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## Descriptions and Redescriptions of Species of the Blackfly Genus *Simulium* from the Northern Andes (Simuliidae, Diptera)

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### INTRODUCTION

The present paper contains studies on certain species of *Simulium* from western South America; most of the specimens were collected during a survey of the blackflies of cool and cold temperate areas of the Andes. Some of the species described or mentioned herein are of interest because of their biting habits and potential or actual role in the transmission of diseases; others are hitherto insufficiently known type species of subgenera of *Simulium*, which are now redescribed in detail, in one case together with a few close allies; and still others are treated here because knowledge of them furthers the general understanding of the composition of the blackfly fauna of the area under consideration. All species occur at altitudes of 2000 meters or higher, and are often found together with *Gigantodax*, *Simulium* (*Pternaspatha*) or other equally characteristic high-altitude forms.

Field and laboratory work for this project was supported in part by a travel grant from the National Geographic Society in 1963 and by Grants GB-5852 and GB-8783 of the National Science Foundation. Mr. Matthew Cormons helped with the drawings, and Dr. Sixto Coscarón gave useful advice and criticism. Many people assisted in the field, most

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of all my wife, Betty Wygodzinsky. Others who helped in the field and to whom I am grateful are Dr. A. D'Alessandro and Dr. P. Barreto, Cali, Columbia; Dr. A. Herrero, formerly of Lima, Peru; Mr. C. H. Pérez, Quito, Ecuador; Mr. J. Ramírez Pérez, Caracas, and Dr. E. W. Schmidt-Mumm, Bogotá, Columbia.

In addition to material deposited in the American Museum of Natural History, in the main collected by the author and his associates, specimens from other collections were also examined. Dr. E. Schlinger, University of California, Berkeley; Dr. G. Shewell, Canadian National Collection of Insects, Ottawa; and Dr. A. Stone, United States National Museum, Smithsonian Institution, Washington, D. C., all lent me valuable specimens from the collections under their care.

The abbreviations used for depositories of the material mentioned in the text are as follows:

A.M.N.H., American Museum of Natural History

C.I.S., California Insect Survey, University of California, Berkeley

C.N.C., Canadian National Collection of Insects, Ottawa

U.S.N.M., United States National Museum, Smithsonian Institution

### *Simulium escomeli* Roubaud

#### Figures 1-6

*Simulium escomeli* ROUBAUD, 1909, p. 428. KNAB, 1914a, p. 18; 1914b, p. 81; 1914c, p. 123. SILVA FIGUEROA, 1917, p. 30. PINTO, 1932, p. 730. VARGAS, 1945, p. 134. SMART, 1945, p. 504. WYGODZINSKY, 1953, p. 330. LEÓN and WYGODZINSKY, 1953, p. 30. WYGODZINSKY, 1958, p. 133. STONE, 1963, p. 16. VULCANO, 1967, p. 11.

*Simulium (Lanea) escomeli*: VARGAS and DÍAZ, 1951, p. 152.

*Simulium (Psilopelmia) escomeli*: VARGAS and DÍAZ, 1953a, p. 146; 1953b, p. 17.

*Psilopelmia rufidorsum* ENDERLEIN, 1934, p. 283.

*Simulium rufidorsum*: VARGAS, 1945, p. 192; SMART, 1945, p. 513.

DISCUSSION: *Simulium escomeli* is the type species of *Psilopelmia* Enderlein, now considered a subgenus of *Simulium*. To help toward a future subgeneric revision of Neotropical *Simulium*, the following detailed redescription of the species is offered. The larvae and pupae have not been reported before, and the redescrptions of the adults complement those of the female by Wygodzinsky (1953) and of the male by Vargas and Díaz (1953b).

DESCRIPTION: FEMALE: Wing length 2.3-2.8 mm.

Color of head black; frons and clypeus silver-gray. Mouth parts brown; maxillary palpi blackish. Antennae (fig. 1B) dark brown; three basal segments orange. Scutum (fig. 1A) reddish orange, with the lateral borders, posterior margin and 1+1 submedian longitudinal stripes silver-gray; these beginning at anterior border of scutum, somewhat

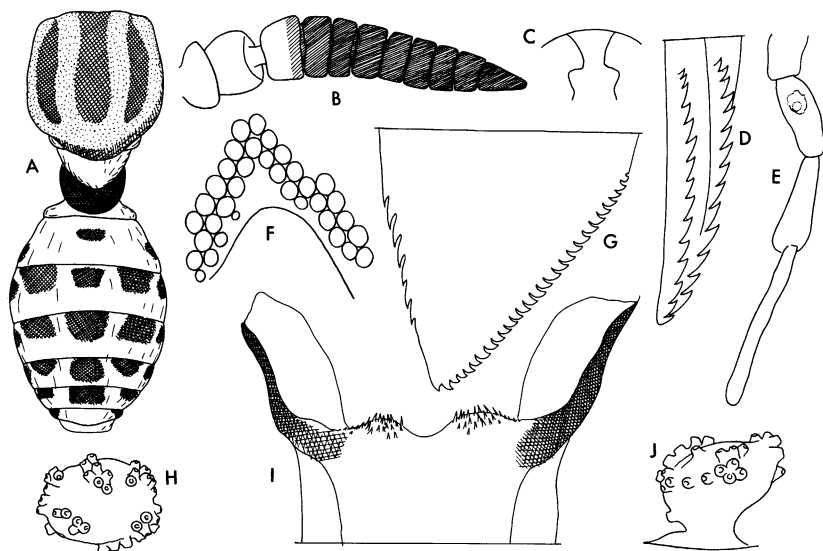


FIG. 1. *Simulium escomeli*, female. A. Thorax and abdomen, dorsal pattern. B. Antennae, with pattern. C. Frons. D. Apex of maxilla. E. Maxillary palp. F. Fronto-ocular triangle. G. Apex of mandible. H. Sensory vesicle of third segment of maxillary palp. I. Posterior border of cibarium. J. Sensory vesicle of maxillary palp, different aspect.

wider anteriorly than posteriorly, slightly convergent before meeting posterior silver-gray area. Scutellum pale yellow. Metanotum black, silvery pruinose. Pleural and sternal region of thorax pale, silvery pruinose. Hairs of scutum short, scattered, pale golden. Hairs of scutellum golden or dark. Mesepimeral tuft yellowish. Wing veins pale yellow; setal tufts of wings golden brown. Stem of halteres yellowish, knob white. Legs pale yellow; dark portions, as seen on slide preparations, shown in fig. 2B–D, color from piceous to black. Light-colored portions of mid and hind tibiae with brilliant white sheen. Fore coxae light colored; mid and hind coxae dark. Setae of legs short, from golden to black; scales absent. Abdomen (fig. 1A) dorsally from pale yellow to silver-gray. Terga II–VI each with a central subquadrate black spot, smallest on II; terga III–VI also with 1 + 1 submedian and II–VII with 1 + 1 sublateral black spots. Surface of all terga matte. Under surface of abdomen grayish.

Frons relatively wide (fig. 1C), lacking median sulcus. Fronto-ocular triangle present, small, not quite as high as wide (fig. 1F). Antennae as shown in figure 1B. Cibarium (fig. 1I) emarginate at center of border, laterad of central emargination somewhat salient and with 1 + 1 groups

of slender pointed denticles arranged in several irregular rows. Mandibles and maxillae serrated on both edges. Mandibles (fig. 1G) with approximately 35 teeth; maxillae (fig. 1D) with about 30 teeth. Maxillary palp as shown in figure 1E; last segment as long as two preceding combined. Third segment not conspicuously widened; sensory vesicle half as wide as diameter of segment, suboval, detailed structure as shown in figure 1H, J.

Setae of scutum as in male, namely, of uniform type, elongate, very narrow at base, then wider, pointed apically, with one rib. Setae scattered, not forming groups or lines. Pleural membrane and katepisternum glabrous. Furcasternum as illustrated (fig. 2E).

Wing venation as usual for *Simulium*. Sc with about eight delicate hairs. Basal section of R bare.  $R_1$  with hairs and spiniform setae arranged in single row, with spiniform setae much more numerous than hairs.  $R_s$  with single row of setae on under surface; setae of upper surface appearing at level of meeting of  $R_s$  and C. Details of wing chaetotaxy as shown in figure 2A.

Shape of legs and proportions of segments as shown in figure 2B-D. First article of fore tarsus approximately eight times as long as wide. Calcipala well developed (fig. 2G), slightly shorter than wide basally, not attaining level of pedisulcus. Claws slender, not strongly curved, lacking basal projection or tooth (fig. 2H).

Abdomen without scales, only with scattered setae, except basal fringe. Tergal plates well developed. Seventh sternite not specialized. Eighth sternite as illustrated in figure 2J, with 1 + 1 groups of 20-25 setae each, some exceptionally stout and dark. Gonapophyses glabrous, setae and microtrichia<sup>1</sup> absent; faintly sclerotized near border. Paraprocts and cerci as shown in figure 2L, M; cerci more heavily pigmented than paraprocts, latter with long pointed projection. Genital fork as shown in figure 2I; stem slender, heavily pigmented, not strongly widened distally; branches as illustrated. Spermatheca (fig. 2F) globular, heavily sclerotized, surface not sculptured; spicules of inner surface present (fig. 2K), scattered, not arranged in groups; duct inserted in circular membranous area.

MALE: Wing length 2.2-2.3 mm.

