terga 5–9 pale with submedian and submarginale black maculae; terga 10 with a median and submarginal black maculae (Fig. 31); tergites with long setae; operculae gills pale, black at base; abdominal sterna 1–6 with small submarginal setae; sternites with black lateral margins. Caudal filaments brown, often with dark brown basal annulations.  


Remarks.—The male and female subimagoes described above have been assigned to this species because they were collected at the same locality and at the same time as were the nymphal types of this species. Furthermore, identical black maculae are present on terga 5–6 of both of these stages (Figs. 31–32) which strongly indicates that this association is correct.  

Leptophlebius rutilus n. sp.  

Nymph.—Length: body 3.5–4.5 mm, caudal filaments 2.9–3.0 mm. General coloration brown, occasionally with iridescent black markings. Head brown, occiput and lateral ocelli large (Fig. 31), maxillary palpi two-segmented. Thoracic nota brown, occasionally with brown and black markings; legs brown; femora with moderately long setae (Fig. 34b), fore femoral band of spines as in Fig. 34a; hind femora 35°. Thanerion brown; anterior surface of middle and hind femora with scattered setae; ventral (leading) margin of middle and hind femora without spines. Basal margin of fore tibiae with long setae; tarsal claws with four to six marginal denticles, and a palisade of six to eight submarginal denticles near apex (Fig. 34c). Abdominal terga brown, often diffused with black; terga with scattered small spines, operculae gills brown at apex, black at base; abdominal sterna light brown. Caudal filaments brown.  

Types.—Holotype: mature nymph, Rio Yurac, 1 km S Aguaytia, Loreto Prov., Peru, 16-VII-63, W. L. Peters, in collection University of Utah, Salt Lake City. Paralectotypes: 8 nymphs, same data and deposition as holotype. Paralectotypes: 4 nymphs, Rio Yurac, 126 km N de Tingo Maria, Peru, 4-X-63, M. Pandura; 1 nymph, Rio Rondon, km 14 on Monzon Road, Huancaco Prov., Peru, 25-VI-63, W. L. Peters; 1 nymph, Rio Pendencia, Tulumayo Valley, San Martin Prov., Peru, 22-VII-63, W. L. Peters; 2 nymphs, Cgf. LaCoeva, 6 km W Tingo Maria, Huancaco Prov., Peru, 24-VI-63, W. L. Peters, above-noted paratypes in
collection University of Utah; 7 nymphs, Rio Tuleymayo, 20 km E. Tingo Maria, San Martin Prov., Peru, 19-VI-83, W. L. Peters; 5 nymphs in collection California State College at Los Angeles, remainder in collection University of Utah; 8 nymphs, Rio Upte Grande, 10 km E. Tingo Maria, San Martin Prov., Peru, 26-VI-83, W. L. Peters. 1 nymph each in the following collections: California Academy of Sciences, San Francisco; Canadian National Collection, Ottawa; British Museum (Natural History), London; J. R. Traver, Amherst, Mass., remainder in collection University of Utah.

Leptophyes petersi n. sp. Leptophyes nymph No. 2 Needham and Murphy 1924: 34.

Male imago (in alcohol). —Length: body 3.5-4.5 mm; fore wing 3.5-4.5 mm. Head pale to light brown; a black macula between ocelli and black around bases of antennae. Pronotum light brown, margined with black and with sublateral black streaks; mero- and mero-notum light brown; pleurae light brown, black anterior to base of fore wing; sutures pale; thoracic sternum black; wings semi-hyaline, opaque between C and R, venation brown; 34-74 croceiemen behind R. (Fig. 40); hind wing with two longitudinal veins and a long thin costal projection (Fig. 10a, b); femora black; ribe light brown with a black macula near apex; tarsi light brown. Abdominal terga pale, suffused with black; terga 2-6 with parallel submedian black longitudinal dashes (Fig. 17); terga 7-10 black; abdominal sternum black with pale spots, offers with parallel submedian pale spots. Peres with a deep median notch, and each penis lobe with a small apical projection; basal segment of genital forceps broad (Fig. 99). Caudal filaments pale.

