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REDESCRIPTION OF THE TYPES OF *PROTONEURA*
TENUIS SELYS AND A STUDY OF VARIATION
IN THIS SPECIES

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UP to the present time our knowledge of *Protoneura tenuis* has been restricted to the three specimens seen and described by Selys. As his original diagnosis is extremely laconic, it is very doubtful whether the species could be identified without a re-examination of the types in the collection of J. C. Dale, now in the Oxford University Museum. Dr. B. M. Hobby kindly searched for these types among the exotic Odonata of the Dale collection; the only specimens with the specific name *tenuis* proved to be five specimens under the name "*Argyia tenuis*," and the senior author has been privileged to examine these through the courtesy of Professor G. D. Hale Carpenter. These five specimens and their pin labels are as follows (none of them is explicitly indicated as being the type):

- 1) "♂ Para χ / 1850" and on underside "♂" (in pencil); is a male *Protoneura*.

* The senior author initiated this study and is responsible for the description and drawings of the holotype and allotype of *P. tenuis* in the Dale collection, Oxford University Museum; the junior author is responsible for that part of the paper and drawings relative to the series of *tenuis* and *calverti* in the Williamson collection, Museum of Zoology, University of Michigan.

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- 2) "♀ Para χ / 1850" and on underside "♀" (in pencil); is a female *Protoneura*.
- 3) "Ent Club" (in ink; no locality); is a male *Metaleptobasis manicaria* Williamson.
- 4) "Para / 1850" (in pencil); is a male *Metaleptobasis mauritia* Williamson.
- 5) "Para / 1848" (in ink); is a female *Metaleptobasis* sp.

There is in addition a printed label "Para" not attached to any specimen.

Selys (1860) cites the name *tenuis* as "Dale MS."; from his remarks in 1869¹ it is evident that the Dale collection contained specimens taken by Bates, and possibly the above five among them (with more doubt as to specimen No. 3, the label indicating that it was presented by the Entomological Club). Selys in 1886 explicitly states that the types of *tenuis* were one male and one female ("le couple-type"), and there can be no doubt that specimens Nos. 1 and 2 are these types, for Nos. 3-5 have not even any outward resemblance to Protoneurines and could not have been included by Selys in his *tenuis*. Dr. Hobby states that no alterations in the arrangement of the Dale exotic Odonata have been made since its acquisition by the Oxford Museum, and he suggests that specimens Nos. 3-5 may have come to be under the name *tenuis* during some rearrangement made by C. W. Dale after the death of his father, J. C. Dale. The " χ " on the labels of Nos. 1 and 2 may perhaps indicate that they are types. The original diagnosis (quoted below), so far as it goes, agrees with specimens Nos. 1 and 2, but it would apply almost equally well to several species of *Protoneura* (*sens. lat.*). The specimens have now been labeled to indicate which of them are the types.

The third specimen described by Selys (1886) from his own collection is of course not a type; he referred it to *tenuis* with some doubt, and Ris (in Williamson, 1915) reported that "it is a very miserable teneral male specimen . . . I can not without a microscope be sure of the appendages in their bad condition." From Selys' description it is not possible to decide

¹ *Bull. acad. belg.*, (2), 27: 646, footnote on Bates's MS. names.

whether this teneral male is *tenuis* or some other species, but we may note that the size (abd. 26, hind wing 16 mm.) is smaller than that of the male type. We have not seen this specimen, as in its bad condition it would probably provide but little information of any value, although it would be as well at some future date that it be examined so that the reference to Selys (1886) may be listed under the correct species.

Williamson (1915) suggested that *tenuis*, which he had not seen, might be a *Protoneura* (*sens. str.*) or more probably an *Epipleoneura*; a study of the types shows that *tenuis* is a *Protoneura* (*sens. str.*) closely related to *P. calverti* Williamson.

PROTONEURA TENUIS SELYS, 1860

Protoneura tenuis Selys, 1860, *Bull. acad. belg.*, (2), 10: 461-62, diagnosis ♂ ♀, Pará, in Dale collection.

Hagen, 1861, *Syn. Neuropt. N. Amer.*, p. 310, listed, Pará.

Protoneura tenuis? Selys, 1886, *Mem. cour. acad. belg.*, 38 (4): 210-11, desc. ♂ juv., Obidos, Amazons (in Selys collection); original diagnosis quoted, "Le couple-type. Coll. Dale."

Protoneura tenuis Kirby, 1890, *Syn. Cat. Neuropt. Odon.*, p. 136, listed, Amazons.

Epipleoneura? *tenuis* Williamson, 1915, *Proc. U. S. Nat. Mus.*, 48: 619, 627, notes on generic position and ♂ juv. of Selys, 1886.

Original diagnosis: "Taille: environ celle de la *capillaris*. i.e. Abdomen environ 25, aile inférieure 17, large de 2½. Troisième segment de l'abdomen noir violet. ♂ Thorax noir, avec deux bandes antéhumérales rousses. ♀ Thorax avec trois lignes latérales, dont une antéhumérale ?, jaunes."

MALE HOLOTYPE, PARÁ

HEAD (Pl. II, Figs. 1-2).—Labium pale cream, the median lobe cleft to slightly less than half its length; labrum shining black, anteriorly narrowly bordered with yellow; bases of mandibles black and yellow, the black basal and of greater extent, following the outline of the labrum and clypeus and thus narrowly separated from them by yellow; anteclypeus brown with yellow area between each anterior angle and the labrum; postclypeus black; frons rounded, almost angulate but not ridged, the two faces at an angle somewhat greater than

ninety degrees, the anterior face shining black with a pair of dull yellow spots shaped like a triangle with rounded angles, separated by a distance less than the width of the median ocellus, extending laterally to the level of the outer edge of the lateral ocellus; at the base of each antenna and anterior to it is a smaller, subtriangular, dull, yellow spot, thus forming a line of four spots across the head; dorsal surface of frons and vertex matt black with slight metallic reflections and a scaly appearance; genae yellow, the boundary between this and the dorsal black extends from the basal angle of the postclypeus to the eye anterior to the antennae in a curved line, the yellow being convex; antennae black, exteriorly pale yellow apically on the scape and basally on the pedicel, the latter becoming dark brown apically, the flagellum dark brown; rear of head matt black; eyes brown.