Frons and clypeus black, with intense silver-gray pruinescence. Mouth parts dark. Antennae black, with scapus, pedicellus, and base of first flagellar segment orange. Eyes purple. Scutum (fig. 3A) velvet black; sides and hind border silver-gray, anterolateral angles testaceous. Fore

<sup>1</sup> Microtrichia were erroneously reported to be present by Wygodzinsky (1953).

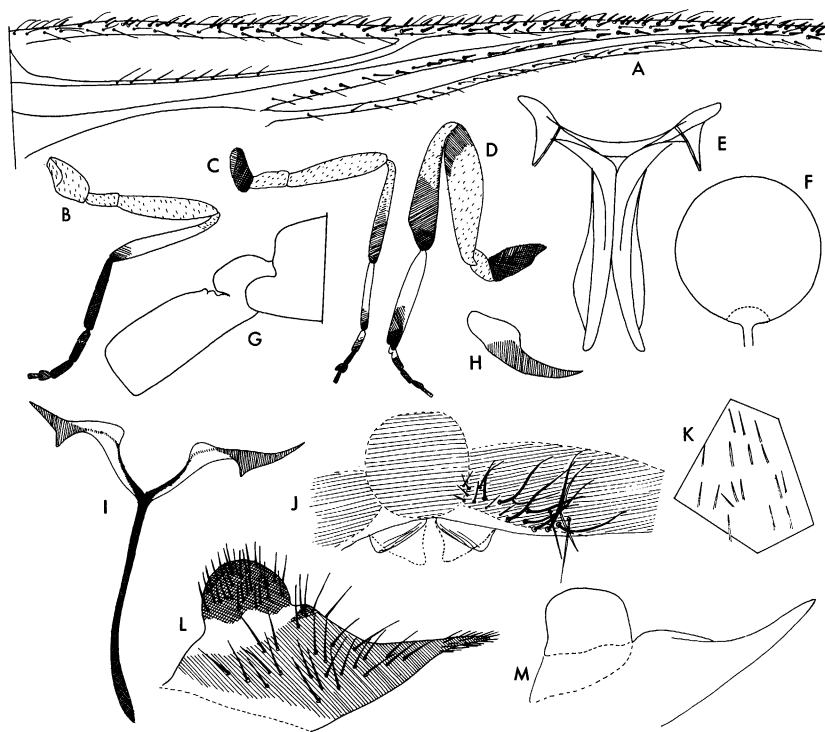


FIG. 2. *Simulium escomeli*, female. A. Detail of wing venation. B. Foreleg, with pattern. C. Midleg, with pattern. D. Hind leg, with pattern. E. Furcasternum. F. Spermatheca. G. Apex of basitarsus of hind leg, with second tarsal article. H. Claw. I. Genital fork. J. Portion of eighth sternite. Gonapophyses contracted; normal shape indicated by dotted line. K. Spicules of inner surface of spermatheca, high magnification. L. Cercus and paraproct, specimen from Surco, Peru. M. Scheme of cercus and paraproct, specimen from Sangolqui, Ecuador.

margin with 1 + 1 cuneiform silver-gray spots, approximately as wide as black space between them, about as long as one-third length of scutum. Scutellum light brown; metanotum black, with intense silvery pruinescence. Pleura brownish, sternal region of thorax blackish, all with silvery pruinescence. Setae of scutum and scutellum and pleural tuft brass colored. Wing vein light brown; setal tufts dark. Halteres as in female. General color of legs pale yellow, dark portions, as seen on slide preparations (fig. 3E-G), color from piceous to black. Fore tibia and light-colored areas of hind tibia and basitarsus with white sheen. Abdomen velvet black. Terga II, VI, and VII with 1 + 1 lateral silver-white

spots, those on II and VI very large, almost touching dorsally, those on VII smaller; VIII silver-white along lateral portions of hind margin.

Holoptic. Shape and proportions of antennal segments as shown in figure 3B. Maxillary palpi as shown in figure 3C; last segment about as long as two preceding combined. Sensory vesicle globular, diameter equal to half the width of third segment; structure of vesicle as shown in figure 2D, J, characterized by much smaller number of sensory tubercles as compared with female.

Chaetotaxy of thorax and wings as in female, but Sc lacking hairs. Shape of legs and proportions of segments as shown in figure 3E–G. Fore basitarsus approximately eight times as long as wide, hind basitarsus 5.0–5.3 times as long as wide. Calcipala as shown in figure 3H.

Parameres as shown in figure 3K, L, N. Basimere about as long as wide. Distimere approximately as long as basimere, stout sub-conical, about twice as long as wide, apical portion somewhat curved; basal process not developed. Apical spinule single. Ventral plate (fig. 3P) sub-triangular, membranous, its very short basal arms sclerotized. Ventral plate slightly swollen at center but lacking keel. Median sclerite (fig. 3M) slightly longer than wide, with short apical incision occupying about one-sixth of length of sclerite. Endoparameres as illustrated (fig. 3 O), with numerous medium-sized and a few large spines.

PUPA: Cocoon (fig. 4G, I) wall pocket-shaped, namely, anteroventral collar absent. Border of anterior opening straight across or faintly salient at middle; border slightly reinforced. Wall of cocoon light brown, translucent, very thin; threads perceptible but delicate. Length of cocoon along dorsal surface 2.2–3.0 mm., along ventral surface 3.0–3.5 mm. Length of pupa 2.4–2.7 mm., of respiratory organ 2.2–2.5 mm., namely, slightly shorter than body of pupa.

Respiratory organ (fig. 4A, C, E) composed of three primary branches divided into eight secondary filaments. Dorsal branch divided into three filaments; first division close to base of branch, second at variable distance from base. Median branch also divided into three filaments; first division generally situated at or above level of second division of dorsal branch, rarely below; second division of median branch situated at a considerable distance from first. Ventral branch divided into two filaments, division situated at or below level of first division of median branch. Filaments tapering slightly from base to rounded apex. Surface of primary branches and secondary filaments with numerous minute tubercles arranged in irregular transverse rows (fig. 4B).

Head and exposed portion of thorax with numerous, small subglobular platelets arranged in irregular fashion as shown in figure 5A. Head (fig.

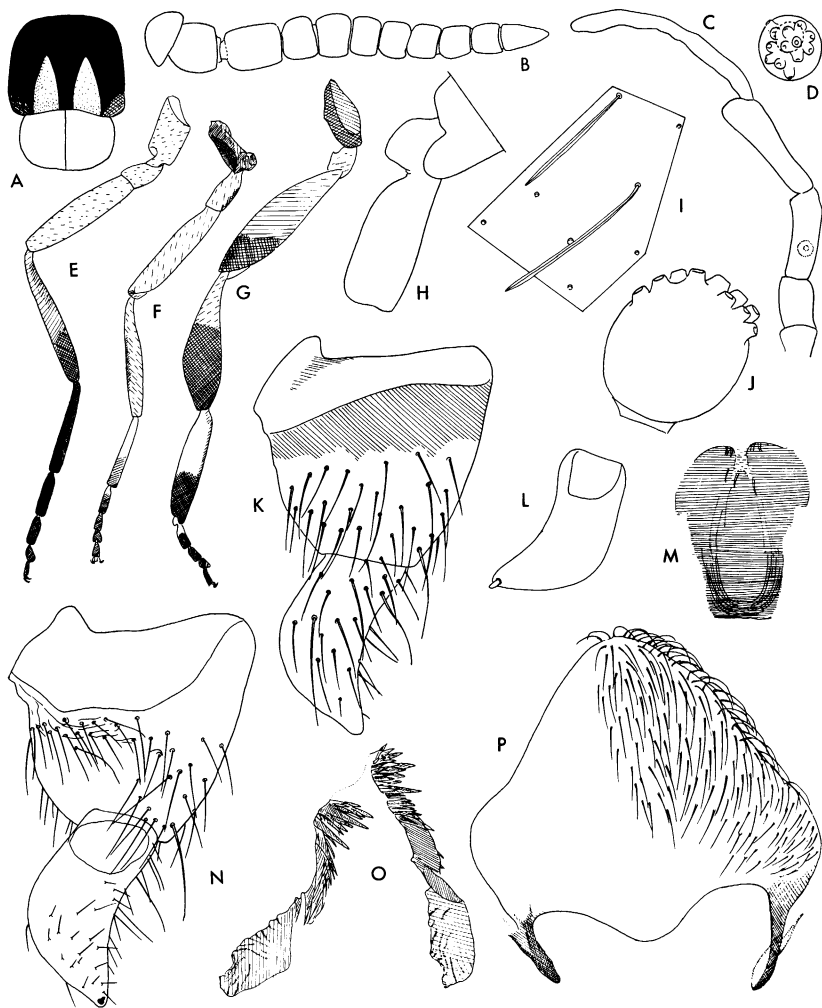


FIG. 3. *Simulium escomeli*, male. A. Head and thorax with pattern, anterodorsal view. B. Antenna, pattern not shown. C. Maxillary palp. D. Sensory vesicle of third segment of maxillary palp. E. Foreleg, with pattern. F. Midleg, with pattern. G. Hind leg, with pattern. H. Apex of basitarsus of hind leg, with second tarsal article. I. Setae of scutum. J. Sensory vesicle of maxillary palpus, view and magnification different from D. K. Paramere, specimen from Surco, Peru. L. Distimere, specimen from Sangolqui, Ecuador. M. Median sclerite. N. Paramere, dorsal aspect, specimen from Surco. O. Endoparameres, slightly twisted. P. Ventral plate.



