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NEW SPECIES OF NEW WORLD LEPTOHYPHINAE (EPHEMEROPTERA: TRICORYTHIDAE)

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Abstract

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The genera *Leptohyphes* Eaton and *Tricorythodes* Ulmer are confined to the New World, and the Nearctic limits of *Leptohyphes* has been extended from Texas to Maryland and Utah. Useful nymphal characters are presented for both genera, and descriptions and figures are included for 22 new species of *Leptohyphes* Eaton, and 7 new species of *Tricorythodes* Ulmer.

A revision of New World Leptohyphinae 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 *Leptohyphes* 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 (1966), and their philosophy is expressed in this paper. Traver (1958a) reviewed and keyed the genera of Leptohyphinae.

Leptohyphes EATON

Leptohyphes 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

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Co., Md., in eastern North America, and Zion's National Park, Utah, in western North America.

Traver (1958*b*) characterized the adult stage and summarized the characters of the described species of the genus occurring north of the Amazon River. The nymph of *Leptohyphes* 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.

Leptohyphes 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. 2*b*); fore femora nearly as broad as long; fore femoral band of spines as in Fig. 2*a*; 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. 2*c*). Abdominal terga brown with black markings; terga 1 with a row of six black maculae; terga 2–6 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 posterolateral projections (Fig. 3); abdominal sterna brown with paired sublateral black dots on sterna 2–9. Caudal filaments brown.

Types.—Holotype: mature nymph, Dikes above Ellenton, Station 1, Savannah River, S.C., 2-IX-55, S. S. Roback, in collection Academy of Natural Sciences of Philadelphia. Paratypes: 1 nymph, Station 5, Savannah River, Georgia–South Carolina, 23-X-51, T. Dolan, IV; 1 nymph, Station 6A, Savannah River, Georgia–South Carolina, 21-VIII-55, S. S. Roback, same deposition as holotype.

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

Leptohyphes robacki N. SP.

Nymph.—Length: body 3.0–4.0 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 brown; legs yellow to light brown; femora with long, bifurcated spines (Fig. 5*b*); fore femoral band of spines as in Fig. 5*a*; hind femora 20% longer than fore femora; ventral (leading) margin of femora gently 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 sterna yellow to light brown with black markings. Caudal filaments yellow to light brown.

Types.—Holotype: nearly mature nymph, Potomac River, Station 2L, 4 mi below mouth of Monacacy, Montgomery Co., Md., 20/21-VIII-57, S. S. Roback, in collection of Academy of Natural Sciences of Philadelphia. Paratopotypes: 1 nymph, same data and deposition as holotype. Paratype: 1 nymph, Upper Three Runs Creek, Station 2, Savannah River, Georgia-South Carolina, 12-VI-51, T. Dolan, IV, same deposition as holotype.

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 5b), and by the shape and coloration of the abdomen (Figs. 3 and 4). The species *L. robacki* is named after Selwyn S. Roback, Academy of Natural Sciences, Philadelphia, Pa., the collector of the holotype.

Leptohyphes 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 between 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. 6b); fore femoral band of spines as in Fig. 6a; 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 irregular brown marking on segments 1-9, 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 sterna light brown; sterna 1-7 often with a median dark brown macula. Caudal filaments light brown, usually with a dark brown basal annulation.

Types.—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 California Academy of Sciences, San Francisco. Paratopotypes: 15 nymphs, same data as holotype, 4 in collection California Academy of Sciences, remainder in collection California State College at Los Angeles. Paratypes: 1 nymph, stream, 8 mi N. White River, Navajo Co., Arizona, 25-VI-51, S. J. Preece; 3 nymphs, White River, 4 mi N. White River, Navajo Co., Arizona, 25-VI-51, S. J. Preece; 11 nymphs, Taylor Creek, Santa Fe Natl. Forest, New Mexico, 26-VIII-37, C. M. Tarzwell; 1 nymph, Virgin River, Zion's Natl. Park, Utah, VI-47, G. F. Edmunds, Jr., above-noted paratypes in collection University of Utah, Salt Lake City; 2 nymphs, Beaver Creek at Beaver Creek Ranger Station, Yavapai Co., Arizona, 7-VII-64, R. K. Allen, in collection California State College at Los Angeles; 2 nymphs, San Francisco River at Clifton, Greenlee Co., Arizona, 4-VII-64, R. K. Allen, in collection California State College at Los Angeles.

Leptohyphes mirus n. sp.

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 brown, compound eyes large (Fig. 10); ocelli large; maxillary palpi one-segmented. Thoracic nota light brown to reddish brown, occasionally with irregular dark brown markings; legs brown; middle and hind femora with black streaks; 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 posterolateral projections (Fig. 8); abdominal sterna 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 usual sexual differences.

Types.—Holotype: mature male nymph, Rio Blanco, Arizona, 3-IV-37, J. G. Needham, in collection University of Utah, Salt Lake City. Allotype: mature female nymph, same data and deposition as holotype. Paratopotypes: 3 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.—*Leptohyphes mirus* 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).

Leptohyphes musseri n. sp.

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; occiput yellow; a narrow black stripe from posterior margin of compound eyes to posterior margin of head and mesad along posterior margin to near epicranial suture; a black stripe often present on frons between lateral ocelli; frons usually brown; head with fine spicules; ocelli small; maxillary palpi three-segmented. Thoracic nota yellow with variable black markings; nota with fine spicules; legs yellow with black maculae; fore femora with a subapical black macula; middle and hind femora with basal and subapical maculae; tibiae 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 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; 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 sublateral maculae (Fig. 13); terga with short spines; operculate gills pale, black at base; abdominal sterna pale. Caudal filaments pale with black annulations.

Types.—Holotype: mature nymph, Solola, Panajachel (1550 m elev.), Guatemala, 21-VIII-62, G. G. Musser, in collection University of Utah, Salt Lake City. Paratopotypes: 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, Amherst, 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. Musser, University of Michigan, Ann Arbor.

Leptohyphes packeri n. sp.

Nymph.—Length: body 3.5–4.5 mm; caudal filaments 3.0–4.0 mm. General color brown with pale markings. Head brown; frons with a triangular macula; epicranium often with a transverse row of pale spots; ocelli small; maxillary palpi three-segmented. Thoracic nota brown with pale macula; pronotum with distinct submedian maculae and pale laterally; mesonotum with distinct pale submedian maculae; legs yellow brown with brown markings; femora with a subapical brown macula; tibiae and tarsi with a brown band near base; femora with moderately long spines (Fig. 15*b*); fore femoral band of spines as in Fig. 15*a*; 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 pallsade of four to six submarginal denticles (Fig. 15*c*). Abdominal terga unicolorous brown; terga with long setae; operculate gills brown with pale maculae (Fig. 14); abdominal sterna brown. Caudal filaments brown.

Types.—Holotype: mature nymph, stream, 6.5 mi from junction of Highways #3 and #5 on Highway #5, Dept. Francisco Morazan, Honduras, 7-XI-64, J. S. Packer, in collection University of Utah, Salt Lake City. Paratopotype: 1 nymph, same data as holotype, in collection California State College at Los Angeles. Paratypes: 2 nymphs, 1 mi W. Campamento on Highway #2 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.

Leptohyphes castaneus n. sp.

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; frons dark brown; head with fine spicules; ocelli small; maxillary palpi three-segmented. Thoracic nota brown with variable dark brown markings; nota with fine spicules; legs brown; femora with moderately long spines (Fig. 16*b*); fore femoral band of spines as in Fig. 16*a*; 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. 16*c*). Abdominal terga unicolorous brown; terga 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. Musser, in collection University of Utah, Salt Lake City. Paratopotypes: 8 nymphs, same data as holotype, 2 nymphs in collection California State College at Los Angeles, remainder in collection University of Utah.