PROTHORAX.—Black, the median lobe with a pair of large subquadrangular dorsal orange spots covering the greater part and narrowly separated middorsally; pleuron black (Pl. II, Figs. 3–5). Posterior lobe somewhat erect, in anterodorsal view the posterior border evenly rounded, very slightly concave medially, the pleuron slightly angulate at the lateral margins of the posterior lobe.

PTEROTHORAX (Pl. II, Fig. 7).—Mesepisternum black with a pair of subtriangular orange stripes separated middorsally, these stripes reaching the mesopleural or humeral suture for some distance below, narrowing above, about half the width of the mesepisternum at midheight, the apex rounded and not quite reaching the antealar sinus, interiorly parallel to the dorsal carina, exteriorly slightly concave; a minute yellow spot below the wing; mesinfraepisternum black; mesepimeron black, the black extending on the metepisternum, which is black above, largely pale yellow below, the yellow forming a stripe which is broadest at the level of the metastigma—but narrower than the combined mesepimeral and metepisternal black—where it reaches the metapleural suture, narrowed above and not reaching the dorsal end of the metepisternum, its anterior edge parallel to the interpleural suture, the greater part of the

dorsal marginal carina and a minute spot below the wing yellow; metepimeron largely pale yellow but invaded by the metepisternal black above, where it curves round to form a dorsal black margin, and below where it broadens to pass on to the metinfraepisternum, which is black above, shading to pale yellow below; there is thus a black stripe of approximately even width over the metapleural suture; venter pale yellow with a pair of black spots anteriorly and two pairs of obscure brownish spots posteriorly; nota black with central yellow spots, wing bases brown to pale yellow.

LEGS.—Second and third wanting, first with coxa pale yellow, anteriorly obscurely brown at the base; trochanters pale yellow; femur anterodorsally black, ventrally and posterodorsally pale yellow for about the basal two-thirds, the apical third black; tibia and tarsus black to dark brown, claws dark brown, spines black to dark brown (Pl. II, Fig. 6).

WINGS.—Hyaline, venation black to dark brown, pterostigma black and about twice as long as wide, covering slightly less than 1 cell. Postnodals, front wing, 10, hind wing, 8–9; postsubnodals, front wing, 9–10, hind wing, 8; superior sector of triangle in hind wing ending at subnodal transversal; median sector arises half a cell before subnodus, subnodal sector arises at subnodus; nodal sector arises front wing at fifth, hind wing at fourth postsubnodal; postnodal sector arises front wing at ninth, hind wing at eighth; subnodal sector ends distal to level of pterostigma; lower sector of arculus ends front wing at level of proximal end of pterostigma, hind wing at level of proximal end of pterostigma or half a cell proximal to it; first antenodal costal space distinctly longest, second and third subequal, together slightly longer than first; second antenodal proximal to arculus by about the length of arculus; cubito-anal cross vein distal to first antenodal front wing $1/6$ – $1/4$ of second antenodal costal space, hind wing less than $1/8$ or about $1/4$; subnodal and median sectors just distinct—1 front wing—or joined at subnodal transversal; the width of the wings about $1/8$ of the length; distance base to nodus about or just over $1/3$ of the

wing length and equaling the distance from the nodus to the sixth postnodal or just proximal to it.

ABDOMEN (Plate II, Fig. 8).—Slender, widened at segment 8, which has a broad sternite; black, 3–6 with a very fine median longitudinal brown line which almost reaches the base and apex of each segment; 1 and 2 pale bluish yellow laterally, but not extending to the base or apex of the segment, on 1 occupying about the ventral two-thirds, on 2 at its widest occupying about the ventral half; 3–7 with a basal ring, on 3 blue, interrupted middorsally, tending to yellow laterally, reaching the ventral margin of the segment and extending apically along it for a short distance; on 4 a deeper blue, more narrowly interrupted middorsally and not reaching the ventral margin, thus forming a pair of small median spots; on 5 similar, but the two spots almost confluent medially; on 6 not interrupted middorsally, narrow, pale yellow, not reaching the ventral margin, and with a pair of obscure deep blue median spots apical and contiguous to it, the spots almost meeting middorsally; on 7 a pale yellow broader ring, not interrupted middorsally, and not reaching the ventral margin; 3–6 with the black shading to brown and yellow laterally, the yellow forming a very narrow ventral stripe which on 3 is a continuation of the basal ring, on 4–6 not reaching the base or the apex of the segment, on 4 confined to the subbasal part of the segment, on 5 extending to about the basal half of the length, and on 6 extending the greater length of the segment; 7–9 laterally yellow, on 7 very narrow and more brown basally, becoming wider and more yellow apically, at the apex occupying about the ventral sixth, on 8 more extensive, becoming wider subapically and then slightly narrowed again, occupying about the ventral quarter at its greatest width, on 9 forming a spot at the basal ventral angle of about the width of the lateral yellow at the apex of 8, and extending for slightly less than the basal third of the segment, with, just caudal and dorsal to this spot, a small ill-defined yellowish brown spot; 10 entirely black; 9 and 10 shining black dorsally; sternites of 1 and 2 pale yellow, hamules

dark brown, of 3-7 dark brown, of 8 very dark brown with the apical quarter pale yellow, of 9 pale yellow, of 10 brown.