FIG. 4. *Simulium escomeli*, pupa. A. Respiratory organ, upper side left. B. Surface structure of filament of respiratory organ. C. Same as A. D. Portion of thorax, with trichomes and base of respiratory organ. E. Same as A. F. Apex of filament of respiratory organ, surface structure not shown. G. Pupa with cocoon, dorsal view. H. Frontoclypeus, male pupa. I. Pupa and cocoon, side view.

5A) with 2+2 frontal and 1+1 facial trichomes, all hairlike, either simple or bifid. Exposed portion of thorax with 5+5 trichomes (fig. 4D), generally bifid (fig. 5D), rarely simple or trifid.

Abdomen as illustrated (fig. 5B). Tergite II with a few short hairs ar-

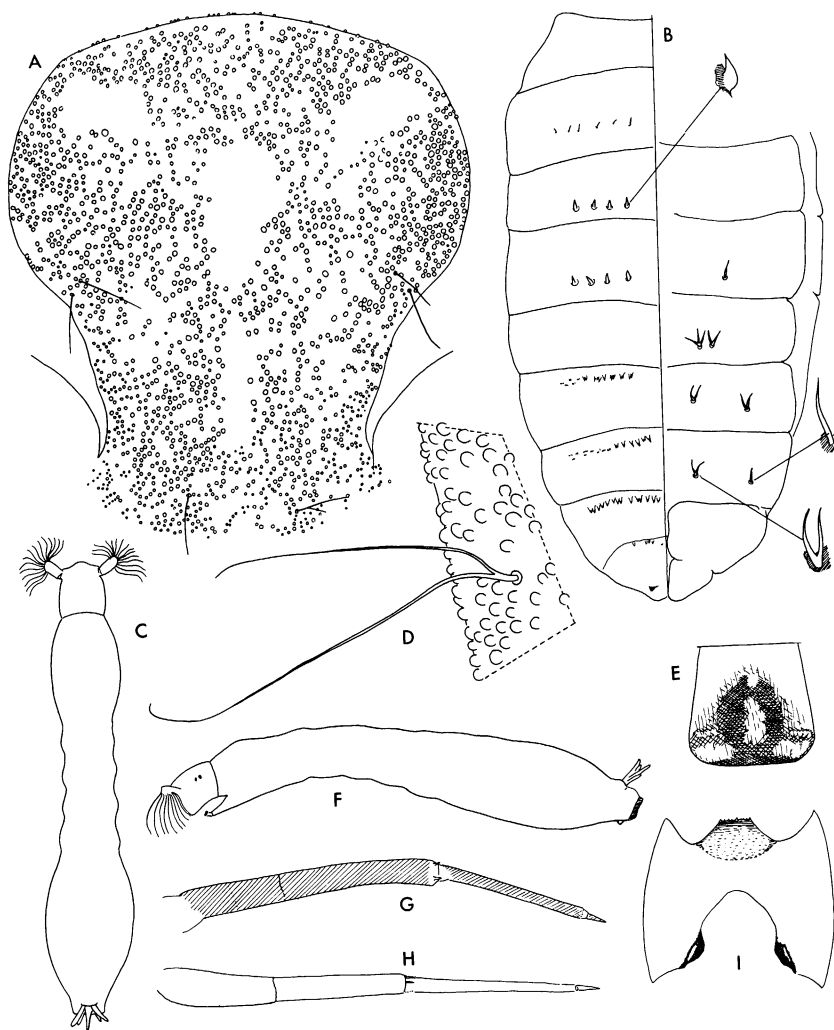


FIG. 5. *Simulium escomeli*. A. Female pupa, fronto-clypeus, with platelets and trichomes. B. Pupa, onchotaxy of abdomen, dorsal surface on left. C. Larva, dorsal view. D. Bifid trichome of head of pupa. E-I. Larva. E. Color pattern of cephalic apotome. F. General aspect, side view. G. Antenna with color pattern, specimen from Surco, Peru. H. Antennae, color pattern not shown, Sangolqui, Ecuador. I. Under surface of head.

ranged in transverse row. Tergites III and IV each with 4+4 simple hooks. Tergite V glabrous. Tergites VI-IX along anterior margin with

transverse row of denticles, medially interrupted on VI and VII, laterally connected with small area of minute, scalelike cuticular processes. Number of denticles on segment VI, 12–14; VII, 16–20; VIII, 26–31; IX, 12–14. Apex of abdomen with small, heavily sclerotized tubercle. Sternite IV with 1 + 1 slender, simple spinelike hooks. Sternites V–VII with 2 + 2 hooks, closely approximated on V, more distant on VI and VII. Hooks bifid or trifid, outer ones on VI and VII occasionally simple. Sternites VI–VIII each with 1 + 1 anteromedian patches of minute scalelike cuticular processes. Apex of abdomen lacking specialized setae.

**LARVA:** Length of mature larva 5.5–6.0 mm.; width of head capsule 0.6 mm. General body shape as shown in figure 5C, F. General body color whitish, with grayish green pigment of varied intensity over most of body. Body integument glabrous, except for perianal hairs.

Head of normal shape, stramineous, head pattern positive, as shown in figure 5E. Cephalic apotome widest shortly before hind margin. Antennae as shown in figure 5G, H, concolorous brown, as long as stem of mouth fan. Segments without secondary constrictions. Ratio of length of segments I–III = 1/1.2–1.3/1.1–1.6. Large fan of mouth brush with 33–38 rays; teeth of rays as illustrated (fig. 6A). Toothing of mandibles as shown in figure 6E, I. Two outer and one large apical tooth, all strongly sclerotized; three subapical teeth, conspicuously decreasing in size from first to third; two marginal teeth present, one distinctly larger than the other. Maxillary palp as illustrated (fig. 6L). Hypostomium (fig. 6B) with median and lateral teeth about equally prominent, intermediate teeth distinctly smaller. Sublateral teeth and lateral serrations well developed. Anterior border of hypostomium strongly pigmented. Hypostomial setae arranged in single rows, numbering four or five. Disc of hypostomium with a few short, simple setae. Gular cleft (fig. 5I) subtriangular, large, twice as deep as postgenal bridge. Cervical sclerites very small, isolated in neck membrane.

Body as shown in figure 5C, F, abdomen gradually widened toward behind, widest well before apex, not subtruncate posteriorly. Ventral papillae obsolescent, not observable in every specimen. Respiratory histoplast as shown in figure 6C. Lateral sclerites of pseudopod (fig. 6D) well developed, elongate subpentagonal; setae arranged on a row of elongate tubercles, three or four to each tubercle; over-all size of setae increasing from upper to lower border of sclerite. Anal sclerite as shown in figure 6J. Area between arms with simple sensory hairs (not shown in drawing). Posterior circllet with 63–70 rows composed each of 10–13 hooks. Anal gills consisting of three lobes, each with 0–3 irregular and generally short secondary lobules (fig. 6F–H, K).

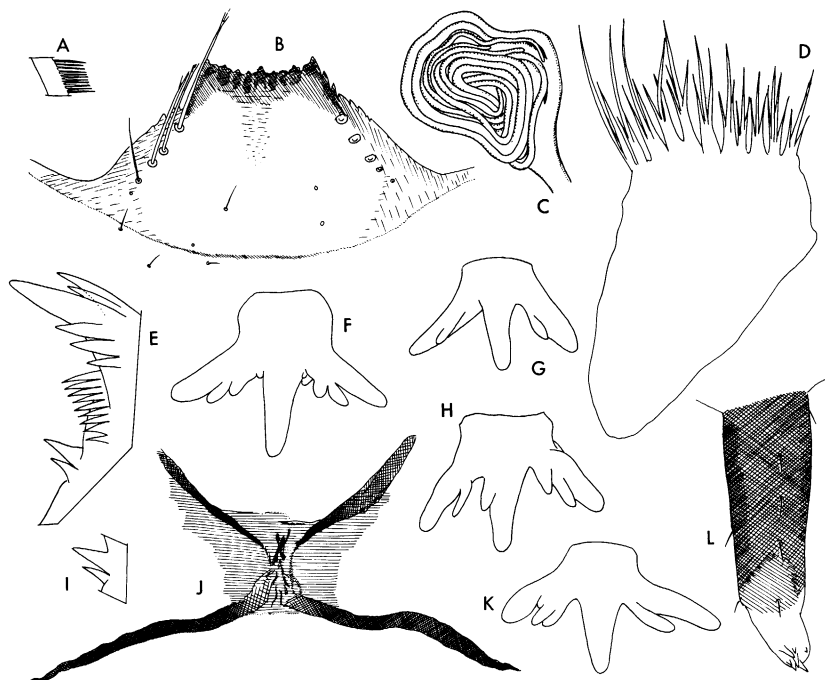


FIG. 6. *Simulium escomeli*, larva. A. Teeth of rays of mouth fan. B. Hypostomium. C. Respiratory histoblast. D. Lateral sclerite of pseudopod. E. Apex of mandible. F-H. Anal gills. I. Serrations of different mandible. J. Anal sclerite. K. Anal gill. L. Maxillary palp.

