

**A SYNOPSIS OF THE GENUS *PARASIMULIUM* MALLOCH (DIPTERA:
SIMULIIDAE), WITH DESCRIPTIONS OF ONE NEW SUBGENUS AND
TWO NEW SPECIES**

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ABSTRACT—A brief review of the genus *Parasimulium* is given which includes a key to the two subfamilies of North American Simuliidae, and a key and illustrations for the identification of the two subgenera and four species of this genus. One new subgenus, *Astoneomyia*, and two new species, *P. (P.) stonei*, and *P. (P.) crosskeyi*, are described. The genus is unique in that only males are known.

The genus *Parasimulium* Malloch, by virtue of its rarity and uniqueness, has stimulated the interest and curiosity of many dipterists since the time of its description. It is hoped this brief review will rekindle that interest and enhance the efforts to collect additional specimens of this fascinating and elusive group. Especially needed are the female and immature stages to help round out our knowledge concerning the true relationships of this genus to other members of the family. It is a great pleasure to dedicate this review of the genus *Parasimulium* to the honor and continued memory of an eminent dipterist and friend, Dr. Alan Stone.

Agreement among workers on the higher classification of the family Simuliidae has not yet been achieved. However, it is generally agreed among more recent workers (Smart, 1945; Crosskey, 1969; Rubtsov, 1974) that the genus *Parasimulium* shows such striking differences from other black flies that it is treated as the basis of a separate subfamily, the Parasimuliinae. On the other hand, Stone (1962, 1963a, 1964, 1965) treated this genus as the basis of the tribe Parasimuliini in the subfamily Prosimuliinae. Based upon a recent examination of seven of the eight known specimens of *Parasimulium*, the present author concurs with the former authors in recognizing the subfamily Parasimuliinae.

Subfamily Parasimuliinae

Parasimuliinae Smart, 1945, Trans. R. Entomol. Soc. Lond. 95:479.

This distinctive subfamily can be characterized and easily separated from the Simuliinae Newman, by the following key to the subfamilies of North American Simuliidae:

1. R_1 joining C slightly beyond middle of wing; branches of Rs conspicuously separated by membrane, posterior branch ending well before terminus of

C; C, Sc and radial veins with moderately long setae on dorsal and ventral surfaces; submedian m-cu fold simple apically; CuA₂ only moderately sinuous; basal cell absent (fig. 1, 2). Facets of eye all similar in size except for a few larger facets near middle of anterior margin of eye; eyes broadly separated by frons dorsally, touching or nearly so below antennae (fig. 15). Calcipala and pedisulcus absent. Mesepimeral tuft absent. Gonostylus without an apical spinule but internal apical margin may be sclerotized. Male only, female unknown. ----- Parasimuliinae

- 1'. R₁ joining C well beyond middle of wing; if Rs forked then branches lying closer together, posterior branch ending near terminus of C; C, Sc, and radial veins with short setae that may or may not be present on 1 surface only; submedian m-cu fold distinctly forked apically; CuA₂ strongly sinuous; basal cell present or absent. Facets of dorsal ½ of male eye usually conspicuously larger than those of ventral ½; eyes usually touching or nearly so at middle of head above antennae, frons usually small. Calcipala and pedisulcus present or absent. Mesepimeral tuft present. Gonostylus of male usually with 1 or more apical spinules

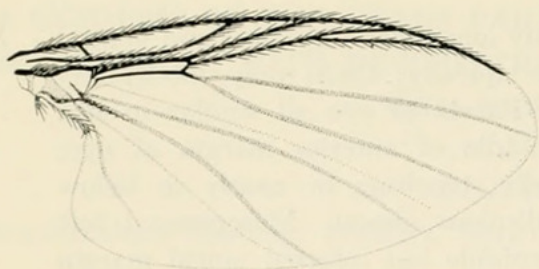
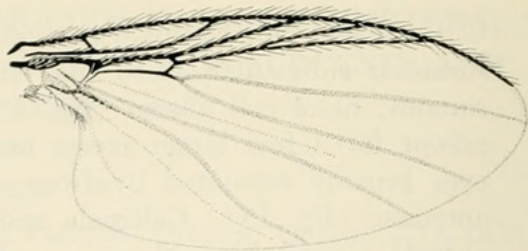
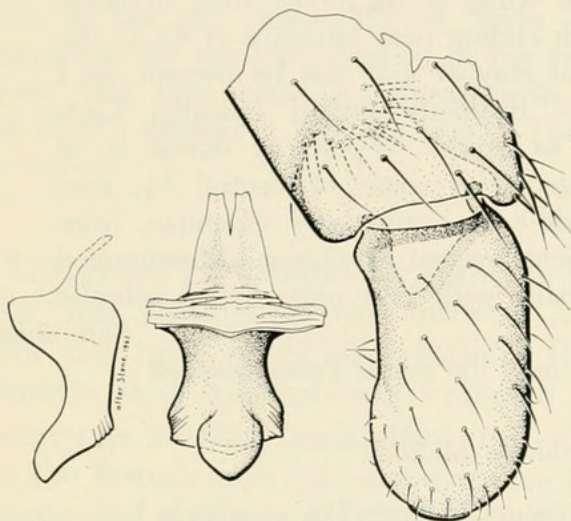
----- Simuliinae