Female imago (in alcohol). —Length: body 3.5-4.5 mm; fore wing 4.5-5.5 mm. General color lighter than male. Other characters as in male except for usual sexual differences.

Nymph. —Length: body 4.0-5.0 mm; caudal filaments 3.5-4.5 mm. General color brown to dark chocolate brown with black and brown markings. Head brown with black markings; vertex with irregular black markings; a black band on frons between compound eyes; head with fine spiculae; ocelli small; maxillary palps three-segmented. Thoracic nota brown with variable dark brown and black markings; nota with fine spiculae; legs unicolored brown, except femora often suffused with black; femora with long spines (Fig. 35b); fore femoral band of spines as in Fig. 35a; hind femora 75%, longer than fore femora; marginal spines of middle and hind femora set in elevated sockets; anterior surface of middle and hind femora with an elevated ridge and scattered spines; ventral (leading) margin of middle and hind femora without spines; base of middle and hind femora with a transverse row of spines; dorsal margin of hind tibiae with heavy spines set in elevated sockets; taral claws with three to five marginal denticiles (Fig. 35c). Abdominal terga dark brown to black; terga 2-6 with parallel submedian black longitudinal dashes (Fig. 36); terga 7-10 dark brown to brown.

Fig. 27-29. Leptophyes maculata: 27a, right fore leg; 27b, fore femoral spine; 27c, taral claw; 28, abdominal terga 7-10, nymph; 29, abdominal terga 7-10, male imago. Figs. 30-32. L. setosa: 30a, right fore leg; 30b, fore femoral spine; 30c, taral claw; 31, abdominal terga 7-10, nymph; 32, abdominal terga 7-10, male imago. Figs. 33-34. L. rutilis: 33, head, male imago; 34a, right fore leg; 34b, fore femoral spine; 34c, taral claw. Figs. 35-36. L. petersi: 35a, right fore leg; 35b, fore femoral spine; 35c, taral claw; 36, abdominal terga 4-5, nymph; 37, abdominal terga 4-5, male imago; 38, sacculate yilli; 39, male genitalia, dorsal view; 40, fore wing, male imago; 40a, hind wing, male imago; 40b, hind wing, male imago (enlarged).
black; operculate gills brown (Fig. 31); abdominal sternum black with parallel submedian black longitudinal dashes on sternum 2-7; Caudal filaments brown.


**Remarks:** Leptobuspus petesi appears to be the most common species of the genus occurring in central Peru. The adults were collected at lights, and the association of the adult and nymphal stages is only tentative. This association appears certain, however, as both stages were collected at the same locality at the same time. In addition, both stages possess parallel submedian black longitudinal dashes on abdominal terga 2-6 (Figs. 36-37). This species is named in honor of William L. Peters, University of Utah, Salt Lake City.

**Leptobuspus asperatus n. sp.**

**Nymph.—** Length: body 4.0-5.0 mm; caudal filaments 3.0-4.0 mm. General color light brown with black markings. Head yellow with black markings; ocicpitis with irregular black markings; a black band on front of compound eyes; lateral ocelli very small as in Fig. 33; maxillary palp three-segmented. Thoracic nota light brown with scattered black markings; legs unicolorous yellow; femora with moderately long spines (Fig. 41b); fore femoral band of spines as in Fig. 41a; hind femora 50%; longer than fore femora; anterior surface of middle and hind femora roughened; ventral (leading) margin of middle and hind femora without spines; dorsal margin of hind claws with small spines; tarsal claws with two to three small marginal denticles (Fig. 41c). Abdominal terga light brown, suffused with black and with a pale median longitudinal stripe; operculate gills black, pale.
at apex; abdominal sternum yellow; with paired sublateral black maculation. Caudal filaments yellow.

