

NEW NORTH AMERICAN SPECIES OF MAYFLIES  
(EPHEMERIDA)

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PLATE 16

In the following article are presented descriptions of several new species of mayflies in three subfamilies of the family Baetidae.

SUBFAMILY LEPTOPHLEBIINAE

Examination of specimens, both nymphs and imagoes, of *Leptophlebia marginata* Linn., shows that this species is quite distinct from those North American species which have previously been described in the genus *Leptophlebia*. All of these species, with the exception of *johnsoni* McD., which with *gracilis* Traver (in *Blasturus*) stands nearer to *Leptophlebia* than to *Paraleptophlebia*, I am transferring to the genus *Paraleptophlebia*.

*Paraleptophlebia sculleni*, sp. nov.

Male imago

*Size.* Body  $6\frac{1}{2}$  mm.; tails  $7\frac{1}{2}$  mm.; wing  $6\frac{1}{2}$  mm.

*Head.* Reddish brown. Antennae pale brown.

*Thorax.* Reddish brown, the pleural sutures paler.

*Legs.* Pale. Fore leg missing, except basal portion, which is faintly yellowish. Middle and hind legs white.

*Wings.* Semi-hyaline, white. All veins white; cross veins almost invisible. Stigmatic cross veins few, simple, and slightly curved.

*Abdomen.* Segment 1, tergites 8 and 9, and all but the basal margin of tergite 7, bright reddish brown; opaque. Segments 2-6 hyaline; segment 2 strongly tinged with reddish brown, 3-6 whitish with smoky markings. Posterior margins of tergites smoky brown, this color extending forward on tergite 6 so that only the basal portion is pure white. Tergites 2-5 faintly shaded with smoky tinge along the mid-dorsal region. Tergite 10 yellowish brown with reddish tinge, the mid-dorsal line and posterior margin darker. A rather wide smoky brown line marks the entire length of the pleural fold. Sternites 8 and 9,

and apical half of sternite 7, pale reddish to yellowish brown. Ganglionic areas reddish brown.

*Genitalia.* Yellowish brown. Long segment of forceps widens suddenly at the base; toward the tip it tapers very slightly. Penes separated by a U-shaped notch, which is almost closed at the top by the approximated inner margins of the penes. A rounded lobe forms the inner apical margin of each division of the penes, laterad of which the apical margin slopes backward obliquely, to end in a minute curved hook. Reflexed spur present; long, wide at the base and tapering suddenly at the tip, which is slightly recurved.

*Tails.* White; joinings also white, slightly opaque.

Holotype—Male imago. Collected by Prof. H. A. Scullen at Corvallis, Oregon, on May 31, 1931. No. 1264.1 in Cornell University collection.

Named for Prof. Scullen, who collected the single specimen representing the species in our collection.

*Paraleptophlebia falcula*, sp. nov.

Head, thorax, and end segments of abdomen dark reddish brown; middle abdominal segments pale with smoky markings.

Male imago

*Size.* Body 7 mm.; tails 9 mm.; wing 7 mm.

*Head.* Reddish brown. Clypeus pale. Antennae pale brown.

*Thorax.* Dark reddish brown. Spaces between pleural sclerites light brown, especially around middle leg and anterior to wing roots. Distal half of mesosternum slightly paler than remainder of thoracic sternum.

*Legs.* Pale. Femora faintly washed with yellow, and with a brownish mark at the apex. On the fore leg, this knee mark is dark reddish brown, and extends over the base of the tibia.

*Wings.* Hyaline, white. Slight reddish tinge at extreme base of subcosta and radius of fore wing. All veins pale, almost invisible. Costal cross veins in the pterostigmatic area simple, somewhat slanted, evenly spaced, and 10–11 in number.

*Abdomen.* Segments 1 and 8–10 opaque, wholly reddish brown, darker above. Tergite 7 reddish brown except for a pale basal margin; 7th sternite pale and semihyaline, except for central portion, which is occupied by a large triangular yellowish ganglionic mark. At about the



middle of this yellow blotch, and again at its anterior end, are small reddish brown spots. Posterior margins of tergites 7-9 very dark reddish brown. On tergite 7, a dark triangle from the posterior dark band on each side extends forward for more than one-half the length of the tergite, leaving the margin next to the pleural fold and the antero-lateral angle pale. Segments 2-6 semi-hyaline, pale, with faint smoky tinge. Posterior margins pale, opaque. On each tergite a smoky transverse band, widest and darkest at the postero-lateral angles, occurs immediately anterior to the pale posterior border. On tergite 2, a dark reddish brown spot is present on each side within this smoky band, above the postero-lateral angle. A single short black dash marks each stigma. Sternite 2 washed with pale reddish brown. Ganglionic areas yellowish brown.

*Genitalia.* Forceps and forceps base pale yellowish, penes yellowish brown. Apex of each triangular division of the forceps base prolonged into a long slender process. Long joint of forceps widest at the middle of its length. Penes separated by an open U-shaped cleft deeper than wide. Tips of penes sharply triangular. Reflexed spurs long, sickle-shaped, acute at the tip; at first bending inward until they almost touch, then directed outward.

*Tails.* White, unmarked.

Holotype—Male imago. Collected by Prof. H. A. Scullen at Corvallis, Oregon, July 4, 1907. No. 1265.1 in Cornell University collection.

*Paraleptophlebia georgiana*, sp. nov.

A dark reddish brown species, in general appearance very similar to *ontario* McD.

Male imago

*Size.* Body 5 mm.; tails 6 mm.; wing 5 mm.

*Head.* Reddish brown. Antennal filament pale brown at base, white distally.

*Thorax.* Dark reddish brown, somewhat paler on pleura and sternum. Lateral margins of pronotum, and scutellum of mesothorax, blackish brown.

*Legs.* White, femora faintly tinged with yellow. Apical ends of femora and basal ends of tibiae pale yellowish brown.

*Wings.* Hyaline, white. Costal, subcostal, and radial veins reddish

brown at extreme base; pale yellowish for remainder of their length. Humeral cross vein reddish brown. All other veins pale; cross veins almost invisible. Costal cross veins of the pterostigmatic area simple, very slightly curved, 8-9 in number.

*Abdomen.* Dark reddish brown dorsally, paler ventrally. Posterior margins of all segments darker reddish brown, these bands continuous around the segments, paler on the sternites. Sternites 1 and 7-10 washed with reddish brown; intermediate sternites pale yellowish. Pleural fold margined with a narrow dark line. A single short black dash marks each stigma.

*Genitalia.* Forceps base reddish brown; forceps and penes paler brown. Long joint of forceps widest at base, narrowed for a short distance, and then widened again about one-third from the base; beyond this point narrowed slightly for the remainder of its length. Penes separated by a V-shaped cleft, longer than wide, and narrowed at the apex. Apex of each division of the penes rounded, and sloping backward obliquely to a blunt projection on each side. Rounded processes at tip approach one another slightly. Reflexed lobe blunt at tip, about equally wide in all parts.

*Tails.* Whitish. Joinings at base narrowly darker.

#### Male subimago

Wings pale smoky brown. Legs and tails yellowish. Venter of abdomen entirely pale reddish brown. Otherwise similar to imago.

#### Female imago

Apart from usual differences, similar to male except as indicated. Posterior half of anterior sclerite of the mesosternum yellow. Legs pale yellowish. Wings faintly tinged with light amber. Longitudinal veins of the costal border in the fore wing pale brown, those in the middle area pale yellowish. Costal cross veins in the pterostigmatic area somewhat more distinct. Tails faintly tinged with amber. A dark red spot on the middle of the posterior margin of the 7th sternite.

#### Female subimago

Wings, legs, and tails as in male subimago. Otherwise similar to female imago.

Holotype—Male imago. Collected by Prof. P. W. Fattig at Swamp Creek near Dalton, Ga., in June 1931. No. 1266.1 in Cornell University collection.



Allotype—Female imago. Same collector, same data. No. 1266.2 in the Cornell University collection.

Paratypes—1 female imago; 1 male and 1 female subimago. Same collector, same data. No. 1266.3-5 in the Cornell collection.

In addition to the types, 3 other female subimagoes were taken by Prof. Fattig at the same time and place.

This species may be distinguished from *ontario* McD. by (1) the slightly smaller size; (2) the paler antennae and legs; (3) the relatively paler venter of the abdomen; and (4) details in the structure of the genitalia. The reflexed lobe of the penes tends to be directed laterally in *ontario* McD., and is slightly widest near the middle of its length. In *georgiana*, this spur is longer, directed backward rather than laterally, and is not wider at the middle than elsewhere. The apical notch between the lobes of the penes is relatively deeper also, in *georgiana*. The ganglionic areas of *ontario* are usually dark brown, a condition not found in *georgiana*.

*Paraleptophlebia compar*, sp. nov.

A species very similar in general appearance to *californica*, sp. nov., but in type of genitalia resembling *associata* McD. Distinguished from the latter species by its much paler color, and by the longer reflexed spurs on the penes.

Male imago

*Size.* Body  $7\frac{1}{2}$  mm.; tails 9 mm.; wing  $7\frac{1}{2}$  mm.

*Head.* Reddish yellow. Clypeus and median carina yellow. Bases of antennae encircled by a blackish line. Antennae pale. Bases of ocelli ringed with purplish black.

*Thorax.* Reddish brown. Anterior margin of pronotum, its mid-dorsal line, and pencillings along the lateral and antero-lateral margins, blackish. Interspaces between pleural sutures pale. A white or yellowish spot just cephalad of the mesothoracic scutellum. Meso- and metanota, and sternal sclerites, tinged with yellow. Purplish black pencillings in an irregular line from the base of the fore wing to fore coxa; from base of hind wing to middle leg; a distinct black line above hind coxa, and black marks around its base.

*Legs.* Pale; white tinged faintly with yellowish. Apical end of femur and basal end of tibia of fore leg reddish brown; on middle and hind legs, pale yellowish brown.

*Wings.* Hyaline, white. Longitudinal veins in anterior half of fore wing pale brown. All other veins colorless; cross veins almost invisible. Costal cross veins in the pterostigmatic area simple, somewhat slanting, evenly spaced and 8-10 in number.

*Abdomen.* Pale, with smoky markings and bands on the tergites. Segments 1-5 and all of 6 except the posterior central portion of the tergite, whitish and semi-hyaline. Posterior half of tergite 6, and segments 7-10, opaque, yellowish. A rather broad purplish grey band on the posterior margin of each tergite, and on each sternite on its posterolateral angle only. Pleural fold marked by a purplish grey band within which is a narrow black pencilling. Lateral margins of tergites with faint smoky to purplish grey clouds. A small blotch in each posterolateral corner. A more diffuse blotch slightly anterior to center on each side, a little above the pleural fold. Indications on some specimens of a narrow dark geminate mid-dorsal line on the basal half of tergites 2-3, and 7-9. Dorsal area of tergites unclouded. Ganglionic area opaque white. Sternite 1 tinged with yellow.

*Genitalia.* Forceps base pale reddish brown; forceps brown at base, shaded with purple in the middle, and pale distally. Penes quite similar to *associata* McD., but with longer reflexed lobes. Long joint of forceps gradually enlarged at base. Tips of penes smoky brown. Penes separated by a rounded notch almost as wide as deep, which is partially closed at the top by the approximated inwardly-directed processes on the inner margin of each division of the penes.

*Tails.* Pale purplish grey at base, becoming paler gradually; tips silvery white. Joinings dark purplish grey except at tip, where they are not darker than the segments.

#### Male subimago

Wings pale smoky brown. Notum of mesothorax with prominent pale blotches and markings. Scutellum and the area immediately anterior to it, wholly pale yellowish white. Mid-dorsal line pale, with two widened areas,—one just posterior to the praescutum, the other at the posterior margin of the scutum. Scutum outlined with dark brown; a pale line margins the dark one on the inner side. A pale line anterior to the wing roots. First fore tarsal joint shaded with brown basally; all tarsal joinings narrowly dark.

#### Female imago

Similar to male except as indicated. Thorax paler, not darker in color than abdomen. All longitudinal veins of both wings dark brown,



strongly defined. Costal cross veins of pterostigmatic area pale brown. Abdomen uniformly orange-tinged (before deposition of eggs).

#### Female subimago

Wings tinged with orange in addition to the smoky brown tone. Even more white on the mesonotum than is present on the male subimago, a pale line extending completely around its margin. All joints of fore tarsus brownish at base. Otherwise as in male subimago.

Holotype—Male imago. Collected by Dr. David Shepherd on Waddell Creek, Rancho del Oso, Calif. No. 1281.1 in the Cornell University collection.

Allotype—Female imago. Same data. No. 1281.2 in the Cornell collection.

Paratypes—2 male imagoes, 1 male subimago, 7 female subimagoes. Same data. No. 1281.3–9 in the Cornell University collection. (1 male imago and 2 female subimagoes in the Stanford University collection.)

#### *Paraleptophlebia californica*, sp. nov.

##### Male imago

*Size.* Body 8 mm.; tails 8 mm.; wing 8 mm.

*Head.* Reddish brown. Margin of clypeus purplish black. Antennae pale brown. Vertex dark red, deeper at the bases of the ocelli.

*Thorax.* Thoracic notum deep reddish brown. Pronotum whitish at the center of the posterior margin; mid-dorsal line, and pencillings on each side and in the postero-lateral angles, black. An indistinct paler spot anterior to the mesonotal scutellum. Pleura reddish with yellow shading, the sutures reddish black. Metanotum brighter reddish laterally. Blackish pencillings on the pleura of the mesonotum from the base of the fore wing to the fore coxa, and on the coxae and antecoxal pieces of the middle and hind legs. Sternum red, the sutures reddish brown.

*Legs.* Fore legs reddish, the tarsi paler. Middle and hind legs yellowish, the tarsi tinged with reddish.

*Wings.* Hyaline. Main longitudinal veins light reddish brown; a reddish brown spot at the extreme base of each wing. Stigmatic area opaque whitish; the cross veins curved, simple, a few forking near the costal margin.

*Abdomen.* Segment 1 largely opaque. Segments 2–7 semi-hyaline,

pale reddish brown much obscured by smoky brown markings. Posterior margins of all segments darker reddish brown, this dark band continuous around the entire segment. On each side of tergites 2-9, a smoky oblique band extends inward from near the antero-lateral angle almost to the median line, where it is joined by the smoky submedian oblique streaks on each side of the pale reddish median area. Another less oblique streak, extending inward and forward from the postero-lateral angle, joins the anterior streak near its origin. Each tergite thus appears to be crossed near the center by a smoky zigzag band. Pleural fold margined by a dark line; dark stigmatic marks present. Tergites 6 and 7, the apical portion of tergite 5, and all of tergites 8-10, tinged with deeper reddish brown. Sternites only slightly paler than the tergites, except for a paler area near the lateral margin.

*Genitalia.* Golden brown; tips of penes sometimes tinged with purplish brown. Forceps widened gradually toward the base. Penes separated apically by a deep rounded notch, into which projects from the inner margin of each division of the penes a short blunt process. Almost opposite this process, on the outer margin, a rather similar projection is directed outward. Apex of penes rounded, sloping obliquely on each side to the above-mentioned blunt projections. Reflexed spur widest at the base, tapering gradually to a sharp point at the tip.

*Tails.* Pale smoky brown, darker at the base. In the basal third the basal portion of each segment is darker than the distal margin. Joinings not darker.

#### Female imago

Head yellowish, with black shading around the bases of the ocelli; a black streak extends down on each side of the median carina from the base of the antennae. Thorax paler red than in the male, the black markings more prominent. Fore leg pale reddish; a reddish brown band at the apex of the femur; the first three tarsal joints smoky except at the tips. Middle and hind legs as in the male. Venation rather deeper reddish brown than in the male; the stigmatic costal cross veins are also reddish brown.

#### Female subimago

Two female subimagoes, with smoky amber-tinged wings and markings very similar to those given above, are tentatively placed in this species.



## Nymph?

Two mature nymphs, in the same vial with one of the female subimagoes, may belong to this species; the color pattern of the abdomen would seem to bear out this possibility. These nymphs have mandibles which are quite similar in their general appearance and line of development to those of the eastern species *swannanoa* Traver. Gills, however, are more like those of the western *packii* Ndhm., being wider than are the gills of any known eastern species (lanceolate rather than narrowly lanceolate).

Holotype—Male imago. Collected by Dr. David Shepherd on Waddell Creek, Rancho del Oso, Calif. No. 1280.1 in the Cornell University collection.

Allotype—Female imago. Same data. No. 1280.2 in the Cornell collection.

Paratypes—3 male imagoes, 1 female imago, 1 male subimago, 1 female subimago. No. 1280.3–6 in the Cornell collection. (1 male and 1 female imago in the Stanford collection.

In general appearance, this species is very close to *compar* n. sp., but is rather darker in color, especially on the venter of the abdomen. The venation is also darker in most specimens. The genitalia of the two species are quite different, however. The deep rounded apical notch and the shape of the reflexed spur in *californica* should render it readily distinguishable from *compar*, in the male sex.

*Blasturus vibex*, sp. nov.

## Male imago

*Size.* Body 13 mm.; tails 27 mm.; wing  $10\frac{1}{2}$ – $12\frac{1}{2}$  mm.

*Head.* Frons yellowish brown. A blackish area along base of median carina, on each side. A dark transverse streak below each eye. Antennae brown. Vertex blackish.

*Thorax.* Very dark reddish brown. Posterior margin of pronotum pale yellowish along middle area. A pale yellow line anterior to wing roots, bordering the dark notum. Sutures of pleura pale yellowish brown.

*Legs.* Fore leg dark brown, femur and tibia somewhat reddish. Middle and hind legs yellowish to pale reddish brown.