Remarks.—*Leptohyphes castaneus* has a brown abdomen similar to that described by Ulmer (1919) for the adult of *L. costaricanus* and may eventually be found to be the nymph of this species.

Leptohyphes murdocki 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 palpi 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. 17*b*); fore femoral band of spines as in Fig. 17*a*; 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. 17*c*). 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 sterna dark brown, suffused with black and with irregular pale markings. Caudal filaments brown with a black basal annulation.

Type.—Holotype: mature nymph, Rio Tocarcuna, Darien Prov., Panama, 30-V-63, W. P. Murdock, in collection University of Utah, Salt Lake City.

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

Leptohyphes namus 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. 10; maxillary palpi two-segmented. Thoracic nota yellow with black markings; pronotum suffused with black; legs unicolorous yellow; femora with moderately long spines (Fig. 18*b*); fore femoral band of spines as in Fig. 18*a*; 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 palisade of four to seven submarginal denticles (Fig. 18*c*). Abdominal terga yellow, lightly suffused with black; terga with a few scattered setae; operculate gills black, pale apically; abdominal sterna pale. Caudal filaments pale with a black basal band.

Types.—Holotype: nearly mature nymph, Rio Pedro Niquel, Green Park on Madden Road, Canal Zone, 1-IX-63, 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-63, W. L. Peters and C. M. Keenan, in collection California State College at Los Angeles.

Leptohyphes plaumanni n. sp.

Leptohyphes sp. Edmunds, Allen and Peters 1963: pl. XIV, fig. 72.

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 palpi 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. 1*a*); fore femoral band of spines as in Fig. 1; hind femora 95% longer than fore

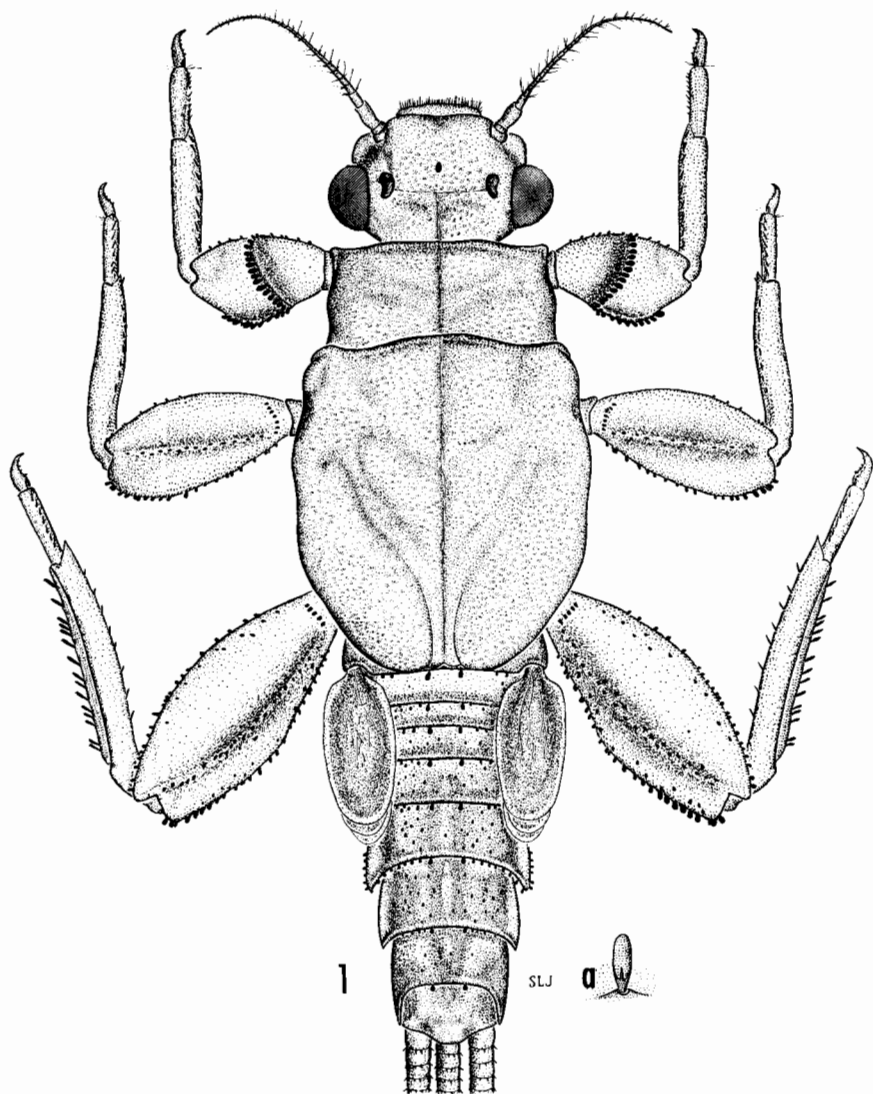


FIG. 1. *Leptohyphes plaumanni*, mature nymph, dorsal view. 1a, fore femoral spine.

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. Plaumann, in collection University of Utah, Salt Lake City. Paratopotypes: 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. Traver, Amherst, Mass. Paratypes: 1 nymph, Cachimbo, Lag. Carangeira, 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 Serra Mantiqueira, Aguas 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.

Leptohyphes cornutus N. SP.

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 maculae near apex; tibiae pale with a large black macula; tarsi pale with a black basal band (Fig. 19a); mesothoracic leg with a long coxal tubercle; femora with short spines (Fig. 19b); 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 sterna black with irregular pale markings. Caudal filaments brown.

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

Leptohyphes undulatus N. SP.

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; a black band on frons between compound eyes; ocelli small; maxillary palpi one-segmented, palpi usually with an apical seta. Thoracic nota light brown to dark 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 submarginal 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 posterolateral projections on segments 7–9 (Fig. 22); operculate gills brown with a pale transverse line near apex (Fig. 23); abdominal sterna 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. Paratopotype: 1 nymph, same data and deposition as holotype. Paratypes: 1 nymph, Campos de Palmas, Luj. da Taipa (1200 m), Parana, Brazil, III-63, F. Plaumann; 59 nymphs,

Guapuava, Rio Coitinho (1100 m), Parana, Brazil, III-63, F. Plaumann, 10 nymphs in collection California State College at Los Angeles; 2 nymphs 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.

Leptohyphes 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 spicules; lateral ocelli small; maxillary palpi three-segmented. Thoracic nota brown and usually with irregular black markings; nota with fine spicules; 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. 24*b*); femoral band of spines as in Fig. 24*a*; 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. 24*c*). 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 sterna brown, often purplish brown. Caudal filaments brown.

Types.—Holotype: mature nymph, Rio Supte Grande, 10 km E. Tingo Maria, San Martin Province, Peru, 26-VI-63, W. L. Peters, in collection University of Utah, Salt Lake City. Paratopotypes: 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, Amherst, Mass.