Type.—Holotype: early mature nymph, Rio Pendencia, Taluma Valley, 24 km E. Tingo Maria, San Martin Prov., Peru, 14/18-VI-63, W. L. Peters, in collection California State College at Los Angeles.

Leptophyes comatus n. sp.

Leptophyes sp. Ilies, 1965: fig. 3F.

Nympus.—Length: body 6.0–7.0 mm; caudal filaments 5.5–6.5 mm. General color yellow with black markings. Head yellow with a black band across from between compound eyes and bases of antennae; ocelli small; head with long setae; maxillary palp three-segmented. Thoracic nota yellow with variable black markings; nota with long setae; legs yellow with black markings; fore femora usually with a faint subapical black macula; middle and hind femora with variable black markings, usually with basal and subapical black maculae; tibiae and tarsi yellow; femora with moderately long spines (Fig. 42b); fore femoral band of spines as in Fig. 42a; hind femora 40% longer than fore femora; anterior surface of middle and hind femora with long setae; ventral (leading) margin of middle and hind femora with small spines; tarsal claws with three to four marginal denticles (Fig. 42c). Abdominal terga 1–9 black with yellow anterior and posterior margins; tergum 10 yellow with paired sublateral black maculae (Fig. 43); terga with long setae; operculate gills pale, black at base; abdominal sternum yellow with black median longitudinal stripe. Caudal filaments yellow, often with black basal annulations.

Type.—Holotype: mature nymph, Rio Hualaga, Station V, near Huancoc, Peru, 25-V-58. J. Ilies, in collection University of Utah, Salt Lake City. Para- topotypes: 16 nymphs, same data as holotype. 1 nymph each in the following collections: J. Ilies, Plön, Germany; California Academy of Sciences, San Francisco; Canadian National Collection, Ottawa; British Museum (Natural History), London; J. R. Traver, Amherst, Mass.; California State College at Los Angeles, remainder in collection University of Utah.

Remarks.—The type locality and ecology of L. comatus is described by Ilies (1965).}

Leptophyes iliesii n. sp.

Nympus.—Length: body 5.5–6.5 mm; caudal filaments 4.0–5.0 mm. General color brown with black markings. Head brown with black markings; occiput brown with a black line from compound eyes to posterior margin of head; a wide black band on frons between compound eyes; ocelli small; maxillary palp three-segmented. Thoracic nota brown with variable black markings; legs brown; femora with a black longitudinal line; femora with moderately long spines (Fig. 42b); fore femoral band of spines as in Fig. 42a; hind femora 60% longer than fore femora; anterior surface of middle and hind femora with an elevated ridge and scattered spines; ventral (leading) margin of hind femora with short spines; base of middle and hind femora with a transverse row of short spines; dorsal margin of middle and hind tibiae with spines; tarsal claws with three to four marginal denticles and a single submarginal denticle near apex (Fig. 43c). Abdominal terga brown with black markings; terga 1–9 with a black transverse band; tergum 10 with a median and paired lateral maculae (Fig. 44); terga with scattered short spines and very long paired spines on posterior margin of segments 1–9 (Fig. 44); operculate gill brown; segments 7–9 with moderate postero lateral projections (Fig. 44); abdominal sternum brown with a diffuse black median marking. Caudal filaments brown.
Types.—Holotype: mature nymph, Station IV, Rio Chilkon, Peru, 1-V-58, J. Illies, in collection University of Utah, Salt Lake City. Paratypes: 8 nymphs, same data as holotype, 4 in collection J. Illies, Pion, Germany; and 4 in collection California State College at Los Angeles. Paratypes: 2 nymphs, Station II, Rio Chillon, Peru, 3-V-58, J. Illies; 1 nymph, Station III, Rio Chillon, Peru, 3-V-58, J. Illies; 7 nymphs, Irrigation Canal near Hacienda Ongoro, Peru, 16-V-58, J. Illies; 5 nymphs, Rio Amadugu near Ongoro, Peru, 16-V-58, J. Illies; 4 nymphs, Rio Sihuas near Arequipa, Peru, 17-V-58, J. Illies, above-noted paratypes in collection University of Utah; 14 nymphs, Station V, Rio Chillon, Peru, 1-V-58, J. Illies, 2 nymphs each in the following collections: California Academy of Sciences, San Francisco; Canadian National Collection, Ottawa; British Museum (Natural History), London; J. R. Traver, Amherst, Mass.; remainder in collection California State College at Los Angeles.