*Wings.* Hyaline. A dark brown streak extends obliquely across the fore wing, overspreading the entire pterostigmatic area and zigzag-

ging inward and downward across the end of the bisector of the median fork. It extends almost to the outer margin of the wing a short distance from the anal angle, and ends just beyond the bisector of the cubital fork. Longitudinal veins of the fore wing reddish brown, cross veins paler brown. Costal cross veins before the bulla barely visible, 9-10 in number. Cross veins in the stigmatic area numerous, crowded, irregular, and tending to fork or anastomose, or both. No brown stain on hind wing. Veins pale yellowish, except the main veins along the costal margin, which are pale brown.

*Abdomen.* Dark reddish brown, the basal and apical segments darker than the middle ones. Posterior margins of middle segments pale, as is also the margin of the pleural fold, in this area. Sternites not paler than tergites. Pale mid-dorsal line and submedian pale oblique streaks visible, but somewhat obscured by the dark background.

*Genitalia.* Yellowish brown. Apical spine of the penes long and sharp-pointed. Reflexed spur not long enough to reach to the base of the cleft between the penes. A shallow indentation only, on the upper portion of the outer margin of each division of the penes.

*Tails.* Dark reddish brown, narrowly and regularly black at the joinings. Middle tail  $\frac{1}{3}$  as long as the lateral tails.

#### ? Female imago

A female imago, tentatively associated with the above-described male, lacks the apical zigzag brown band on the fore wing. Only the pterostigmatic area is brown-stained. Subanal plate ends in two broadly rounded lobes, separated by a broadly rounded notch.

Holotype—Male imago. Collected by Prof. H. A. Scullen at Corvallis, Oregon, April 16, 1931. No. 1263.1 in Cornell University collection.

Paratype—Male imago. Same collector. May 16, 1930. No. 1263.3 in the Cornell collection.

The female imago, taken at Corvallis on March 28, 1930, by Mr. Loring Hudson, is not included among the type material.

This species is mentioned by Dr. McDunnough in his recent description of *Blasturus pacificus* (Canad. Ent. 65: 156, 1933) as a probable variant of the latter. The two males we have show great similarity in structure of genitalia to Dr. McDunnough's new species, but it is also true that in this genus the differences in genitalic structure between closely allied species are not great. I venture, therefore, to describe



*vibex* as a new species, although it may later fall as a synonym of *pacificus*.

*Habrophlebiodes annulata*, sp. nov.

Male imago

*Size.* Body  $4\frac{1}{2}$  mm.; wing  $4\frac{1}{2}$  mm.

*Head* and *thorax* dark reddish brown; no pale markings. Eyes large, contiguous dorsally. Notum darker than pleura and sternum.

*Legs.* Reddish brown. Femora darker than other joints; fore femur much the darkest. All tarsi slightly paler than tibiae. Middle and hind femora with darker apical band, and indication of dark basal streak. Tibiae darker basally.

*Wings.* Longitudinal veins of both wings reddish brown. Humeral vein and cross veins in pterostigmatic area of fore wing pale brown; the latter slightly heavier near the costal margin, and 5-6 in number. All other cross veins entirely pale, almost obsolescent. Both wings have a small dark reddish brown area at the extreme base.

*Abdomen.* Dark reddish brown dorsally; paler reddish brown and sub-hyaline ventrally. Posterior margins of all segments, both tergites and sternites, rather widely banded with darker color, giving the insect an annulated appearance. Dark geminate streak bordering the mid-dorsal line, with very faint indications of pale oblique submedian marks in basal half, except on the last three or four tergites. A narrow dark line, usually double, on and closely parallel to the pleural fold. A very faint crescentic mark may lie parallel to the inner of these dark lines. Sternites have a dark brown streak next to pleural fold. Ganglionic marks may appear darker on the apical segments.

*Genitalia.* Dark reddish brown. Apical extensions of the 9th sternite blunt and rounded at tip. Penes much wider than in *americana*, not narrowed in the central portion as in the latter species.

*Tails.* Missing.

Holotype—Male imago. Collected by Prof. R. B. Bird in Oklahoma, March 1932. No. 1260.1 in Cornell University collection.

Paratype—Male imago. Same data. No. 1260.3 in the Cornell collection.

*Thraululus presidianus*, sp. nov.

Male imago

*Size.* Body 6 mm.; tails 9 mm.; wing  $7\frac{1}{2}$  mm.

*Head.* Dark reddish brown.

*Thorax.* Dark reddish brown. A paler brown streak anterior to the wing roots; paler area around base of middle leg, on prosternum and anterior portion of mesosternum.

*Legs.* Fore femur dark reddish brown. Fore tibia dark reddish brown at base, paler brown beyond base. Other legs missing from the single specimen.

*Wings.* Fore wing stained with reddish brown at base, on membrane as well as on veins, this color extending faintly along the costal margin almost to the bulla. Bases of all main longitudinal veins, especially subcosta, radius, and media, deep golden brown; this color becoming fainter on the marginal portions of the veins. Intercalaries and cross veins pale. Humeral vein brown. Costal cross veins before the bulla almost invisible; 11-13 in number. Beyond the bulla these are somewhat better defined, about 23 in number; simple and rather regularly spaced. Veins of hind wing pale in center and marginal areas, purplish brown at base. No basal stain on hind wing.

*Abdomen.* Segment 1 opaque, dark reddish brown. Segments 2-7 semi-hyaline, smoky, shaded with pale reddish brown; this shading less apparent on middle segments. Posterior margins of tergites narrowly darker greyish brown, this dark band preceded by a paler parallel band. Joinings of middle sternites pale, opaque. On tergites 1-3, the pleural fold is margined with dark brown. Segments 8-10 opaque, reddish brown.

*Genitalia.* Penes short and stout, truncate apically, the outer apical margin longer than the inner; separated by a V-shaped cleft. The dorsal extensions of the forceps base are extremely slender and elongate, bearing short spines at the tips. These extensions are dorsad of the forceps but ventrad of the penes, arising from a dorsal extension of the forceps base.

*Tails.* Pale whitish. At base, distinctly ringed with dark purplish brown at joinings. Joinings other than those at base, opaque white.

Holotype—Male imago. Collected by Mr. F. L. Thomas at Presidio, Texas, in August 1931. No. 1261.1 in Cornell Univ. collection.

This species, represented by a single male specimen, is smaller than the northern *albertanus* McD., and differs from that species somewhat in coloration. It may be distinguished from *primanus* Etn. by the lack of the brown stain on the hind wing and the paler abdomen. It does not seem to resemble closely any of the neotropical species of the genus.



*Thraulodes speciosus*, sp. nov.

## Male imago

*Size.* Body  $7\frac{1}{2}$  mm.; tails 15 mm.; wing  $8\frac{1}{2}$  mm.

*Head.* Blackish brown. Eyes deep red (basal portion black). Antennal filament pale brown.

*Thorax.* Reddish brown. Pronotum black on anterior and lateral margins and on basal half of median line. Mesonotum rather yellowish red, brighter in color than remainder of thorax. Tip of scutellum dark brown. Black streak on pleura from base of fore wing to fore coxa. Other black markings around antecoxal pieces of middle and hind legs. Prosternum blackish brown. Large dark brown rounded blotches (ganglionic marks?) on praesternum and sternum on the mesothorax.

*Legs.* Fore femur reddish brown, yellowish at base; two longitudinal black streaks present, one near the base, the other in the apical half. A dark band slightly beyond the middle. Tibia yellowish at center, reddish brown near each end; basal end dark red, apex blackish. Fore tarsus yellow or reddish yellow. Claws and apical two-thirds of distal segment reddish black. Middle and hind legs bright yellow, the femora tinged with red, and with a wide reddish apical band. Middle tibia reddish at base. Claws and apical half of distal tarsal segments reddish brown.

*Wings.* Hyaline, iridescent. The three main longitudinal veins of the costal border of the fore wing golden yellow; other longitudinal veins yellowish brown. Cross veins rather darker brown. Humeral cross vein reddish brown, margined by a brown cloud which is wider on the side away from the base. All basal cross veins in costal and subcostal spaces, and in the following spaces in the basal half of the wing disc, narrowly margined with brown. A small purplish brown cloud at the bulla on the subcosta; another directly below it on the radial sector. Sometimes a much smaller dark spot also on the second branch of the radial sector. Median vein somewhat thickened at its fork. 5 to 7 costal cross veins before the bulla, all but the basal of these prominently margined. In the pterostigmatic area are about 15 costals, of which only the two nearest the bulla are margined. These costals are irregularly spaced, and 2 or 3 of them are forked. In the hind wing, a small, purplish cloud occurs at the base of the subcostal and radius. Veins of the costal margin brownish, others pale. Basal costal cross vein black, in the paratype, also that portion of the subcosta basad of the cross vein.

*Abdomen.* Tergite 1 very narrow, brownish. Tergite 2 dark reddish

brown. Tergite 3 semi-hyaline, pale smoky brown, except for a large reddish triangle in the postero-lateral angle and extending along the pleural fold. Segments 4-6 semi-hyaline, yellowish, the tergites with reddish brown markings. Each tergite has a large reddish triangle in the postero-lateral corner, the edge of which margins the pleural fold except at the extreme anterior border. At the end of this triangle on the pleural fold, a small reddish spot may be present. Wavy black lines, 3-5 in number, are present within this reddish triangle, parallel to the pleural fold, on tergites 4 and 5. A pale smoky cloud partially obscures the basal median portion of tergite 6; similar pale clouds faintly visible in tergites 4 and 5. Tergites 7-10 opaque, red with brownish tinge. All tergites blackish on the posterior margins. Sternites 1-3 and 8-9, reddish. Ganglionic areas marked with reddish brown patches (on apical sternites, almost black).

*Genitalia.* Forceps base and forceps pale brown; tips of forceps purplish. Penes reddish brown. Forceps long, slender, bowed outward strongly from near the base. Distal portion bends inward, the tips approaching one another. Apical median extension of forceps base rather dome-shaped. Each division of the penes is somewhat urn-shaped, flaring at base and apex, slender in central portion. Reflexed spurs of the penes long and slender, directed inward; in normal position the tips cross one another.

*Tails.* Yellowish white. Joinings rather widely purplish black. Near the base, each joining seems composed of a double ring. Further out, alternate joinings are distinctly wider. Beyond the middle, all joinings are equally wide.

#### Female imago

Similar to the male, except in the coloring of the abdomen, which is wholly reddish; tergites with black posterior margins; ganglionic areas of sternites dark reddish brown. Subanal plate excavated at the center of the apical margin.

Holotype—Male imago. Collected by Mr. J. A. Kusche in Rustler Park, Chiracahua Mts., Arizona, July 3, 1927. No. 3733 in the collection of the California Academy of Science.

Allotype—Female imago. Same data. No. 1267.2 in Cornell collection.

Paratypes—1 male and 1 female imago; female, same data as above; male, taken at Cave Creek, Chiracahua Mts., Ariz., June 24,



1927. Male, No. 1267.3 in the Cornell University collection; female in collection of California Academy of Science.

As far as I can determine, this is the first record of a species of *Thraulodes* occurring north of Mexico. This species differs from *mexicanus* Etn. in the possession of prominent basal costal cross veins, and in the structure of the male genitalia. It lacks the amber tinge in the fore wing which is characteristic of *lepidus* Etn. In several details of coloration it differs quite markedly from *hilaris* Etn., but is probably nearer to the latter than to any other of the neotropical species. It differs from *irretitus* Nav. in details of the venation of the hind wing; in having [fewer] stigmatic cross veins anastomosed; and lacks the median band on the femur.

*Choroaterpes nanita*, sp. nov.

Paler than other North American species of this genus.

*Size.* Body 8 mm.; tails 8 mm.; wing 6 mm.

Male imago

*Head.* Reddish brown. Clypeus narrowly black on the frontal margin. Eyes reddish brown.

*Thorax.* Dark reddish brown on notum, pleura paler red-brown. Pale areas on each side of mesoscutellum above wing base, and around bases of middle and hind legs. Narrow black pencillings on postero-lateral margins of pronotum and above coxae of all legs. Venter pale; lateral margins of mesosternum pale reddish brown.

*Legs.* Pale whitish. Femur marked with a black longitudinal pencilling for almost its entire length, and a narrow black transverse line at the apex, on its outer surface.

*Wings.* Hyaline. The three main longitudinal veins of the costal margin brownish at base, yellowish brown to the bulla, and pale beyond bulla. Humeral cross vein yellowish brown. No color on wing membranes. All other veins pale. Cross veins, even in stigmatic area, almost invisible.

*Abdomen.* Subhyaline, whitish. Marked dorsally with smoky black zigzag bands across the center of each side of each tergite. A black comma-shaped mark over each stigma. A short black transverse mark on the posterior margin on each side, above the postero-lateral angle. Median line, anterior margin, lateral margin, posterior margin except for the black transverse bar, postero- and antero-lateral angles, and

large triangles on each side of the median line on both anterior and posterior margins, wholly pale. Tergites 9 and 10 washed with yellow. Ventrally pale. Ganglionic areas opaque. A chestnut brown streak borders the pleural fold on sternite 9.

*Genitalia.* Forceps whitish, penes pale yellowish brown. Long joint of forceps considerably swollen in its basal third. Penes acute at tip, together appearing rather pyramidal in outline.

*Tails.* White. Joinings in basal two-thirds black, alternate joinings wider. In distal third, joinings opaque, hardly darker than the segments.

#### Male subimago

Paler than the imago, especially on head and thorax. Thoracic notum rich dark brown with a yellow mid-dorsal line, narrowest at the anterior margin of the mesonotum. Lateral margin of mesonotum anterior to wing root outlined with black; directly above this black line is a yellow line, which curves upward to join the pale mid-dorsal line just above the wing roots.

Holotype—Male imago. Collected by Mr. H. J. Parks, Jr., at Austin, Texas, in June. No. 1268.1 in the Cornell University collection.

Paratype—Male subimago. Same data. No. 1268.3 in the Cornell collection.

#### *Choroaterpes oklahoma*, sp. nov.

A dark brown species with paler brown-mottled abdomen.

#### Male imago

*Size.* Body 7 mm.; tails 8 mm.; wing 8 mm.

*Head.* Dark reddish brown.

*Thorax.* Dark reddish brown, darkest on meso- and metanota and mesothoracic sternum, which appear shiny black. A pale streak anterior to the wing root; pale areas around bases of legs; pleural sutures pale brown.

*Legs.* Fore leg smoky. Femur yellowish brown, ringed with dark brown at base and apex, and with a median brown band. On the inner surface at the apex, a brown streak. A longitudinal black streak outlines it on each side on the outer surface. Knee black. Tibia purplish grey, paler at each end; a brown streak at its apex. Tarsus pale. Middle and hind legs paler. Femora with smoky median bands, a



longitudinal brown streak at each end, and outlined with black on outer surface. On inner surface, pale in center, brown at each end. Knee widely dark brown. Tibiae and tarsi pale, joinings narrowly brown. Upper margin of outer surface of tibia black-lined.

*Wings.* Subhyaline. A brownish area at base of fore wing, on both membrane and veins. Longitudinal veins of costal half yellowish brown; all other veins colorless. Cross veins almost invisible. Stigmatic area opaque white.

*Abdomen.* Smoky brown, paler ventrally, the basal and apical segments dark reddish brown. Posterior margin of each tergite, its median line, and an oblique streak laterad from the posterior margin at the middle line, pale yellowish. Darker smoky brown submedian streaks border the pale median line. Pleural fold pale except for a blackish comma-shaped mark over each stigma. Postero-lateral angles outlined with orange. Sternites 4-8 pale, subhyaline. Sternites 1-3 washed with smoky brown. Sternite 9 pale except for a dark brown lateral triangle based on the antero-lateral angle.

*Genitalia.* Penes and forceps base pale smoky brown. Forceps wholly white. Long joint of forceps swollen in its basal third. Penes quite similar in form to those of the eastern *basalis* Bks., but with a median longitudinal line or fold near the tip.

*Tails.* Smoky greyish brown, the extreme distal portion pale. Joinings narrowly blackish. Each segment (except those at the extreme base) is pale in its basal half, so that the tail has a distinct annulate appearance.

Holotype—Male imago. Taken by Mr. C. Sandoz in Murray Co., Oklahoma, March 20, 1932. No. 1269.1 in the Cornell University collection.

Paratype—Male imago. Same data. No. 1269.3 in the Cornell collection.

*Choroterpes ferruginea*, sp. nov.

*Size.* Body  $5\frac{1}{2}$  mm.; wing 6 mm.

*General appearance.* A reddish brown species, with grey-brown abdomen and reddish wing bases.

*Head.* Brown above, with paler antennae.

*Thorax.* Nearly uniform reddish brown; a few blackish markings on the pleura.

*Legs.* Femora yellowish, each with a median purplish band, and shaded with reddish brown at the apex. Tibiae and tarsi whitish.

*Wings.* Subhyaline; the stigmatic area opaque white. A considerable area at the base of the fore wing, and a large portion of the hind wing, suffused with a reddish brown tint. Longitudinal veins of the costal margin pale yellowish; all other veins colorless.

*Abdomen.* Grey-brown above, becoming darker and reddish at the ends. Ventrally pale translucent except on the end segments. A very narrow mid-dorsal pale line that becomes obsolescent at the rear is overspread on segments 4 and 5 by broad pale mid-dorsal triangles. Smaller triangles are in the same position on segments 3 and 6. A continuous black line follows the lateral margin on segments 2 to 8, with a parallel interrupted pale line in the spiracular area immediately above it. Blackish submedian streaks border the mid-dorsal line on the apical segments. The posterior margins of the tergites are narrowly black, most evident at the postero-lateral angles. Sternite 9 reddish at the sides.