PENIS (Pl. I, Figs. 4-5).—Shaft-spines absent; internal fold apparently absent, but perhaps represented by a small fold beneath the base of the third segment; third segment large, produced into a lobe on each side, the lobe curved ventrad and then dorsad, hence convex in ventral view.

ABDOMINAL APPENDAGES (Pl. I, Figs. 1-3).—Superiors black, brown medially and ventrally, subequal in length to segment 10, slightly shorter than the inferiors, in dorsal view broader at the base, subbasally widened internally and the surface slightly concave exterodorsally, then tapered to the rounded apex, exteriorly slightly convex; in a slightly more lateral view the inferiors appear exterior to the superiors; in dorsointernal view with a ventral laminar swelling occupying about the middle third of the length; in lateral view moderately concave dorsally, the apex narrowed and directed ventrad and slightly mesad, the ventral swelling well marked; inferiors dark brown, subcylindrical, in lateral view broad basally, then abruptly narrowed and subcylindrical to the slightly dorsally directed apex.

Apical margin of segment 10 with a middorsal V-shaped excision, ventral to which is a small rounded black supra-anal tubercle—probably homologous with the supra-anal plates of *Epipleoneura lamina* and *E. incusa*.

Abdomen + appendages, 32, hind wing, 18, costal length pt. hind wing, 0.60-0.65 mm.

FEMALE ALLOTYPE, PARÁ

HEAD.—As in male, but the pale spots bright yellow, the mandible bases without yellow outlining the lateral edges of the labrum and the black not extending so far laterally on the genae (Pl. III, Fig. 7).

PROTHORAX (Pl. III, Figs. 4-6).—Black with a pair of bright yellow stripes extending from the sides of the anterior over the median to the sides of the posterior lobe; pleuron angulate as in male, black, the extreme ventral angle dull yellow; posterior lobe erect, in anterodorsal view the posterior margin straight middorsally, in dorsal view the posterior margin with a slightly

convex projection middorsally, which in caudal and lateral views is seen to be due to a ridge running parallel to the posterior margin on the ventral surface of the lobe.

PTEROTHORAX (Pl. III, Fig. 10).—Mesepisternum and mesepimeron black, the middorsal carina narrowly yellow, a narrow yellow stripe against the mesopleural suture and anterior to it, extending along about the basal $3/4$ of the mesepisternum, posterior to the suture a short stripe beginning just below the end of the previous stripe and extending dorsally, not reaching the dorsal margin; the lower third of the mesostigmal lamina yellow and a yellow spot below the wing; mesinfraepisternum black, the posterior angle narrowly yellow; metepisternum and metepimeron pale yellow with a black stripe over the metapleural suture which widens above on the metepisternum and joins the mesepimeral black just anterior to the wing base; apical carina of metepisternum yellow; metinfraepisternum with about the anterior half black, the posterior half yellow; venter yellow with a pair of dark brown spots posterior to the third coxae and a pair of ill-defined pale brown spots farther caudad; nota black, yellow centrally, wing bases brown.

LEGS (Pl. III, Fig. 8).—Coxae yellow, the second and third brown at the base anteriorly; femora pale yellow, about the apical, $1/3$, $3/8$, and $3/10$ of the first, second, and third respectively, black; tibiae, tarsi, and spines black, claws dark brown.

WINGS.—Pterostigma dark brown, the encircling veins black; postnodals front wing, 10, hind wing, 9; postsubnodals front wing, 9, hind wings, 8; superior sector of triangle crossing the subnodal transversal and ending on the wing margin slightly distad—in right front wing practically coalesced with the transversal, but nevertheless it can be seen that they actually do cross; postnodal sector arises front wing at eighth, hind wing at seventh or eighth postsubnodal; lower sector of arculus ending front wing half a cell proximal to pterostigma or beneath the middle of pterostigma, hind wing at proximal end of pterostigma; second antenodal costal space relatively shorter than in male, the first distinctly the longest, third slightly—about $1\ 1/4$ times—longer than second, together rather longer than first; cubito-anal cross vein distal to first antenodal front

wing, $1/3$ or $1/4$ of second antenodal costal space, hind wing, $1/4$; the rest of the venation as in the male.

ABDOMEN (Pl. III, Fig. 12).—Black, the following yellow: segments 1 and 2 lateroventrally, basal rings, interrupted mid-dorsally, on 3–5, a pair of basal dorsal spots on 6 and 7, smaller on 7, 3–7 narrowly lateroventrally, lateroventral spots on 8 and 9, triangular on 8, rounded and apical on 9; sternites black, the following yellow: of 1, apical half of 2, apex of 7 narrowly, a pair of basal spots and the apical third of 8 and the black of 8 medially with a subapical triangular projection.

ABDOMINAL APPENDAGES.—Black, shorter than 10; ovipositor yellow above, brown below, the valves reaching the level of the apex of the anal appendage (Pl. III, Figs. 1–3).

Abdomen + appendages, 26.5, hind wing, 18, costal length pt. hind wing, 0.60 mm.

The following data on a rather large series of *Protoneura tenuis* in the Williamson collection, Museum of Zoology, University of Michigan, show the variation within a single species and indicate to a certain degree the reliability of generic characters which have been used for Protoneurines.

Material examined, 43 ♂, 21 ♀: BRAZIL: Porto Velho, Amazonas, February 13 (2 ♂ 2 ♀), 17 (3 ♂ 1 ♀), 21 (5 ♂ 3 ♀), 22 (2 ♂ 1 ♀), and 27 (1 ♂ 1 ♀, pair), and May 3 (1 ♂), 4 (2 ♂ 1 ♀), 18 (1 ♂), and 24 (1 ♀); Villa Murquinho, Matto Grosso, April 1 (2 ♂), 3 (1 ♂), 4 (5 ♂ 2 ♀), 6 (1 ♂ 1 ♀), and 7 (1 ♂); Belem, Pará, August 7 (3 ♂ 2 ♀), 8 (6 ♂ 1 ♀), and 14 (4 ♂ 2 ♀). BOLIVIA: Río Beni, Cashuela Esperanza, Provincia de Vaca Diez, April 10 (2 ♂), 11 (1 ♂ 1 ♀), and 13 (2 ♀). All were collected by J. H. Williamson and J. W. Strohm in 1922.