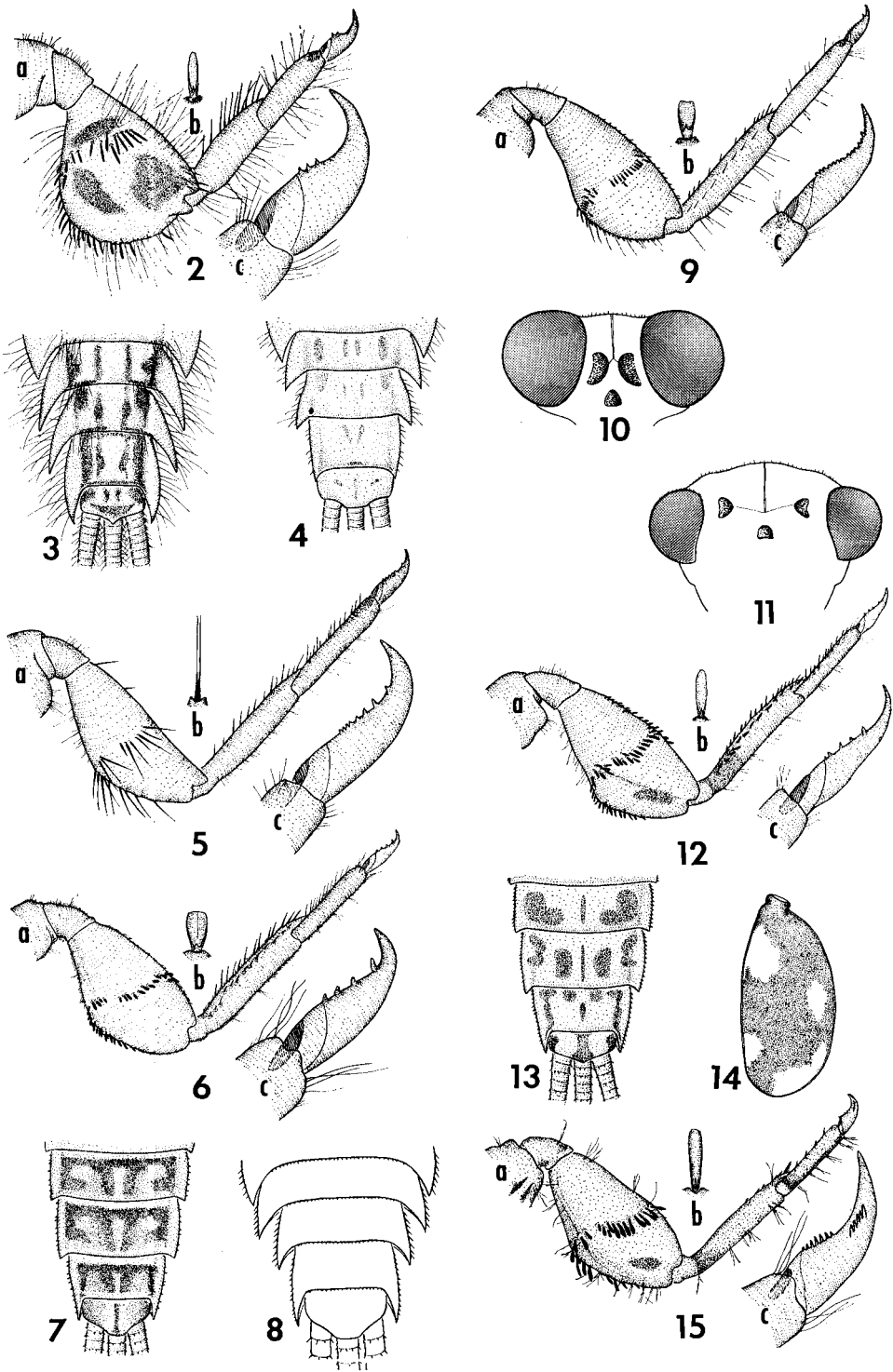
Remarks.—This species is named in honor of my daughter, Jody Anne Allen.

Leptohyphes gibbus n. sp.

Leptohyphes sp. B. Traver 1944: 16.

Nymph.—Length: body 1.5–2.5 mm; caudal filaments 0.5–1.0 mm. General color yellow with brown and black markings. Head yellow; occiput roughened; a median carina between compound eyes; ocelli small; maxillary palpi absent. Thoracic nota yellow with variable black markings; prothorax depressed anteriorly; mesothorax with submedian ridges and apex of wing pads elevated forming paired submedian humps (Fig. 26); femora brown; tibiae and tarsi dark

FIGS. 2–3. *Leptohyphes dolani*: 2*a*, right fore leg; 2*b*, fore femoral spine; 2*c*, tarsal claw; 3, abdominal terga 7–10. FIGS. 4–5. *L. robacki*: 4, abdominal terga 7–10; 5*a*, right fore leg; 5*b*, fore femoral spine; 5*c*, tarsal claw. FIGS. 6–7. *L. apache*: 6*a*, right fore leg; 6*b*, fore femoral spine; 6*c*, tarsal claw; 7, abdominal terga 7–10. FIGS. 8–11. *L. mirus*: 8, abdominal terga 7–10; 9*a*, right fore leg; 9*b*, fore femoral spine; 9*c*, tarsal claw; 10, head, male nymph; 11, head, female nymph. FIGS. 12–13. *L. musseri*: 12*a*, right fore leg; 12*b*, fore femoral spine; 12*c*, tarsal claw; 13, abdominal terga 7–10. FIGS. 14–15. *L. packeri*: 14, operculate gill; 15*a*, right fore leg; 15*b*, fore femoral spine; 15*c*, tarsal claw.



brown, light brown basally and apically; femora with short spines (Fig. 25*b*); fore femoral band of spines as in Fig. 25*a*; 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. 25*c*). Abdominal terga yellow with variable black markings; terga 5-9 with median tubercles; tubercles well developed on terga 5-8, small of terga 9; operculate gills yellow, black at base; abdominal sterna yellow. Caudal filaments yellow.

Types.—Holotype: mature nymph, Nova Teutonia, Brazil, XI-63, F. Plaumann, in collection University of Utah, Salt Lake City. Paratopotypes: 2 nymphs, same data and deposition as holotype. Paratype: 1 nymph, Cachoeirinha Brook, Ourofino, Minas Gerais, Brazil, 22-VIII-40, H. Kleerekoper, in collection J. R. Traver, Amherst, Mass.

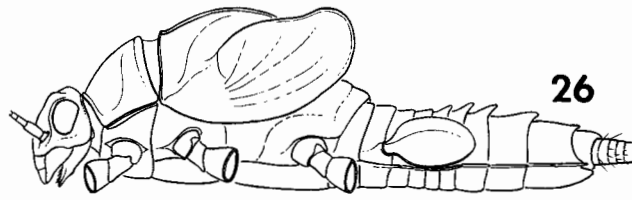
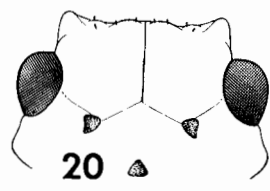
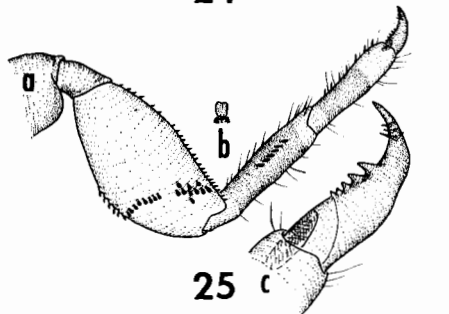
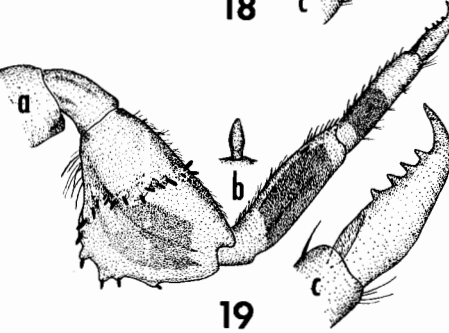
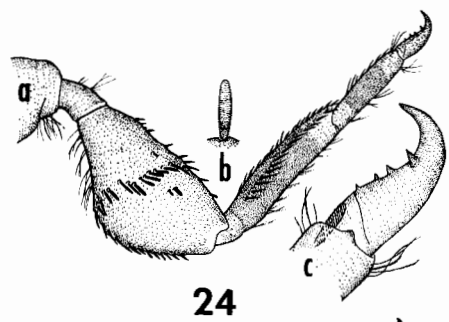
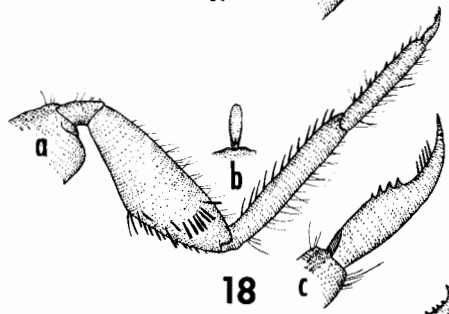
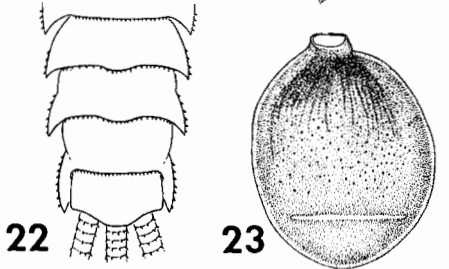
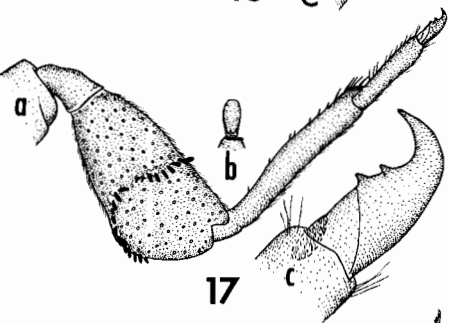
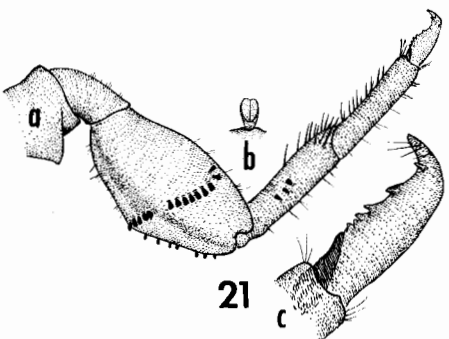
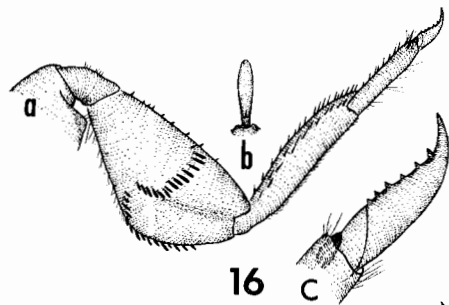
Remarks.—The ecology of this species is described by Traver (1944).