Forceps pale. Penes reddish. Tails white, sometimes faintly ringed with reddish brown toward the base; often wholly pale.

*Holotype*—Male imago. Collected by Prof. J. G. Needham at Wintergreen Point, Old Forge, N. Y., in August 1905, No. 1270.1 in Cornell University collection.

*Paratypes*—6 male imagos; 3 of these collected at Old Forge, same data as the holotype; 1 taken at Juanita Island, Lake George, N. Y., on Aug. 21, 1920, and 2 taken at Commissioner's Is., Lake George, Aug. 25, 1920, by Prof. Needham. No. 1270.3-8 in the Cornell collection.

#### SUBFAMILY EPHEMERELLINAE

In the treatment of this large group, I follow Dr. McDunnough in reducing Chitonophora to Ephemerella, and considering all North American species as belonging to the one genus Ephemerella. This I subdivide into groups, as does Dr. McDunnough, but with a few minor differences. Thus the species *needhami* McD., *septentrionalis* McD., and *aurivillii* Bngtssn., along with several new species, I am considering as members of a group distinct from *invaria* Wlk. and its immediate allies; this division I designate the *needhami* group. That unique species, *hecuba* Etn., is considered as belonging to a group of its own. Otherwise I use the same grouping of species which Dr. McDunnough employed in his recent excellent paper on the eastern species of this genus (Canad. Ent. **63**: 30-42, 61-67, 187-197, 201-216. 1931).



*Ephemerella glacialis*, sp. nov.

1884—Eaton—Revis. Monogr., p. 131; figs. 11–15, Pl. 38 (as Nymph No. 2). Wash. Terr.

1930—Walley—Canad. Ent. 62: 17 (in discussion of *E. grandis*).

This species of the *fuscata* group, known only in the subimago and nymphal stages, is closely allied to *grandis* Etn., from which species it may be distinguished by the better development of the tubercles on the occiput, lateral margin of the pronotum, and on the mesothorax.

## Nymph

*Size.* Body 14–15 mm.; tails 8–10 mm.

*General color.* Mature specimens deep blackish brown, usually with a pale mid-dorsal stripe the length of the body. Immature forms are lighter brown with numerous pale markings.

*Head.* No frontal shelf nor true frontal horns. Roughened around the ocelli and bases of antennae. Occipital tubercles quite prominent, conic, directed backward.

*Thorax.* Submarginal pronotal tubercles larger than in *grandis*; in the antero-lateral angle is another small spine. Anterior submedian tubercle larger than the posterior ones; of these, one is very small and lies near the median line, the other is larger and laterad of the anterior spine. Anterior median mesothoracic tubercles much as in *grandis*. The submedian pair are well developed (in *grandis* there is an elevated submedian ridge only); median posterior tubercle larger than in *grandis*.

*Legs.* Anterior margin of fore femur unmodified by teeth or spines. Legs much as in *grandis*, but slightly more slender, especially the middle and hind tarsi. 6 to 7 denticles on each claw. Femora unicolorous in mature specimens; banded with pale areas in immature forms. Tibiae with pale basal and apical bands, the latter more prominent. Tarsi pale in the apical half.

*Abdomen.* Gills borne on segments 3–7. Lateral margins of the abdominal segments very much as in *grandis*. Dorsal spines also very similar to that species, but those on tergites 8 and 9 are slightly longer relatively. Some specimens are unicolorous dorsally; most have a wide pale mid-dorsal stripe between the rows of spines. Ventrally almost unicolorous brownish black in mature form.

*Tails.* Blackish brown at the base; beyond this, alternating pale and dark areas, the pale areas more extensive.

## Female subimago

Vertex of head yellowish, with rather extensive reddish brown shading centrally and next to the eyes.

*Thorax.* Mesonotum shiny blackish brown. Pleura and sternum paler brown, the latter shaded with grey. A pale area anterior to the wing root contains a purplish red streak; a purplish line margins the anterior portion of the mesonotum, and similarly colored areas are present on the pleura. Femora dull reddish brown; tibiae greyed brown; tarsi blackish. Wings pale greyish; venation purplish black.

*Abdomen.* Blackish, the posterior margins of all segments pale, producing an annulate appearance. Tails blackish brown.

Holotype—Female nymph. Collected by Prof. A. S. Hazzard and others (J. E. H., M. J. M.) in Glacier National Park, Mont., Midvale Creek, June 8, 1932. No. 1262.1 in the Cornell University collection.

Paratypes—1 female subimago (with nymph slough), Cayoosh Creek, Seton Lake, B. C., July 31, 1933; reared by Dr. J. McDunnough; 2 mature nymphs, same data, collector, Dr. McDunnough: 22 nymphs, Glacier National Park, June 8–9, and June 16, 1932; collector, Prof. Hazzard and others. No. 1262.3–27 in the Cornell collection. (Female subimago and nymphs taken by Dr. McDunnough are in the Canadian National Collection.)

*Ephemerella doris*, sp. nov.

A species of the *bicolor* group, rather close to *temporalis* McD. Imago with a curved row of dark spots on the venter of the abdomen, a small black spot at the apex of each coxa, and blackish submedian abdominal streaks. Nymph with the postero-lateral spine on segment 3 considerably longer than its width at base; dorsal spines subparallel; distance between spines on 5–7 less than the length of these segments at the median line.

Male imago (incompletely freed from subimaginal skin)

*Size.* Body 7 mm.; wing  $7\frac{1}{2}$  mm.

*Head.* Eyes orange. Base of antenna pale, the filament brownish. A dark spot below the antenna, at the corner of each eye.

*Thorax.* Yellowish brown. A few black dots on the pronotum. Metanotum, and the lateral areas below the mesoscutellum, reddish



brown. A black spot on each side of the median line, on the metanotum. Mesothoracic ganglion black margined.

*Legs.* Pale yellowish. A small black spot on each coxa, near the apex. Claws, tarsal joinings, and the apex of the fore tibia light reddish brown.

*Wings.* Hyaline; venation hyaline. A short dark streak along the costa and radius of the fore wing, near the base; faint brownish tinge at base in the anal region. Stigmatic cross veins anastomosed.

*Abdomen.* Yellowish. The posterior margins of the basal and middle tergites are reddish brown. Distinct black submedian streaks are present on tergites 2, 3, and 6-7; slight indications of these on the other tergites. A small black spot on each side of the median line at the anterior margin, on tergites 8 and 9; tergite 10 wholly whitish. A dusky line follows the course of the main longitudinal trachea on each side; between it and the pleural fold are incomplete black streaks in the stigmatic area. Ventrally pale; a very narrow black line near the posterior margin of each basal and middle sternite. Four dark marks cross each sternite in a somewhat curved line; these consist of a short oblique submedian streak on the anterior margin, and a central dot, on each side. Ganglionic areas black-margined.

*Tails.* Pale. Joinings distinct, purplish black.

*Genitalia.* Of the type usual for this group.

### Nymph

*Size.* Body 7-8½ mm.; tails 5-6 mm.

*General color.* In one color phase, marked conspicuously with alternate areas of blackish brown and cream-white.

*Head.* Antennae, occiput, and a small area anterior to each ocellus, pale whitish. Remainder dark reddish brown. Occipital tubercles rounded, quite well developed in both sexes.

*Thorax.* Lateral margin of pronotum concave; its antero-lateral angle acute, projecting slightly. Pronotum yellowish brown laterally, pale in the median area, which is margined by dark brown somewhat oblique bands. Mesonotum dark brown across the anterior margin and in a median triangular area just behind the margin; within this dark band are small pale spots, one median and two lateral in position. Another dark transverse band crosses the posterior margin and passes behind the bases of the wing buds. The intervening area is pale cream-colored, with one small dark brown dot on each side.

*Legs.* Yellowish brown. Femora somewhat flattened and relatively

wide, often with pale median mottling and pale at the apex. Tibiae with a dark median band; tarsi dark-banded at the base; tip of claw dark brown. Fore femur only twice as long as wide.

*Abdomen.* Tergites 1, 4, 5, and 8 are largely pale; remaining tergites largely dark reddish to blackish brown, with a sprinkling of pale dots. Indications of black submedian stripes, which on the pale tergites are represented by black areas on the anterior margins only; laterad of each of these dark spots is usually another dark patch. Tips of the postero-lateral spines and bases of the lateral extensions pale, a brownish band between. Bases of the operculate gills blackish brown, sprinkled with pale dots. Postero-lateral spines well developed on segments 2-9; short but distinct on segment 2; on 3, almost twice as long as its width at the base. Spines on 4-7 long and slender; on 8 and 9 wider. Outer margin of segment 9 convex, the spine straight. Dorsal abdominal spines on tergites 1-3 quite long, blunt, somewhat finger-like, sloping backwards. On 4-7 more flattened than on the basal segments, as is usual in this group. Very short, but present, on 8 and 9. The spines of each pair on tergites 1-3 diverge slightly at the tip. However, the rows of spines lie parallel to each other. The distance between the spines on tergites 5-7 is less than the length of these tergites at the middle line. Ventrally yellowish, with a series of dark lateral streaks on each side. The usual curved row of dark dots is more or less evident.

Two of the specimens included in the paratypes are almost wholly reddish brown, showing none of the conspicuous alternation of light and dark areas so marked in all the other nymphs. Other specimens are brownish with dark markings, and a wide pale dorsal line the length of the body.

*Tails.* Yellowish. One or two dark rings near the base; beyond this, rather indistinct bands of pale brown alternate with the yellow.

*Holotype*—Male imago, reared from nymph. Collected by J. R. Traver on the Uharie River near Farmer, North Carolina, May 6, 1929. No. 1292.1 in the Cornell University collection.

*Paratypes*—5 male and 4 female nymphs, Withlacoochee River, near Macon, Georgia, March 21-22, 1931; collector, Prof. P. W. Fattig; 1 male and 1 female nymph, outlet of Lake Waccamaw, N. C., April 11, 1929; collector, Prof. J. G. Needham. No. 1292.-3-13 in the Cornell collection.

We have other specimens of this species, representing the three apparent color phases, from Withlacoochee River, Georgia, and a single nymph



from the Neuse River near Ft. Barnwell, N. C., taken on April 9, 1930. The species, while quite close to *temporalis* McD., may be separated from that species in the nymphal stage by (1) its smaller size; (2) the distinct concavity of the outer margin of the prothorax; (3) the greater width of the femora in proportion to their length; and (4) the fact that the lateral extensions of segments 5-7 are distinctly narrower at the base than is the case in *temporalis*. The postero-lateral spine on segment 3 is likewise slightly longer and more outcurved than in *temporalis*. The dorsal spines on tergites 1-3 are slightly narrower at the base, in *doris*, but wider and blunter at the tips; those on 8 and 9, while very small, are still better developed than in *temporalis*.

*Ephemerella angusta*, sp. nov.

A slender species apparently allied to the members of the *needhami* group; head and thorax smooth; dorsal spines present; lateral extensions of the abdomen inconspicuous; known in the nymphal stage only.

Nymph

*Size.* Body 7-8 mm.; tails 4-5 mm.

*General color.* Light reddish brown (alcoholic specimens).

*Head.* Smooth. Antennae pale. Canines of the mandibles rather well developed. Maxillary palp rather weak, but composed of three complete joints.

*Thorax.* Smooth. No definite markings in any of the specimens examined. In mature nymphs, the wing pads and the portion of the mesonotum immediately anterior to them are dark brown.

*Legs.* Pale, apparently not banded. Rather long and slender, especially those of the hind pair, which are fully as long as the abdomen. Short spines on the posterior margins of the femora, and a few on the upper surface of the fore femur, near the apex. 6 to 7 denticles on each claw.

*Abdomen.* Relatively long and slender; the basal and apical segments narrow, the middle ones slightly wider. Lateral extensions inconspicuous. Short postero-lateral spines present on segments 4-9. Gills borne on segments 3-7. Dorsal spines present on segments 2-8; short and inconspicuous on tergites 2 and 3, well developed on 5-7. Anterior margin of each tergite pale, the remaining portion reddish brown; the posterior margins may be narrowly darker. Pleural margin narrowly brown; a dark spot at the insertion of each pair of gills. Dark

lateral patches may be present on the middle segments, next to the gills. No definite ventral markings.

*Tails.* Yellow to yellowish brown. In mature nymphs, marked at the base with incomplete dark rings, apparently due to the tail of the enclosed subimago. Practically bare at base and tip; in the middle area, a few short spines at the joinings.

*Holotype*—Female nymph. Collected by Prof. J. G. Needham on Provo River, Utah, near Deer Creek, July 29, 1926. No. 1290.1 in the Cornell University collection.

*Paratypes*—3 male and 1 female nymph, same data; 2 male nymphs, North Fork of the Ogden River, Utah, July 27, 1926; same collector. No. 1290.3-8 in the Cornell collection.

We have also several immature nymphs of this species from the Yellowstone National Park, taken by Mr. J. T. Needham in 1921, and two others from the same locality, taken by Dr. Muttkowski in August 1922.

*Ephemerella hystrix*, sp. nov.

A species of the *needhami* group, known only in the nymphal stage. Long slender divergent spines present on abdominal segments 2-9.

Nymph

*Size.* Body 10 mm.; tails missing.

*General color.* Light reddish brown.

*Head.* Smooth, without horns or tubercles. Mandible almost straight on the outer margin. Canines moderately stout, rather short, tips rounded. Galea of maxilla conical; the three joints of the palp subequal one to the other.

*Thorax.* Smooth; without tubercles. A few irregular pale markings on each side of the pronotum.

*Legs.* Fore and middle leg missing. Hind femur slightly flattened; 10 to 12 spines and numerous rather long hairs on its posterior margin. Somewhat longer hairs along the posterior margin of the tibia, shorter ones on the tarsus; the latter has also a series of spines on the anterior margin. Claw rather stout at the base, the tip distinctly curved; 7 to 8 denticles on its inner margin. All joinings, the distal end of the tarsus, and the claw, dark reddish brown. One small dark spot on each coxa; two near the apical margin of each trochanter; no other markings.

*Abdomen.* Gills present on segments 3-7. Long slender spines, curved near the tips, present on tergites 2-9. Each spine bears a



series of spinules near its tip, on the anterior margin. Spines on tergite 2 are shorter than the following pairs; quite close together near the median line; slightly longer than the length of the tergite at the median line. The spines on the succeeding tergites gradually increase in length to the 5th pair, on tergite 6; spines on 6 and 7 about equal in length; those on 8 and 9 slightly shorter, subequal to each other. On tergites 3-7 the spines of each pair are progressively divergent; on 2 and 3, these are directed backward, while spines on 4-7 show a progressive tendency to turn outward as well as backward; the pair on tergite 7 are most widely divergent. On tergite 8, the spines are closer together than on 7; on 9, closer together than on 8. Spines on these last tergites are slightly stouter and less curved at the tips; those on 9 tend to be horizontal rather than erect. Gills pale. Basal tergites pale reddish brown in color, becoming progressively darker toward the apex; tergite 9 very dark red-brown. A median dark stripe between the spines on tergites 7 and 8; traces of dark submedian streaks on the preceding tergites. Large dark reddish brown patches beneath the gills and on tergites 8 and 9. Short lateral extensions of the abdomen are present, which bear short postero-lateral spines on segments 4-7. Postero-lateral angles of segments 8 and 9 somewhat incurved, rounded.

Venter pale reddish basally; sternite 9 almost wholly dark red-brown. Each sternite is marked with a broad lateral triangle of dark red-brown, within each of which is a darker oblique submedian streak. These triangles, on the middle and apical sternites, are connected by a dark transverse bar across the anterior margin. Ganglionic areas pale with dark outlines on sternites 1-6; on 7-8, dark brown.

*Tails.* Missing.

Holotype—Female nymph. Collected by Mr. Frank T. Barry on Big Blackfoot River, Potomac, Montana, June 29, 1906.

No. 1287.1 in the Cornell University collection.

This is the species briefly described, but not named, by Prof. J. G. Needham in his paper on the Rocky Mountain species of *Ephemerella* (Ann. Ent. Soc. Amer. 20: 116, 1927).

*Ephemerella euterpe*, sp. nov.

A species of the *needhami* group. Genitalia without spines; venation light reddish brown; prominent dark ventral markings. Nymph without dorsal spines.

## Male imago

*Size.* Body 10–11 mm.; wing 10–11 mm.; tails  $10\frac{1}{2}$ – $11\frac{1}{2}$  mm.

*Head.* Dark brown, paler on frontal margin and at bases of antennae. Antennae light brown. Eyes probably light orange, in life.

*Thorax.* Reddish brown. Pronotum shaded with smoky brown. Mesonotum margined with darker brown; narrow darker brown median and submedian streaks on the scutum, and a very narrow black line along the lateral margin. A dark transverse streak on the praescutum. Mesonotal scutellum outlined with black, its lateral margins dark red-brown. A pale area on each side of the scutum near the anterior margin of the scutellum. Metanotum dark brown. Two dark brown streaks on the pleura, one anterior to each leg; intersegmental spaces yellowish. Prosternum, the portion of the mesosternum anterior to the middle leg, and a dark anterior and lateral margin around the middle sclerite of the mesosternum, dark red-brown. Remainder of sternum light reddish brown. Ganglionic areas blackish.

*Legs.*—Yellowish. Apical margin of fore trochanter, a narrow line on the edge of the fore femur, and a small spot near its apex, reddish brown. Fore femur faintly tinged with smoky at base and apex. Distal joint of fore tarsus, and claw, smoky. Very small spines on the fore tibia. Claws and tarsal joinings of middle and hind legs pale smoky.

*Wings.* Hyaline. Stigmatic area opaque whitish, the cross veins anastomosed near the costal margin. Longitudinal veins light reddish brown except those of the anal area which are wholly pale. Cross veins pale, indistinct.