MALE

HEAD.—The coloration is the same as in the type except in regard to the series of 4 spots across the anterior face of the frons. These spots are of approximately equal size in 20 specimens (very obscure in 3); the median pair are larger, as in the type, in 20 (obscure in 2), very small with the distance between greater than the width of the median ocellus in 2, and absent

in 1. In living specimens the spots of the frons are yellowish green and the eyes are very dark brown above and light green below.

PROTHORAX.—Typical in all 43 males.

PTEROTHORAX.—According to the color notes made by Mr. Jesse H. Williamson the dorsal areas are red, the lateral pale areas almost white with a greenish cast, and the underparts all white, in life. In the dried specimens of this most excellently preserved series the dorsal spots are scarlet or bright orange, the lateral areas bluish white with pale yellow tints and the underparts a creamy white. The color pattern is essentially the same in all the males, but the extent of certain black areas varies (Pl. II, Fig. 7, Pl. IV, Figs. 1–5). Grouped roughly, there are 15 different combinations of the pattern elements as recorded in Table I.

TABLE I

T as in holotype, Pl. II, Fig. 7; I, II, III, and V, as in Pl. IV, Figs. 1, 2, 3, and 5, respectively

Number of Specimens	Dorsal Red Area	Extension on Humeral	Mesepimeral Pale Stripe
6	T	T	T
11 (Fig. 1)	I	I	I
7	T	III	T
3 (Fig. 3)	III	III	T
2	T	I	T
2	T	III	I
2	I	III	T
2	III	III	I
1	T	I	I
1 (Fig. 2)	T	II	I
1	I	I	T
1	I	T	T
1	III	I	T
1 (Fig. 4)	III	I	I
1 (Fig. 5)	V	I and V	I

LEGS (Pl. IV, Fig. 6).—Coxae very pale yellow or cream, brown at base. Trochanters cream, the lower portion of the first pair sometimes with a brown triangular area on the anterodorsal surface. Femur of first pair anterodorsally black except for a pale basal area (the base sometimes narrowly marked

with black or obscure brown), ventrally and posterodorsally cream for slightly more than the basal half, the pale area divided by a narrow grayish band, apical portion black or very dark brown; second and third pair with apical $1/3$ or $2/5$ and $1/4$ respectively, black; the basal cream area with an obscure grayish band covering slightly more than its median third, and sometimes united along the posterodorsal carina with the apical black. Tibiae and tarsi dark brown or black; in a few specimens the basal $2/3$ to $3/4$ of the tibiae is medium to dark brown. Claws dark brown or dark amber with black tips.

ABDOMEN.—The coloration is remarkably uniform and typical on all the segments except 9 (Pl. IV, Fig. 7). In 24 specimens the lateral yellow area on this segment extends from base to apex and has just apical to midlength an upward extension doubling its width for about $1/3$ the length of the segment; in 9 specimens the lateral pale area is represented only by an isolated oblong spot situated in the region corresponding to the upward extension in the preceding; in 7 additional specimens this spot is present but obscured; and in 3 specimens segment 9 is entirely black.

PENIS.—When this structure is fully expanded in water, the lateral fold is discernible at the base of the third segment (Pl. I, Fig. 6), and the lateral lobes of this segment extend dorsad in a smooth curve.

ABDOMINAL APPENDAGES.—The superiors are slightly longer than the tenth abdominal segment (dorsally); occasionally the ventral laminar swelling appears to be slightly different from the type, but this is doubtless due to the orientation or to distortion in drying. The inferiors extend beyond the superiors from 0.1 to almost 0.3 mm., the distance depending partly upon the position of the appendages.

FEMALE

The pale areas referred to as yellow in the allotype are a very pale cream color in all of this series.

HEAD.—Coloration similar to the male, but the pale areas are clearer and more sharply defined. The apical portion of the mandible is pale, and whether or not it is exposed to outline the

lateral edges of the labrum depends upon the position of the mandible. Median lobe of the labium cleft less than one-half its length in 7, one-half in 8, more than one-half in 4, and undeterminable in 2 specimens. The 4 pale spots across the anterior face of the frons are of approximately equal size in 4 specimens; the median spots, larger in 17 specimens. A triangular pale area with its base on the eye margin, at the level of the interocellary region, is present in all specimens. Apical ring of the first antennal segment conspicuously pale cream. The top of the head is black with metallic red reflections (7 specimens), or with both green and red reflections (anteriorly green in 13, red in 1).

PROTHORAX.—The color pattern in general is similar to that of the allotype (Pl. III, Figs. 4–6). In 12 specimens the black dorsum of the anterior lobe is divided by a pale transverse bar of variable width and length. When long it is semicircular and widened at each end. It is connected with the pale lateral area in 6 specimens. The pale lateral areas of the median and posterior lobes are more widely separated by black in 14 specimens than in the allotype, and in 2 specimens these lateral pale areas of the posterior lobe are narrowly joined across the posterior margin. A pair of small pale spots near the posterior margin of the median lobe are present in 2 specimens.

PTEROTHORAX.—Pale humeral as in allotype (Pl. III, Fig. 10) in 9 specimens; the upper portion ventral to the humeral suture barely touching the lower portion (Pl. III, Fig. 11a) in 6, widely overlapping it (Pl. III, Fig. 11b) in 4, and represented by 2 isolated spots (Pl. III, Fig. 11c) in 2 specimens. The metepisternal pale stripe touches the lateroalar carina and is usually confluent with the pale area there in 15, and does not quite reach the carina in 7 specimens. The black stripe of the second lateral suture is considerably wider (about 1 1/2 times but not as wide as in *calverti*, Pl. V, Fig. 7) in 15 and intermediate between these and the allotype in 3 specimens. Mesostigmal lamina elevated only in the lateral half with the highest point near the anterior margin accentuated by a small pale area; posterior margin not abruptly raised from thorax; length

at mesal margin greater than at midheight, more so than shown in the drawing of the allotype (Pl. III, Fig. 9).