Leptohyphes maculatus N. sp.

Male subimago (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; terga 2-10 with a median black macula (Fig. 29); abdominal sterna pale. Penes of the *petersoni*-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; occiput with irregular black markings; a black band on frons between compound eyes; ocelli small; head with long setae; maxillary palpi 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. 27*b*); fore femoral band of spines as in Fig. 27*a*; 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. 27*c*). Abdominal terga brown, suffused with black; terga 2-10 each with a median black macula, maculae most conspicuous on terga 5-10 (Fig. 28); operculate gill brown, pale in middle; abdominal sterna yellow, often suffused with black; sterna 2-9 often with

FIG. 16. *Leptohyphes castaneus*: 16*a*, right fore leg; 16*b*, fore femoral spine; 16*c*, tarsal claw. FIG. 17. *L. murdocki*: 17*a*, right fore leg; 17*b*, fore femoral spine; 17*c*, tarsal claw. FIG. 18. *L. nanus*: 18*a*, right fore leg; 18*b*, fore femoral spine; 18*c*, tarsal claw. FIGS. 19-20. *L. cornutus*: 19*a*, right fore leg; 19*b*, fore femoral spine; 19*c*, tarsal claw; 20, head, male nymph. FIGS. 21-23. *L. undulatus*: 21*a*, right fore leg; 21*b*, fore femoral spine; 21*c*, tarsal claw; 22, abdominal terga 7-10; 23, operculate gill. FIG. 24. *L. jodiannae*: 24*a*, right fore leg; 24*b*, fore femoral spine; 24*c*, tarsal claw. FIGS. 25-26. *L. gibbus*: 25*a*, right fore leg; 25*b*, fore femoral spine; 25*c*, tarsal claw; 26, nymphal head, thorax, and abdomen, lateral view.



a median and paired lateral black maculae. Caudal filaments light brown with a basal dark brown annulation.

Types.—Holotype: mature nymph, Rio Huallaga, Tingo Maria, Huanuco Prov., Peru, 10/12-VII-63, W. L. Peters, in collection University of Utah, Salt Lake City. Paratopotypes: 1 male subimago and 6 nymphs, 10-VII/19-VIII-63, other data and deposition same as holotype. Paratypes: 1 nymph, Rio Previsto, 32 km W. Aguaytia, Loreto Prov., Peru, 16-VII-63, W. L. Peters; 2 nymphs, Rio Yurac, 1 km S. Aguaytia, Loreto Prov., Peru, 16-VII-63, W. L. Peters; 1 nymph, stream, 1 km W. Hotel Turistas, Tingo Maria, Huanuco Prov., Peru, 22-VI-63, W. L. Peters; 4 nymphs, Cqa. LaCueva, 6 km W. Tingo Maria, Huanuco Prov., Peru, 24-VI-63, W. L. Peters; 1 nymph, Rio Rondos, km 14 on Monzon Road, Huanuco Prov., Peru, 25-VI-63, W. L. Peters; 8 nymphs, Rio Tulumayo, 20 km E. Tingo Maria, San Martin Prov., Peru, 23/28-VI-63, W. L. Peters; 7 nymphs, Rio Pendescia, Tulumayo Valley, San Martin Prov., Peru, 23-VI-63, W. L. Peters, above-noted paratypes in collection University of Utah; 1 nymph, Tingo Maria, Monzon Valley, Peru, 23-XII-54, E. I. Schlinger and E. S. Ross, in collection California Academy of Sciences, San Francisco; 23 nymphs, Rio Bella jct. Rio Monzon, Monzon Valley, Huanuco Prov., Peru, 25-VIII-63, W. L. Peters, 5 nymphs in collection California State College at Los Angeles, 2 nymphs each in the following collections: California Academy of Sciences, San Francisco; Canadian National Collection, Ottawa; British Museum (Natural History), London; and J. R. Traver, Amherst, Mass., remainder in collection University of Utah.

Remarks.—The male subimagos herein described as *Leptohyphes 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 maculae on the abdominal terga of both of these stages also indicates that this association is correct (Figs. 28–29).

Leptohyphes setosus 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 wide black band between ocelli and compound eyes; bases of antennae black. Pronotum pale with a thin black line along posterior margin; mesonotum brown; pleurae brown with black markings; thoracic sterna pale; wings opaque; venation pale (crossveins indistinct); hind wing with a long costal projection; 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 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 epicranial suture; occiput often with paired sublateral black maculae; a black band on frons between compound eyes; head with short setae; maxillary palpi 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. 30*b*) and long setae; fore femoral band of spines as in Fig. 30*a*; hind femora 65% 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. 30c). 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. 31); terga with long setae; operculate gills pale, black at base; abdominal sterna 1-6 with small sublateral black maculae; sterna 7-9 with black lateral margins. Caudal filaments brown, often with dark brown basal annulations.