*Abdomen.* Light reddish to olive brown dorsally, the apical segments darker brown. Anterior margins narrowly dark, posterior margins pale. Pleural fold pale. A narrow dark line parallels the pleural fold in the stigmatic region; a dark dot at the stigma, a dark line near the anterior margin, and near the center a small pale oblong area outlined in dark brown. Traces of a pale median line and of pale submedian streaks on the basal tergites. Ventrally pale yellowish white with deep purplish brown markings, in the form of lateral triangles based on the anterior margin and extending laterally almost to the posterior margin. On sternite 1, and 7–9, this dark area is continuous across the anterior margin; on the middle segments the triangles are not united. Sternites 7–9 largely dark. Ganglionic areas blackish brown.

*Tails.* Dark purplish brown basally, paler distally. Joinings not distinct.



*Genitalia.* Reddish brown. Second joint of forceps slightly bowed; somewhat enlarged basally, and apically on the outer margin only. Terminal joint short, thick, conical. Penes united except at the apex, where a V-shaped cleft separates them; no spines are present.

#### Female imago

Head and thorax greyish yellow. Legs somewhat paler than in the male. Cross veins of wings very faintly indicated. Abdomen purplish grey dorsally when filled with eggs. Ventral markings reddish purple; tendency for the dark lateral triangles to be united along the anterior margin. Subanal plate pale. Tails as in the male.

Some of the paratypes have a distinctly purplish red wash on head, thorax, legs, and abdomen. The allotype, described above, lacks this reddish tinge.

#### Nymph

*Size.* Body 10–11 mm.; tails 5 mm.

*General color.* Light reddish brown.

*Head.* Smooth, without horns or tubercles. Genae produced laterally as in *maculata*, forming a frontal shelf which overhangs the mouthparts. Antennae dark reddish brown at base, paler distally. Maxillary palp as in *maculata*. Canines moderately long, tips rather blunt. Galea of maxilla rather stout, both margins rounded out, a crown of long hairs at the tip on the upper margin; 2 long stout spines and several more slender ones at tip on the inner margin.

*Thorax.* Much as in *maculata*. A few indistinct dark brown markings on each side of the pronotum and anterior to the wing roots on the mesonotum. Ganglionic areas darkened on sternum.

*Legs.* Femora without tubercles; only a few short spines along each margin. Legs fringed with hairs as in *maculata*. Tips of femora and tibiae, both ends of the tarsi, and claws, dark reddish brown. 4 or 5 denticles on each claw, near the middle of the inner margin. Ventrally a small reddish brown spot at the apex of the trochanter, near the anterior margin.

*Abdomen.* Gills borne on segments 3–7, sometimes reddish in color. Lateral extensions of the abdominal segments quite prominent; each produced into a postero-lateral spine. No dorsal spines. Apical tergites distinctly reddish. Ventrally marked with broad lateral triangles as in the imago, which are distinctly reddish in color, and often connected along the anterior margin. Ganglionic areas darkened.

*Tails.* Blackish brown at base, becoming pale reddish brown distally. Two or three narrow dark bands cross each tail near the base. Except in the basal third, each tail is fringed with rather long hairs.

*Holotype*—Male imago. Collected by Dr. David Shepherd on Waddell Creek, Rancho del Oso, Calif. No. 1286.1 in the Cornell University collection.

*Allotype*—Female imago. Same data. No. 1286.2 in the Cornell University collection.

*Paratypes*—1 male imago; 7 female imagoes, one reared from the nymph; 1 male subimago; 2 female subimagoes; 3 nymphs. Same data as holotype. No. 1286.3–12 in the Cornell collection, 1 male, 2 females, 1 nymph, in the Stanford University collection.

*Ephemerella maculata*, sp. nov.

A member of the *needhami* group. Genitalia of male without spines; venation dark purplish brown. Nymph without dorsal spines.

Male imago

*Size.* Body 8 mm.; wing 8 mm.

*Head.* Blackish brown; frontal margin translucent, pale. Antennae deep smoky brown. Eyes dull orange.

*Thorax.* Very dark olive brown. Mesonotal scutellum and its lateral margins, the lateral margins of the mesonotum, and most of the sternum, blackish brown; the latter paler around the bases of the legs. Ganglionic areas distinctly blackish. Pleura dark brown, the intersegmental spaces yellowish.

*Legs.* Fore femur yellowish at the base, brown at apex; tibia deep olive brown; tarsus paler smoky brown. Middle and hind legs yellowish white; blackish pencillings on the femora at base and apex; tibiae shaded with brown at base; tarsi pale smoky brown.

*Wings.* Hyaline. Longitudinal veins dark purplish brown, cross veins of the fore wing finer but distinctly dark. A dark reddish brown spot is present at the base of the subcosta and radius of both fore and hind wings, and a dark streak at the base of the anal region of the fore wing. Stigmatic area opaque whitish, the cross veins anastomosed.

*Abdomen.* Smoky to olive brown dorsally; tergites 1–2 and 7–8 washed with blackish brown; middle tergites shaded with reddish brown medially. A dark brown line is present on each tergite just above the pale pleural fold; a brown crescentic mark lies on this line near the ante-



rior margin, and a darker spot at the stigma. Two or three small rounded pale areas may lie on each side of this dark line, on the middle tergites. Tergite 9 washed with reddish brown in its posterior half; base of tergite 9, and most of 10, yellowish. Posterior margins of tergites narrowly pale. Ventrally pale yellowish white with prominent brownish black markings. On sternites 1-7, these consist of a wide dark anterior margin, from which lateral extensions reach backward almost to the posterior margin; ganglionic areas blackish. Sternites 8 and 9 largely brownish black.

*Tails.* Missing, from the single male imago available. In a nearly mature male subimago, black at the base, becoming deep brown distally.

*Genitalia.* Dark smoky brown. Second joint of forceps somewhat bowed; slightly swollen at the base and apically on the outer margin only. Third joint short, stout, rounded. The penes are united for two-thirds of their length; at the apex a wide V-shaped cleft separates them. The entire structure is roughly hour-glass-shaped.

#### Female imago

*Head.* Yellowish brown.

*Thorax.* Notum paler than in the male,—reddish brown with yellow shading. Pronotum greyish brown. Fore leg reddish brown, the last tarsal joint paler. Femora of middle and hind legs tinged with yellowish red, the tarsi smoky except the distal joint, which is pale. Wings as in the male.

*Abdomen.* Blackish brown when filled with eggs. Tergites marked with reddish brown above the pleural fold. Venter as in the male. Subanal plate yellow apically. Tails blackish at the base, deep smoky brown distally; joinings indistinctly darker.

#### Nymph

*Size.* Body of male, 7 mm., of female, 9 mm.; tails 4-5 mm.

*General color.* Yellowish to pale yellowish brown, with brown markings.

*Head.* Smooth, without frontal horns or occipital tubercles. Genae produced laterally and anteriorly below the antennae, so that the frontal margin appears as a square-cornered shelf overhanging the mouthparts. Maxillary palp well developed, dark brown distally; the basal joint long and constricted near the middle, appearing to be composed of two joints; second joint short, third almost as long as the first, and tapering distally. Canines quite long and sharp-pointed.

*Thorax.* Antero-lateral angles of the pronotum produced forward. An indentation on the front margin near the lateral angle, on each side; front margin convex. Thorax without spines or tubercles (one female nymph examined possessed a short lateral tubercle on only one side of the pronotum). Dark brown spots and pencillings on each side of the pronotum, and on the mesonotum between and anterior to the wing pads, and on the anterior margin.

*Legs.* Yellowish white. Femora moderately flattened, without tubercles or spines, but with fringes of long hairs on the posterior margin. Tibiae likewise fringed on the posterior margin. Tibia marked narrowly at each end with dark reddish brown; apex of tarsus and tip of claw dark red. 3 to 4 short blunt denticles on each claw at about the middle of the inner margin.

*Abdomen.* Abdominal segments 2-9 with quite well developed lateral extensions, each bearing a postero-lateral spine; spines on 2-7 rather short, long on 8 and 9. No dorsal spines. Tergites 1-2, 5-6, and the median and lateral areas of 7, shaded with reddish brown, which is darkest laterally, forming distinct dark patches. Gills borne on segments 3-7. A black spot at the insertion of each gill. Ventrally yellowish, with brownish black bands on the anterior margins and lateral extensions backward from these, as in the imago. Ganglionic areas darkened.

*Tails.* Pale yellowish white, the extreme tips dark brown (in fully mature nymphs, the bases are also dark brown). Each is marked near the base by two dark reddish brown cross bands. Hairs short and few near the base; beyond the basal third, each tail is well fringed.

*Holotype*—Male imago. Collected by Mr. Charles D. Michener in San Gabriel Canyon, San Gabriel Mts., Calif., June 9, 1932. No. 1284.1 in the Cornell University collection.

*Allotype*—Female imago. Same data. No. 1284.2 in the Cornell collection.

*Paratypes*—1 female imago, 1 male and 1 female subimago, same locality, May 24, 1932; collected by C. D. Michener. 1 female subimago, reared, Waddell Creek, Rancho del Oso, Calif.; collected by Dr. David Shepherd. No. 1284.3-6 in the Cornell collection.

Nymphs of this species were collected at San Gabriel Canyon by Mr. Charles Michener on May 23, 1931, but none were reared. However, several subimagoes were reared by Dr. Shepherd from similar nymphs taken at Waddell Creek, thus associating the nymph and adult stage.



We have also two nymphs taken at San Antonio Canyon, Calif., on May 23, 1923, by Prof. J. G. Needham.

The wings of the subimago are pale smoky brown with a faint tinge of red.

*Ephemerella concinnata*, sp. nov.

A member of the *needhami* group, apparently close to *septentrionalis* McD., but with somewhat shorter legs. Very inconspicuous dorsal spines on the nymph, which is the only stage known.

Nymph

*Size.* Body of male  $11\frac{1}{2}$  mm., of female 13 mm.; tails  $8\frac{1}{2}$  mm.

*General color.* Dark reddish brown with a wide pale median streak almost the entire length of the body. Head, thorax, and basal abdominal segments bear numerous rather long whitish hairs.

*Head.* Smooth, without horns or tubercles. Very dark blackish brown anterior to the ocelli. Vertex and occiput yellow, with a dark brown stripe near the inner margin of each eye, these stripes connected anteriorly by a brown cross band between the eyes, forming a mark like three sides of a square. In the enclosed pale space are brown markings on each side of the median line. Antennae white at base, banded with dark brown immediately beyond; remainder yellowish white.

*Thorax.* Dark reddish brown, with indistinct small dark brown spots on each side of the pronotum and anterior to the wing roots on the mesonotum. A wide median yellowish stripe, within which are two narrow brown lines, one on each side of the very narrow pale median line, extends the entire length of the thorax dorsally. Pleura largely yellow, with brown markings. Venter yellow between the legs and along the lateral margins, the median sclerites dark red-brown.

*Legs.* Relatively long and slender, the hind leg longest; tarsus about two-thirds as long as the tibia, which is subequal to the femur. In the female, this leg is 6 mm. in length. Numerous short spines on the upper surface and along the posterior margin of each femur; longer spines on the anterior margin and apex of each tibia, and on the anterior margin of each tarsus. Numerous long hairs on the posterior margin of each joint. Femora dark brown, pale at apex, and with rather large yellow blotches at the base and near the middle on the upper surface. On the lower surface, a long curved pale streak follows the posterior margin. Tibiae yellow, with a narrow dark brown basal band and a wider dark band between the middle and the apex. Tarsus dark brown, yellowish

at each end, the apical pale band wider. Distal half of claw dark red. 8 to 9 rather long sharp denticles on each claw, those nearest the apex being longest.

*Abdomen.* Dark reddish brown dorsally, with a wide pale yellowish median streak extending to the end of the 7th tergite. Within this pale streak lies the dark median line, widest on tergites 6 and 7, narrow on the basal tergites. Rather inconspicuous dorsal spines are present on tergites 2-8, appearing as slightly raised areas on each side, upon which areas are borne numerous short dark spinules. The lateral extensions of the abdominal segments are quite prominent, each ending in a rather long postero-lateral spine. A dark brown band crosses each lateral extension near the middle of its length. Gills borne on segments 3-7; pale, each with a dark flask-shaped mark, within the basal portion of which is a pale dot. Tergites 8-10 almost wholly dark red-brown, except for the pale lateral extensions. Ventrally reddish brown with a lateral series of dark marks on each side, short oblique submedian streaks from the anterior margin, and between these and nearer the center of each sternite, two dark dots.

*Tails.* Yellow, crossed by narrow dark brown bands. At the base, two or three narrow dark bands; nearer the middle are three dark bands, each two joints in width, which occur every third or fourth joint; beyond these the tails are yellowish except for the blackish brown tip. Basally a whorl of spines is present at each joining, and occasional short hairs; beyond the middle the spines cease and rather long hairs fringe the tails on each side.

*Holotype*—Female nymph. Collected by Prof. A. S. Hazzard on Railroad Creek, Glacier National Park, Montana, June 8, 1932. No. 1285.1 in the Cornell University collection.

*Paratype*—Male nymph. Cutbank Creek, Glacier National Park, June 27, 1932. Same collector. No. 1285.3 in the Cornell collection.

This species, while seemingly quite close to the eastern *septentrionalis*, is considerably larger, and possesses also inconspicuous dorsal spines, which are lacking in the latter species.

Two smaller nymphs, taken in Glacier National Park in June 1932 by Prof. Hazzard, may be the immature stages of *concinata*, but show certain structural differences as well as differences in color pattern. The median dark brown line is wider, and margined on each side by a wide submedian yellow streak for the entire length of the body. The



lateral margin of the pronotum is widely yellow; the femora are yellow except for two narrow dark bands. Dorsal spines obsolescent. Ventral markings consist of two narrow yellow lateral lines and a partial median yellow line. For the present these nymphs are being held as a color phase of *concinata*.

*Ephemerella allegheniensis*, sp. nov.

A species of the *fuscata* group, closely allied to *tuberculata* Morgan. Known in the nymphal stage only. Body and femora flattened; numerous dorsal spines on head and thorax.

Nymph

*Size* (mature male nymph). Body  $8\frac{1}{2}$  mm.; tails 4 mm.

*General appearance.* In life, greenish brown; in alcohol, yellowish to reddish brown with black markings. A smooth-appearing nymph, with prominent dorsal spines. (Description drawn from alcoholic specimen.)

*Head.* Frontal margin notched laterally, to receive the bases of the antennae. Anterior margin of the clypeus almost straight. Very short blunt frontal horns are present. Occipital tubercles very high and prominent, much larger than in *tuberculata*. Head roughened near each ocellus. Reddish brown in color; a transverse black band extends between the eyes, and black lateral streaks on the occipital horns. Clypeus, frontal horns, and notches of the frontal shelf narrowly black-margined.

*Thorax.* A pair of rounded tubercles on the pronotum near the posterior margin, one on each side of the median line. Another pair of smaller tubercles situated on the lateral margin, between the middle and the anterior margin. A single very large mesonotal tubercle is situated between the wing roots. On each side of the mesonotum near the antero-lateral angle is a small rounded projection. The surface of the mesonotum is likewise distinctly roughened on each side of the median line and anterior to the wing roots. On the anterior margin of the mesosternum, near the median line, are two short blunt projections, and the prosternum bears a single median spine. All spines and tubercles are better developed than in *tuberculata*. Dorsum of thorax reddish brown with paler yellowish areas and black markings. Antero-lateral angles of the pronotum and an area on each side of the median line on the posterior margin, yellowish. A curved black mark on each side of the median line near the anterior margin. Posterior half of the lateral mar-

gin black. Median area of the mesonotum at the anterior margin, lateral areas just back of the antero-lateral angles, and the posterior half of the median area, pale yellowish. Black markings on the antero-lateral angles and along the anterior margin; brownish black areas anterior to the wing roots; and a wide black stripe running up each side of the prominent median tubercle, from the edges of the wing pads. Venter pale yellowish.

*Legs.* Fore femur with numerous tubercles and spines on the anterior margin, 4 to 5 spines on the posterior margin, and its upper surface bearing many small wart-like excrescences. Thumb-like process at apex of tibia well developed, blunt. Tarsus distinctly widened apically. Claw with 3 long and 1 short denticle. The middle femur bears 6-7 short teeth on the anterior margin and about 5 spines on the posterior margin; hind femur similar, but spine-like processes on the anterior margin less developed. Legs yellowish in color, indistinctly mottled and marked with brown. Femur pale apically; a pale band near the base of each tibia; fore tarsus brown at base. A small black dot is usually present on the outer anterior margin of the trochanter, ventrally.

*Abdomen.* Dorsum reddish to reddish brown, the last three tergites largely yellow. In some specimens, the anterior tergites are suffused with reddish brown. Posterior margins narrowly reddish brown. Conspicuous black lateral patches next to the gills on tergites 3-4 and 6-7, most conspicuous on tergite 4. Median line usually blackish on each tergite. Dorsal spines present on tergites 2-8; short and inconspicuous on 2 and 8, best developed on 5-7. No fringe of hairs on the posterior margins on tergites 8 and 9, as in *tuberculata*. Gills on segments 3-7, typical for the *fuscata* group. Lateral extensions on the abdominal segments 3-7 slightly more flaring than in *tuberculata*; the extension of segment 8, moreover, flares widely outward at about the middle of its length, and bears a relatively long postero-lateral spine, which is slightly incurved at its tip. Ventrally yellowish, with conspicuous black markings. These consist of a lateral row of black dashes on each side; a small black dot between these dashes and the pleural margin; short black submedian oblique dashes near the anterior margin; and a pair of black dots nearer the center of each sternite. The effect is of black lateral streaks and dots, and a curving row of four black dots between.