The subfamily Parasimuliinae contains only the genus *Parasimulium*.

Genus *Parasimulium* Malloch

Type-species: *Parasimulium furcatum* Malloch (by monotypy).

Parasimulium Malloch, 1914, U.S. Dep. Agric., Bur. Entomol. Tech. Ser. 26:24. Knab, 1914, Ins. Insc. Mens. 2:180. Enderlein, 1921, Deut. Tierärztl. Woch. 29:199. Enderlein, 1921, Zool. Anz. 53:43. Dyar and Shannon, 1927, Proc. U.S. Nat. Mus. 69(10):2. Stiles and Hassall, 1928, Treasury Dep., U.S. Publ. Hlth. Serv., Hyg. Lab. Bull. 150:368. Enderlein, 1928, Zeitschr. Desinfekt. Gesundht. 20:10. Enderlein, 1930, Arch. Klassif. Phylog. Entomol. 1:87. Edwards, 1931, Dipt. Pat. S. Chile 2, Fasc. 4:122. Bequaert, 1934, In Strong, Sandground, Bequaert and Ochoa, Onchocerciasis. Harvard Univ. Press, Cambridge, p. 207. Twinn, 1936, Can. Jour. Res., D, 14:101. Rubtzov, 1940, Zool. Inst. Acad. Sci. USSR (N.S. 23) 6(6):251, 469. Stone, 1941, Proc. Entomol. Soc. Wash. 43:146. Vargas, 1941a, Rev. Inst. Salub. Enferm. Trop. 2:116. Vargas, 1941b, Rev. Inst. Salub. Enferm. Trop. 2:216. Stains and Knowlton, 1943, Ann. Entomol. Soc. Amer. 36:260. Vargas, 1945, Inst. Salub. Enferm. Trop. Monogr. 1:98. Smart, 1945, Trans. R. Entomol. Soc. Lond., 95:479. Vargas, Martínez Palacios, and Díaz Nájera, 1946, Rev. Inst. Salub. Enferm. Trop. 7:102. Vargas and Díaz Nájera, 1948, Rev. Inst. Salub. Enferm. Trop. 9:66. Nicholson and Mickel, 1950, Univ. Minn. Agric. Exp. Sta. Tech. Bull. 192:14. Wirth and Stone, 1956, In R. L. Usinger (Ed.), Aquatic insects of California. Univ. Calif. Press, Berkeley and Los Angeles, p. 403. Rubtzov, 1956, Zool. Inst. Acad. Sci. USSR (N.S. 64) 6(6):142. Shewell, 1958, Proc. Tenth Int. Cong. Entomol., Montreal. 1:643. Grenier and Rageau, 1960, Bull. Soc. Path. Exot. 53:738. Peterson, 1960, Great Basin Naturalist. 20:82. Rubtzov, 1960, Fliegen Palaerkt. Reg. 3 (14), Lfg. 206:98. Grenier and Rageau, 1961, Verhandl. XI. Int. Kong. Entomol., Wien. 1:175. Stone, 1962, Proc. Entomol. Soc. Wash. 64:174. Stone, 1963a, U.S. Dep. Agric. Tech. Bull. 1284:14. Dumbleton, 1963, New Zealand Jour. Sci. 6:321. Stone, 1963b, Bull. Brooklyn Entomol. Soc. 58:127. Stone, 1964, State Geol.