Remarks.—This species is named in honor of Joachim Illies, Max-Planck-Gesellschaft, Pion, Germany, who collected the types of this and the previously described species.

Leptopygites tuberculatus n. sp.

Nymph.—Length: body 5.0–6.0 mm; candal filaments 3.5–4.5 mm. General color yellow with black markings. Head yellow with black markings; a thin black line along posterior margin of head from compound eyes to epicranial sutures; a black design on front between compound eyes and bases of antennae; ocelli small; head with fine spicules; maxillary palpi three-segmented. Thoracic nota yellow with variable black markings; nota with fine spicules; legs yellow with black and brown markings; femora often with variable black maculae; tarsi with a brown band; femora with short spines (Fig. 46b); fore femoral band of spines as in Fig. 46c; hind femora 75%; longer than fore femora; hind femora with a round apical tubercle, ventral (leading) margin of middle and hind femora with small spines; tarsal claws with four to five small marginal denticles, and a palisade of four to five long submarginal denticles near apex (Fig. 46c). Abdominal terga yellow with black markings; terga often with black transverse bands and with darker paired sublateral maculae; terga with setae, especially segments 1–7; terga 5–9 with a round median tubercle (Fig. 47); operculate gills brown with pale margins; abdominal sternum yellow, sternum 7–9 often with black lateral margins. Candal filaments light brown.


Tricorythodes Ulmer

This genus is confined to the New World and is known from Uruguay to southern Canada. Trawler (1958a and 1959) characterized the adult stage. The nymph was first described by Needham (1905) as Caenis allicta, and later des-
cripitations were published by Traver (1931) and Burks (1953). The nymphal ecology, habit, and life history is discussed by Berner (1950).

The new species described in this paper are from geographical areas where the immature stage of described species are known, or from geographical areas where it would appear unlikely that they eventually will be found to be the nymphs of described adults. The specific characters which are useful in distinguishing the nymphs of this genus are: (1) the shape and the relative width to the length of the femora; (2) the shape and coloration of the operculate gills on segment 2; (3) the number and arrangement of the denticles on the tarsal claws; (4) color characters of the body and appendages; and (5) the presence or absence of tubercles and protuberances.

**Triocyrtobodes emendants n. sp.**

*Nymph.*—Length: body 3.0-4.0 mm; caudal filaments 1.0-2.0 mm. General color brown with black markings. Head brown; epicranial suture and posterior margin of head marked by a fine black line; head with long setae on margins of genae and clypeus; maxillary palp absent. Thoracic nota brown with variable black markings; nota margined with long setae; legs yellow; fore femora uni-convex yellow; middle and hind femora yellow with variable black markings; tibiae yellow with a black apical marking; tarsi yellow with black apical spot (Fig. 48a); fore femora less than twice as long as broad; fore leg as in Fig. 86a; hind femora 40%; longer than fore femora; tarsal claws with five to seven denticles (Fig. 48b). Abdominal tergum brown to yellow with black transverse bands; terga 1-5 brown; terga 7-10 yellow; tegu 9-10 often with a longitudinal median stripe; operculate gills rounded medially, and with a black U-shaped marking (Fig. 49); abdominal sternum yellow. Caudal filaments pale.