*Tails.* Yellowish to yellowish brown basally, becoming reddish brown at or near the middle where each is crossed by 4 or 5 narrow bands of white.



## Variations

Some of the younger nymphs show, besides the black markings described above, distinct traces of rose color in large areas on the pro- and mesonotum; the median line on the abdominal tergites and some of the lateral markings may likewise be rose colored. There is also a considerable range of variation in the relative amounts of light and dark areas on the dorsum of the body.

The paratype collected by Mr. Argo from the Potomac River is similar in all structural characters, but bears fringes of hairs on the legs. Measurements given are from this specimen, as all others are immature.

Holotype—Female nymph, partially mature. Collected by J. R. Traver on Cacapon River, W. Va., August 13, 1930. No. 1288.1 in the Cornell collection.

Paratypes—1 male nymph, mature; taken by Mr. Virgil Argo near Harper's Ferry, the Potomac River, Md.; 12 nymphs (4 males, 8 females), same data as the holotype. No. 1288.3–15 in the Cornell collection.

Most of the specimens which we have of this species were collected near the head of the Cacapon River, W. Va., after that river emerges from beneath the mountain known as Sandy Ridge. At the time of collection, I was with the members of the West Virginia University Biological Expedition. For a further account of that interesting river, the Cacapon, the reader is referred to the article by Drs. Needham and Strausbaugh (*Sci. Monthly* **33**: 80–85. 1931). Four nymphs were taken also by Prof. Needham at Elk Garden, W. Va., on Aug. 21, 1930.

This species, while very similar in general appearance to *tuberculata*, may be distinguished from it by (1) the greater development of the tubercles on the head and thorax, especially of the median mesonotal spine; (2) the smoother appearance of the body, which is almost lacking in hairs; (3) the widely flaring lateral margin of the 8th abdominal segment; and (4) the distinctive color pattern, particularly on the venter of the abdomen. In its habitat it is similar also to *tuberculata*, dwelling among mosses and other aquatic vegetation growing on large rocks in swift water.

*Ephemerella proserpina*, sp. nov.

A very large species of the *fuscata* group, related to *spinifera* Ndm. and *yosemite* n.sp. Known in the nymphal stage only. Occipital tubercles prominent; pronotal tubercles rather low and blunt, especially the sub-

marginal pair; dorsal spines on 8 and 9 about twice the size of those on the preceding tergites.

### Nymph

*Size.* Body 20 mm.; tails 13 mm.

*General color.* Very dark reddish brown.

*Head.* No true frontal shelf, the mouthparts projecting beyond the frontal margin. Rudiments of frontal horns faintly indicated. Head considerably roughened in the region of the ocelli. Occipital tubercles prominent. Clypeus and genae fringed with hairs.

*Thorax.* Submedian tubercles of the pronotum unequal in size; anterior one moderately large and blunt, the two posterior ones smaller, the outer of these being larger than the inner one. Submarginal tubercles much reduced, even smaller than in *yosemite*. Submedian mesonotal tubercles low and blunt; the pair near the middle of the anterior margin, and elevation laterad of these, much as in *yosemite*. A well developed median tubercle is near, but not on, the posterior margin, between the wing buds. Thorax sprinkled irregularly with fine black dots. A rather prominent median tubercle on the prosternum.

*Legs.* Anterior margin of the fore femur unmodified, without teeth or spines. Fore femur rather wide near the base; tibia and tarsus rather stout, the thumb of the tibia blunt and moderately long. Middle and hind legs relatively longer and more slender than in *yosemite*; the tibiae about one-fifth longer than the femora, which are not flattened. Legs thickly set with minute black spinules. Legs not banded. 6 to 7 denticles on each claw.

*Abdomen.* Gills present on segments 3-7; dull reddish brown, the margins pale, and with a pale basal patch. Lateral extensions and postero-lateral spines rather well developed on segments 3-9; no pale apical areas on these, as in *yosemite*. Dorsal spines prominent; present on tergites 2-9; sharp at the tips, the margins spinulate. Spines on tergite 2 erect, slightly shorter than the others. Spines on 3-7 sloping backward slightly, and increasing gradually but slightly in length from 3 to 5; those on 5-7 subequal in length. Rows of spines closest together on tergite 2; divergent on 3-5; subparallel on 6 and 7, not as far apart as on 5; divergent again on 8, convergent on 9. Spines on tergites 8 and 9 at least twice as long and large as those on the preceding tergites. Spines on 8 similar in form to preceding ones; long hairs on these spines and on the anterior median portions of tergites 8 and 9. Spine on 9 about as long as on 8, but more slender at the base; straight, and directed



backward. The lateral margin of the 9th tergite is flared slightly near the anterior border, and the postero-lateral spine tends to turn outward, as in *spinifera*. No yellowish dorsal markings, but the median area of each tergite is somewhat paler red than the lateral portions; this is most noticeable on tergite 8. Ventrally dark reddish brown like the dorsum; faint indications of lateral dark marks, and of a dark dot near the middle of the lateral margin of each sternite. Lateral extensions blackish brown.

*Tails.* Dark reddish brown, narrowly banded with yellowish except near the base; usually  $2\frac{1}{2}$  dark segments alternate with  $1\frac{1}{2}$  pale ones. A whorl of very short spines at each joining.

Holotype—Female nymph. Collected by Mr. Charles Michener in Mill Creek Canyon, San Bernardino Mts., Calif., April 2, 1931. No. 1294.1 in the Cornell University collection.

This species may be distinguished from its nearest ally, *yosemite*, by (1) the much greater size; (2) the inequality of the second pair of submedian tubercles on the pronotum; (3) the much lower submarginal tubercles on the pronotum; (4) the longer and more slender middle and hind legs. It may readily be separated from *spinifera* by the much greater size, the very short submarginal pronotal tubercles, and the unequal submedian tubercles of the pronotum.

*Ephemerella yosemite*, sp. nov.

A member of the *fuscata* group; related to *spinifera* Ndm. and *proserpina* n. sp. Only the nymph is known. Occipital tubercles very prominent; submedian tubercles of the pronotum unequal and blunt. Dorsal spines prominent, those on tergites 8 and 9 twice as high as on the preceding tergites.

Nymph

*Size* (specimen not yet mature). Body 13 mm.; tails 9 mm.

*General color.* Blackish brown with yellow markings.

*Head.* Occipital tubercles very prominent. No true frontal shelf, the mouthparts projecting beyond the frontal margin. Very faint indications of rudimentary frontal horns. Head roughened in the region of the ocelli. Lateral margins, median area of the frons up to the vertex, a line along the inner margin of the eye and up the occipital tubercles, and the middle of the occiput, blackish brown; remainder yellowish. Antennae black at base, dark brown beyond.

*Thorax.* Very short tubercles near the middle of the lateral margin of the pronotum, one on each side. A pair of blunt submedian tubercles slightly back of the middle of the sclerite, one on each side; posterior to these a pair of very small tubercles on each side. Submedian tubercles of the mesonotum likewise rather heavy and blunt. A pair of smaller tubercles on each side of the median line, on the anterior margin; laterad of each of these a broader tubercle-like elevation. A slight elevation of the median line at the posterior margin. Thoracic notum dark brown; tubercles, anterior margin, and the anterior median portion of the mesonotum, blackish; postero-lateral angle of the pronotum and the median posterior portion of the mesonotum yellowish; irregularly sprinkled with fine black dots. Venter yellowish brown, sprinkled with fine dark dots. A prominent median tubercle on the prosternum.

*Legs.* Anterior margin of the fore femur unmodified by teeth or spines; rather wide and thick, widest near the base. Tibia and tarsus likewise relatively thick; tibial thumb moderately long, blunt at the tip. Femora dark brown with three or four large pale areas; all are considerably flattened. Tibiae blackish, with wide yellow bands at each end. Tarsus and claw blackish; a pale brownish median band on the tarsus, and one near the base of each claw. 5 to 6 denticles on each claw. Tibiae of middle and hind legs scarcely longer than the femora. Legs thickly set with minute dark spinules.

*Abdomen.* Gills present on segments 3-7. Dorsal spines on tergites 2-9; those on 2-7 quite prominent, slanting backward slightly; pointed at the tips; subequal on 4-7, slightly shorter on 2 and 3. Spines on 8 and 9 show a sudden increase in size, being more than twice as high and correspondingly larger than those of the preceding tergites. On tergite 8 these spines are erect; on 9 they slant backward. Rows of spines divergent on 2-5; convergent on 6-7; on 8 and 9, farther apart, sub-parallel. Lateral extensions of the abdomen and the postero-lateral spines quite well developed on segments 4-9, smaller on 3. Dorsally blackish brown with a reddish tinge laterally. A large yellow patch occupies most of tergite 8; the apical portions of the lateral extensions on 4-8 are also pale, most prominently so on segment 8. Gills dark olive brown margined with whitish, and with a white patch near the base. Long hairs on the dorsal spine of segment 8 and along the median areas of tergites 8 and 9; shorter hairs on the spine of tergite 9. The lateral margin of tergite 9 is practically straight, as is the postero-lateral spine. Ventrally dull reddish brown, sprinkled with numerous fine dark dots. Posterior margins of the sternites narrowly darker. A



series of dark lateral streaks on each side, and faintly darker over the ganglionic areas.

*Tails.* Blackish brown, banded narrowly with yellow; usually 3 dark segments alternate with one pale one. A whorl of very short spines at each joining.

Holotype—Female nymph, not yet mature. Collected by Dr. P. R. Needham on Merced River, the Yosemite Valley, Calif., February 8, 1933. No. 1293.1 in the Cornell University collection.

Paratypes—6 immature nymphs, same data; 3 immature nymphs, Feather River, Chester, Calif., Nov. 11, 1932. Same collector. No. 1293.3–11 in the Cornell collection.

From *spinifera*, its near ally, this species may be distinguished by (1) the much larger size; (2) the blunter submedian tubercles on the pronotum, which are likewise very unequal in size; (3) the much smaller and blunter lateral pronotal tubercles; and (4), the shorter and thicker joints of the legs. From *proserpina*, to which it is most closely related, it may be separated by (1) the smaller size; (2) the slightly larger submarginal tubercles of the pronotum; (3) the very small equal paired posterior submedian tubercles of the pronotum; (4) the shorter legs and more flattened femora; and (5) the practically straight lateral margin and postero-lateral spine of segment 9.

*Ephemerella micheneri*, sp. nov.

A species of the *serrata* group, allied to *tibialis* McD.; venation pale.

Male imago

*Size.* Body 6–7 mm.; wing 7 mm.; tails 8 mm.

*Head.* Yellowish, shaded with brown around the bases of the antennae. Basal joint of antenna brown; second joint pale; filament brown. Eyes orange.

*Thorax.* Yellow, with brownish black markings. Pronotum mottled with brown. A brown transverse band and a short longitudinal streak on the pleura of the prothorax, above the fore leg. Scutum of mesonotum margined narrowly with brown, and with a narrow brown median line. Scutellum narrowly margined with brown; two median and two lateral brown streaks just anterior to the scutellum. Metanotum brownish, with two lateral dark brown streaks and three median dark dots. A purplish brown streak extends obliquely across the pleura from the wing base to the anterior margin of the prothoracic pleura. Above

and anterior to the middle and hind legs are two blackish streaks, and the coxae are black-marked. Sternum yellowish to yellowish brown, the lateral areas of the mesosternum anterior to the middle legs shaded with darker brown. The median areas of the pro- and mesosterna are outlined in black; especially prominent is the transverse black streak across the anterior margin of the mesosternum. Ganglionic areas of the meso- and metasterna are more or less distinctly darkened.

*Legs.* Yellowish. Fore tibia and tarsus pale smoky, the tibia darker than the tarsus. Fore tibia very long, as in *tibialis*; about twice the length of the femur. A narrow brownish red line near the apex of each femur, on the inner surface. Claws and basal joints of tarsi pale smoky.

*Wings.* Sub-hyaline to hyaline. Venation pale. A purplish streak extends up on to the membrane of the fore wing just below the costal margin, on the outer surface. On the inner surface, the costa and subcosta are brownish at the extreme base, the latter with a small black dot basally. Stigmatic area opaque whitish.

*Abdomen.* Brownish dorsally, yellowish ventrally. Tergites 2-8 rather heavily shaded with reddish to olive brown laterally; on the basal tergites this shading is more or less continuous across the dorsum also, while on 5-8 the median area is yellowish. Posterior margins of all segments pale. A blackish brown dot on the middle tergites, and a short streak on the basal and distal tergites, marks the stigmatic area. Pleural fold pale. Ventrally, a reddish brown streak, sometimes rather triangular, margins the pleural fold on each sternite. Ganglionic areas purplish black, the basal ones with blackish outlines and a dark median dot. Basal and middle sternites yellowish white, apical sternites yellow, sometimes marked extensively with powder white.

*Genitalia.* Yellowish amber. Forceps rather strongly bowed, the second joint enlarged basally and slightly so at the apex. Penes separated apically by a V-shaped cleft. The apical margin of each bears two or three blunt processes. A spine-like lateral process is present on each side. In lateral view, this spine projects upward.

*Tails.* White. Joinings purplish black.

#### Female imago

Head with extensive cream-white areas on the vertex and along the inner margin of each eye. Thorax with more extensive dark markings than in the male, these markings often reddish brown. Apical bands on the femora wider and darker red than in the male. Main longitudinal veins of the fore wing pale brownish. Abdomen, when filled with eggs,



dark reddish brown, without markings dorsally except the black stigmatic streaks and the pale posterior margins. Segments 8-10 yellowish brown. Tails amber at base, joinings as in the male.

### Nymph

Nymphs taken at the same time and place as the imagoes, but not reared, are marked so much like the imagoes that they are tentatively associated with them.

*Size.* Body of male,  $6\frac{1}{2}$ -7 mm., of female 7-8 mm.; tails 3-4 mm.

*General appearance.* Yellowish brown with darker brown markings

*Head.* Smooth, without tubercles or frontal horns. Maxillary palp rather well developed, the basal joint almost as long as the 2nd and 3rd combined. Canines wide, short, blunt.

*Thorax.* Smooth, without tubercles or spines. Irregular dark brown markings on each side of the pronotum, and on the mesonotum between and anterior to the wing roots. Median areas of the pro- and mesosterna outlined in black, as in the imago; the ganglionic areas distinctly dark.

*Legs.* Pale yellowish. A blackish spot at the base of the tarsus; apex of tarsus, and claw, blackish brown. Fore femur unmodified on the anterior margin; bearing only a few short spines on the upper surface and several long hairs and spines on the posterior margin. Other femora very similar. 7 to 8 denticles on each claw.

*Abdomen.* Dorsal spines present on the apical margins of tergites 2-8; short on 2 and 8, somewhat longer on 3 and 4, longest on 5-7. Abdominal segments 4-9 with short lateral extensions, of which all but segment 8 bear short blunt postero-lateral spines. Gills borne on segments 3-7. Yellowish to yellowish brown in color, the basal and middle tergites more or less shaded with black. Fully mature nymphs usually show lateral black patches on tergites 2-8; anterior margins blackish brown; and a variable amount of brown shading along the median line. Markings on tergite 8 are less distinct, consisting of a median brownish grey triangle based on the anterior margin, and occasionally a brown lateral mark. Ventrally the ganglionic areas are darkened, and a double row of lateral brown marks, each somewhat curved, is present on each side.

*Tails.* Alternately yellow and brownish black, each joining brown. Black areas close together and more numerous at the base than elsewhere. A whorl of short spines at each joining.

Holotype—Male imago. Collected by Mr. Charles D. Michener in San Gabriel Canyon, San Gabriel Mts., California, June 25, 1932. No. 1283.1 in the Cornell University collection.

Allotype—Female imago. Same data. No. 1283.2 in Cornell collection.

Paratypes—10 male imagoes, 12 female imagoes, same locality, same collector; May 28, June 9, 25, and 28, and July 21 and 23, 1932. No. 1283.3–24 in the Cornell collection.

I take pleasure in naming this species for Mr. Charles Michener, who has collected many fine specimens of mayflies for the Cornell collection from the vicinity of Pasadena, Cal. Nymphs were collected by Mr. Michener at the same locality on May 23, 1931, and June 23, 1932. We have also seen three male subimagoes of this species, from the Stanford University collection, taken at Waddell Creek, Rancho del Oso, Calif., by Dr. David Shepherd.

*Ephemerella teresa*, sp. nov.

A species of the *serrata* group, seemingly close to *micheneri* n.sp. Known only in the nymphal stage; dorsal abdominal spines present; maxillary palp wanting; lateral extensions of the abdominal segments moderately well developed.

Nymph

*Size.* Body 5–7 mm.; tails 2–4 mm.

*General color.* Pale reddish brown, marked with darker brown.

*Head.* Smooth. Maxillary palp entirely wanting. Antennae pale.

*Thorax.* Smooth. Median line of pronotum elevated into a carina anteriorly; depressed posteriorly, where it is bordered by lateral carinae. Indistinct darker mottling on the pro- and mesonotum. A short black mark behind each leg, on the pleura. Ganglia of the sternum dark, very distinct in most specimens; often a dark transverse line along the anterior margin of each division of the sternum, especially prominent on the mesosternum, from which short lateral lines may extend backward.

*Legs.* Pale. The usual spines are present on the upper surface of the fore femur and along the posterior margins of all the femora. Tips of tarsi, tibiae, and claws reddish brown. 9–10 denticles on each claw.

*Wing pads.* In mature nymphs, a prominent purplish line is often seen on the developing wing, close to and paralleling the costal margin.



The main longitudinal veins of the middle area of the fore wing may also be indicated by narrow dark lines.