**MATERIAL EXAMINED:** *Chile:* Tarapaca: mouth of Lluta River, Oct. 1, 1966 (M. E. Irwin; C.I.S.), three females; Valle de Lluta, June, 1912 (C. E. Porter; U.S.N.M. and A.M.N.H.), nine females; Valle de Azapa, June, 1912 (C. E. Porter; U.S.N.M.), four females; Arica, Chinchorro, June, 1912 (C. E. Porter; U.S.N.M.), one female. *Peru:* Lima: Lima, March 28, 1943 (U.S.N.M.), nine females; Chan Chan, goatherd camp, June 7 (C. H. Townsend; U.S.N.M.); Santa Eulalia, April 28 (C. H. Townsend; U.S.N.M.), two females; Santa Clara, 1300 feet, April, 1914 (C. H. Townsend; U.S.N.M.), one female; Chosica, March 14 (C. H. Townsend; U.S.N.M.), one female; Rimac River near Chosica, 1200 meters, water temperature 21° C., on blades of grass and on rocks, August 17, 1965 (P. and B. Wygodzinsky; A.M.N.H.), numerous larvae and pupae, three females, three males, reared; Surco, 1900-2100 meters, human bait, Aug. 17, 1965 (P. and B. Wygodzinsky, F. Blancas;

A.M.N.H.), three females; Tapicara, 1800 meters, July 22, 1953 (A. Herrer; A.M.N.H.), one female, one male, reared. Ancash: Chimbote, March 21, 1943 (A.M.N.H.), two females. Ecuador: Azuay: 10 kilometers south of Cuenca, 2200 meters, March 13–14, 1965 (L. Peña; C.N.C.), one female; Cuenca, 2200 meters, March 10–20, 1965 (L. Peña; C.N.C.), one female; Tarqui-Santa Isabel road, 2200–2800 meters, March 10–13, 1965 (L. Peña; C.N.C.), two females. Chimborazo: Chilicay, July, 1955 (Levi Castillo; U.S.N.M.), two females. Cotopaxi: 10 kilometers north of Latacunga, 3100 meters, in small partially shaded stream in pasture, 9° C., on trailing grasses, July 26, 1969 (P. and B. Wygodzinsky, H. Pérez; A.M.N.H.), larvae, pupae, and two reared females. Pichincha: Amaguna, Valle de Chillos, 2650 meters, small, clear stream, on trailing leaves of grasses and trees, August 13, 1969 (P. and B. Wygodzinsky, H. Pérez; A.M.N.H.), several pupae, three reared females, and one male; Conocoto, Valle de Chillos, 2600 meters, in small roadside ditch with very clear water, on exposed plant roots, August 13, 1969 (P. and B. Wygodzinsky, H. Pérez), very numerous larvae and pupae, 13 reared females, eight reared males; 1 kilometer east of Sangolqui, Valle de Chillos, 2500 meters, in stream 5 meters wide with gravelly bottom, 15° C., on grasses trailing near shore, July 25, 1969 (P. and B. Wygodzinsky, H. Pérez) very numerous larvae and pupae, many reared adults; Guallabamba, 1650–1850 meters, June 6–7, 1965 (L. Peña; C.N.C.), seven females. Carchi: Bolivar, Rio Chota, 1800–2000 meters, June 10, 1965 (L. Peña; C.N.C.), four females; Los Duendes, 2000 meters, June 10, 1965 (L. Peña; C.N.C.), five females.

*Simulium metallicum* Bellardi

*Simulium metallicum* BELLARDI, 1859, p. 13.

*Simulium riveti* ROUBAUD, 1906, p. 108 (new synonym).

DISCUSSION: *Simulium metallicum* has been recorded from Mexico, Guatemala, Costa Rica, Panama, Trinidad, Venezuela, and Colombia, and is now also reported from Ecuador. The species is common in the northern Andean countries; its bibliography is very extensive.

*Simulium riveti* Roubaud was described from Ecuador. Wygodzinsky (1953) redescribed the female from Ecuadorian specimens. Material of larvae, pupae, and adults of both sexes recently collected in Ecuador, as well as in Colombia and Venezuela shows that *riveti* fully agrees with *metallicum*; hence the above synonymy. A correct identification of this species is especially important because of its epidemiological role. Lewis and Ibañez de Aldecoa (1962) considered *Simulium metallicum* to be the main or only vector of human onchocerciasis in northern Venezuela.

This disease has lately been reported from Colombia (Assís and Little, 1965), and León and Wygodzinsky (1953) implied that it might also occur in Ecuador.

**MATERIAL EXAMINED:** *Ecuador:* Azuay: Rio León, near Ona, 2200 meters, March 21–22, 1965 (L. Peña; C.N.C.), two females. Pichincha: Amaguana, Valle de Chillos, 2650 meters, on grass and tree leaves trailing in small stream under bushes, August 13, 1969 (P. and B. Wygodzinsky; A.M.N.H.), larvae, pupae, three reared females; 1 kilometer east of Sangolqui, Valle de Chillos, 2500 meters, human bait, July 25, 1969 (P. and B. Wygodzinsky; A.M.N.H.), one female; Guailabamba, 1650–1850 meters, June 6–7, 1965 (L. Peña; A.M.N.H.; C.N.C.), three females. Carchi: Bolivar, Rio Chota, 2000 meters, June 10, 1965 (L. Peña; C.N.C.), one female. Province not known: Santa Isabella, July 2, 1953 (H. R. Yusti; U.S.N.M.), one female. *Colombia:* Valle: Valley of Rio Pance, 1250–1400 meters, small streams and irrigation ditches, 20° C., on grasses trailing in water, August 22, 1967 (P. and B. Wygodzinsky, P. Barreto; A.M.N.H.), numerous larvae, pupae, and reared males and females; Saladito-Dagua road, west slope of mountain range, 1600 meters, small clear stream in pasture with much organic detritus, on grasses and on rocks, August 26, 1967 (P. and B. Wygodzinsky; A.M.N.H.), pupae and one reared female; El Queremal, 1450 meters, in irrigation ditches, 21° C., August 19, 1967 (P. and B. Wygodzinsky; A.M.N.H.), larvae, pupae, numerous reared males and females; 10 kilometers west of Delfina, small stream falling over rock wall, on surface of rocks, 400 meters, August 26, 1967 (P. and B. Wygodzinsky; A.M.N.H.), several pupae; Pichindé, 1700 meters, on grass blades in small stream, August 28, 1967 (P. and B. Wygodzinsky; A.M.N.H.), several pupae. Cundinamarca: 3 kilometers south of Chipaque, 2400 meters, small stream in pasture, 16° C., on either surface of grass blades and other vegetation, July 30, 1967 (P. and B. Wygodzinsky; A.M.N.H.), larvae, pupae, and numerous reared males and females; Finca San Pablo, 3 kilometers north of Alban, 1800 meters, small partially shaded stream, 18° C., on blades of grass and between fallen leaves, August 1–12, 1967 (P. and B. Wygodzinsky; A.M.N.H.), larvae, pupae, and several reared males and females; stream 2 kilometers southeast of Alban, 2400 meters, 13°–16° C., on blades of grass, on leaves of watercress, and on and under rocks (P. and B. Wygodzinsky, E. Schmidt-Mumm; A.M.N.H.) numerous larvae, pupae, and reared males and females; 5 kilometers west of Caqueza, on road from Choachi to Villavicencio highway, 2100 meters, in water trickling down pasture, 25° C. (P. and B. Wygodzinsky; A.M.N.H.), numerous larvae, pupae, and

reared males and females, also females biting humans. *Venezuela*: Mérida: 5 kilometers southwest of Mérida, 1900 meters, small streams in river valley, on vegetation, February 15, 1968 (P. and B. Wygodzinsky, M. Cormons; A.M.N.H.), numerous pupae and reared males and females; 3 kilometers southwest of Mucuruba, 2350 meters, small streams in pasture, slightly shaded, 15°–17° C., on grasses and on underside of leaves of watercress, February 9–26, 1968 (P. and B. Wygodzinsky, M. Cormons; A.M.N.H.), numerous pupae and reared males and females.

*Simulium ignescens* Roubaud

Figures 7A, B, E–H, J, K, M, N, P; 8B, C, E, G.

*Simulium ignescens* ROUBAUD, 1906, p. 107. VARGAS, 1945, p. 147. SMART, 1945, p. 506. WYGODZINSKY, 1951, p. 223 (part). LEÓN AND WYGODZINSKY, 1953, p. 31. WYGODZINSKY, 1958, p. 134. VULCANO, 1967, p. 13.

*Eusimulium ignescens*: SURCOUF AND GONZÁLEZ RINGONES, 1911, p. 281. Pinto, 1932, p. 732.

DISCUSSION: This species was described from the Napo Province of Ecuador, based upon two females. No additional data on the species became available until Wygodzinsky (1951) gave a detailed redescription of what he considered *ignescens*. He saw larvae, pupae, and adults of both sexes from northwestern Argentina, and females from Ecuador and Bolivia. Among the Bolivian specimens then examined was an individual of *Chirostilbia rubiginosa* Enderlein which Wygodzinsky (*loc. cit.*) designated lectoholotype; at the same time, *Chirostilbia rubiginosa* was synonymized with *Simulium ignescens* with which it agreed well. Later, Wygodzinsky (1953, 1958) reported additional specimens of *ignescens* from Bolivia and Peru, and Coscarón and Wygodzinsky (1960) mentioned *ignescens* from the Argentinian province of Buenos Aires.

Recently I collected larvae and pupae and reared adults of *Simulium ignescens* in Ecuador and Colombia; I also re-examined material from Peru. I found that although Ecuadorian, Colombian, and Peruvian adults are extremely close to those from Argentina, the larvae and pupae are so different from the Argentinian specimens as to make it obvious that they are not conspecific. I therefore propose to resurrect Enderlein's name and apply it to the Bolivian and Argentinian forms, and reserve *ignescens* for the northern species.