*Type.*—Holotype: mature nymph, Green River, Huleoat Canyon, Daggett Co., Utah, 11-EX-52, G. F. Emmonds, Jr., in collection University of Utah, Salt Lake City. Paratypes: 1 nymph, same data as holotype, 1 nymph in collection California State College at Los Angeles, remainder in collection University of Utah. Paratypes: 1 nymph, Rio Guayalajo, Tamaulipas Prov., Mexico, 22-XII-59, L. Berner, in collection University of Utah.

*Remarks.*—This species is named in honor of George F. Emmonds, Jr., University of Utah, Salt Lake City, who collected the holotype of this unusual species.

**Triocyrtobodes candens n. sp.**

*Male imago* (in alcohol).—Length: body 3.0-4.0 mm; fore wings 4.0-5.0 mm. Head brown. Thorax brown; legs brown to pale; fore: femora brown; fore tibiae light brown, dark brown apically and with a basal brown annulation; tarsi pale; middle and hind legs pale; wing translucent, brown at base; subcosta much darker than other longitudinal veins. Abdomen translucent white to opaque brown; segments 1-2 opaque brown, suffused with black; segments 3-7 translucent.
white; segments 8–10 opaque brown suffused with black; terga 4–7 each with an indistinct median macula; terga 8–9 each with a distinct median macula; terga 10 with a postmedian central whitish area (Fig. 54). Forelegs and forearms base pale; pretarsi fuscous. Thoracic plate with a prominent black mesocoxa (Fig. 55). Caudal filaments gray.

**Nymph.**—Length: body 4.0–5.0 mm; caudal filaments 3.0–4.0 mm. General color brown; head with short lateral frontoocypal tubercles, a frontal shelf, and genal projections; tubecules, frontal shelf, and genal projections covered with spinules (Fig. 51); maxillary palpi three-segmented. Thoracic nota margined with long setae; pronotum widest anteriorly and anterolaterally corners project anteriorly (Fig. 51); legs unicolorous brown; fore femora less than twice as long as broad; fore femoral band of spines as in Fig. 52a; hind femora 15% longer than fore femora; tarsal claws with a single subapical denticle (Fig. 52b). Abdominal terga pale with black markings; terga 1–2 suffused with black; terga 4–7 pale with a black median macula; terga 8–9 suffused with black and a black median macula; terga 10 suffused with black (Fig. 53); operculate gills pale, black at base with a black transverse line across basal margin (Fig. 50); abdominal sternum pale. Caudal filaments pale.

**Type.**—Holotype: mature nymph, North Fork White River at White River, Fort Apache Indian Reservation, Navajo Co., Arizona, 5-VII-64, R. K. Allen, in collection University of Utah, Salt Lake City. Paratypes: 5 male imagoes and 3 nymphs, same data as holotype, 2 nymphs each in the following collections: California Academy of Sciences, San Francisco; Canadian National Collection, Ottawa; British Museum (Natural History), London; J. R. Traver, Amherst, Mass., remainder in collection California State College at Los Angeles.


**Remarks.**—The adult and nymphal stages of *T. condylus* are positively associated as the male imagoes were reared from nymphs.

**Tricorythodes dimorphus n. ssp.**

**Tricorythodes** Edwards, Allen & Peters, 1965: pl. XIII, fig. 71

**Male nymph.**—Length: body 2.5–3.5 mm; caudal filaments 2.0–3.0 mm. General color yellow to light brown with black markings. Head yellow to light brown; compound eyes large (Fig. 57); maxillary palpi one-segmented, and with an apical seta. Thoracic nota yellow to light brown with irregular black markings; nota with scattered setae; legs yellow with black markings; femora with variable black markings; tibiae with a black apical macula; tarsi with a black apical spot (Fig. 58a); fore femora twice as long as broad; fore femoral band of spines as in Fig. 58a; hind femora 15% longer than fore femora; tarsal claws with six to eight marginal denticles, and a single submarginal denticle near apex (Fig. 16b). Abdominal terga yellow to light brown; terga 1–3 with a black transverse band; terga 7–9 occasionally with a black transverse band, band usually interrupted.
medially; terga 10 usually pale; operculum gills rounded mesally, and with a black apical marking (Fig. 56); abdominal sternum yellow. Caudal filaments yellow.