Types.—Holotypes: mature nymph, Rio Huallaga, Tingo Maria, Huanuco Prov., Peru, 14/16-VIII-63, W. L. Peters, in collection University of Utah, Salt Lake City. Paratopotypes: 7 male subimagoes, 2 female subimagoes, and 13 nymphs, 10-VII/19-VIII-63, other data and deposition same as holotype. Paratypes: 7 nymphs, Rio Pendescia, 24 km E. Tingo Maria, San Martin Prov., Peru, 14/18-VI-63, W. L. Peters; 10 nymphs, Rio Aguaytia, Aguaytia, Loreto Prov., Peru, 15-VIII-64, W. L. Peters; 27 nymphs, Rio Yurac, 1 km S. Aguaytia, Loreto Prov., Peru, 16-VII-63, W. L. Peters; 2 nymphs, Rio Bella jct. Rio Monzon, Monzon Valley, Huanuco Prov., Peru, 25-VII-63, W. L. Peters; 3 nymphs, Rio Yurac, 126 km de Tingo Maria, Peru, 4-X-63, M. Pandura; 23 nymphs, Rio Supte Grande, 10 km E. Tingo Maria, San Martin Prov., Peru, 26-VI-63, W. L. Peters, above-noted paratypes in collection University of Utah; 98 nymphs, Rio Tulumayo, 20 km E. Tingo Maria, San Martin Prov., Peru, 23-VI/14-VIII-63, W. L. Peters, 10 nymphs in collection California State College at Los Angeles, 2 nymphs each in the following collections: California Academy of Sciences, San Francisco; Canadian National Collection, Ottawa; British Museum (Natural History), London; and J. R. Traver, Amherst, Mass., remainder in collection University of Utah.

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 5-9 of both of these stages (Figs. 31-32) which strongly indicates that this association is correct.

Leptohyphes rallus n. sp.

Nymph.—Length: body 3.5-4.5 mm; caudal filaments 2.0-3.0 mm. General color brown, occasionally with irregular black markings. Head brown; lateral ocelli large (Fig. 33); maxillary palpi two-segmented. Thoracic nota brown, occasionally with brown and black markings; legs brown; femora with moderately long spines (Fig. 34b); fore femoral band of spines as in Fig. 34a; hind femora 35% longer than fore femora; anterior surface of middle and hind femora with scattered setae; ventral (leading) margin of middle and hind femora without spines; dorsal margin of hind tibiae with long spines; 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; operculate 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. Paratopotypes: 8 nymphs, same data and deposition as holotype. Paratypes: 4 nymphs, Rio Yurac, 126 km N. de Tingo Maria, Peru, 4-X-63, M. Pandura; 1 nymph, Rio Rondos, km 14 on Monzon Road, Huanuco Prov., Peru, 25-VI-63, W. L. Peters; 1 nymph, Rio Pendescia, Tulumayo Valley, San Martin Prov., Peru, 22-VII-63, W. L. Peters; 2 nymphs, Cqa. LaCueva, 6 km W. Tingo Maria, Huanuco Prov., Peru, 24-VI-63, W. L. Peters, above-noted paratypes in

collection University of Utah; 7 nymphs, Rio Tulumayo, 20 km E. Tingo Maria, San Martin Prov., Peru, 19-VII-63, W. L. Peters, 5 nymphs in collection California State College at Los Angeles, remainder in collection University of Utah; 8 nymphs, Rio Supte Grande, 10 km E. Tingo Maria, San Martin Prov., Peru, 26-VI-63, 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.

Leptohyphes petersi n. sp.

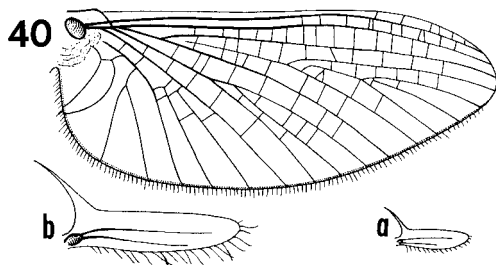
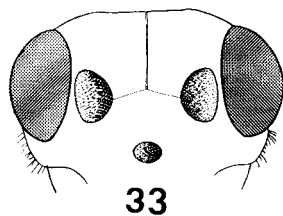
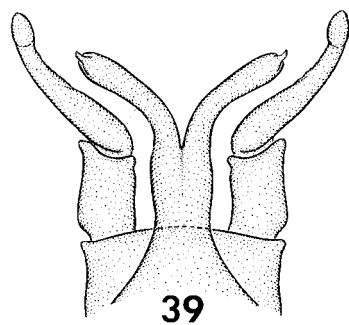
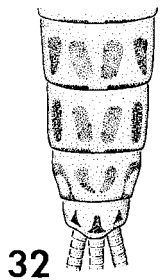
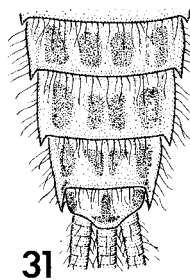
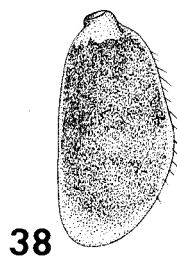
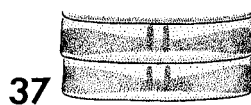
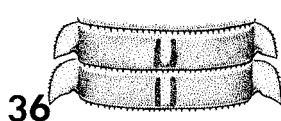
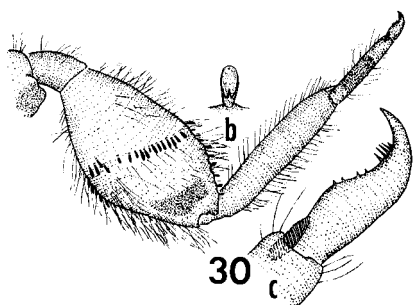
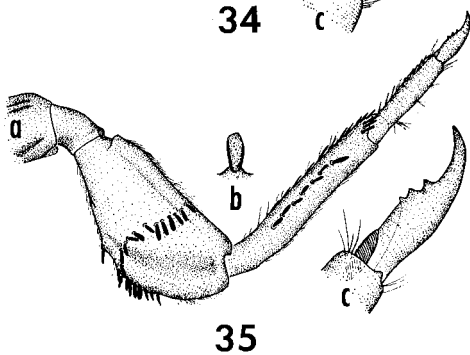
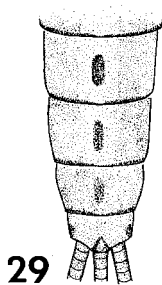
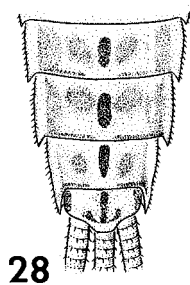
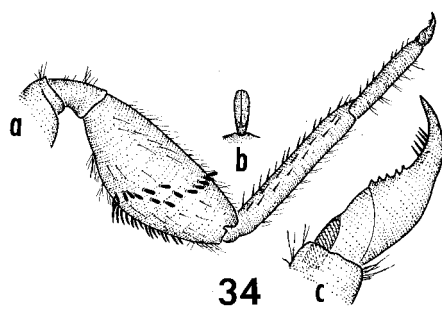
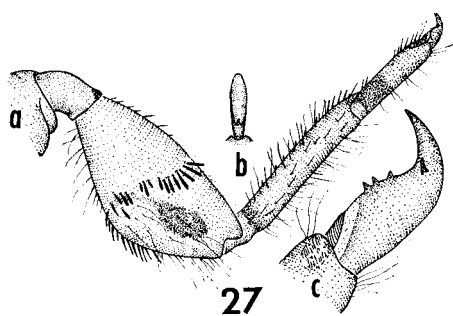
Leptohyphes nymph No. 2 Needham and Murphy 1924: 34.