1 *Parasimulium melanderi* ♂2 *Parasimulium stonei* ♂

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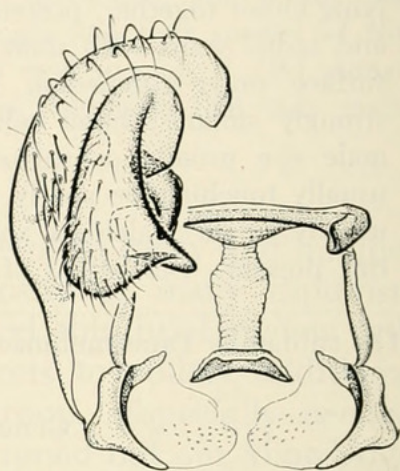
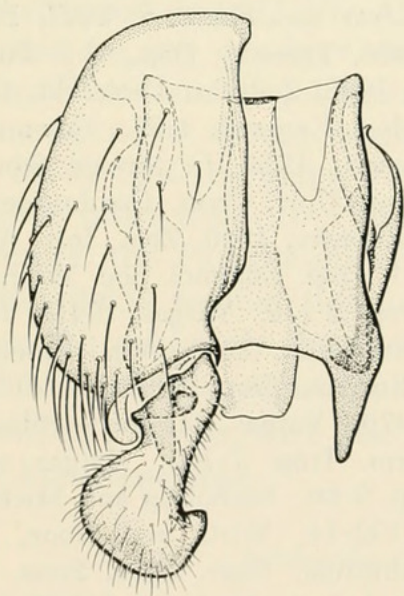
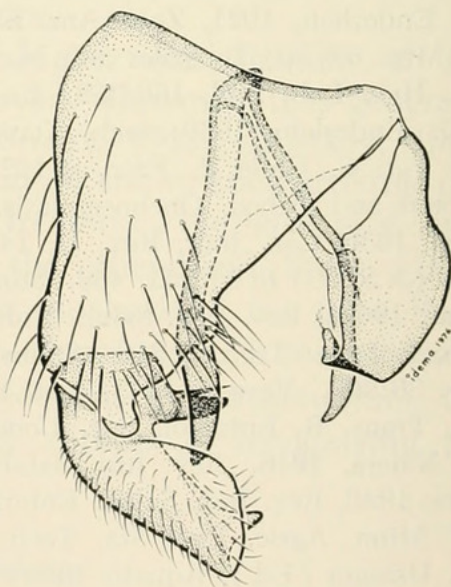
Parasimulium melanderi6 *Parasimulium furcatum*7 *Parasimulium furcatum*8 *Parasimulium furcatum*

Plate 1

Fig. 1-2, wings. 1, *Parasimulium* (A.) *melanderi*, holotype. 2, *P.* (P.) *stonei*, holotype. Fig. 3-5, male terminalia of *P. melanderi*, holotype. 3, ventral plate, lateral view. 4, ventral plate, ventral view. 5, gonostylus and part of gonocoxite, ventral view. Fig. 6-8, male terminalia of *P. furcatum*, holotype. 6, terminal (end) view showing gonocoxite, gonostylus, ventral plate, median sclerite, and parameres. 7, same structures, ventral view. 8, same structures, lateral view. Terminal view (6) and lateral view (8) at right angles to plane of ventral view (7).

Nat. Hist. Surv. Conn. Bull. 97:10. Abdelnur, 1968, Quaest. Entomologicae. 4:121. Crosskey, 1969, Bull. Brit. Mus. (Nat. Hist.), Entomol. Suppl. 14:13. Rubtzov, 1974, Trudy Zool. Inst., Acad. Sci. USSR. 53:253 (p. 40 in English translation by British Library Lending Division).

Although the synonymy listed above is not complete, it does contain the main references to the genus *Parasimulium*.

The important characteristics of this genus are the same as those given above for the subfamily Parasimuliinae.

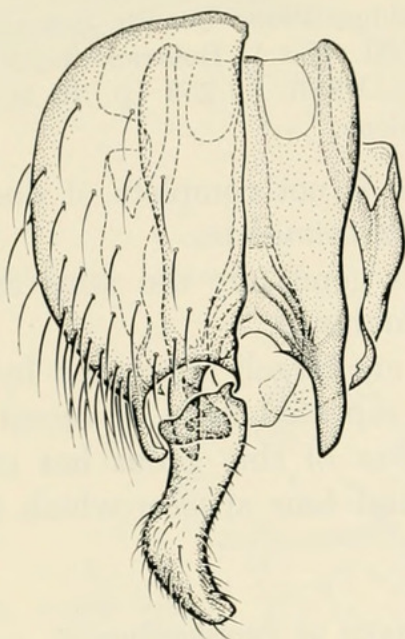
The historical aspects of the genus are largely presented by Stone (1941, 1962, 1963b) and need not be repeated here. A recent study of seven of the eight¹ known specimens of this genus has resulted in the recognition of two subgenera and four species which can be separated by the following key.