**Female nymph.—**Length: body 4.0–5.0 mm; caudal filaments 35–40 mm. General color brown. Compound eyes small. Other characters as in male except for usual sexual differences.


**Tricyrtobodes cristatus n. sv.**

**Nymph.—**Body 5.5–6.5 mm; caudal filaments 5.0–6.0 mm. General color black. Head black; head with a median crest on occiput, and small submedian tubercles medially compound eyes; without frontal shelf; frontoclypeal tubercles, or genal projection; head with short setae; pronotum with short median tubercle; mesonotum with a long median tubercle on anterior margin (Fig. 59); fore femoral band of spines as in Fig. 60a; fore femora more than twice as long as broad; subapical dorsal (hind) margin of femora saddle-shaped (Fig. 60a); hind femora 35% longer than fore femora; tarsal claws with 16–18 denticles (Fig. 60b). Abdominal terga black with pale markings; terga with long setae; operculum gills black; abdominal sternum black, often with black median maculae and lateral black margins. Caudal filaments brown.

**Types.—**Holotype: nearly mature nymph, Brook, Sierra Co. Mar., Brazil, F. Plaumann, V-64, in collection University of Utah, Salt Lake City. Paratypes: 3 nymphs same data as holotype, 2 nymphs in collection California State College at Los Angeles, remainder in collection University of Utah.

**Tricyrtobodes barbae n. sp.**

**Nymph.—**Length: body 7.0–8.0 mm; caudal filaments 3.5–4.5 mm. General color yellow and black. Head yellow with black markings on occiput; frons with a black triangle between bases of antennae; head with short genal projections and a short round frontal shelf, rows of long setae along margin of frontal shelf, on genal projections, and along lateral margin of head; maxillary palpi one-segmented. Troncatic nota black with variable yellow markings; nota margined with long setae; pronotum widest anteriorly and anterolateral corners project anteriorly; femora yellow with a black marking; fore femora more than twice as long as broad; fore femoral band of spines as in Fig. 61a; hind femora 53%, longer than fore femora; tarsal claws with one denticle (Fig. 61b). Abdominal terga black with variable yellow markings; terga 1–10 with long setae along posterior margin; segments 1–6 with a median row of long setae; segments 7–9 with sub-lateral rows medially and to the gills; operculum gills black; abdominal sternum suffused with black. Caudal filaments yellow, black at base.

**Types.—**Holotype: mature nymph, Rio Jucutings, Brazil, IV-62, F. Plaumann, in collection University of Utah, Salt Lake City. Paratypes: 1 nymph, same data as holotype, in collection California State College at Los Angeles.
The Canadian Entomologist

Tricyrtobodes sordidus sp. n.

Nymph.—Length: body 6.0-7.0 mm; caudal filaments 5.0-6.0 mm. General color yellow when light brown with dark brown and black markings. Head yellow to light brown with variable black markings on occiput and frons; maxillary palpi one-segmented. Thoracic nota black with yellow markings; pronotum black often with pale anterior and posterior margins; mesonotum black with variable pale markings; nota with long setae; legs yellow with black markings; fore femora with black markings; tibiae with a black apical macula (Fig. 62a); fore femora more than twice as long as broad, femoral band of spines as in Fig. 62b; hind femora 55%, longer than fore femora; tarsal claws with six to eight denticles (Fig. 62b). Abdominal terga black with yellow markings; segments 1–9 black, anterior and posterior margins often yellow; segment 10 yellow with variable black maculae; operculate gills dark brown with pale margins; abdominal sterna yellow. Caudal filaments yellow.