I have been unable to find reliable external differences between females of *ignescens* and *rubiginosum*, and Wygodzinsky's (1951) redescription of *rubiginosum* (as *ignescens*) continues to apply to *ignescens*. The only character separating the females of the two species seems to be the relative

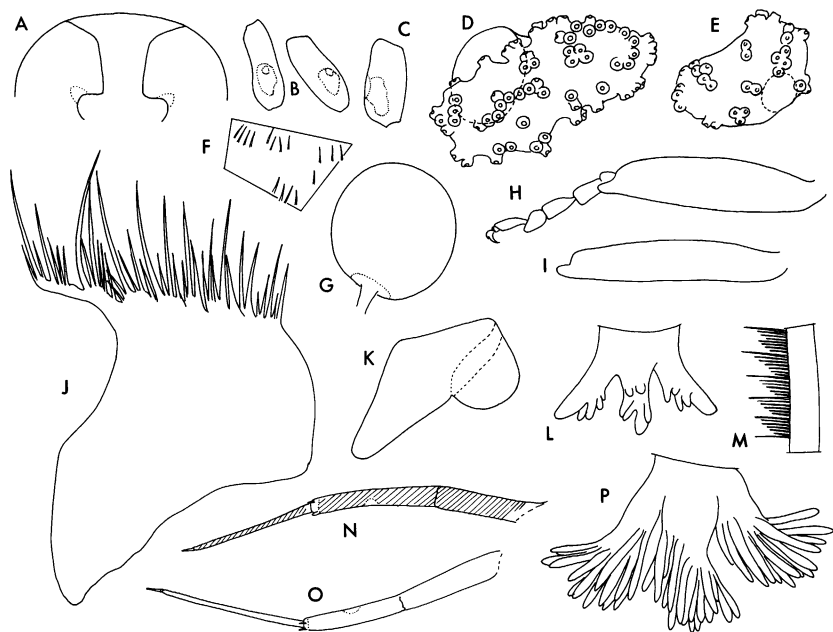


FIG. 7. A, B. *Simulium ignescens*, female. A. Frons. B. Third segments of maxillary palp, with outlines of sensory vesicle. C, D. *S. rubiginosum*, female. C. Third segment of maxillary palp, with outline of sensory vesicle. D. Sensory vesicle, enlarged. E-H. *S. ignescens*. E. Sensory vesicle of maxillary palp of female; magnification as in D. F. Spicules of inner surface of spermatheca. G. Spermatheca. H. Posterior tarsus of male. I. *S. rubiginosum*, male, hind basitarsus. J, K. *S. ignescens*. J. Lateral sclerite of pseudopod of larva. K. Cercus and paraproct of female. L. *S. ignescens*, anal gill of larva. M, N. *S. ignescens*, larva. M. Teeth of rays of mouth fan. N. Antenna, with pattern. O. *S. rubiginosum*, antenna of larva, pattern not shown. P. *S. ignescens*, anal gill of larva. All specimens of *ignescens* illustrated are from the Aloag-Santo Domingo road, Ecuador; those of *rubiginosum* from Tucumán, Argentina.

size of the sensory organ of the maxillary palp, which is much less than half the length of the third segment of the palp in *ignescens* (fig. 7B, E), but almost half as long as the segment in *rubiginosum* (fig. 7C, D). There are also more sensory tubercles in the latter species. The frons of the female of *ignescens* is illustrated here for the first time (fig. 7A); it is of the same shape as that in *rubiginosum*. The spermatheca of *ignescens* (fig. 7G) and of *rubiginosum* is globular, and the spicules of its inner surface are subequal in size and arranged in short, irregular transversal rows (fig. 7F). The duct is inserted in a circular, membranous area.

Males of *ignescens* and *rubiginosum* cannot be distinguished except by

the posterior basitarsus which is slightly but distinctly widened in *ignescens* (fig. 7H), and parallel-sided in *rubiginosum* (fig. 7I).

The pupae of *ignescens* have respiratory organs with 10 filaments, arranged in five groups of two filaments each (fig. 8B, C). The head has 2+2 frontal and 1+1 facial trichomes, which are branched and very large as compared with the size of the frons. There are 1+1 groups of closely spaced minute platelets laterally at the base of the frons (fig. 8E), but the rest of its surface lacks platelets. The pupae of *rubiginosum* have respiratory organs with only eight filaments, arranged in two groups of three, and one of two, filaments (fig. 8A, D). The trichomes of the head are as in *ignescens*. The groups of closely spaced platelets are as in *ignescens*, but there are larger platelets scattered over the whole surface of the frons (fig. 8F). When Wygodzinsky redescribed *rubiginosum* (as *ignescens*) he did not figure the trichomes of the thorax; they are here illustrated for *ignescens* (fig. 8E, G), and are indistinguishable from those of *rubiginosum*.

The larvae of *ignescens* and *rubiginosum* are quite similar, but they can be distinguished by the antennae and the anal gills. In *ignescens* the third segment of the antennae is about as long as either the first or the second (fig. 7N); in *rubiginosum* the third antennal segment is longer than either the first or the second (fig. 7O). In *ignescens* each of the primary lobes of the anal gills bears 15–20 long and slender secondary lobules (fig. 7P); in *rubiginosum* each of the primary lobes bears only four to five very short secondary lobules (fig. 7L). The lateral sclerite of the proleg of the larva of *ignescens* (fig. 7J), and the teeth of the rays of its mouth fan are illustrated here (fig. 7M); they do not differ from those of *rubiginosum*.

The material here listed as *ignescens* is not completely uniform. Populations may differ from each other by wing length, the degree of darkening of the metanotum of the female, and the number of setae on the base of R and R<sub>1</sub>, arranged in some cases in a single row, and in others in one or two irregular rows, or even clearly in several rows. Pupae may differ in color and size of the cocoon, the degree of prominence of the median projection of the upper border of its anterior opening, and the thickness and length of the respiratory organs. These differences are meristic rather than qualitative in character, and if accepted as of taxonomic significance would necessitate the creation of a large number of taxonomic units distinguishable only on a statistical basis.

I have found one variable character in the *ignescens* complex possibly more significant. All Colombian specimens examined, the Ecuadorian specimens from the Pujili-Santo Domingo road (namely, the east slope of the Andean chain) and the Peruvian specimen now seen, have the

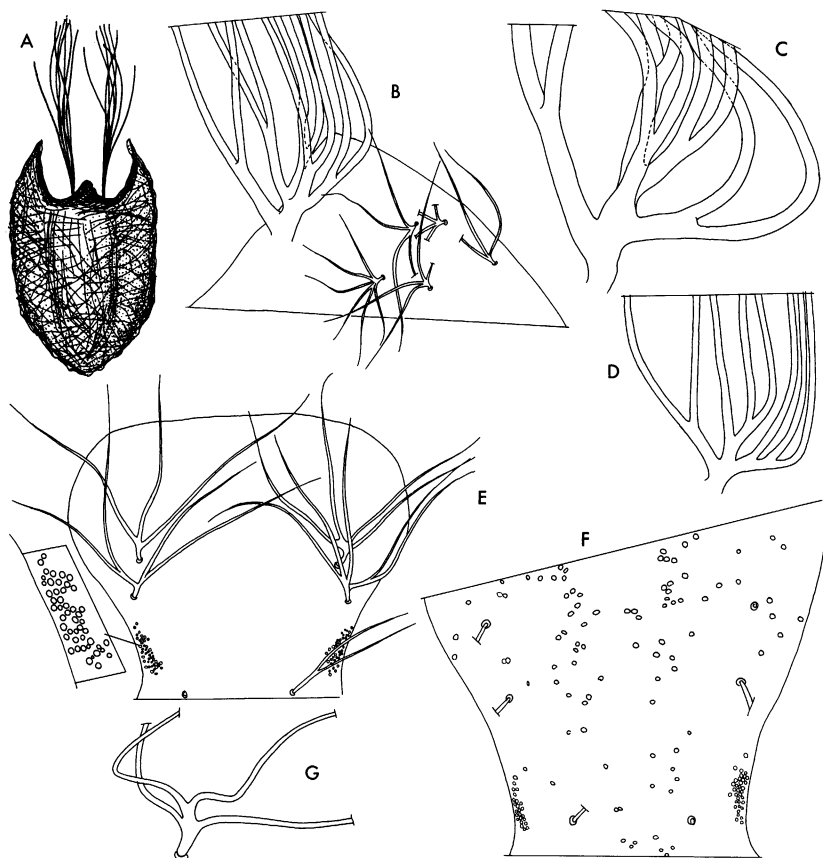


FIG. 8. A. *Simulium rubiginosum*, pupa with cocoon, dorsal view. B, C. *S. ignescens*, pupa. B. Portion of thorax, with base of respiratory organ and with trichomes. C. Base of respiratory organ, different specimen, upper branch at right. D. *S. rubiginosum*, base of respiratory organ, upper branch at right. E. *S. ignescens*, pupa, frontoclypeus with platelets and trichomes. F. *S. rubiginosum*, portion of frontoclypeus with bases or insertions of trichomes, and platelets. G. *S. ignescens*, portion of trichome of head, enlarged. Origin of specimens as in figure 7.

abdominal segments I–III yellow in both sexes. Most specimens obtained in the high inter-Andean valley of Ecuador (Province of Cotopaxi and Valle de Chillos) have abdominal segments I–IV yellow in both sexes, although occasional specimens showed segment IV so darkened as to make an exact classification impossible. The abdominal color scheme found in the highland specimens agrees with that of *rubiginosum*, but

morphologically the Ecuadorian highland specimens agree fully with the remaining Ecuadorian and Colombian specimens of *ignescens*.