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; meso- and meta-notum light brown; pleurae light brown, black anterior to base of fore wing; sutures pale; thoracic sterna black; wings semi-hyaline, opaque between C and R₁; venation brown; 54–74 crossveins behind R₁ (Fig. 40); hind wing with two longitudinal veins and a long thin costal projection (Fig. 40a, b); femora black; tibiae 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. 37); terga 7–10 black; abdominal sterna black with pale spots, often with parallel submedian pale spots. Penes with a deep median notch, and each penis lobe with a small apical projection; basal segment of genital forceps broad (Fig. 39). 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 dark brown and black markings. Head brown with black markings; vertex with irregular black markings; a black band on frons between compound eyes; head with fine spicules; ocelli small; maxillary palpi three-segmented. Thoracic nota brown with variable dark brown and black markings; nota with fine spicules; legs unicolorous 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; tarsal claws with three to five marginal denticles (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

Figs. 27–29. *Leptohyphes maculatus*: 27a, right fore leg; 27b, fore femoral spine; 27c, tarsal claw; 28, abdominal terga 7–10, nymph; 29, abdominal terga 7–10, male imago. Figs. 30–32. *L. setosus*: 30a, right fore leg; 30b, fore femoral spine; 30c, tarsal claw; 31, abdominal terga 7–10, nymph; 32, abdominal terga 7–10, male imago. Figs. 33–34. *L. rallus*: 33, head, male nymph; 34a, right fore leg; 34b, fore femoral spine; 34c, tarsal claw. Figs. 35–40. *L. petersi*: 35a, right fore leg; 35b, fore femoral spine; 35c, tarsal claw; 36, abdominal terga 4–5, nymph; 37, abdominal terga 4–5, male imago; 38, operculate gill; 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. 38); abdominal sterna black with parallel submedian black longitudinal dashes on sterna 2-7. Caudal filaments brown.

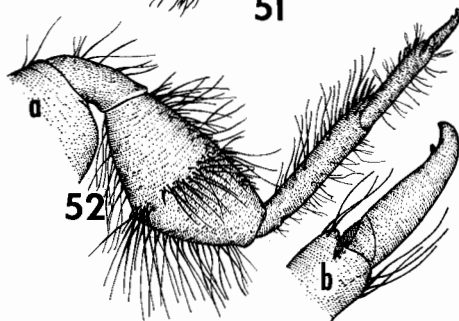
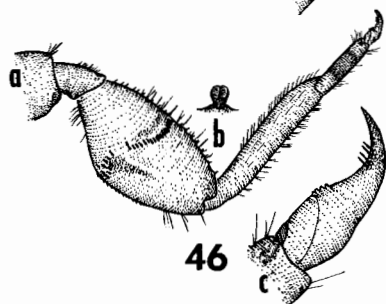
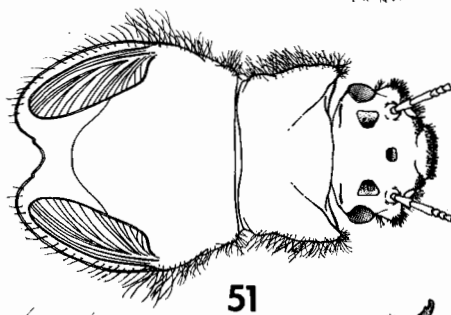
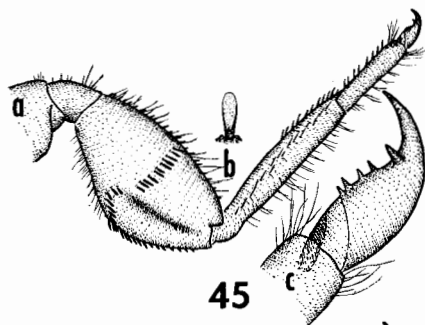
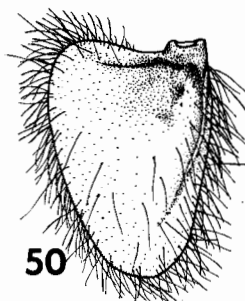
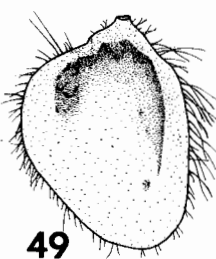
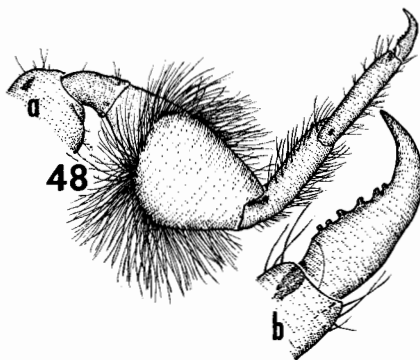
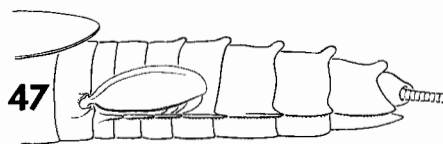
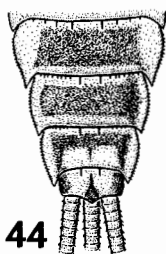
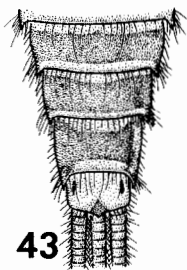
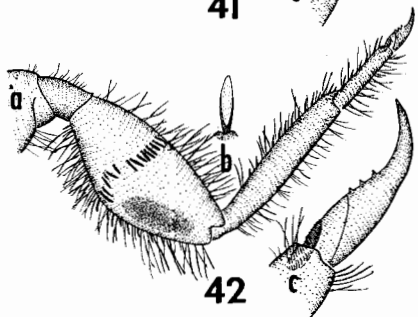
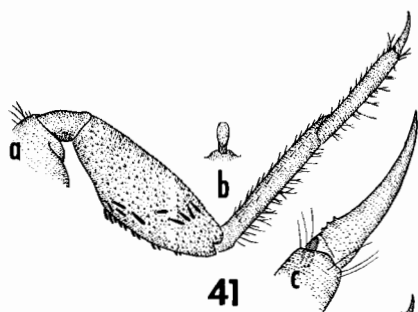
Types.—Holotype: male imago, Rio Huallaga, Tingo Maria, Huanuco Prov., Peru, 11/12-VIII-63, W. L. Peters, in collection University of Utah, Salt Lake City. Allotype: female imago, same data and deposition as holotype. Paratopotypes: 511 male imagoes, 12 female imagoes, and 43 nymphs, 10-VII/19-VIII-63, W. L. Peters, other data same as holotype, 25 male imagoes, 2 female imagoes, and 15 nymphs in collection California State College at Los Angeles, 2 male imagoes and 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 University of Utah. Paratypes: 13 nymphs, Rio Pendescia, Tulumayo Valley, San Martin Prov., Peru, 14-VI/22-VII-63, W. L. Peters; 1 nymph, Boqueron Abad, Peru, 6-IV/5-V-62, J. Sehunke; 1 nymph, Rio Yurac, 1 km S. Aquaytia, Loreto Prov., Peru, 16-VII-63, W. L. Peters; 3 nymphs, Rio Previsto, 32 km W. Aguaytia, Loreto Prov., Peru, 19-VII-63, W. L. Peters; 11 nymphs, Rio Bella jct. Rio Monzon, Monzon Valley, Huanuco Prov., Peru, 25-VII-63, W. L. Peters; 6 nymphs, Rio Rondos, km 4 on Monzon Road, Huanuco Prov., 25-VI-63, W. L. Peters; 1 male imago and 1 nymph, Cqa. LaCueva, 6 km W. Tingo Maria, Huanuco Prov., Peru, 12-VIII-63, W. L. Peters; 40 nymphs, Rio Tulumayo, 20 km E. Tingo Maria, San Martin Prov., Peru, 28-VI/14-VIII-63, W. L. Peters, above-noted paratypes in collection University of Utah; 1 nymph, Camino del Pichis, Peru, 4-VII-20, J. C. Bradley, in collection Cornell University, Ithaca, N.Y.

Remarks.—*Leptobryphes petersi* 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.