*Abdomen.* Lateral extensions only moderately developed on the basal and middle segments, well developed on segments 8 and 9; postero-lateral spines on segments 4-9, the margins serrate. Dorsal spines present on tergites 4-7; short and farthest apart on 4, somewhat longer and subequal on 5-7, slightly convergent apically. Each bears minute spinules. Gills present on segments 3-7; purplish in color; a dark spot at the insertion of the first gill. Tergites narrowly dark brown on the posterior margins, round black lateral spots on tergites 2 and 3. Frequently larger reddish brown lateral patches are present next to the gills on segments 4-8, and small dark spots on tergite 9. On the holotype, the dark lateral areas are coalescent across the dorsum of tergites 4-8, forming a dark median blotch on each; dark median marks are also present on the basal tergites and on 9. Ventrally yellowish, with a more or less distinct series of dark lateral marks as in *serrata*; the ganglionic areas may also be darkened.

*Tails.* Pale yellowish, with whorls of dark reddish brown spines at each joining. At the base, one or two joinings may be faintly brownish.

Holotype—Male nymph. Collected by Mrs. Theresa R. Seemann in San Antonio Canyon, Calif., May 29, 1923. No. 1289.1 in the Cornell University collection.

Paratypes—3 female and 2 male nymphs, same data; 2 female nymphs, same location, same collector, May 12, 1923. No. 1289.3-9 in the Cornell collection.

This species I name in honor of Mrs. Theresa R. Seemann, who collected the specimens. It is close to *micheneri*, but may be distinguished from the latter species by the absence of the maxillary palp, the better development of the postero-lateral spines on segments 8 and 9, and by the less conspicuous dorsal spines.

*Ephemerella cognata*, sp. nov.

A member of the *serrata* group; known in the nymphal stage and female subimago only. Rather close to *tibialis* McD., but possessing distinct dorsal spines. Maxillary palp vestigial.

Nymph

*Size.* Body of female, 7-8 mm.; tails  $4\frac{1}{2}$  mm.

*General color.* Dark reddish brown.

*Head.* Smooth, without horns or tubercles. Mandibles well developed; outer margin almost straight. Canines quite large; relatively long and broad, the tips acute. Galea of maxilla conical; many long hairs at the tip on the outer margin; 2 long spines and several bristles near the apex on the inner margin. Maxillary palp represented only by a minute stub.

*Thorax.* Without spines or tubercles; however, on each side of the pronotum near the center of the posterior margin is a slight rounded elevation.

*Legs.* Femora somewhat flattened, anterior margins unmodified. On the posterior margin of each, and on the upper surface of the fore femur near the apex, are several rather long spines. Hairs on the posterior margins of the tibiae and tarsi; in addition, the hind tibia bears spines on each margin. Claws slightly curved at the tip; each bears 9 to 10 rather long sharp denticles on the inner margin. Apex of tibia and a median band on the tarsus pale; remainder of each leg reddish brown.

*Abdomen.* Gills present on segments 3-7; greyish lavender in color. Lateral extensions on segments 4-9 better developed than in *tibialis*; the margins serrate. Each is produced into a postero-lateral spine, best developed on segments 8 and 9. True dorsal spines are present on tergites 4-7; on tergite 4 these are slightly wider apart than on the following segments. Short spinules are borne on the spines of tergites 6 and 7; slightly larger spinules fringe the posterior margins of tergites 1-3 and 8-9, on each side of the median line. On tergite 3, the posterior margin is extended very slightly in the areas usually occupied by spines. Tergites dark reddish brown; indications of a darker median line and of dark lateral patches. Lateral extensions yellowish. Ventrally dark reddish brown. Markings consist of a series of black lateral streaks and indistinct darker blotches in the ganglionic areas.

*Tails.* Yellowish at base; alternate bands of brown and yellow are present beyond the middle. A whorl of spines at each joining.

#### Female subimago

Body greyish. A dark mark on the mesothoracic pleura anterior to the middle leg. Mesonotum margined laterally with deep chestnut brown. Wings very pale smoky. No distinct markings on the legs. Black lateral marks on the venter of the abdomen, as in the nymph; ganglionic areas faintly darker on sternites 1-7. On the middle sternites, traces of dark oblique submedian streaks at the anterior margins,



and of short curved marks nearer the center of each sclerite. Sternites 8 and 9 wholly pale. Tails white, joinings purplish black.

Holotype—Female nymph. Collected by Dr. David Shepherd on Waddell Creek, Rancho del Oso, Calif. No. 1291.1 in the Cornell University collection.

Paratypes—4 female nymphs; 1 female subimago, reared from nymph; same data as holotype. No. 1291.3–5 in the Cornell University collection (2 nymphs in the Stanford University collection).

We have also a single female nymph from San Antonio Canyon, Calif., June 11, 1923, collected by Prof. J. G. Needham, which seems to be of this species, but is slightly smaller than the nymphs from Waddell Creek.

#### SUBFAMILY SIPHLONURINAE

#### *Siphonurus spectabilis*, sp. nov.

*Size.* Body of male imago, 14 mm.; of female, 15–16 mm.: wing of male, 13 mm.; of female, 15–16 mm.: tails of male and female, 18 mm.

*General appearance.* Recognizable by the brown patch at the bulla of the fore wing and on the radial fork of the hind wing, and by the margined cross veins. Differs from other species of this genus in the structure of the male genitalia, and the shape of the apical margin of the subanal plate of the female. Hind wing of male tinged with orange.

#### Male imago

*Head.* Whitish. A wide purplish brown band extends across the median carina, leaving as pale areas a very narrow frontal margin and a wide band below the ocelli. Ocelli ringed with purplish black. Basal joint of antenna grey in its distal half, white basally; filament white. Eyes bluish grey above, black in lower portion. No oblique colored band across the eye.

*Thorax.* Yellowish brown marked with reddish brown. Lateral and anterior margins of mesonotum reddish brown. A wide purplish streak anterior to the wing roots. A reddish brown streak on the pleura, extending obliquely forward and downward from the fore wing, anterior to the middle leg. A reddish brown patch on the middle and hind coxae; fore coxa marked by two black longitudinal streaks. Purplish markings on the prosternum and a transverse band on the mesonotum between the middle legs.

*Legs.* Fore leg shorter than body. Legs whitish. Fore femur and

tibia, and trochanters of all legs, washed with yellowish. Fore femur narrowly reddish brown at the apex; tibio-tarsal joining reddish brown; all other joinings pale.

*Wings.* Subhyaline. Veins dark reddish brown; humeral cross vein very heavy and dark. Stigmatic area opaque whitish; cross veins mostly straight, showing a slight tendency to fork and anastomose. These veins about 18 in number; about 8 costals before the bulla. In the fore wing, the cross veins of the costal space before the bulla, and all cross veins of subcostal and radial spaces except at the apical margin, rather widely margined with dark reddish brown. At the bulla, 3 or 4 cross veins in the subcostal space are more widely margined, sometimes almost connected by the resulting brown clouds. In the radial space directly below them, a continuous dark brown blotch covers four cross veins, completely filling that portion of the space. A dark triangle partially fills the fork of the radial sector lying directly below this wide dark blotch. Some cross veins in the disc of the wing likewise narrowly margined. Anal region distinctly yellowish at the wing base, with two purplish grey streaks running out on the large veins. Cross veins of fore wing less numerous than is usual in this genus, and tending to be arranged in several series across the wing.

Hind wing distinctly tinged with yellowish orange, most noticeable in the apical portion. Several cross veins in the disc, and in several of the radial spaces beyond the radial fork, narrowly margined. In the radial space and the space of the first radial sector is a prominent dark brown wedge-shaped mark, beginning at the first fork of the sector and extending apically over four cross veins, completely filling these two spaces. Wing faintly purplish grey at the extreme base. Widened in the anal region, in this respect more like *Parameletus* than *Siphonurus*.

*Abdomen.* Yellowish white with brown markings. Posterior margins and median areas of tergites faintly washed with brown. The usual dark lateral triangles are much reduced in extent, being restricted to the postero-lateral angles and the lateral margins. Oval dark submedian spots present but rather indistinct. Between these and the lateral triangles is another longitudinal streak in the anterior portion of the basal and middle tergites. Tergites 7-10 distinctly reddish brown. Anterior pale triangles distinct in the antero-lateral angle, diffuse near the median line. A postero-lateral spine present on tergite 9. Pleural fold white. Ventrally, the oblique bands are broad, deep purplish brown in color, and united anteriorly to form more or less complete dark U-marks. A pale oval area is enclosed by each dark band on each



side, near the anterior margin. No dark dots visible within the dark U-marks. Sternite 9 entirely purplish black except for a yellowish brown lateral margin.

Forceps and forceps base purplish to purplish brown. Penes dark reddish brown. Penes somewhat resemble *alternatus* and *phyllis* in form, but have an additional long narrow forward-projecting process, reaching beyond the forceps base, which is not found in either of those species. Basal joint of forceps not clearly separated from the long joint, and entirely lacking the usual prominence on the inner margin, so that the forceps are narrowed gradually from the base. Apical margin of the forceps base between the forceps is very slightly concave at the center.

*Tails.* Dark purplish brown at base, soon shading into purplish grey, which becomes paler distally. A narrow purple streak extends forward from the base to beyond the middle, on each side of each tail. Joinings very narrowly darker in basal half.

#### Male subimago

Wings greyish. Both fore and hind wings distinctly dark grey at base of the main veins of the costal margin and in the anal region; orange tinge of hind wing not distinguishable. Tarsi smoky brown, the joinings dark reddish brown. Dorsal abdominal markings rather more distinct than in the imago. Tails darker than in imago.

#### Female imago

Posterior margin of head purplish, with faint submedian streaks extending forward on the occiput. Lateral anterior margin of pronotum reddish brown, its posterior margin purplish in the median area. Oblique purplish streaks on the pleura, between middle and hind legs. A purplish streak on the anterior margin of the fore femur at its base. Fore tibia and tarsus, and tarsi of middle and hind legs, shaded and streaked longitudinally with smoky purplish brown. Subanal plate extended backward on its apical margin into a median spine. Otherwise similar to the male imago.

#### Female subimago

Similar to male subimago.

## Nymph

Yellowish brown. Labrum and tips of mandibles and maxillae dark reddish brown. A brownish triangle below and laterad of each antenna. Pro- and mesonota with lateral reddish brown markings, also the antecoxal pieces and coxae. Legs yellowish. A brown basal and apical band on each femur; a brown basal band on each tibia; basal and apical bands on the tarsi. Wing pads clearly show the dark patches and dark veins of the imago.

Gills double on the 1st and 2nd abdominal segments only. Tergites 6 and 9 distinctly reddish brown. Each tergite with reddish brown submedian marks, ventrally reddish brown. Apical and lateral margins of all sternites whitish; a whitish submedian band on each side. Middle and apical sternites with dark reddish brown median triangles, and oblique submedian streaks in the pale bands. Laterally on the anterior margin of each is a dark brown transverse streak. Tails yellow; the usual dark band beyond the middle is orange-brown in color and rather diffuse.

Holotype—Male imago, reared from nymph. Collected by Dr. David Shepherd on Waddell Creek, Rancho del Oso, Calif. No. 1279.1 in the Cornell University collection.

Allotype—Female imago, reared. Same data. No. 1279.2 in the Cornell collection.

Paratypes—11 male subimagoes, 6 female subimagoes, reared; 2 nymphs; same data. No. 1279.3–13 in the Cornell collection. (4 male and 2 female subimagoes in the Stanford University collection.)

*Siphonurus marshalli*, sp. nov.

Hind wing entirely stained with coffee brown, the cross veins of the disc heavily infuscated; fore wing tinged faintly with amber in the basal half, the cross veins of the disc, especially at and below the bulla, heavily infuscated. Hind tarsus barely longer than the tibia.

## Male imago

*Size.* Body 13–14 mm.; wing 13–14 mm.; tails 30–32 mm.

*General color.* Blackish brown, the abdomen paler ventrally.

*Head and thorax* deep blackish brown. Pleural sutures, an area anterior to each middle and hind leg, and a transverse band anterior to the hind legs, paler, yellowish brown. Scutellum reddish.



*Legs.* Fore femur and tibia dark reddish brown, tarsus slightly paler in color. Middle and hind legs yellowish, shaded faintly with reddish brown, especially on the tarsi and the bases of the tibiae. Hind tarsus barely longer than the tibia.

*Wings.* Fore wing tinged with amber in its basal half, the extreme base stained with brown. Cross veins of the costal and subcostal spaces, except in the stigmatic area, and in the disc of the wing, rather widely margined with dark brown. At the bulla a zigzag dark band is thus formed, three cross veins in width, and extending to the first branch of the cubitus; another small cloud is present in the radial space halfway between the bulla and the base of the wing. All veins dark brown. Hind wing entirely yellowish to coffee brown in color, slightly paler in the basal two-thirds of the costal and subcostal spaces. Cross veins of the disc, below the subcosta, are very heavily margined with dark brown, heaviest between the subcosta and median vein. A dark cloud is formed at the point where the radial sector leaves the radius, and a smaller one halfway from this to the wing margin. Subcostal veins infuscated only at the extreme base and near the apex.

*Abdomen.* Segments 1-3 and 8-10 dark reddish brown, the sternites slightly paler than the tergites, and semitranslucent. Middle segments semi-hyaline, the sternites yellowish, the tergites reddish brown with wide darker reddish brown markings. These consist of dark posterior margins, wide patches in the postero-lateral angles, and a somewhat lighter reddish brown shading on the posterior two-thirds of the central part of each tergite. Tergites 8 and 9 have yellowish antero-lateral angles. Tergite 10 is somewhat paler than 8 and 9; sternite 8 is largely deep yellow-brown except for the darker anterior margin.

*Tails.* Dark reddish brown, almost blackish at the base; tips slightly paler.

*Genitalia.* Reddish brown. Basal joint of the forceps with no extension on the inner margin. Penes appear to be somewhat of the type of *quebecensis* Prov., but differ markedly from this species in details of structure.

#### Female imago

Wing nearly 15 mm. in length. In general appearance, very similar to the male, but the abdomen is almost wholly reddish brown. Fore wing may lack the amber tinge at the base, and the brown infuscations of the cross veins in both wings are paler than in the male. Hind wing brown-tinged as in the male, but the color paler.

Holotype—Male imago. Collected by Mr. Byron C. Marshall at Imboden, Arkansas, April 6, 1927. No. 1299.1 in the Cornell University collection.

Allotype—Female imago—Same data, same collector. No. 1299.2 in the Cornell collection.

Paratypes—3 male imagoes and 1 female imago, April 5 and 6, 1922, and April 15, 1927; same collector. These specimens returned to Mr. Marshall. No. 1299.3–6.

This beautiful and unusual species I name in honor of Mr. Marshall, the collector.

*Ameletus shepherdii*, sp. nov.

A small species with pale whitish abdomen and amber-tinted wings.

Male imago

*Size.* Body 8 mm.; wing 8 mm.; tails 12 mm.

*Head.* Light reddish brown; frontal margin translucent amber.

*Thorax.* Light reddish brown. Mesonotum yellowish except for the reddish anterior portion, which is narrowly margined with white; scutellum pale whitish, its postero-lateral margins dark red-brown. Pleura yellowish red, with reddish brown sutures and pale whitish areas.

*Legs.* A transverse reddish brown stripe on the fore coxa. Fore leg pale amber, the femur and last three tarsal joints paler than the tibia. Tibia slightly longer than the femur. Middle and hind legs whitish, the joinings amber yellow.

*Wings.* Hyaline. Tinged distinctly with amber, especially evident on the hind wing and the stigmatic area of the fore wing. A small reddish brown spot at the base of the fore wing. Venation pale reddish brown to amber; cross veins finer than the longitudinals. Stigmatic cross veins anastomosed near the costal margin; about 8 costals beyond the bulla are straight, then follow about 12 that are anastomosed. Before the bulla are 10 to 12 costal cross veins, distinctly amber-tinged. The stigmatic area is somewhat opaque.

*Abdomen.* Segment 1 opaque, pale reddish brown. Segments 7–10, and the posterior portion of 6, opaque, yellowish red in color, rather darker dorsally. Intermediate segments pale whitish to cream colored, semi-translucent; faintly washed with pale yellowish red on the tergites, especially along the lateral borders and an indistinct band across the posterior portion. Posterior margins and ganglionic areas opaque whitish. Sternites 2 and 3 may be faintly tinged with yellowish. No distinct markings.



*Tails.* Amber-colored, paler at the tips. Joinings opaque, faintly deeper amber.

*Genitalia.* Amber-yellow. Penes somewhat resemble *cooki* McD., but the distal portions are directed outward, and a blunt thumb-like process occupies the position of the inner spine of that species. The tubercle on the inner distal margin of the forceps base is blunt and quite prominent. The apical margin is but slightly excavated.

#### Female imago

Body 9 mm., wing  $9\frac{1}{2}$  mm. Head and thorax as in male. Fore leg pale reddish brown. Tibiae and tarsi of middle and hind legs amber, femora whitish. Wings more strongly amber-tinged than in the male; venation distinctly dark reddish brown, darker than in the male. Entire dorsum of abdomen flushed with pale reddish brown, venter paler. Tails missing.

#### Male subimago

Very similar to imago. Wings greyish, but with amber tinge, at least in the later stages. Mesonotum pale whitish, with extensive lateral and anterior patches of reddish brown. Pleura paler than in the imago.

#### Nymph (from nymph slough of 1 male specimen)

Color probably pale yellowish red in life. Tarsi banded with dark reddish brown at base and apex. Abdominal segments 9 and 10 dark reddish brown; posterior margins of tergites and the narrow lateral extensions reddish brown. No other distinct markings. Posterolateral spines present on segments 2-9; short and inconspicuous on 2, increasing gradually in length posteriorly. Tails with a wide dark red-brown band across the middle.