**BIOLOGY:** All the aquatic instars I collected were generally found in clear, fast-flowing, but not torrential, mountain streams, attached to vegetation or the surface of rocks. They were associated with other species of *Simulium* and with certain *Gigantodax*.

This species has been reported to attack man (León and Wygodzinsky, 1953), but I have not observed it in this capacity. Ecuadorian and Colombian females reared from pupae showed upon dissection the presence of a considerable number of fully formed eggs; this suggests autogeny at least for the first ovarian cycle.

**MATERIAL EXAMINED:** *Peru:* Puente Santa Ursula, 1800 meters, January 21, 1953 (A. Herrero; A.M.N.H.), one reared female with pupa. *Ecuador:* Cotopaxi: Rio Sutuchi (L. A. León; A.M.N.H.), two females; 10 kilometers south of Latacunga, 3100 meters, partly shaded stream in pasture, 9° C., on trailing grasses, July 26, 1969 (P. and B. Wygodzinsky, H. Pérez; A.M.N.H.), larvae, pupae, three females and 9 males, reared. Pichincha: Amaguana, Valle de Chillos, 2650 meters, small clear stream, 9° C., trailing grasses, August 13, 1969 (P. and B. Wygodzinsky, H. Pérez; A.M.N.H.), several pupae and numerous reared males and females; Conocoto, Valle de Chillos, 2600 meters, in small roadside ditch with very clear water, on exposed plant roots, August 13, 1969 (P. and B. Wygodzinsky, H. Pérez; A.M.N.H.) one reared male with pupa; Aloag-Santo Domingo de los Colorados road, 2250 meters, shallow, 4-meter wide stream with gravelly bottom, on leaves of large bamboo branch, August 7, 1969 (P. and B. Wygodzinsky, J. Pérez; A.M.N.H.), very numerous larvae and pupae and numerous reared males and females; Aloag-Santo Domingo road, Tatatambo, 2500 meters, small stream in meadow, on vegetation, August 7, 1969 (P. and B. Wygodzinsky, H. Pérez; A.M.N.H.), larvae, pupae, one female and one male, reared; Aloag-Santo Domingo road, 2650 meters, in small, heavily shaded stream below small cascade, much organic material deposited on bottom and vegetation, August 19, 1969 (P. and B. Wygodzinsky, H. Pérez; A.M.N.H.), a few larvae and pupae, six females and five males reared. *Colombia:* Cauca: near Puracé, 2300 meters, small stream in open pasture, 15° C., on grasses and exposed roots in places of very fast flow, August 17, 1967 (P. and B. Wygodzinsky; A.M.N.H.), very large number of larvae and pupae, five females and one male, reared; Rio Piéndamo, east of Silvia, near Indian cooperative, 2800 meters, large stream with boulders, 19° C., on grasses trailing in stream near shore, August 24, 1967 (P. and B. Wygodzinsky; A.M.N.H.), several pupae, four females, one

male, reared. Valle: 2 kilometers west of Felidia, 1700 meters, stream 3 meters wide, in small rapids on dead leaves, August 28, 1967 (P. and B. Wygodzinsky; A.M.N.H.), numerous pupae, one male and one female, reared. Cundinamarca: near Tequendama Falls, small stream near highway, 2150 meters, on grasses, July 20, 1967 (P. and B. Wygodzinsky; A.M.N.H.), numerous larvae and pupae, two females, one male, reared; Finca San Pablo, 3 kilometers north of Alban, 1800 meters, small partly shaded stream, August 1-12, 1967 (P. and B. Wygodzinsky; A.M.N.H.), two females, one male, reared; 2 kilometers southeast of Alban, small stream in pasture, 2400 meters, on vegetation and undersurface of rocks, August 6, 1967, and August 24, 1969 (P. and B. Wygodzinsky, E. Schmidt-Mumm; A.M.N.H.), numerous pupae and reared females and males; 1 kilometer west of Guasca, river approximately 5 meters wide, 2650 meters, on grasses near shore, July 20, 1967 (P. and B. Wygodzinsky, E. Schmidt-Mumm; A.M.N.H.), several pupae, two females, four males, reared. Boyacá: Arcabuco-Villa de Leiva road, small partly shaded stream crossing road, 13° C., 2600 meters (P. and B. Wygodzinsky, E. Schmidt-Mumm; A.M.N.H.), one pupa.

*Simulium rubiginosum* (Enderlein)

Figures 7C, D, I, L, O; 8A, D, F

*Chirostilbia rubiginosa* ENDERLEIN, 1934, p. 287. SMART, 1945, p. 512. VARGAS, 1945, p. 191.

*Simulium ignescens* auct.: WYGODZINSKY, 1951, p. 233 (part); 1953, p. 325. COSCARÓN AND WYGODZINSKY, 1960, p. 1124.

DISCUSSION: As explained above for *ignescens*, I have found it necessary to resurrect Enderlein's name for the Bolivian and Argentinian specimens of this complex. Wygodzinsky's (1951) redescription and figures of *ignescens* refer to Argentinian specimens of *rubiginosum*.

The species is now known from Bolivia, northwestern Argentina, and the south of the province of Buenos Aires.

The above is intended to be the complete list of references for this species.

BIOLOGY: This species has been found to attack mules. Reared females that were dissected during the course of the present work contained numerous mature eggs; the species may be autogenous for the first gonotrophic cycle.

*Simulium bicoloratum* Malloch

Figures 9-14

*Simulium bicoloratum* MALLOCH, 1913, p. 649. KNAB, 1914b, p. 81. PINTO, 1932, p.

744. IRIARTE, 1943, p. 191; 1946, p. 412. ORTIZ, 1944, p. 245. VARGAS, 1945, p. 119. SMART, 1945, p. 501. VARGAS AND DÍAZ, 1951, p. 131; 1953, p. 140. WYGODZINSKY, 1953, p. 327. BRICEÑO IRAGORRY AND ORTIZ, 1957, p. 49; WYGODZINSKY, 1958, p. 133. STONE, 1963, p. 6. VULCANO, 1967, p. 7.  
*Odagmia bicolorata*: ENDERLEIN, 1925, p. 208; 1930, p. 97.  
*Ectemnaspis macca* ENDERLEIN, 1934, p. 281; 1936, p. 122.  
*Simulium molli* VARGAS, 1943, p. 142; 1945, p. 165. SMART, 1945, p. 509.  
*Simulium gaudeatum* KNAB, 1914a, p. 81; 1914b, p. 123. PINTO, 1932, p. 744.  
VARGAS, 1945, p. 140. SMART, 1945, p. 505. VULCANO, 1967, p. 12 (new synonym).

DESCRIPTION: FEMALE: Wing length 2.8–3.2 mm.

Color of head black, frons and clypeus silver-gray. Mouth parts brown. Maxillary palpi and antennae black (fig. 9C). Scutum yellow, with extensive areas darkened as shown in figure 9I, J; dark areas most frequently velvet black (fig. 9J), but median portion of pattern in some specimens entirely or partially dark orange (fig. 9I). Light-colored space at center of posterior third of scutum about as long as posterior dark area. Scutellum yellow; metanotum velvet black, anteriorly at center with 1 + 1 more or less confluent spots of silver pruinescence. Pilosity of scutum golden yellow, posterior erect hairs black, similar to those of scutellum. Paratergite black. Anepisternum and katepisternum black, remaining pleural region brownish, all with delicate silver pruinescence. Pronotal and mesepimeral tufts golden yellow. Wings with C dark brown, remaining veins yellowish; all wing setae black. Base of halteres black, stem brownish, capitulum pale yellow. Legs black; fore coxae, basal third or fourth of all femora, and about basal half of all tibiae, yellow; exact color pattern as seen in slide preparations illustrated in figure 9N, P, Q. Light-colored portion of tibiae with brilliant white sheen. Setae of legs short, yellowish or black; scales absent. Abdomen (fig. 9I) with segments I and II golden yellow, fringe of first segment golden yellow or black. Dorsum of segments III–V velvet black. Dorsum of segment VI from entirely yellow to partly or entirely dark brown or black; VII–IX from brown to black. Terga I–V dull, VI–IX polished. Under surface of abdomen yellowish, center of sterna with small dark spot; genital region black.