Key to the Subgenera and Species of *Parasimulium*
Males²

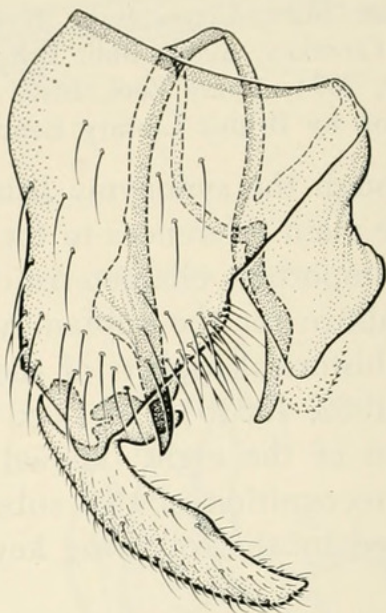
1. Stem of Rs shorter than or, at most, subequal to posterior branch (R_{4+5}) of fork; submedian m-cu fold faint, becoming evanescent at about level of distal end of anterior branch (R_{2+3}) of Rs; A_2 absent or very faint (fig. 2). Halter entirely yellow. Gonostylus yellow; in ventral view narrowing distally and somewhat rounded, pointed, or inner distal corner produced as a short, rounded, upturned lobe. Ventral plate of aedeagus, in ventral view, broad, dorsoventrally flattened, and somewhat H-shaped (fig. 7, 9, 13) *Parasimulium* (*Parasimulium*) Malloch.... 2
- 1'. Stem of Rs distinctly longer than posterior branch (R_{4+5}) of fork; submedian m-cu fold weak but extending more nearly to wing margin; A_2 present and distinct (fig. 1). Halter entirely brownish black. Gonostylus black; in ventral view broad, apex broadly rounded with a short, median sclerotization (fig. 5). Ventral plate of aedeagus, in ventral view, a narrow, subquadrate structure, with short, bulbous, apical liplike projection, and basal arms extending laterally at right angles beyond its margins (fig. 4) *Parasimulium* (*Astoneomyia*) *melanderi* Stone
2. Gonostylus relatively long, slender, and sinuous, its width more nearly uniform along its length. Ventral plate, in ventral view, narrower than in following species, its mediodistal margin more deeply concave, and with a series of distinct wrinkles or ridges (fig. 9) *stonei* n. sp.
- 2'. Gonostylus relatively short, its base obliquely narrow, abruptly enlarging at about $\frac{1}{2}$ to $\frac{2}{3}$ its length then tapering distally to a broader, obliquely rounded, or narrow, upturned point. Ventral plate, in ventral view, broad, its mediodistal margin nearly straight across, or shallowly concave, and without distinct wrinkles or ridges (fig. 7, 13) 3
3. Inner distal corner of gonostylus produced as a short, rounded, upturned lobe. Mediodistal margin of ventral plate nearly straight across; apico-

¹The single specimen in the British Museum (Natural History) was available for study only after this paper was sent to press.

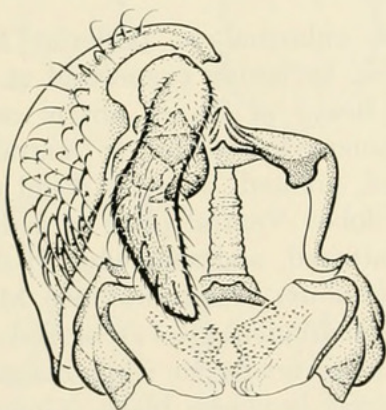
²The female and immature stages are not known.