Tricyrto­bodes tailus sp. n.

Nymph.—Length: body 3.5-4.5 mm; caudal filaments 1.5-2.5 mm. General color brown with dark brown to black markings. Head brown, black markings on vertex: head with a median tubercle on occiput and small submedian tubercles medial to compound eyes (Fig. 63); head with long setae, maxillary palpi one-segmented. Thoracic nota brown with variable dark brown and black markings, pronotum with a long median tubercle near anterior margin; mesonotum with a long median tubercle between wing bases (Fig. 65); nota with long setae; legs brown, subapical dorsal hind margin of femora saddle-shaped (Fig. 64a); fore femora more than twice as long as broad; fore femoral band of spines as in Fig. 64b; hind femora 17%, longer than fore femora; tarsal claws with 9-11 denticles (Fig. 66b). Abdominal terga brown with black markings; segments 1-6 each with a black transverse stripe; segments 7-10 with a pale median longitudinal stripe and sublateral black maculae, usually in the shape of an inverted V; terga with long setae; operculate gills reddish brown with pale margins; abdominal sterna light brown. Caudal filaments brown.

Type.—Holotype: mature nymph, Nova Teconia, Brazil, III-62, F. Paulmann, in collection University of Utah, Salt Lake City. Para­type: 2 nymphs, same data as holotype, 3 nymphs in collection California State College at Los Angeles, remainder in collection University of Utah. Para­type: 1 nymph, Atirubasha River, Nova Teconia Brazil, XII-62, F. Paulmann, in collection University of Utah.

Acknowledgments

Grateful acknowledgment is made to G. F. Edmunds, Jr., University of Utah, for the loan of his entire collection of Leptotryphonæa, particularly the Peruvian material collected by W. L. Peters. I am grateful to Selwyn S. Rosack, Academy of Natural Sciences of Philadelphia; J. R. Traver, Anherst, Mass.; and James L. Packer, Tegucigalpa, Honduras, for the loan of nymphal material. I also thank Jerry J. Battaglia, California State College at Los Angeles, and Steve L. Jensen, University of Utah, for preparing the included illustrations.
SPECIALIZATION IN THE EGG STRUCTURE OF EXENTERUS (HYMENOPTERA: ICHEMNOIDAE) IN RELATION TO DISTRIBUTION AND ABUNDANCE

W. R. M. MAISON

Entomology Research Institute, Canada Department of Agriculture, Ottawa

Abstract


Like all other Tryphonidae, the European species of Exenterus have eggs that are attached to the wall of a cell which is a stalk inserted into the host integument. Their eggs present an interesting series of evolutionary steps from the typical tryphonine condition in which the egg has a small single stalk with a knob-like anchor to an extremely specialized condition in which the stalk is doubled and its two parts migrate to opposite ends of the egg; the anchoring part of the stalk is consequently enlarged until it half encloses the egg and functions as an extremely efficient organ of attachment to the host cuticle. In dry periods the simple type of stalk becomes brittle and easily broken, resulting in the death of the parasite. The specialized eggs with protected stalks are not subject to such hazards; thus species with specialized eggs can succeed in dryer climates and can better survive dry seasons. Correlated with these specializations is an increase in range of species, and greater abundance of individuals. The success of the European species introduced into North America for biological control has been roughly proportional to the amount of specialization in the egg structure. Little is known of the life histories of the American species of Exenterus but the few facts available do not appear to contradict the type of correlation exhibited by the European species.

Introduction

Most Ichneumonidae are endoparasitoids, that is, the adults lay their eggs inside the bodies of the host insects and the larvae complete development inside the host. Structural and physiological modifications enable the endoparasitoids to survive and develop successfully within the confines of a host. The evolution of specialized eggs in Ichneumonidae is an example of such adaptive radiation, and is of particular interest because it is closely related to the success of biological control using this group of insects.

References

(Received 13 December 1966)