Frons wide (fig. 9B), conspicuously bituberculate at lower border. Clypeus as illustrated (fig. 9A). Fronto-ocular triangle about as high as wide (fig. 9K). Antennae as shown in figure 9C. Cibarium (fig. 9M) with large heavily pigmented cornuae; space between cornuae simple, without spines or denticles. Mandibles (fig. 9D) and maxillae serrated on both edges. Mandibles with 38–46, maxillae with 25–27, teeth. Maxillary palp as shown in figure 9G, last segment about as long as two preceding combined. Third segment not conspicuously widened; sensory vesicle half as

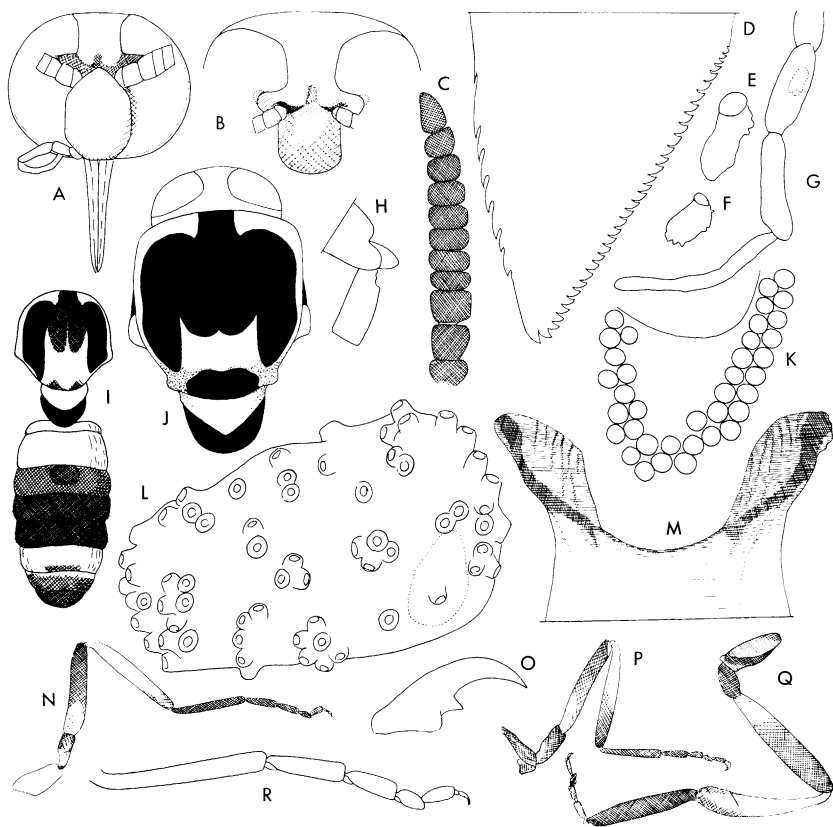


FIG. 9. *Simulium bicoloratum*, A-E. Female. A. Head, frontal view. B. *Idem*, antero-dorsal view. C. Antenna. D. Apex of mandible. E. Sensory vesicle of third segment of maxillary palp. F. Male, sensory vesicle of maxillary palp, same magnification as E. G-R. Female. G. Maxillary palp. H. Apex of posterior basitarsus, with second tarsal article. I. Color pattern of thorax and abdomen, light-colored specimen. J. Color pattern of thorax, normal dark-colored specimen. K. Fronto-ocular triangle. L. Sensory vesicle of maxillary palpus. M. Posterior border of cibarium. N. Foreleg, with pattern. O. Claw. P. Midleg, with pattern. Q. Hind leg, with pattern. R. Fore tarsus, magnified. All illustrations are made from Colombian specimens (Sibaté-Aguadita road), except figure 1 which is from a Bolivian insect (Chapare, Cochabamba).

wide as diameter of segment, suboval; detailed structure shown in figure 9L.

Setae of scutum as those illustrated for male (fig. 10H, I), namely

minutely feathered apically. Setae scattered, not forming groups or lines. Pleural membrane and katepisternum glabrous. Furcasternum as in male (fig. 10J).

Wing venation as usual for *Simulium*. Sc with 25–30 setae. Basal section of R with setae arranged in two or more irregular rows. R<sub>1</sub> with hairs and spiniform setae arranged in several rows. R<sub>s</sub> with single row of setae on under surface; no setae on upper surface.

Shape of legs and proportion of segments as shown in figure 9N, P, Q. Fore basitarsus about 8.5 times as long as wide. Calcipala (fig. 9H) well developed, attaining pedisulcus. Claws (fig. 9 O) not strongly curved, subbasally with medium-sized, pointed projection.

Abdomen without scales, setae scattered and short, except those of basal fringe. Tergal plates well developed. Seventh sternum not specialized. Eighth sternite as illustrated (fig. 11A), with 1 + 1 groups of large and small setae. Gonapophyses small, subtriangular, glabrous, setae and microtrichia absent; rather conspicuously sclerotized on medial half. Cerci and paraprocts as shown in figure 11B. Cerci low, more heavily pigmented than paraprocts, the latter elongate, subconical, narrowly rounded apically. Genital fork as shown in figure 11C, D, J. Stem slender, heavily pigmented, distal knob lighter in color. Spermatheca (fig. 11E) globular, heavily sclerotized, surface not sculptured; spicules of inner surface present (fig. 11F), distinctly of two different sizes, arranged in indistinctly transverse series. Spermathecal duct inserted in small, circular membranous area.

MALE: Wing length 2.8–3.2 mm.

Color of head, mouth parts, palpi, and antennae black; frons and clypeus silvery pollinose. Color of scutum (fig. 10F) much as in female, but light-colored area of center of posterior portion shorter than in female, not as long as posterior black area. Scutellum yellow, darkened at sides and in many cases narrowly along base. Metanotum as in female. Pleura and sternal region of thorax piceous, with faint silvery pruinescence. Paratergite black. Color of thoracic setae, wings, and halteres as in female. Coloring of legs either as in female (see fig. 9N, P, Q) but with fore coxa black, or mostly black (fig. 10D, M, N), with tibiae of forelegs and midlegs partly yellow, yellow areas with brilliant white sheen. Setae of legs black. Abdomen velvet black dorsally, grayish below, genital region black. Tergite VI with 1 + 1 large silvery spots laterally.

Holoptic. Shape and proportions of antennal segments as shown in figure 10C. Maxillary palpi as shown in figure 10E; last segment as long as two preceding combined. Sensory vesicle (figs. 9F; 10E) suboval, its diameter less than half the width of third segment; structure of vesicle



FIG. 10. *Simulium bicoloratum*, male. A. Portion of wing. B. Sensory vesicle of maxillary palp. C. Antenna; color not shown. D. Foreleg, with pattern. E. Maxillary palp. F. Color scheme of thorax, dorsally. G. Apex of hind basitarsus, with second tarsal article. H. Apical portion of setae of scutum, high magnification. I. Portion of scutum, with setae. J. Furcasternum. K. Apex of hind basitarsus, with second tarsal article. L. Hind tibia and basitarsus. M. Midleg, with pattern. N. Hind leg, with pattern. All illustrations were made from Colombian specimens (Sibaté-Aguadita road), except A and K which were made from Peruvian material (Patihuayco).

as shown in figure 10B; sensory tubercles less numerous than in female.

Chaetotaxy of thorax and wings as in female, but Sc with only 3 or 4 setae in some specimens (fig. 10A), and setae on basal section of R arranged in single row. Shape of legs and proportion of segments as shown in figure 10D, M, N. Fore basitarsus about 10 times as long as wide, hind basitarsus (fig. 10L) four times as long as wide. Calcipala as illustrated (fig. 10K). Furcasternum as illustrated (fig. 10J).

Parameres as shown in figure 11H, K. Basimere slightly longer than wide. Distimere slightly shorter than basimere, elongate subconical, slightly more than twice as long as wide, apical portion slightly slanted. Basal projection absent. Apical spinule single. Ventral plate (fig. 11,

subtriangular, strongly constricted at sides, producing abruptly narrowed apical portion; basal arms very short, strongly sclerotized. Setae of ventral plate comparatively short; median keel absent. Median sclerite (fig. 11G) slightly longer than wide, base narrow, apical portion conspicuously widened, slightly incised at middle. Endoparameres (fig. 11I) with large plate and numerous small and large spines.

**PUPA:** Cocoon (fig. 12A–D) wall pocket-shaped, namely, anteroventral collar absent. Anterior opening simply rounded, slightly inclined in side view, upper margin not salient at middle. Cocoon very thick, threads visible only under high magnification, held together by amorphous, very brittle substance. Cocoon strikingly light colored, almost white when observed *in situ*, completely opaque when observed in alcohol. Anterior margin of cocoon conspicuously thickened, dorsal surface of cocoon with two or three thick longitudinal ridges along whole length of body of cocoon. Length of cocoon along dorsal surface 2.7–3.0 mm., along ventral surface 3.5–4.0 mm. Length of body of pupa 2.9–3.5 mm., of respiratory organ 2.0 mm., namely distinctly shorter than length of pupa proper.

Respiratory organ (figs. 12A, B, E, G; 13A, B) with basal half lying in vertical, and apical half in horizontal, plane; composed of three, short primary branches divided into eight secondary filaments. Dorsal branch almost perpendicular to main longitudinal axis of respiratory organ, divided into three filaments; first division very close to base of branch, second at short distance from first; filaments bending to follow general direction of other filaments. Median branch similar to dorsal one. Ventral branch divided into two filaments, division close to base of branch. All filaments tapering considerably from base to rounded apex. Surface of branches and filaments with minute tubercles of two sizes, arranged in intricate pattern giving surface crinkled appearance (fig. 13E, F, H).

Head and exposed portion of thorax with numerous platelets arranged in irregular fashion as shown in figure 13G. Platelets of head of male more numerous than those of female. Larger tubercles with numerous small protuberances (fig. 13D). Head with 3+3 frontal, 1+1 facial, and 1+1 ocular trichomes. Trichomes (fig. 12F) large, heavily sclerotized, almost black, with 30–40 branches. Exposed portion of thorax with 5+5 trichomes similar to those of head (fig. 13C).

Abdomen with onchotaxy as in *Simulium escomeli* (see fig. 5B).

**LARVA:** Length of mature larva 6.5–7.0 mm., width of head capsule 0.65 mm. General body shape as shown in figure 14A, B. General body color whitish, with grayish green pigment dorsally, some anteriorly but concentrated on posterior half of body. Body integument glabrous, except for perianal hairs.