Leptobryphes asperulus 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; occiput with irregular black markings; a black band on frons between compound eyes; lateral ocelli large as in Fig. 33; maxillary palpi 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 tibiae 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

FIG. 41. *Leptobryphes asperulus*: 41a, right fore leg; 41b, fore femoral spine; 41c, tarsal claw. FIGS. 42-43. *L. comatus*: 42a, right fore leg; 42b, fore femoral spine; 42c, tarsal claw; 43, abdominal terga 7-10. FIGS. 44-45. *L. illiesi*: 44, abdominal terga, 7-10; 45a, right fore leg; 45b, fore femoral spine; 45c, tarsal claw. FIGS. 46-47. *L. tuberculatus*: 46a, right fore leg; 46b, fore femoral spine; 46c, tarsal claw; 47, nymphal abdomen, lateral view. FIGS. 48-49. *Tricorythodes edmundsi*: 48a, right fore leg; 48b, tarsal claw; 49, operculate gill. FIGS. 50-52. *T. condylus*: 50, operculate gill; 51, nymphal head and thorax, dorsal view; 52a, right fore leg; 52b, tarsal claw.



at apex; abdominal sterna yellow; with paired sublateral black maculae. Caudal filaments yellow.

Type.—Holotype: nearly mature nymph, Rio Pendescia, Tulumayo 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.

Leptohyphes comatus n. sp.

Leptohyphes sp. Illies, 1965: fig. 3E

Nymph.—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 frons between compound eyes and bases of antennae; ocelli small; head with long setae; maxillary palpi 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 maculae; 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 sterna yellow with black median longitudinal stripe. Caudal filaments yellow, often with black basal annulations.

Types.—Holotype: mature nymph, Rio Huallaga, Station V, near Huanuco, Peru, 25-V-58, J. Illies, in collection University of Utah, Salt Lake City. Paratopotypes: 16 nymphs, same data as holotype, 1 nymph each in the following collections: J. Illies, 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 Illies (1965).

Leptohyphes illiesi n. sp.

Nymph.—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 palpi three-segmented. Thoracic nota brown with variable black markings; legs brown; femora with a black longitudinal line; femora with moderately long spines (Fig. 45b); fore femoral band of spines as in Fig. 45a; 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. 45c). 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 posterolateral projections (Fig. 44); abdominal sterna brown with a diffuse black median marking. Caudal filaments brown.

Types.—Holotype: mature nymph, Station IV, Rio Chillon, Peru, 3-V-58, J. Illies, in collection University of Utah, Salt Lake City. Paratopotypes: 8 nymphs, same data as holotype, 4 in collection J. Illies, Plön, Germany, and 4 in collection California State College at Los Angeles. Paratypes: 6 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 Anadago 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, 3-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, Plön, Germany, who collected the types of this and the previously described species.

Leptohyphes tuberculatus N. sp.

Nymph.—Length: body 5.0–6.0 mm; caudal 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 suture; a black design on frons 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. 46*b*); fore femoral band of spines as in Fig. 46*a*; 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 submaginal denticles near apex (Fig. 46*c*). Abdominal terga yellow with black markings; terga often with black transverse bands and with darker paired sublateral maculae; terga with setae, especially segments 1–5; terga 5–9 with a round median tubercle (Fig. 47); operculate gills brown with pale margins; abdominal sterna yellow, sterna 7–9 often with black lateral margins. Caudal filaments light brown.

Types.—Holotype: mature nymph, Rio Huallaga, Tingo Maria, Huanuco Prov., Peru, 14/16-VIII-63, W. L. Peters, in collection University of Utah, Salt Lake City. Paratopotypes: 14 nymphs, 10-VII/16-VIII-63, other data same as holotype, 7 nymphs in collection California State College at Los Angeles, remainder in collection University of Utah. Paratypes: 1 nymph, Cqa. LaCueva, 6 km W. Tingo Maria, Huanuco Prov., Peru, 6-VIII-63, W. L. Peters; 2 nymphs, Rio Aguaytia, Aguaytia, Loreto Prov., Peru, 23-VI-63, W. L. Peters; 4 nymphs, Rio Pendescia, 24 km E. Tingo Maria, Tulumayo Valley, San Martin Prov., Peru, 23-VI/22-VII-63, W. L. Peters; 3 nymphs, Rio Rondos, km 14 on Monzon Road, Huanuco Prov., Peru, 25-VI-63, W. L. Peters; 2 nymphs, Rio Tulumayo, 20 km E. Tingo Maria, San Martin Prov., Peru, 23-VI-63, W. L. Peters; paratypes deposited in collection University of Utah.

Tricorythodes ULMER

This genus is confined to the New World and is known from Uruguay to southern Canada. Traver (1958*a* and 1959) characterized the adult stage. The nymph was first described by Needham (1905) as *Caenis allecta*, and later des-

criptions were published by Traver (1935) 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.

Tricorythodes edmundsi 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 palpi absent. Thoracic nota brown with variable black markings; nota margined with long setae; legs yellow; fore femora unicolorous yellow; middle and hind femora yellow with variable black markings; tibiae yellow with a black apical macula; tarsi yellow with black apical spot (Fig. 48a); fore femora less than twice as long as broad; fore leg as in Fig. 48a; hind femora 40% longer than fore femora; tarsal claws with five to seven denticles (Fig. 48b). Abdominal terga brown to yellow with black transverse bands; terga 1–6 brown; terga 7–10 yellow; terga 9–10 often with a longitudinal median stripe; operculate gills rounded mesally, and with a black U-shaped marking (Fig. 49); abdominal sterna yellow. Caudal filaments pale.

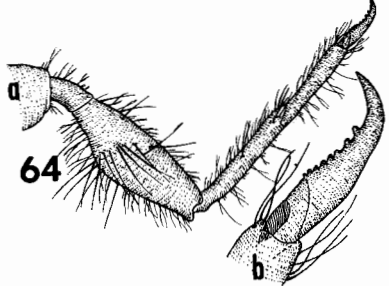
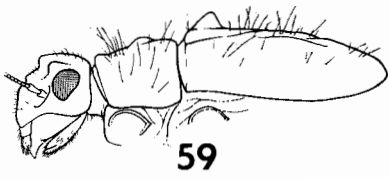
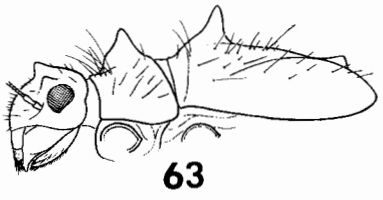
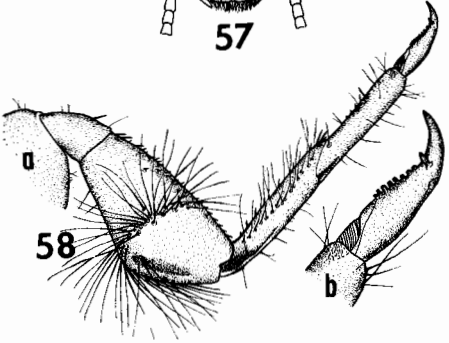
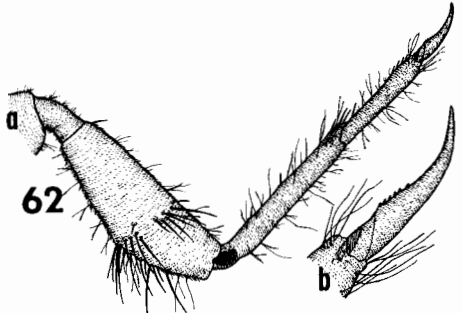
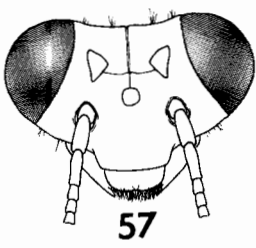
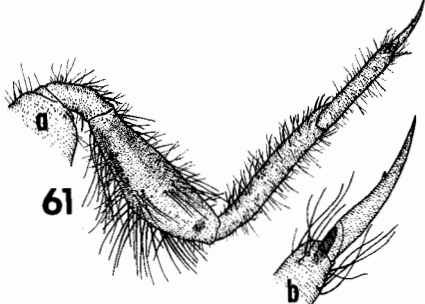
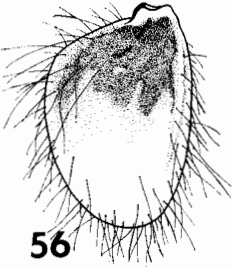
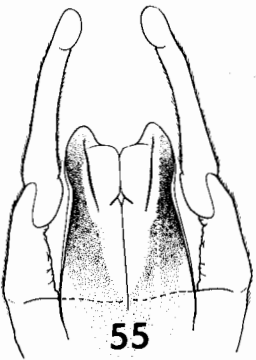
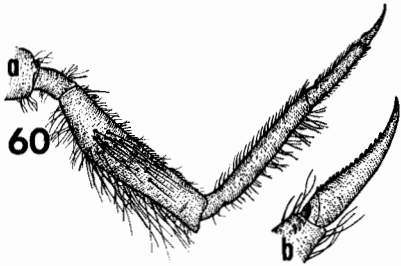
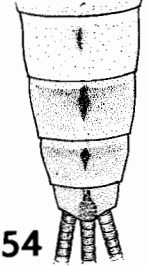
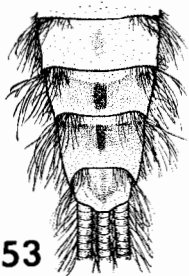
Types.—Holotype: mature nymph, Green River, Hideout Canyon, Daggett Co., Utah, 11-IX-52, G. F. Edmunds, Jr., in collection University of Utah, Salt Lake City. Paratopotypes: 8 nymphs, same data as holotype, 3 nymphs in collection California State College at Los Angeles, remainder in collection University of Utah. Paratypes: 11 nymphs, Rio Guayalejo, Tamaulipas Prov., Mexico, 22-XII-39, L. Berner, in collection University of Utah.