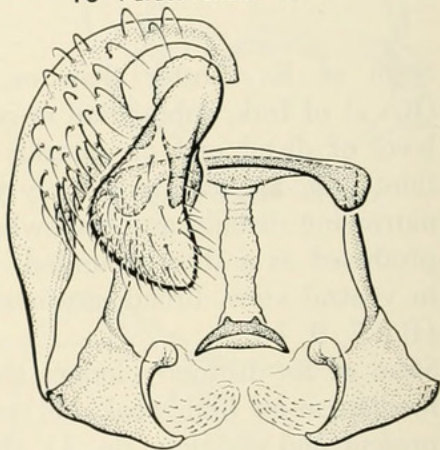
9 *Parasimulium stonei*



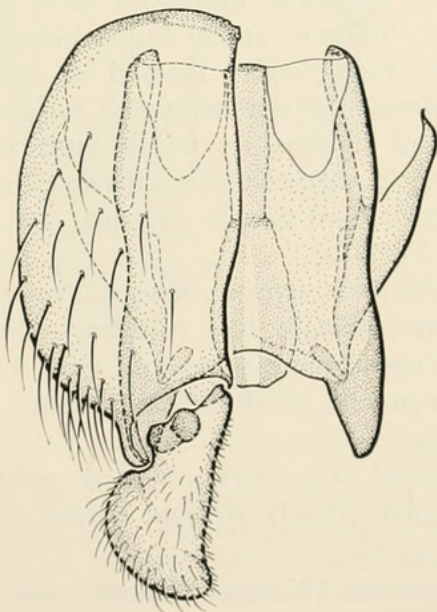
10 *Parasimulium stonei*



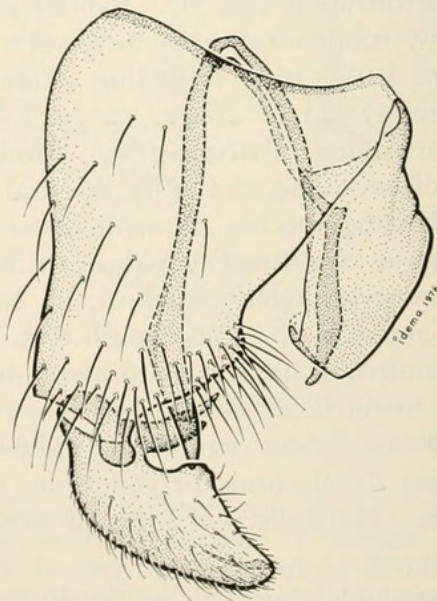
11 *Parasimulium stonei*



12 *Parasimulium crosskeyi*



13 *Parasimulium crosskeyi*



14 *Parasimulium crosskeyi*

- lateral processes more slender distally, enlarged shoulderlike at about level of mediodistal margin (fig. 7) *furcatum* Malloch
- 3'. Inner distal corner of gonostylus more obliquely and evenly rounded, without a distinct upturned lobe. Mediodistal margin of ventral plate shallowly but distinctly concave; apicolateral processes more uniformly broad throughout (fig. 13) *crosskeyi* n. sp.

Subgenus *Parasimulium* Malloch

The characters of this subgenus are presented in the above key. Three closely related species, *P. furcatum* Malloch, *P. stonei* n. sp., and *P. crosskeyi* n. sp., are assigned to this taxon.

Parasimulium (*Parasimulium*) *furcatum* Malloch fig. 6, 7, 8, 17

Parasimulium furcatum Malloch, 1914, U.S. Dep. Agric., Bur. Entomol. Tech. Ser. 26:24; fig. 4. Knab, 1914, Ins. Insc. Mens. 2:180. Dyar and Shannon, 1927, Proc. U.S. Nat. Mus. 69(10):3; pl. 1, fig. F. Stone, 1941, Proc. Entomol. Soc. Wash. 43:146; figs. 1-6. Stains and Knowlton, 1943, Ann. Entomol. Soc. Amer. 36:260. Vargas, 1945, Inst. Salub. Enferm. Trop., Monogr. 1:140. Smart, 1945, Trans. R. Entomol. Soc. Lond. 95:479. Stone, 1962, Proc. Entomol. Soc. Wash. 64:174 (part). Stone, 1963b, Bull. Brooklyn Entomol. Soc. 58:128 (part).

Holotype. ♂, Redwood Creek, Bair's Ranch, Humboldt County, Calif., H. S. Barber. Cat. No. 15405, USNM.

Remarks. This species was reasonably well described by Malloch (1914), briefly redescribed by Dyar and Shannon (1927), and some features were more extensively described by Stone (1941). After the discovery of two additional specimens of *Parasimulium* in the Melander collection, Stone (1962) amplified the description with notes on a few of the external characters not mentioned in the original description because of the poor condition of the type specimen. However, these amplifications were based on specimens which are now included as part of the type-series of the new species *P. stonei* described below, and possibly might not hold true for *P. furcatum*. Only by the discovery of additional specimens of *P. furcatum* can this be ascertained and an adequate description of the species be made. The features of *P. melanderi* Stone noted by Stone (1963b) to be com-

←

Plate 2

Fig. 9-14, male terminalia. 9-11, *Parasimulium stonei*, holotype. 9, ventral view showing gonocoxite, gonostylus, ventral plate, median sclerite, parameres, and aedeagal membrane. 10, same structures, lateral view. 11, same structures, terminal view. 12-14, *Parasimulium crosskeyi*, holotype. 12, same structures, terminal view. 13, same structures, ventral view. 14, same structures, lateral view.

monly shared with *P. furcatum*, were characters of generic value and apply equally well to all four species now included in the genus *Parasimulium*.