LEGS (Pl. IV, Fig. 8).—Coxae cream, a brown area sometimes present at the base in all 3 pairs but usually obscure or wanting. Trochanters entirely pale. Femora pale for about the basal $1/2$, $2/3$, and $3/5$ of the first, second, and third pair, respectively; grayish bands of the pale area incomplete ventrally on first, complete and covering approximately the median third on the second and third; apical black area of about the same width on all 3 pairs, although proportionately less on each succeeding pair, and on no specimen as narrow as in the allotype (Pl. III, Fig. 8). Tibiae dark brown to black; in paler specimens the basal portion may be brown. Tarsi brown to black. Claws dark amber, black tipped.

ABDOMEN.—Allotypical in 4 specimens; coloration obscure laterally on segments 3–4 in 9, 3–5 in 7 specimens; segments 3–6 brown to lateral margin in 1 specimen.

WINGS (♂ ♀).—The following data is based upon 86 ♂ front and hind wings (1 incomplete) and 42 ♀ front and hind wings (43 ♂ and 21 ♀ specimens). Pterostigma covers 1 cell in front wing, ♂ 12, ♀ 7, hind wing, ♂ 8, ♀ 8; less than 1 cell in front wing, ♂ 74, ♀ 35, hind wing, ♂ 77, ♀ 34. Postnodals front wing, ♂ 8–12, ♀ 9–11, hind wing, ♂ 7–9, ♀ 7–10; postsubnodals front wing, ♂ 9–10, ♀ 9–11, hind wing, ♂ 7–8, ♀ 7–9 (see Table II). The superior sector (Cu_1) ends before the subnodal transversal in hind wing, ♂ 1; at the subnodal transversal in front wing, ♂ 32, ♀ 18, hind wing, ♂ 10, ♀ 4; slightly beyond but fused with the transversal vein in front wing, ♂ 43, ♀ 19, hind wing, ♂ 48, ♀ 19; and definitely crosses this vein in front wing, ♂ 11, ♀ 5, in hind wing, ♂ 26, ♀ 19. In 3 ♂ 1 ♀ specimens the sector crosses the transversal vein in all 4 wings. The median sector (M_3) arises less than one-half cell before the subnodus in front wing, ♂ 34, ♀ 20, hind wing, ♂ 22, ♀ 17; one-half cell in front wing, ♂ 50, ♀ 21, hind wing, ♂ 49, ♀ 24; more than one-half cell in front wing, ♂ 2, ♀ 1, hind wing, ♂ 14, ♀ 1. Subnodal sector (Rs) arises at subnodus in all except in 1 ♀ in which it is slightly beyond in both front and

hind wings. Nodal sector (M_2) arises in front wing nearest to fourth postsubnodal in ♂ 2; at $4\frac{1}{2}$, ♂ 3, ♀ 1; at or nearest to fifth, ♂ 80, ♀ 39; almost to sixth, ♀ 2; abnormal in ♂ 1: hind wing at or near fourth in ♂ 85, ♀ 41; $4\frac{3}{4}$, ♀ 1. Postnodal sector (M_{1a}) arises in front wing at eighth postnodal in ♂ 15, ♀ 7; at ninth, ♂ 66, ♀ 27, at tenth, ♂ 5, ♀ 8: in hind wing at seventh, ♂ 10, ♀ 8; at eighth, ♂ 73, ♀ 28; at ninth, ♀ 3; just proximal to pterostigma, ♂ 2, ♀ 2; at first subpterostigmal, ♀ 1. Median sector (M_3) ends distal to level of pterostigma in all ♂ wings and in all ♀ wings except 1 front and 2 hind wings in which it terminates on a level with the distal end. Lower sector of arculus (M_4) ends in front wing at level of distal end of pterostigma in ♂ 1; at level of proximal end, ♂ 28, ♀ 10; $\frac{1}{2}$ cell beyond proximal end, ♂ 12, ♀ 10; $\frac{1}{4}$ cell before pterostigma, ♂ 1; $\frac{1}{2}$ cell before, ♂ 29, ♀ 11; 1 cell before, ♂ 11, ♀ 7; $1\frac{1}{2}$ cells before, ♂ 4, ♀ 4: hind wing, at level of proximal end of pterostigma in ♂ 17, ♀ 3; $\frac{1}{2}$ cell beyond, ♂ 15, ♀ 4; $\frac{1}{2}$ cell before, ♂ 41, ♀ 28; 1 cell before, ♂ 9, ♀ 4; $1\frac{1}{2}$ cells before, ♂ 2, ♀ 2; 2 cells before, ♂ 1, ♀ 1. The first antenodal costal space distinctly longest, second and third subequal, together slightly longer than the first in all. Second antenodal cross vein proximal to arculus by approximately $\frac{1}{2}$ length of arculus, front wing, ♂ 16, ♀ 31, hind wing, ♂ 3, ♀ 11; by length of arculus, front wing ♂ 67, ♀ 11, hind wing, ♂ 60, ♀ 26; by more than length of arculus, front wing, ♂ 3, hind wing, ♂ 22, ♀ 5. Cubitoanal cross vein distal to first antenodal, front wing, $\frac{1}{5}$ of second antenodal costal space, ♂ 2, ♀ 1, $\frac{1}{4}$ ♂ 23, ♀ 7, $\frac{1}{3}$ ♂ 28, ♀ 11, $\frac{2}{5}$ ♂ 32, ♀ 23, $\frac{3}{5}$ ♂ 1; hind wing, $\frac{1}{6}$ ♂ 3, $\frac{1}{5}$ ♂ 12, ♀ 6, $\frac{1}{4}$ ♂ 28, ♀ 13, $\frac{1}{3}$ ♂ 33, ♀ 14, $\frac{2}{5}$ ♂ 8, ♀ 9, and absent in ♂ 1. Width of hind wings about $\frac{1}{7}$ of the length; less than $\frac{1}{7}$ in ♂ 26, ♀ 17, $\frac{1}{7}$ in 2 ♂, 2 ♀, and slightly more than $\frac{1}{7}$ in 15 ♂ 2 ♀ specimens.