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

Tricorythodes condylus 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

FIGS. 53–55. *Tricorythodes condylus*: 53, abdominal terga 7–10, nymph; 54, abdominal terga 7–10, male imago; 55, male genitalia, dorsal view. FIGS. 56–58. *T. dimorphus*: 56, operculate gill; 57, nymphal head, front view; 58a, right fore leg; 58b, tarsal claw. FIGS. 59–60. *T. cristatus*: 59, nymphal head and thorax, lateral view; 60a, right fore leg; 60b, tarsal claw. FIG. 61. *T. barbatus*: 61a, right fore leg; 61b, tarsal claw. FIG. 62. *T. sordidus*: 62a, right fore leg; 62b, tarsal claw. FIGS. 63–64. *T. bullus*: 63, nymphal head and thorax, lateral view; 64a, right fore leg; 64b, tarsal claw.



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 posteromedian chitinized area (Fig. 54). Forceps and forceps base pale; penes fused nearly to apex; each penis lobe with a chitinized band and marked with black (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 frontoclypeal tubercles, a frontal shelf, and genal projections; tubercles, frontal shelf, and genal projections covered with spicules (Fig. 51); maxillary palpi three-segmented. Thoracic nota margined with long setae; prothorax widest anteriorly and anterolateral 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 35% 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 sterna pale. Caudal filaments pale.

Types.—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. Paratopotypes: 3 male imagoes and 36 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. Paratypes: 1 nymph, White River, 8 mi N. White River, Navajo Co., Arizona, 25-VI-51, S. Preece; 5 nymphs, E. Fk. Black River, below 3 Forks Apache Natl. Forest, Greenlee Co., Arizona, 24-VI-37, C. M. Tarzwell; 22 nymphs, Black River, Apache Natl. Forest, Greenlee Co., Arizona, 23-VI-37, C. M. Tarzwell; 47 nymphs, E. Fk. Buffalo, Black River Apache Natl. Forest, Greenlee Co., Arizona, 1-VII-37, C. M. Tarzwell; 2 nymphs, Oak Creek, Sedona, Coconino Co., Arizona, 23-VI-51, S. Preece, above-noted paratypes in collection University of Utah; 169 nymphs, Little Colorado River on Highway 73, Apache Natl. Forest, Apache Co., Arizona, 3-VII-64, R. K. Allen, 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. sp.

Tricorythodes? Edmunds, Allen & Peters, 1963: 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. 58b). Abdominal terga yellow to light brown; terga 1-6 with a black transverse band; terga 7-9 occasionally with a black transverse band, band usually interrupted

medially; terga 10 usually pale; operculate gills rounded mesally, and with a black apical marking (Fig. 56); abdominal sterna yellow. Caudal filaments yellow.

Female nymph.—Length: body 4.0–5.0 mm; caudal filaments 3.0–4.0 mm. General color brown. Compound eyes small. Other characters as in male except for usual sexual differences.

Types.—Holotype: mature male nymph, Beaver Creek at Beaver Creek Rangers Station, Coconino Natl. Forest, Yavapai Co., Arizona, 7-VII-64, R. K. Allen, in collection California Academy of Sciences, San Francisco. Allotype: mature female nymph, same data and deposition as holotype. Paratopotypes: 2 male and 5 female nymphs, same data as holotype, in collection California State College at Los Angeles. Paratypes: 1 male nymph, Red River, Carson Natl. Forest, Taos Co., New Mexico, 28-VII-37, C. M. Tarzwell; 1 male nymph, Middle Fk. Black River, Apache Natl. Forest, Greenlee Co., Arizona, 23-VI-37, C. M. Tarzwell, above-noted paratypes in collection University of Utah; 2 male nymphs, Oak Creek at Red Rock Crossing, Coconino Natl. Forest, Yavapai Co., Arizona, 7/8-VII-64, R. K. Allen, in collection California State College at Los Angeles.

Tricorythodes cristatus N. sp.

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 mesad to compound eyes; without frontal shelf, frontoclypeal tubercles, or genal projections; head with short setae; pronotum with a 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; operculate gills black; abdominal sterna black, often with black median maculae and lateral black margins. Caudal filaments brown.

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

Tricorythodes barbatus 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. Thoracic 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 55% 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 3–6 with a median row of long setae; segments 7–9 with sub-lateral rows mesad to the gills; operculate gills black; abdominal sterna suffused with black. Caudal filaments yellow, black at base.

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

Tricorythodes sordidus N. SP.

Nymph.—Length: body 6.0–7.0 mm; caudal filaments 5.0–6.0 mm. General color yellow to light brown with dark brown and black markings. Head yellow to light brown with variable black markings on occiput; head with long setae 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. 62a; 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.

Types.—Holotype: mature nymph, San Jose, San Jose Prov., Costa Rica, 9-VIII-62, G. G. Musser, in collection University of Utah, Salt Lake City. Paratopotypes: 12 nymphs, same data as holotype, 4 nymphs in collection California State College at Los Angeles, remainder in collection University of Utah. Paratype: 1 nymph, stream, 11 mi S.E. San Isidro del General (Pan American Highway), Costa Rica, 22-VII-62, G. G. Musser, in collection University of Utah.

Tricorythodes bullus N. SP.

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 mesad 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. 63); 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. 64a; hind femora 15% longer than fore femora; tarsal claws with 8–11 denticles (Fig. 64b). 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.

Types.—Holotype: mature nymph, Nova Teutonia, Brazil, III-62, F. Plaumann, in collection University of Utah, Salt Lake City. Paratopotypes: 3 nymphs, same data as holotype, 2 nymphs in collection California State College at Los Angeles, remainder in collection University of Utah. Paratype: 1 nymph, Arirhanha River, Nova Teuronia Brazil, XII-62, F. Plaumann, in collection University of Utah.

Acknowledgments

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SPECIALIZATION IN THE EGG STRUCTURE OF *EXENTERUS* (HYMENOPTERA: ICHNEUMONIDAE) IN RELATION TO DISTRIBUTION AND ABUNDANCE

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Abstract

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Like all other Tryphoninae, the European species of *Exenterus* have eggs that are attached to the host by 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 concurrently 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 drier climates and can better survive droughty 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 endoparasites, 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 endoparasites