Parasimulium furcatum can be distinguished from *P. stonei* and *P. crosskeyi* by the features given in the key. If Malloch's description of *P. furcatum* is accurate in light of the condition of the specimen, and it can only be assumed that it is, the following features will also help to distinguish it from the two new species: Frons undusted (greyish pollinose in *stonei* and *crosskeyi*); second (*sic*) segment (= scape) of antenna black (yellow in *stonei* and *crosskeyi*); abdomen brown except basal scale (= tergum 1) yellow (terga 1 and 2, and sterna 1-3 yellow in both *stonei* and *crosskeyi*); and, knob of halter brown, its stem yellow (halter entirely yellow in *stonei* and *crosskeyi*).

It should be noted that Stone had mounted the remaining parts of the broken specimen of *P. furcatum* on a slide. These parts were generally unsuitable for study due to shifting under the cover slip. They have been removed from the slide and are now in glycerine to facilitate their study.

Parasimulium (Parasimulium) stonei Peterson, new species
fig. 2, 9, 10, 11, 15, 16, 18

Parasimulium furcatum, Stone, 1962, Proc. Entomol. Soc. Wash. 64:174 (part). Stone, 1963a, U.S. Dep. Agric. Tech. Bull. 1284:14 (part). Stone, 1963b, Bull. Brooklyn Entomol. Soc. 58:128 (part).

Description. Male. General color of thorax orange brown to dark brownish black; abdomen brownish black except basal segments which are yellow. Length: Body, 1.7-1.8 mm (based on 2 whole pinned specimens), wing, 1.7-2.2 mm (based on 1 slide mounted and 2 pinned specimens).

Head (fig. 15) dark reddish brown to brownish black, greyish pollinose; with sparse yellow pile and a few longer brownish setae; 0.4-0.5 mm wide, slightly narrower than thorax. Frons widening dorsally, about twice as wide at inner dorsal angles of eyes as at narrowest point above antennae; clypeus small with sparse brownish pile. Anteromedial facets of eye larger than others which somewhat decrease in size dorsally, ventrally, and posteriorly; small but distinct, slightly raised, shiny bulla present near dorsolateral margin of eye. Antenna with 8 flagellomeres; entirely pale yellow, with longer than usual pale pile; pedicel slightly longer and wider than scape, and about twice as long as basal flagellomere. Palpus yellowish brown, with pale yellow pile; segment 5 about as long as segments 3 and 4 combined; segment 3 enlarged, somewhat globular. Sensory vesicle of 3rd palpal segment about $\frac{1}{3}$ as long as segment, opening to exterior by a distinct, rather uniformly wide neck, its mouth rounded.

Scutum, scutellum, and postnotum concolorous, greyish pollinose; scutum with short, recumbent, yellow pile, and a few longer brownish setae laterally and posteromedially; scutellum with long brownish setae. Pleuron slightly paler than dorsum of thorax, with a rather uniform greyish pollinosity; mesepimeral tuft absent. Katepisternum short and narrow, weakly delineated from