A comparison of postnodals and postsubnodals as shown in Table II indicates that the extremes of variation are less in the postsubnodal series except in the front wings of the females.

The only venational characters which show a reliable degree of constancy are the following: (1) subnodal sector arises at

TABLE II
 POSTNODAL AND POSTSUBNODAL CROSS VEINS, THE LATTER INDICATED IN BOLD-FACE TYPE

Number of Cross Veins	♂		♀		Number the Same in Each Set of Wings				Number the Same in Both Series			
	f.w.	h.w.	f.w.	h.w.	♂		♀		♂		♀	
	f.w.	h.w.	f.w.	h.w.	f.w.	h.w.	f.w.	h.w.	f.w.	h.w.	f.w.	h.w.
7		2 14		2 6		5		1 2		2		2
8	1	63* 71**		23 33**		25 33*		9 15		51*		22
9	10** 38*	20*	4 14**	15** 3	4* 14	6	1 5*	5 1	10*		4	1
10	57 48**		22** 25	2	23 19		8 10	1	33		13	
11	16		16 3		3		6 1				3	
12	2											

* One wing represented.

** Where the holotype ♂ and allotype ♀ wings would occur if data for them were included.

Protonemura tenuis Seljns

subnodus; (2) nodal sector arises in front wing at or nearest fifth, in hind wing at the fourth postnodal; (3) median sector arises proximal to subnodus and ends distal to level of the pterostigma; (4) the first antenodal space is about twice as long as the second and also longer than the third. These are all in accordance with Mr. Williamson's definition of the genus (1915: 619). However, the use of the termination of the superior sector in relation to the subnodal transversal as a character to subdivide the genus into two groups is not adequately upheld. According to the data for *tenuis* only 86.6 per cent of the front wings and 64.5 per cent of the hind wings, or only 75.6 per cent of the total number of wings would place it in the proper group.

Measurements (in mm.): pterostigma, hind wing, ♂ 0.5–0.8, average, 0.693, ♀ 0.65–0.8, average, 0.703; length of hind wing, ♂ 15.6–18.0, average, 16.84, ♀ 17.2–18.5, average, 17.84; width of hind wing, ♂ 2.2–2.6, average, 2.38, ♀ 2.4–2.6, average, 2.48; length of abdomen to apex of segment 10, ♂ 29.9–33.6, average, 31.66, ♀ 26.3–29.4, average, 27.36; length of abdomen + appendages, ♂ 30.5–33.9, average, 32.26; superior appendages, ♂ 0.4–0.5, average, 0.406, ♀ 0.2–0.3, average, 0.24; inferior appendages, ♂ 0.6–0.8, average 0.69. The superior appendages were measured from the base (dorsally) to the tip; the inferiors from a point at about the middle of the base (laterally) to the tip. All the above measurements were made with a microscopical vernier micrometer kindly loaned for the purpose by Dr. T. H. Hubbell.

The locality records indicate that *P. tenuis* has a rather wide distribution around the Amazon River basin, but according to field notes of Mr. J. H. Williamson it was found only on small muddy creeks in dark woods. Specimens were generally seen hovering just above the water in dark places. Mating pairs were taken at Porto Velho on February 13, 17, and 27.

After the data for the *Protoneura tenuis* in the Williamson collection were summarized we learned of additional specimens in institutions which had given financial aid to the expedition made by Mr. J. H. Williamson and Captain J. W. Strohm in

1922. Through the courtesy of Mr. Nathan Banks of the Museum of Comparative Zoology, Dr. Hugo Kahl of the Carnegie Museum, and Dr. W. J. Gerhard of the Field Museum of Natural History, these specimens were received for determination. They are from the following localities in Brazil: Porto Velho, Amazonas, February 17 (2 ♂ 2 ♀ M.C.Z.; 3 ♂ 2 ♀ C.M.; 2 ♂ 2 ♀ F.M.N.H.), February 27 (1 ♂ F.M.N.H.); Villa Murquinho, Matto Grosso, April 6 (1 ♂ M.C.Z.). The color pattern, venation, and measurements of these specimens are within the range of variation recorded above. The British Museum also has a specimen (♂) from Pará, the coloration of which differs slightly from that of the holotype.

Protoneura calverti is closely related to *tenuis*. A study of the type ♂, allotype ♀, and 6 ♂ 3 ♀ paratypes in the Williamson collection shows that the 2 species are remarkably similar in size and coloration. In *calverti* the average length of the pterostigma is less (♂ 0.615 mm., ♀ 0.7 mm.), length of the hind wing is greater (♂ 17.55 mm., ♀ 18.1 mm.), width of hind wing is less (♂ 2.19 mm., ♀ 2.38 mm.), length of abdomen is greater (♂ to segment 10, 32.65 mm., ♀ 27.7 mm.), the superior appendages are longer (♂ 0.485 mm., ♀ 0.3 mm.), and the inferior appendages are about the same (♂ 0.7 mm.). With the exception of the length of the hind wing the average measurements for *calverti* are within the extremes for *tenuis*.