In size, this species is close to *cooki* McD., but differs from that species (1) in the much paler abdomen, (2) in the distinct amber tinge of the wings, and (3) in the details of the structure of the genitalia. The species is named in honor of Dr. David Shepherd, the collector.

*Holotype*—Male imago. Collected by Dr. David Shepherd on Waddell Creek, Rancho del Oso, California. Other data lacking. No. 1282.1 in the Cornell University collection.

*Allotype*—Female imago. Same data. No. 1282.2 in Cornell University collection.

*Paratypes*—5 male and 2 female subimagoes. Same data. No. 1282.-3-6 in the Cornell collection. 2 males and 1 female in the Stanford collection.

*Isonychia christina*, sp. nov.

A bright red species with pale smoky brown tarsi and very pale brown venation.

## Male imago

*Size.* Body 10 mm.; wing 10 mm.; tails 20–26 mm.; fore leg 8 mm.

*Head.* Reddish. Median frontal carina and frontal margin edged with dark red; bases of antennae red, the filament reddish. Eyes reddish purple; a pale blue double transverse band on each.

*Thorax.* Very dark red. Pleura somewhat paler, usually with deep rose markings. Scutella of the meso- and metanota, and the middle of the sternum, darker red. Rose markings on the borders of the mesonotum; often a small pale spot anterior to the scutellum, and a small cream-colored area on each side of it.

*Legs.* Femur and tibia deep reddish black, femur paler basally, tibia pale at the extreme base. Tarsus pale smoky brown, usually narrowly paler at each joining; the basal third of the first joint pale whitish. Very rarely the entire tarsus is paler yellowish brown, darker at each joining. The claws are marked with deep rose. Tarsus fully as long as the tibia. Middle and hind legs yellowish white; claws and last tarsal joint faintly tinged with reddish. All coxae deep rose in color.

*Wings.* Hyaline; stigmatic area opaque white. Venation very pale brownish; each longitudinal vein is outlined by two narrow dark lines.

*Abdomen.* Intense red dorsally and ventrally, the apical segments even brighter red. Middle segments somewhat semi-translucent. Posterior margins of all segments black, wider on the tergites. Pleural fold margined with an interrupted black line; above it on the dorsum is another dark parallel line. Sternites often slightly paler at the anterior margin. Pale mid-dorsal line and darker submedian streaks almost obsolescent. On the sternites, the ganglionic area is usually rather pale, and margined by dark oblique submedian streaks.

*Tails.* White, washed with brownish red at the base; 4 to 6 of the basal joinings are usually red, all others colorless.

*Genitalia.* Forceps base reddish, deeply excavated apically. Forceps deep smoky brown, the terminal joint pale. Penes of the "albomani-cata" type; pale reddish in color.

## Female imago

Frons of head as in male; vertex cream-colored, largely suffused with reddish. Wide reddish areas between the bases of the ocelli and in the



space between the eye and the lateral ocellus. A wide red geminate median stripe; the corners of the occiput purplish black, the posterior margin shaded with reddish. Mesonotum flesh-colored, usually with a narrow yellow median stripe anteriorly. Extensive powder-yellow markings suffused with deep rose on the borders of the mesonotum, on the pleura and on each side of the mesoscutellum. Venation very slightly darker than in the male. Tails yellowish at base, joinings as in male. Subanal plate yellowish red; rather deeply excavated apically, its outer angles acute.

### Nymph

Reddish brown, darker on the apical segments. A median white stripe, beginning on the frontal carina, extends along the thorax and continues as an interrupted line the length of the abdomen. Pale submedian streaks usually margin it on the abdominal tergites. Base of antenna pale, followed by dark brown joints near the base; pale yellowish apically. Tibial spine of fore leg about one-half as long as the tarsus; slightly outcurved apically. Claws usually with 7 denticles. Posterolateral spine on segment 9 only slightly longer than that on segment 8. Gills pale brown, with a darker median line and anterior margin. Two diffuse darker spots on the outer margin of each.

Holotype—Male imago. Collected by Miss Christine N. Hardy, at the Balch Hall light, Ithaca, N. Y., July 24, 1931. No. 1251.1 in the Cornell University collection.

Allotype—Female imago. Same data. No. 1251.2 in the Cornell collection.

Paratypes—10 male imagoes, same data; 16 female imagoes, August 7, 1932, same locality; 6 male imagoes, June 17, 1931, same locality. All collected by Miss Hardy. No. 1251.3-34 in the Cornell collection.

Besides local material, we have specimens in the Cornell University collection, which may be of this species, from St. Lambert, Quebec, July 27, 1927, collected by Mr. G. S. Walley; and from Ottawa, Ont., July and August 1924, collected by Dr. J. McDunnough, Dr. F. P. Ide and Mr. G. S. Walley.

This species is named in honor of Miss Christine Hardy, to whom we are indebted for many fine specimens of this and other species of the genus *Isonychia* collected in the vicinity of Ithaca, N. Y. It occurs locally along with *albomanicata* Ndhm., with which it has probably been

confused in the past. It may be separated from that species (1) by the brighter red color of the entire body, the thorax being red instead of brownish as is *albomanicata*; (2) by the pale smoky fore tarsi; (3) by the slightly darker venation; (4) by the yellower middle and hind legs; and (5) by the darker tail bases. As compared with *christina*, true *albomanicata* appears paler and duller and of a purplish rose color; fore tarsi wholly pale or slightly tinged with rose at the joinings; middle and hind legs wholly white. The differences in the nymphs seem to support the idea that *christina* is in fact a valid species, and not a redder and darker variant of *albomanicata*. The nymph of *christina* is paler, with a continuous pale mid-dorsal line and submedian streaks on the tergites; gills pale brown instead of deep purple; usually but 7 denticles on the claw instead of 8-10; the postero-lateral spines on segments 8 and 9 relatively shorter than in *albomanicata*, that on 8 being  $\frac{3}{4}$  of 9, while in *albomanicata* the spine on 8 is but  $\frac{2}{3}$  of 9, and both spines are longer.

*Isonychia circe*, sp. nov.

A rather pale reddish species; fore tarsus smoky brown, first two joints pale at base; venation pale.

Male imago

*Size.* Body  $9\frac{1}{2}$ - $10\frac{1}{2}$  mm.; wing 9-10 mm.; tails 20 mm.; fore leg 7-8 mm.

*Head.* Yellowish. A black spot between the eye and the base of the antenna; the latter pale, tinged with red; filament dusky. Eyes purplish.

*Thorax.* Reddish, tinged with yellow. Lateral aspects of the anterior portion of the mesonotum yellowish red; a spot anterior to the mesonotal scutellum, areas on each side of this and the metanotal scutellum, and the pleura in large part, yellowish. Scutellum and sternum, and a small area in the middle of the anterior portion of the mesonotum, dark reddish brown.

*Legs.* Fore tarsus usually equal to tibia; tibia relatively short, not much longer than the femur. Fore femur dark red, paler at base; tibia dark reddish black. Tarsus smoky brown, the basal two-thirds of the first joint, the basal half of the second joint, and a narrow area at the base of the third joint, pale yellowish. Middle and hind legs clear pale yellow, the claws faintly smoky at the tip. All coxae marked with rose.

*Wings.* Hyaline. Stigmatic area somewhat opaque, whitish. Veins very pale yellowish.



*Abdomen.* Pale red, very slightly duller and paler ventrally. Basal segments slightly darker red; apical segments brighter and paler, often tinged with yellow and with powdery whitish areas; opaque. Middle segments semi-translucent. Posterior margins of all segments distinctly purplish black, these dark bands wider and deeper in color on the tergites. Pleural fold pale in the anterior half, shaded with smoky in the posterior half of each segment. A continuous smoky stripe parallels the pleural fold on the dorsum; each stigma has a small black mark. Mid-dorsal line obscurely pale, narrow at base and becoming progressively wider apically. On the middle tergites it is margined by obscure smoky submedian streaks. On the apical segments, opaque powdery white streaks may be present, two on each side of the median line.

*Tails.* White; a few of the basal joints may be faintly yellowish. Two or three joinings at the extreme base are bright red. All other joinings white.

*Genitalia.* Amber, sometimes tinged with rose. Forceps base rather deeply excavated apically. Basal joint of forceps fully three-fourths as long as the second joint. The combined terminal joints do not equal the second joint in length. Distal joint shorter than the third. Penes of the "albomanicata" type. Very broad and turning outward apically.

#### Female imago

Body or wing, 10-11 mm.

Head flesh-colored. Faint indications of a dusky pattern near the middle of the vertex, from which may be traced faint extensions forward to the bases of the ocelli, and backward to the corners of the occiput. The latter are filled by a large black spot. A narrow reddish line usually follows the inner margin of the eye, sometimes expanding anteriorly to tinge the space between the eye and the lateral ocellus. Numerous rose markings on the thorax. Venation usually as in the male; sometimes faintly yellowish brown. Abdomen brownish dorsally, dull rose ventrally. Posterior margins of the tergites rather darker and wider than in the male. Subanal plate with a moderate apical excavation, its outer angles subacute. Fore tarsus rather paler than in the male.

Holotype—Male imago. Collected by Prof. P. W. Fattig on Chattahoochee River, Atlanta, Georgia, August 8, 1932, No. 1252.1 in the Cornell University collection.

Allotype—Female imago. Same data. No. 1252.2 in the Cornell collection.

Paratypes—10 male imagoes, Chattahoochee River, Atlanta, Ga., on June 30, 1932, July 4–10, 1931, and August 1, 1931; 4 female imagoes, same location, July 4–10, 1931; 2 female imagoes, Alcova River, south of Monroe, Ga., August 12, 1931; 2 female imagoes, Apalachee River, north of Monroe, Ga., same date. Collector, Prof. P. W. Fattig. No. 1252.3–20 in the Cornell collection.

*Isonychia diversa* sp. nov.

*Length.* Body 9 mm.; wing 9 mm.; tails 19 mm.

A rather small brownish species with pale venation. The genitalia are unique among the members of this genus.

*Head* and thorax dark reddish brown, brightest on the notum. Pleura somewhat paler.

*Legs.* Fore femur dark red, becoming blackish at the apex. Tibia almost black. Tarsus pale reddish brown, the basal half of the first and second joints yellowish. Fore tarsus as long as the tibia. Middle and hind legs whitish, the femora slightly tinged with reddish, the claws pale smoky.

*Wings.* Hyaline. Venation wholly pale.

*Abdomen.* Smoky brown with a reddish brown tinge; paler on the middle sternites, which are somewhat translucent. Tergites 9 and 10 dark red-brown, sternites 8–10 bright reddish. Each segment has a prominent dark brown posterior margin. The pleural fold is narrowly pale on the extreme margin, above which pale line is a narrow dark reddish brown strip at the center; a small dark mark is present at the stigmatic area. Mid-dorsal line pale; very narrow on the basal segments, increasing in width posteriorly. Dark brown wedge-shaped submedian streaks bound it on each side; these are obscure basally, well marked apically. Laterad of each dark streak is another paler translucent strip, followed by a darker one. Postero-lateral angles reddish brown, antero-lateral angles paler, translucent. Sternites marked similarly to the tergites, with a rather wider pale median stripe and alternating dark and light stripes on each side.

*Tails.* White, unmarked.

*Genitalia.* Forceps base reddish; deeply excavated on its apical margin. Forceps pale. Penes differ from all other known species of this genus, and are somewhat reminiscent of the genus *Siphlophlepton*. United to form a broad base, they are suddenly incurved and then curve outward again to form more or less rounded apical lobes, which are



separated by a median V-shaped notch. Each lobe bears a slight indentation on its apical margin. The long second joint of the forceps is at least a third longer than the two terminal joints together. The basal joint is relatively long and slender.

Holotype—A single male imago. Taken by Dr. George Ainslee at Knoxville, Tenn., June 30, 1916. No. 1253.1 in the Cornell University collection.

*Isonychia fattigi*, sp. nov.

A dark red species with smoky fore tarsi and pale venation.

Male imago

*Size.* Body 10–11½ mm.; wing 10½–11½ mm.; tails 25–30 mm.

*Head.* Frons pale, translucent; suffused with red on the carina, frontal margin, and around the bases of the antennae. Blackish shading between the ocelli, and a black spot between the eye and the antenna. Antennal filament pale brownish. Eyes dark purplish (alcoholic specimen).

*Thorax.* Reddish black; mesonotal scutellum, metanotum, and sternum blackish. Pleura paler with deep rose markings.

*Legs.* Femur and tibia of fore leg reddish black; tarsus smoky brown, somewhat darker at the apex of each joint. Tarsus fully as long as tibia. Middle and hind legs yellowish white; coxae rose-colored; distal joint of tarsus, and tarsal joinings, reddish.

*Wings.* Hyaline. Stigmatic area more or less opaque, whitish. Longitudinal veins of the costal margin of the fore wing very pale yellowish; all other veins colorless.

*Abdomen.* Dark wine red, not paler ventrally; apical segments brighter red. Posterior margins of all segments rather widely blackish; a black line parallels the pleural fold. Basal portion of each sternite rather paler and somewhat translucent; antero-lateral angles of tergites slightly translucent. Mid-dorsal line obscurely paler; narrow dark submedian and lateral streaks may be present, usually much obscured.

*Tails.* White, tinged with reddish at base. Joinings of the first 8 or 10 basal segments red; all other joinings paler.

*Genitalia.* Forceps base reddish brown; deeply excavated on its apical margin. Forceps reddish brown, the terminal joints pale. Penes amber-colored; of the "*albomanicata*" type. The long second joint of the forceps is somewhat longer than the combined terminal joints.

## Female imago

Body 11–12 mm.; wing 13–14 mm.

Head whitish, suffused with red. Frons as in male. A geminate median rose streak on the vertex and occiput. A large red spot between the eye and the lateral ocellus. Bases of ocelli suffused with red; space between the lateral ocelli wholly or in part red. A large black spot in the corner of the occiput, and a black shading along the entire posterior margin of the head.

Pronotum creamy white, suffused with rose. Thorax with more numerous and extensive rose markings than in the male. Basal portion of each joint of the fore tarsus pale, the apical half of each dull ruddy. Venation very pale brown.

Lateral extension of the 9th segment translucent. Subanal plate rather deeply excavated apically; the outer angles subacute.

Holotype—Male imago. Collected by Prof. P. W. Fattig on Swamp Creek, Dalton, Georgia, May 25, 1931. No. 1254.1 in the Cornell University collection.

Allotype—Female imago. Same data, June 1931. Same collector. No. 1254.2 in the Cornell collection.

Paratypes—2 male imagoes, 2 female imagoes, same data as above; also 2 females; Apalachee River near Monroe, Ga., June 12, 1931; same collector. No. 1254.3–8 in the Cornell collection.

In addition to the type specimens, a female with similar markings, but rather paler, was taken at Toccoa Falls, Ga., July 5, 1931, by Girl Scouts, for Prof. Fattig.

I take pleasure in naming this beautiful species for Prof. Fattig of Emory University, who collected these and many other fine specimens from Georgia. He states that these specimens "were obtained by sweeping the leaves of the trees and bushes."

*Isonychia harperi*, sp. nov.

A rather dark red species; fore tarsus reddish brown, venation pale.

## Male imago

*Size.* Body 12 mm.; wing 12 mm.; tails 25–30 mm.; fore leg 8 mm.

*Head.* Reddish. Eyes purplish, transverse band blue.

*Thorax.* Notum and sternum reddish black. Pleura paler, rather sharply marked off from the darker notum, and with rose markings. Mesonotal scutellum and adjacent areas deep reddish black; a rose spot



anterior to it. Metanotal scutellum and the posterior portion of the mesosternum also very dark, as well as a small area at the anterior margin of the mesonotum.

*Legs.* Fore tarsus slightly longer than the tibia. Femur dark red, paler at the base; tibia deep reddish black. Tarsus reddish brown, slightly paler on the basal third of the first joint and the two distal joints. Middle and hind legs greenish white, the claws reddish.

*Wings.* Hyaline, iridescent. Venation very pale yellowish, each of the longitudinal veins outlined by two narrow dark lines. Stigmatic area opaque whitish.

*Abdomen.* Dark wine red; all segments slightly paler at the base, thus presenting a somewhat annulate appearance. Apical segments brighter red, opaque; middle segments semi-translucent. Posterior margins of all segments darker, rather wide and black on the tergites, narrower and paler on the sternites. Pleural fold marked by two dusky parallel lines, one on the extreme margin and the other dorsal to it; often a paler streak lies next to pleural fold ventrally. A short black dash marks the stigma. Paler mid-dorsal line and submedian streaks usually almost obsolescent.

*Tails.* Deep reddish brown basally for about 2 mm.; remainder of tail white. All joinings colorless.

*Genitalia.* Forceps base reddish brown, deeply excavated apically. Forceps deep smoky brown basally, the terminal joint paler. Penes reddish brown; of the "albomanicata" type.

#### Female imago

*Head* yellowish. A large spot of dark red between the eye and the lateral ocellus. Corners of occiput black, the dark shading more or less continuous across the entire posterior margin. Narrow extensions from this dark margin form blackish markings on each side of the pale median line on occiput and vertex. Venation light brown. Thorax with extensive deep rose markings. Subanal plate with only a moderate apical excavation, its outer angles subacute. Tails pale reddish at base, yellow for a short distance beyond, becoming rather flesh-colored distally.

Holotype—Male imago. Collected by Mr. L. Harper at Ft. Jackson, N. Y., the St. Regis River, Sept. 2-3, 1932. No. 1255.1 in the Cornell collection.