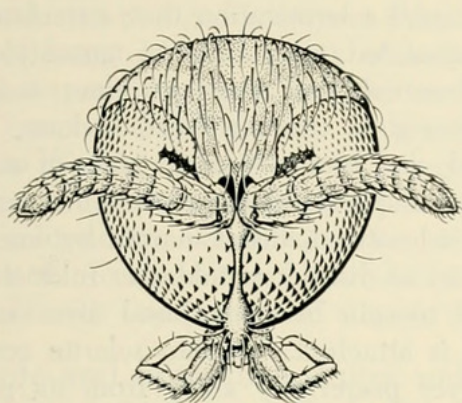
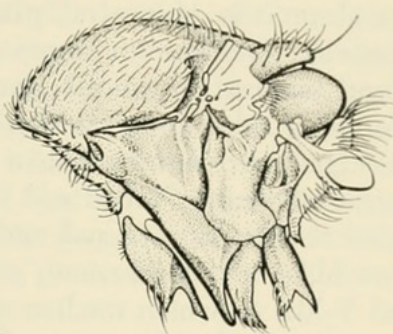
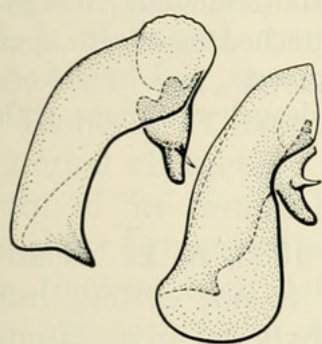
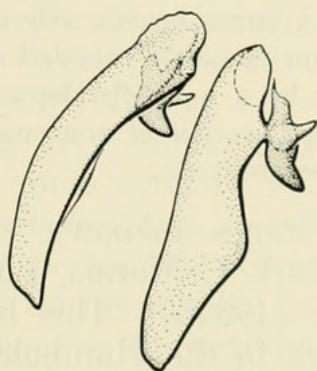
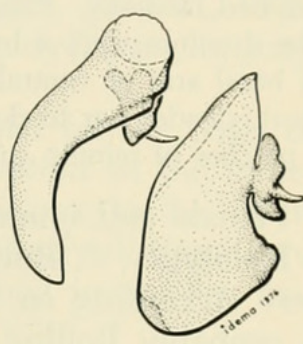
15 *Parasilulium stonei* ♂16 *Parasilulium stonei* ♂17 *Parasilulium furcatum*18 *Parasilulium stonei*19 *Parasilulium crosskeyi*

Plate 3

Fig. 15-19, 15-16, *Parasilulium stonei*, holotype. 15, head. 16, thorax, lateral view. 17-19, gonostyli of male terminalia in situ, showing left gonostyli in posteroventrolateral view (this view shows left gonostylus in its broadest aspect, and right gonostylus in its narrowest aspect). 17, *P. furcatum*. 18, *P. stonei*. 19, *P. crosskeyi*.

anepisternum by a wide, shallow depression. Wing as in fig. 2; membrane hyaline, faintly yellowish; veins pale yellow; setae on stem vein and base of costa pale yellow, rest of setae on veins varying from yellow to brownish. Halter pale yellow, with yellow pile. Legs entirely yellow to reddish yellow, with yellow pile and a few longer brownish setae; hind basitarsus not swollen, about 4.5 times as long as wide.

Abdominal terga 1 and 2 yellow; terga 3-9 reddish brown to brownish black, greyish pollinose, their hind margins narrowly yellowish grey; sterna 1-3 yellow, remaining sterna concolorous with posterior terga; basal fringe and most abdominal setae yellow, but a few brownish setae may be present especially on posterior segments. Terminalia as in fig. 9-11, 18. Gonocoxite brownish black, with sparse yellow pile; subconical in shape, greatest width nearly equal to greatest length; dorsal margin with a broad, slightly raised, subapical convexity bearing yellow setae; outer distal margin with a short, distinct, and rather broad digitiform process that articulates with base of gonostylus. Gonostylus yellow, with fine yellow setae; rather long and slender, tapering distally to a narrowly rounded or pointed apex, about 3 times as long as greatest width which is about

mid length and at which point there is a small sclerotization that articulates with apicolateral process of ventral plate. Associated with base of gonostylus is a small, heavily sclerotized two-pronged structure that overlaps inner margin of apicolateral process of ventral plate; 1 prong of this structure is long, slender and pale, while other prong is short, broad, and blunt. Ventral plate of aedeagus somewhat H-shaped, narrower than in other 2 species of same subgenus, its apicolateral arms moderately broad and heavily sclerotized, distal margin between these arms rather deeply concave and with a series of distinct wrinkles or folds that protrude pouchlike in lateral view; proximal margin between basal arms narrowly produced V-like to which median sclerite is attached. Median sclerite consisting of a long, slender basal section that curves posteriorly away from its point of attachment to ventral plate, and gradually expands distally for about $\frac{1}{2}$ its length, then rather abruptly expands clublike and whose apical margin is faintly notched medially. Paramere a large, heavily sclerotized, subrectangular, trough-like structure, with a broad but unevenly rounded apex; attached basally to apex of basal arm of ventral plate by a long, slender arm or process, and by a very short, slender bar to dorsolateral corner of gonocoxite. Aedeagal membrane with 2 patches of minute spiniform processes.

Female and immature stages unknown.

Holotype. ♂, Bolling Park, California, June 19, 1935, A. L. Melander. According to Stone (1963b), "This locality is not certain but is probably Bolling Grove in the Humboldt Redwoods area, Humboldt County."

Paratypes. 2♂♂, Viento [Hood River County], Oregon, July 1, 1917, A. L. Melander (USNM, CNC).