The thoracic coloration of *calverti* in both sexes shows less extensive pale areas. In the male the mesepisternal scarlet (or orange) area of the palest specimens is about the same as in the darkest specimens of *tenuis* (Pl. IV, Fig. 5, and Pl. V, Fig. 1) but without any upward extension on the humeral suture. These dorsal stripes in the darkest specimens extend less than half the distance to the antealar carina (Pl. V, Fig. 2). In all the specimens studied, the metepisternal pale stripe (first lateral) does not touch the metinfraepisternum below or the lateroalar carina above, and the black area of the metepimeron below is continuous ventrally with the stripe from the opposite side (Pl. V, Fig. 1). In the female the metepisternal pale stripe does not reach the antealar carina above, is much nar-

rower at the lower end, and is not wider than the black stripe of the second lateral suture ventral to it (compare Pl. III, Fig. 10, and Pl. V, Fig. 7). The dark areas on the ventral surface are more sharply defined and extensive.

The femora of the legs in *calverti* (Pl. V, Figs. 3 and 6) have slightly more extensive dark areas than in *tenuis*. The males have the first leg almost entirely black anterodorsally and posterodorsally, the second anterodorsally only, and the third black anterodorsally only in the median third of the basal pale area. In both males and females, the apical black area occupies 1/2 (or more), 2/5, and 1/3 of the first, second, and third legs, respectively. The tibiae and tarsi are the same as for *tenuis*.

In structural characters *calverti* may be distinguished from *tenuis* by the shape of the male appendages and genitalia (Pl. I) and the mesostigmal lamina of the female which has the posterior margin distinctly raised above the level of the thorax, especially in the lateral 3/4, giving it the appearance of an elevated ridge.

PLATE I

Protoneura tenuis Selys, holotype ♂, Pará, Brazil, 1850, Dale collection.

FIGS. 1-3. Abdominal appendages in dorsal, lateral, and ventral views, respectively; Fig. 1a, a superointernal view of the left superior appendage.

FIGS. 4-5. Penis (dry condition) in ventral and lateral views.

Protoneura tenuis Selys, ♂, Belem, Pará, Brazil, August 8, 1922, J. H. Williamson and J. W. Strohm.

FIG. 6. Penis (fully expanded in water) in lateral view.

Protoneura calverti Williamson, holotype ♂, Tumatumari, British Guiana, February 8, 1912, E. B. Williamson.

FIGS. 7-9. Abdominal appendages in dorsal, lateral, and ventral views, respectively; Fig. 7a, a superointernal view of the right superior appendage.

FIGS. 10-11. Penis (fully expanded in water) in ventral and lateral views.

All drawings of structural features were made with the aid of a camera lucida.

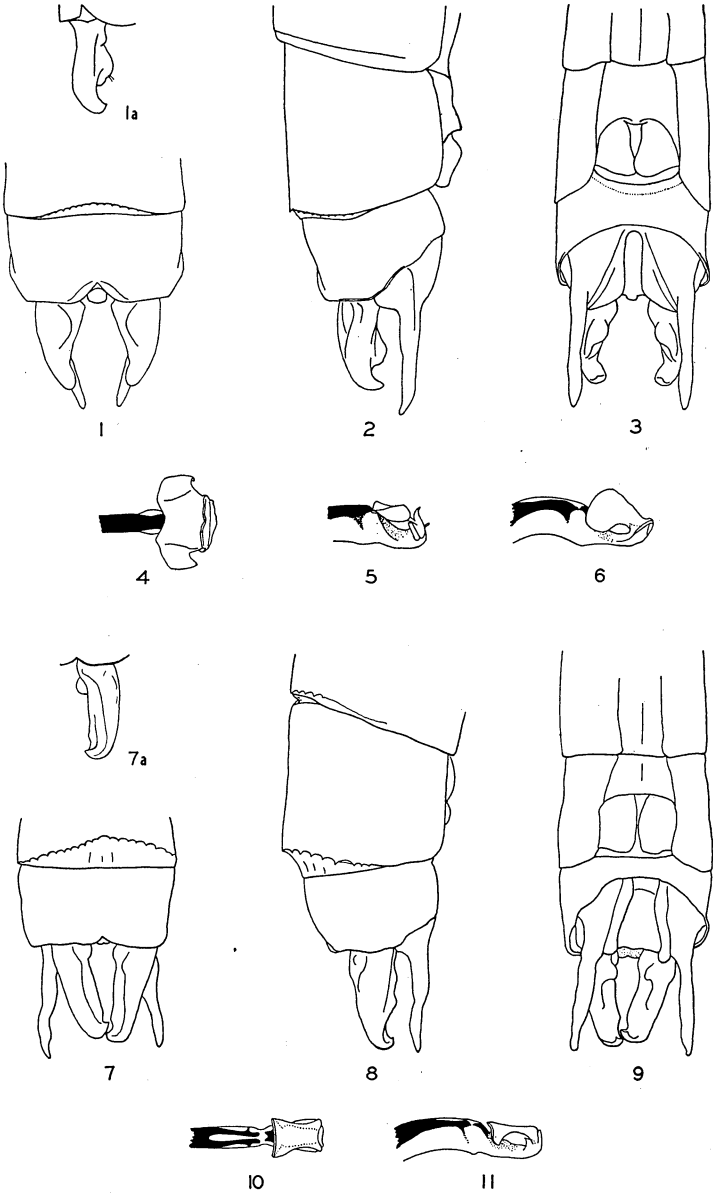


PLATE II

Protoneura tenuis Selys, holotype ♂, Pará, Brazil, Dale collection.

FIG. 1. Color pattern of the head, front view.