Allotype—Female imago. Same data. No. 1255.2 in the Cornell collection.

Paratypes—2 male imagoes, same data; 4 male and 4 female imagoes, same locality, August 24 and 30, 1932. Same collector. No. 1255.3-12 in the Cornell collection.

Other specimens in the Cornell collection which seem to be of this species are from Cascadilla Creek, Ithaca, N. Y., July 20, 1932, and from Wilseyville, N. Y., August 1932, collected by J. R. Traver; from Kellogg Creek near Painesville, Ohio, September 11, 1932, same collector; and from Hopkinton, N. Y., June 28, 1932, by Mr. L. Harper.

The species is named for Mr. Lawrence Harper, who collected these and many other fine specimens for the Cornell University collection.

One of the specimens from Kellogg Creek, Ohio, which is placed in this species tentatively, was reared from a dark reddish brown nymph in which the tibial spine of the fore leg is so strongly outcurved as to be almost sickle-shaped. Antennae dark brown; a pale mid-dorsal stripe on the basal tergites only; each tergite darker brown in the anterior half. Claws with 7-8 denticles; gills and postero-lateral spines on 8 and 9 very similar to *albomanicata*.

*Isonychia matilda*, sp. nov.

A dark red species; fore tarsus and tails dark reddish brown; venation dark brown.

Male imago

*Size.* Body 12 mm.; wing 12 mm.; tails 18-24 mm.; fore leg 9-10 mm.

*Head.* Dark reddish black. Eyes dark grey.

*Thorax.* Notum and sternum deep reddish black, pleura reddish brown. Creamy white areas suffused with deep rose anterior to the wing roots and on the pleura above each leg.

*Legs.* Fore tibia deep reddish black; femur very dark red, paler basally; tarsus entirely dark reddish brown. Tarsus slightly exceeds the tibia in length. Middle and hind legs yellowish white; femora sometimes faintly tinged with reddish and with indistinct dusky pencillings; tarsi and apical half of tibia tinged with pale reddish; claws and distal tarsal joint somewhat dusky.

*Wings.* Hyaline, iridescent. Venation dark reddish brown. Stigmatic area tinged with reddish brown, the cross veins very numerous, often forking and anastomosed. The apical third of the fore wing is sometimes very faintly tinged with brown, most noticeable on the outer margin.



*Abdomen.* Deep dark red dorsally and ventrally, the apical segments brighter red. The basal and middle segments have a narrow pale translucent area at the anterior margin; the remainder of each of these segments is often semi-translucent. Apical segments are opaque. Each segment has a narrow black posterior margin. The pleural fold is margined by a double black line; a third blackish line lies parallel to these on the dorsal side. Only faint traces of a paler mid-dorsal line and of submedian streaks are present, but narrow black lateral streaks are evident on the middle tergites. A continuous pale reddish mid-ventral streak extends the length of the venter, with the usual pale oblique submedian streaks, a tiny pale dot at the end of each; two small pale dots also near the center of each sternite.

*Tails.* Dark reddish brown, becoming pale brown toward the tips. Joinings very narrowly paler than the joints.

*Genitalia.* Dark reddish brown. Forceps base deeply excavated apically. The combined terminal joints of the forceps are approximately equal in length to the long second joint. Penes of the "albomani-cata" type.

#### Female imago

Frontal portion of head pale brown, with dark brown markings at the bases of the antennae and ocelli. Vertex and occiput greyish. Dark reddish brown between the bases of the ocelli. A narrow purplish brown line follows the inner margin of the eye; corners of the occiput purplish brown, this color extending across the posterior margin. Mesonotum yellowish brown. Abdomen slightly paler than the male, the lateral dark streaks obsolete. Subanal plate rather deeply excavated apically, its outer angles acute.

#### Nymph

Head and thorax very dark olive brown, sometimes tinged with dark red. Abdomen very dark red; reddish black apically. A pale median stripe on the frontal carina, head and thorax, sometimes interrupted by a brown area between the ocelli. Antennae deep reddish brown at the base, becoming gradually paler brown on the middle and distal joints.

Legs deep red-brown with large pale areas. Tibial spine of fore leg approximately one-half the length of the tarsus; moderately stout, slightly outcurved apically. Claws usually with but 5 denticles each. Faint traces of a narrow pale median line and of pale submedian streaks on the basal tergites. Gill lamellae deep purplish red, whitish at the

base and along the anterior margin. Postero-lateral spine on the 9th segment is but slightly longer than the spine on 8.

Holotype—Male imago. Collected by Dr. J. G. Needham in Wild Flower Preserve, Slaterville, N. Y., August 1932. No. 1256.1 in the Cornell University collection.

Allotype—Female imago. Same locality, Sept. 11, 1931; reared. Collector, J. R. Traver. No. 1256.2 in the Cornell collection.

Paratypes—4 male imagoes, 6 female imagoes, same locality, August and Sept. 1931, reared; collector, J. R. Traver. 2 female imagoes, same locality, August 1932; collector, J. G. Needham. 1 male and 1 female imago, Wilseyville, N. Y., August 1931, reared; collector, J. R. Traver. No. 1256.3-16 in the Cornell collection.

We have specimens of this species also from the Wild Life Preserve at McLean, N. Y., August 26, 1925.

*Isonychia pictipes*, sp. nov.

A small pale species; fore tibia bicolored, pale in middle, dark at each end; venation pale.

Male imago

*Size.* Body 8-9 mm.; wing 8-10 mm.; tails 18-22 mm.

*Head.* Pale reddish. Frontal margin narrowly black; a black spot between the eye and the antenna. Antennal filament dusky at base, pale at tip.

*Thorax.* Reddish with a yellowish tinge. Middle of mesonotum, the scutella of the meso- and metanota, and the sternum darker reddish brown. Lateral aspect of the anterior portion of the mesonotum and sides of the metanotum distinctly yellowish. Pale lavender shading anterior to the wing root, and on some of the pleural sutures.

*Legs.*—Fore femur madder red, paler at base; margined narrowly with black in the apical half. Tibia bicolored; pale yellowish in the central part, the basal third and a narrower apical band dark reddish brown. Tarsus pale smoky brown, the basal half of the 1st and 2nd joints and the basal third of the 3rd joint pale, whitish. Fore tarsus slightly exceeds the tibia in length. Middle and hind legs whitish, with a faint amber tinge; claws pale smoky.

*Wings.* Hyaline; a small portion on the stigmatic area opaque whitish. Venation wholly pale.

*Abdomen.* Pale reddish, paler ventrally. Basal segments darker,



apical segments brighter red. Posterior margins of all segments with prominent purplish black bands, wider on the tergites. A short black line marks each stigma and a rather wide dusky stripe closely parallels the pleural fold on each tergite. An indistinct paler mid-dorsal line is usually present, but more or less obscure. No dark submedian nor lateral streaks.

*Tails.* Pale yellowish white; tips entirely white. Two or three of the basal joints may be faintly pinkish. All joinings pale.

*Genitalia.* Yellow, often tinged with reddish. Forceps base deeply excavated apically, its lateral arms rather wide. The combined terminal joints do not equal the second joint in length; and, of the terminal joints, the distal is the shorter. Penes quite similar in form to *sicca* Walsh.

#### Female imago

Body or wing, 11 mm. Head flesh-colored. No red median mark on the vertex. A faint narrow reddish line follows the inner margin of each eye. A large black spot is in each corner of the occiput, and a smaller dark dot laterad of this, nearer the median line. A double black line is present on each side of the anterior margin of the pronotum; posterior margin also dusky. Veins pale yellowish. The opaque area in the stigma is more extensive than in the male. Pale mid-dorsal abdominal line obsolescent. Subanal plate and lateral extension of the 9th segment translucent; the former rather deeply excavated apically, its outer angles acute.

Holotype—Male imago. Collected by Prof. P. W. Fattig in Williamson Swamp Creek, Bartow, Georgia, May 31, 1931. No. 1257.1 in Cornell University collection.

Allotype—Female imago—Apalachee River north of Monroe, Georgia, August 12, 1931. Same collector. No. 1257.2 in the Cornell collection.

Paratypes—4 male imagoes, same data as allotype; 2 male imagoes, Alcova River south of Monroe, Georgia; same collector. No. 1257.3–8 in the Cornell collection.

#### *Isonychia sadleri*, sp. nov.

A large red species with smoky brown fore tarsi and pale venation

#### Male imago

*Size.* Body 14–16 mm.; wing 13–14 mm.; fore leg 9–10 mm.; tails 30–35 mm.

*Head.* Frons pale reddish. A black spot between the eye and the base of the antenna. Median carina and frontal margin narrowly red; base of antenna washed with red. Antennal filament whitish. Ocelli ringed at base with very dark reddish brown. Vertex dark reddish brown. Eyes purplish, transverse band pale.

*Thorax.* Very dark reddish brown; pleura paler brown, usually with extensive deep rose markings above the legs. A paler spot anterior to the mesonotal scutellum. Scutella of the meso- and metanota, the median area of the metanotum, and the mesosternum, very dark reddish black. Anterior portion of the metanotum, and areas laterad of the scutellum pale, usually tinged with deep rose. Narrow rose markings on the sides of the mesonotum.

*Legs.* Fore leg shorter than the body; tarsus fully as long as the tibia. Femur very dark reddish brown, somewhat paler basally. Tibia deep reddish black. Tarsus dark smoky brown; the base of the first joint, the sides of the fourth joint, and a narrow streak at the base of the distal joint, tend to be paler. Middle and hind legs yellowish white; claws and all tarsal joinings reddish. Coxae marked with rose. The last tarsal joint is tinged with smoky red.

*Wings.* Hyaline. Main longitudinal veins of the fore wing each outlined by two narrow parallel brownish lines. Stigmatic area opaque whitish, cross veins colorless. All other veins very pale yellowish brown.

*Abdomen.* Intense dark red; segments 6-10 largely bright red; dorsum and venter very similar. All segments with rather wide black posterior margins, wider on the tergites. On tergites 3-9, a very narrow pale streak margins this dark border posteriorly, in the median area. Pleural fold bordered with black on each tergite except for a narrow pale area at each anterior and posterior margin. Traces of a rather wide paler mid-dorsal line are most evident on the apical segments. Obscure dark submedian streaks may border this line; apically these may be replaced by bright red. The usual pale oblique submedian streaks are present on the venter.

*Tails.* White, tinged with reddish brown at the base. The first 6 or 8 joinings near the base are dark red; all others are colorless.

*Genitalia.* Forceps base reddish brown; deeply excavated on its apical margin, its lateral arms rather wider than in *albomanicata* Ndhm. Forceps dark brown, paler apically. The combined terminal joints are not quite equal in length to the long second joint. Distal joint shorter than the third joint. Penes of the "albomanicata" type; pale reddish brown.



## Female imago

*Size.* Body 17 mm.; wing 16 mm.

Frontal portion of head as in the male. Vertex and occiput yellowish, with a median geminate reddish streak which is widest just back of the ocelli. Space between the eye and the lateral ocellus dark red. Corners of the occiput filled by a black spot. Mesonotum greenish yellow. Thorax with numerous deep rose markings. Venation slightly darker than in the male. Pale mid-dorsal abdominal line present the length of the abdomen; on apical segments, margined by bright red submedian streaks. Abdomen brighter and paler than in the male. Lateral extension of the 9th segment translucent, tinged with red. Subanal plate rather deeply excavated apically, its outer angles subacute. Tails yellowish at base, otherwise as in the male.

Holotype—Male imago. Collected by Dr. W. O. Sadler at Fish Hatchery on Cascadilla Creek, Ithaca, N. Y., June 12, 1932. No. 1258.1 in Cornell University collection.

Allotype—Female imago—Same data. No. 1258.2 in the Cornell collection.

Paratypes—10 male imagoes, same data; 1 male imago, same location, June 19, 1931. All collected by Dr. Sadler. No. 1258.3–13 in the Cornell collection.

This species I name for Dr. Sadler, who collected the specimens from the hatchery ponds, where they had fallen upon the surface of the water.

A single teneral male imago, reared from a nymph taken in Ringwood Creek in Ellis Hollow, N. Y., is probably of this species. The nymph is dark reddish brown with a prominent wide pale mid-dorsal stripe the length of the abdomen. The basal joint of the antenna is pale in part; immediately beyond this, the joints are very dark brown, becoming paler distally. Tibial spine rather slender and slightly outcurved, not quite half as long as the tarsus. Gills pale yellowish brown, darker along the anterior margin; one diffuse dark spot on the outer corner of the posterior margin. Postero-lateral spine on segment 9 slightly longer than that on segment 8.

*Isonychia thalia*, sp. nov.

1932—Traver—J. Elisha Mitchell Sci. Soc. **47**: 208 (as *georgiae* McD.).

The similarity of genitalia in the specimens of *Isonychia* reared from nymphs taken in Davidson River, N. C., to those of *georgiae* McD., as

figured by Dr. McDunnough, led me to place my specimens in that species. However, material recently received from Towns Creek, Cleveland Co., Ga., sent by Prof. P. W. Fattig, proves to be the true *georgiae*, which is quite distinct in size and coloration from the specimens I had erroneously placed in that species. Slight differences in the genitalia are also evident, on further study of the two species.

I propose the name *thalia* for those specimens from Davidson River which I have previously listed under *georgiae*. Descriptions are given in the article referred to above.

Holotype—Male imago. Davidson River, N. C., July 9, 1930. Reared from nymph. No. 1259.1 in the Cornell University collection.

Allotype—Female imago—Same locality, July 21, 1930. No. 1259.2 in Cornell collection.

Paratype—Female nymph—Same locality, June 27, 1930. No. 1259.3 in Cornell collection.

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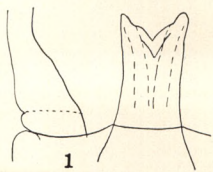
## EXPLANATION OF PLATE 16

### GENITALIA OF MALE IMAGOS

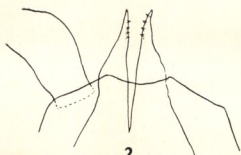
- Fig. 1. *Ephemerella euterpe* sp. nov. Penes and portion of forceps.  
 Fig. 2. *Choroterpes nanita* sp. nov. Penes and portion of forceps.  
 Fig. 3. *Paraleptophlebia californica* sp. nov. Penes.  
 Fig. 4. *Siphonurus marshalli* sp. nov. Penes.  
 Fig. 5. *Choroterpes oklahoma* sp. nov. Penes and portion of forceps.  
 Fig. 6. *Ephemerella micheneri* sp. nov. Genitalia.  
 Fig. 7. *Paraleptophlebia falcula* sp. nov. Forceps and forceps base.  
 Fig. 8. *Isonychia diversa* sp. nov. Genitalia (upper portion of forceps omitted).  
 Fig. 9. *Siphonurus spectabilis* sp. nov. Penes.  
 Fig. 10. *Paraleptophlebia compar* sp. nov. Penes.  
 Fig. 11. *Isonychia thalia* sp. nov. Penes.  
 Fig. 12. *Thraulodes speciosus* sp. nov. Penes.  
 Fig. 13. *Ephemerella maculata* sp. nov. Penes and portion of forceps.  
 Fig. 14. *Habroplebiodes annulata* sp. nov. Penes and forceps base.  
 Fig. 15. *Paraleptophlebia falcula* sp. nov. Penes.  
 Fig. 16. *Thraulodes presidianus* sp. nov. Penes.  
 Fig. 17. *Paraleptophlebia sculleni* sp. nov. Penes.  
 Fig. 18. *Paraleptophlebia georgiana* sp. nov. Penes.  
 Fig. 19. *Ameletus shepherdii* sp. nov. Penes.



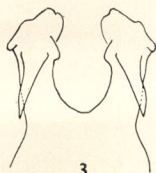
PLATE 16



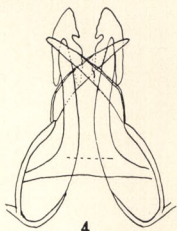
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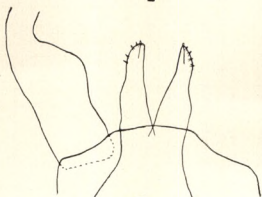
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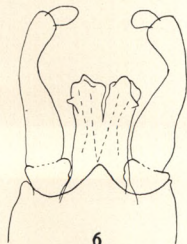
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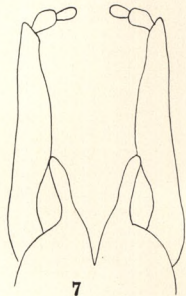
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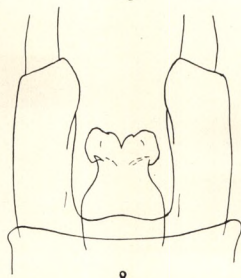
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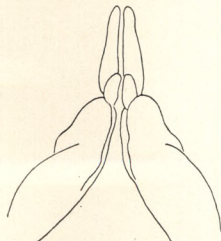
6



7



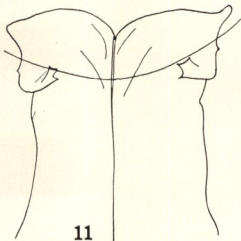
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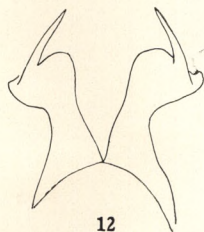
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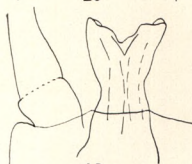
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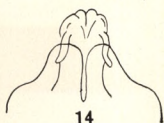
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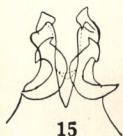
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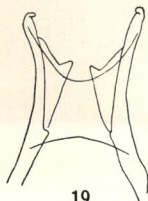
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