Remarks. This species is closely related to both *P. furcatum* and *P. crosskeyi* n. sp. However, it can easily be distinguished from them by its long slender gonostyli, and the more narrow ventral plate with its conspicuous wrinkles or folds that, in lateral view, appear to form a pouchlike bulge. Other possible characters for separating *P. stonei* and *P. furcatum* are discussed under the latter species.

Parasimulium (*Parasimulium*) *crosskeyi* Peterson, new species
fig. 12, 13, 14, 19

Parasimulium furcatum, Stone, 1963b, Bull. Brooklyn Entomol. Soc. 58:128 (part).

Description. Male. As far as can be determined from the 2 specimens at hand, this species agrees in all particulars with *P. stonei* except for the structural details of the terminalia. Terminalia as in fig. 12-14, 19; larger in overall size than in other 2 species of this group. Gonocoxite subconical, greatest length slightly more than greatest width; digitiform process on outer distal margin rather long, slender, and slightly enlarged apically. Gonostylus yellow, with yellow pile; rather slender on basal $\frac{2}{3}$, then somewhat abruptly widening, then tapering mesally to an obliquely rounded or pointed apex, base obliquely narrow; greatest length about 2.75 times its greatest width; point of greatest width on outer margin with a small sclerotization that articulates with apicolateral process of ventral plate. Associated with base of gonostylus is a small, heavily

sclerotized two-pronged structure which is similar to that in *P. stonei* but is somewhat larger. Ventral plate of aedeagus similar to that of *P. stonei*, somewhat H-shaped but much broader and with larger apicolateral processes, less deeply concave distal margin, and without wrinkles or folds. Median sclerite similar to that of *P. stonei* but enlarged apical section with a shallow notch that appears to extend to near its base as a weakened line. Paramere a large, heavily sclerotized, troughlike plate similar to that of *P. stonei* but its apical margin more evenly rounded, and entire structure shaped as in fig. 14. Aedeagal membrane with two patches of minute setae-like processes.

Female and immature stages unknown.

Holotype. ♂, Benson Park [Multnomah County], Oregon, June 24, 1935, A. L. Melander.

Paratypes. 1 ♂, Corvallis [Benton County], Oregon, June 21, 1925, A. L. Melander. 1 ♂, Eagle Creek [Hood River County], Oregon, June 15, 1925, A. L. Melander [BM[NH]].

Remarks. This species is very similar to *P. stonei* on the basis of external characters, but is more similar to *P. furcatum* in the structure of its terminalia. *Parasimulium crosskeyi* seems to be intermediate between these two species. However, it is easily distinguished by the structural details of the terminalia as outlined in the key and by comparing the accompanying illustrations.

This species is named in honor of another eminent dipterist and friend, Dr. R. W. Crosskey of the British Museum (Natural History).

Astoneomyia Peterson, new subgenus

Type-species: *Parasimulium melanderi* Stone

This subgenus is characterized and can be separated from the nominate subgenus by the features given in the key. In addition, the only included species, *P. melanderi*, is totally brownish black with brownish-black pile, and has very different terminalia as can be seen from the accompanying illustrations. The future discovery of additional stages of the unique type-species may require this subgenus to be elevated to full generic status.

Parasimulium (*Astoneomyia*) *melanderi* Stone
fig. 1, 3, 4, 5

Parasimulium melanderi Stone, 1963b, Bull. Brooklyn Entomol. Soc. 58:127; figs. 1-4.

Holotype. ♂, Nooksack River, Mt. Baker, Washington, August 11, 1925, A. L. Melander.

Remarks. This species was well described and illustrated by Stone (1963b) and need not be redescribed here although improved illustrations of the species are provided. *Parasimulium melanderi* is

readily separated from the other three species of the genus. In fact, the features of the wing, the color of the body integument and pile, and especially the unusual structure of the terminalia, all as detailed in the key, make it sufficiently distinctive to merit its placement in a separate subgenus as is done here.

Stone mounted the left wing and the terminalia of *P. melanderi* on a slide, but because they had shifted position and parts of the terminalia were not under the coverslip, all these parts were removed from the slide and are now stored in glycerine.

I am grateful to Dr. F. C. Thompson, Systematic Entomology Laboratory, United States Department of Agriculture, Washington, D.C., for the loan of specimens used in this study. I express my appreciation to Dr. Lloyd Knutson, editor of this journal, for inviting me to contribute to this special issue honoring Dr. Alan Stone.

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