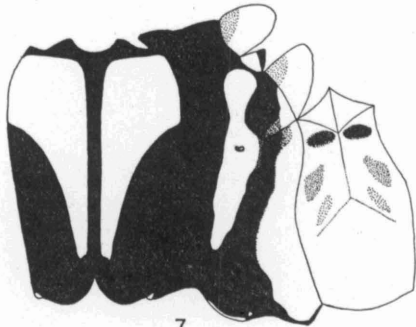
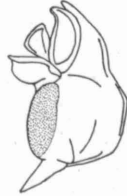
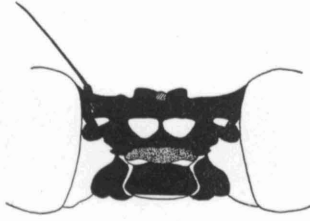
FIG. 2. Median lobe of the labium.

FIGS. 3-5. Prothorax in dorsal, anterodorsal (to show shape of hind lobe), and lateral view, respectively. The stippled area indicates the orange and the remainder, the black part of the pattern.

FIG. 6. Color pattern (diagrammatic) of the first leg showing ventral, anterodorsal, and posterodorsal surfaces. The other legs are missing in the holotype.

FIG. 7. Color pattern (diagrammatic) of the pterothorax.

FIG. 8. Color pattern of the abdomen in dorsolateral view.



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PLATE III

Protoneura tenuis Selys, allotype ♀, Pará, Brazil, 1850, Dale collection.

FIGS. 1-3. Terminal segments of the abdomen in dorsal, ventral, and lateral views, respectively.

FIGS. 4-6. Prothorax. The stippled areas indicate black, the white areas, yellow.

FIG. 7. Head pattern, front view.

FIG. 8. Color pattern (diagrammatic) of the legs.

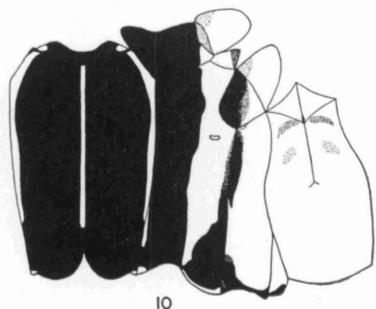
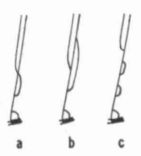
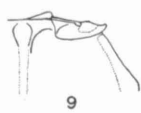
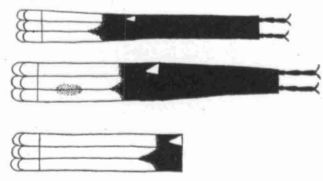
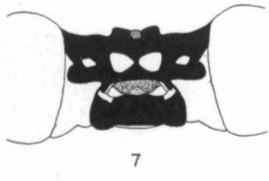
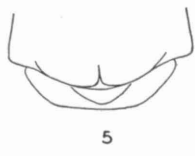
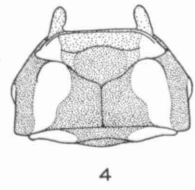
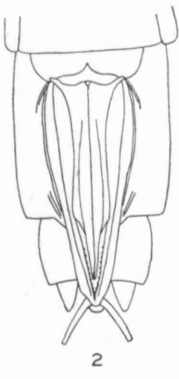
FIG. 9. Mesostigmal lamina.

FIG. 10. Color pattern (diagrammatic) of the pterothorax.

FIG. 12. Color pattern of the abdomen in dorsolateral view.

Protoneura tenuis Selys, Williamson series.

FIG. 11. Upper portion of the humeral pale stripe; *a*, *b*, *c*, indicate variations found in the series of 21 ♀.



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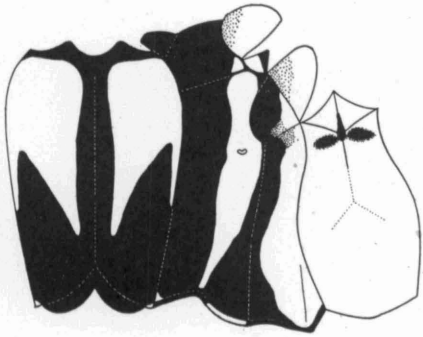
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PLATE IV

Protoneura tenuis Selys.

- FIGS. 1-5. Color-pattern variations in the pterothorax of the ♂. Fig. 1, ♂, Porto Velho, Amazonas, Brazil, February 17, 1922; Fig. 2, ♂, same locality, February 22, 1922; Fig. 3, ♂, Río Beni, Cashuela Esperanza, Bolivia, April 11, 1922; Fig. 4, ♂, Porto Velho, Amazonas, February 21, 1922; Fig. 5, ♂, Villa Murтинho, Matto Grosso, April 4, 1922.
- Fig. 6. Color pattern (diagrammatic) of the legs of the ♂ showing only a part of the black tibiae.
- FIG. 7. Variations in the color pattern of the ninth abdominal segment.
- FIG. 8. Color pattern (diagrammatic) of the legs of the ♀.



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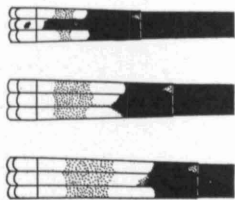
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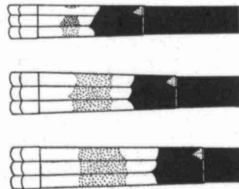
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PLATE V

Protoneura calverti Williamson.

- FIG. 1. Color pattern (diagrammatic) of the pterothorax of the holotype ♂, Tumatumari, British Guiana, February 8, 1912.
- FIG. 2. Color pattern of the mesepisternum of the darkest paratype ♂, Potaro Landing, British Guiana, February 10, 1912.
- FIG. 3. Color pattern (diagrammatic) of the legs, holotype ♂.
- FIG. 4. Variations in the pattern of the ninth abdominal segment in the ♂ paratype series.
- FIG. 5. Color pattern of the head (front view), allotype ♀, Tumatumari, British Guiana, February 8, 1912.
- FIG. 6. Color pattern (diagrammatic) of the legs, allotype ♀.
- FIG. 7. Color pattern (diagrammatic) of the pterothorax of the allotype ♀.