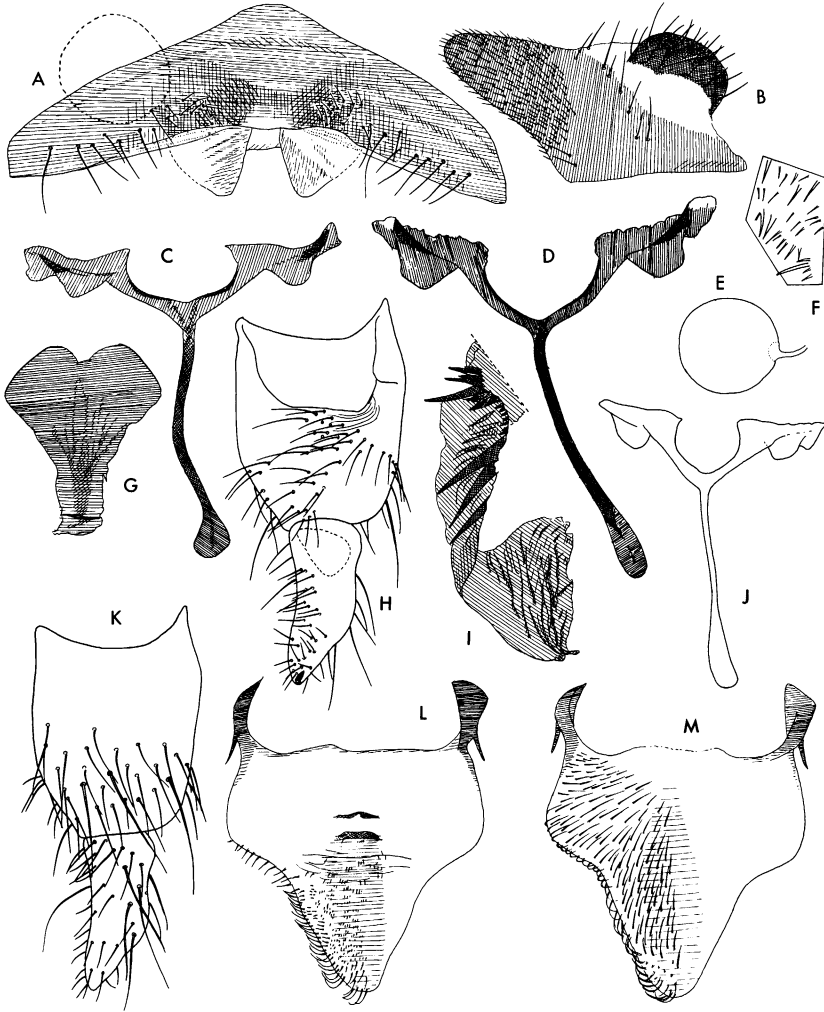


FIG. 11. *Simulium bicoloratum*. A-F. Female. A. Eighth sternite with gonapophyses, and outlines (stippled) of spermatheca drawn to scale. B. Cercus and paraproct. C, D. Genital forks. E. Spermatheca. F. Spicules of inner surface of spermatheca. G-I. Male. G. Median sclerite. H. Paramere, upper surface. I. Endoparamere. J. Female, genital fork. K-M. Male. K. Paramere, under surface. L. Ventral plate. M. Ventral plate, other surface. Most illustrations were made from Colombian specimens (Sibaté-Aguadita road); D is from a specimen from Bolivia (Chapare, Cochabamba) and J from a female from Ecuador (Aloag-Santo Domingo road).

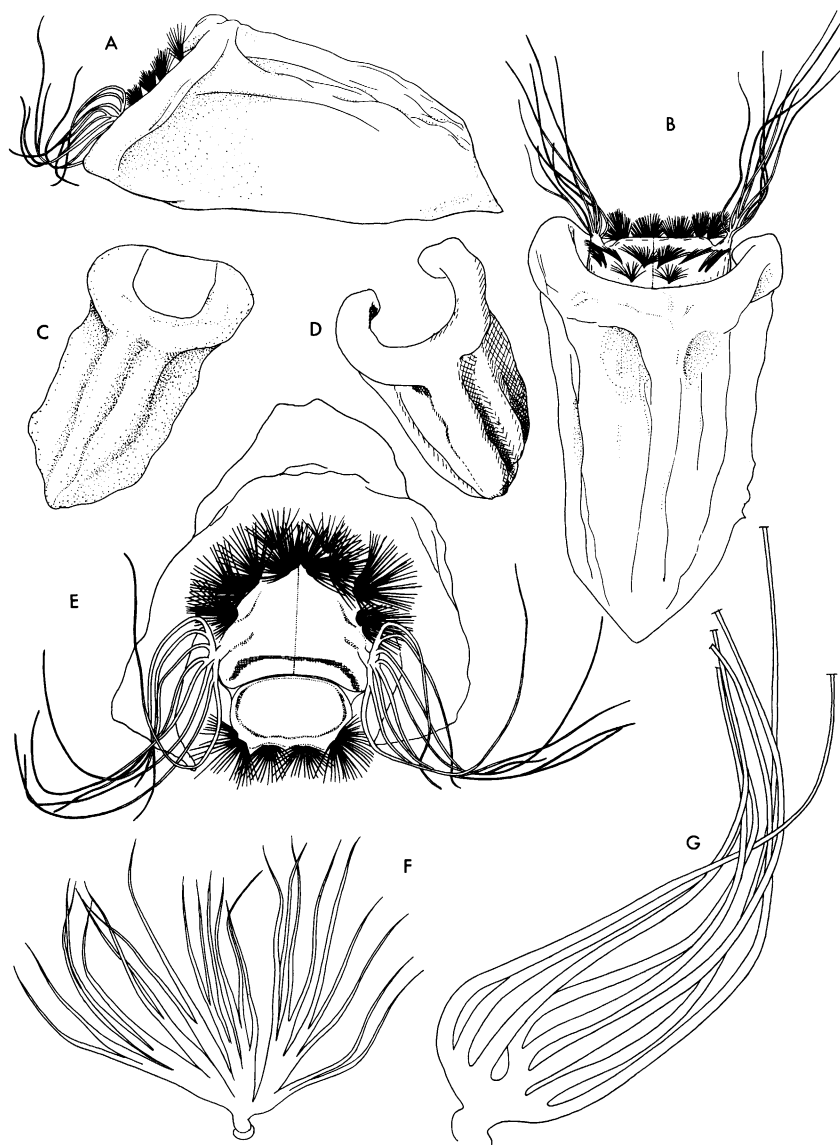


FIG. 12. *Simulium bicoloratum*, pupa. A. Pupa and cocoon, side view. B. Pupa and cocoon, dorsal aspect. C, D. Empty cocoons, dorsal view. E. Pupa in cocoon, front view. F. Thoracic trichome. G. Respiratory organ, upper branch at left. All specimens from Colombia (Sibaté-Aguadita road).

Head of normal shape; cephalic apotome yellowish, head pattern positive, brown, pattern elements as shown in figure 14E. Cephalic apotome widest just before hind margin. Antennae as shown in figure 14F, very light brown, as long as stem of mouth fan. Second antennal segment with two constrictions, situated in unpigmented areas. Ratio of lengths of segments I-III =  $1/1.2-1.5/1-1.15$ . Large fan of mouth brush with 40-50 rays; teeth of rays as illustrated (fig. 14I). Toothing of mandibles as shown in figure 14J. Two outer and one large apical tooth, all strongly sclerotized; three subapical teeth, conspicuously decreasing in size from first to third; two marginal teeth present, one distinctly longer than other. Maxillary palp as illustrated. Hypostomium as illustrated (fig. 14D); median and lateral teeth about equally prominent, intermediate teeth less salient. Sublateral teeth indistinct, lateral serrations well developed. Hypostomial setae arranged in single rows, numbering 7-9 in each row. Disc of hypostomium with a few simple setae. Gular cleft (fig. 14H) pointed, subtriangular, as high as wide, twice as high as depth of post-genal bridge. Cervical sclerites very small, isolated in membrane.

Body as shown in figure 14A, B. Abdomen gradually widened toward behind, widest well before apex, not subtruncate posteriorly. Ventral papillae absent. Respiratory histoblast as shown in figure 14C. Lateral sclerite of pseudopod well developed, of irregular shape (fig. 14G), with large dorsally directed projection. Setae of sclerite arranged in groups composed of one large and several medium-sized setae along anterior margin of sclerite; scattered submarginal setae also present. Over-all size of setae uniform. Anal sclerite as shown in figure 14M. Area between arms with delicate sensory setae (only their insertion shown in figure 14M). Posterior circlet with 80-85 rows each composed of an average of 17 hooks. Anal gill consisting of three groups of 15-20 elongate lobules (fig. 14L).

MATERIAL EXAMINED: *Bolivia*: Zongo, April 1, 1946 (W. H. Komp; U.S.N.M.), two females. *Peru*: Lima: Chacahuaru, Quebrada de Unturu, Rimac Valley, 2600 meters, September 24, 1963 (A. Herrer and P. Wygodzinsky; A.M.N.H.), one pupa; Patihuayco, 2300 meters, June-July, 1953 (A. Herrer; A.M.N.H.), three females, three males, reared. Huanuco: Sariepampa, 3600 meters, May 9-11, 1946 (F. Woytkowski; U.S.N.M.), two females. *Ecuador*: Pichincha: Aloag-Santo Domingo de los Colorados road, 2400 meters, August 9, 1969 (P. and B. Wygodzinsky; A.M.N.H.), five females; road Quito-Papallacta, west slope of range, 3300 meters, irrigation ditch in pasture, fast flowing, 9° C., on grasses and other vegetation and under rocks, July 20 to August 4, 1969 (P. and B. Wygodzinsky, H. Pérez; A.M.N.H.), several larvae and pupae; Rio

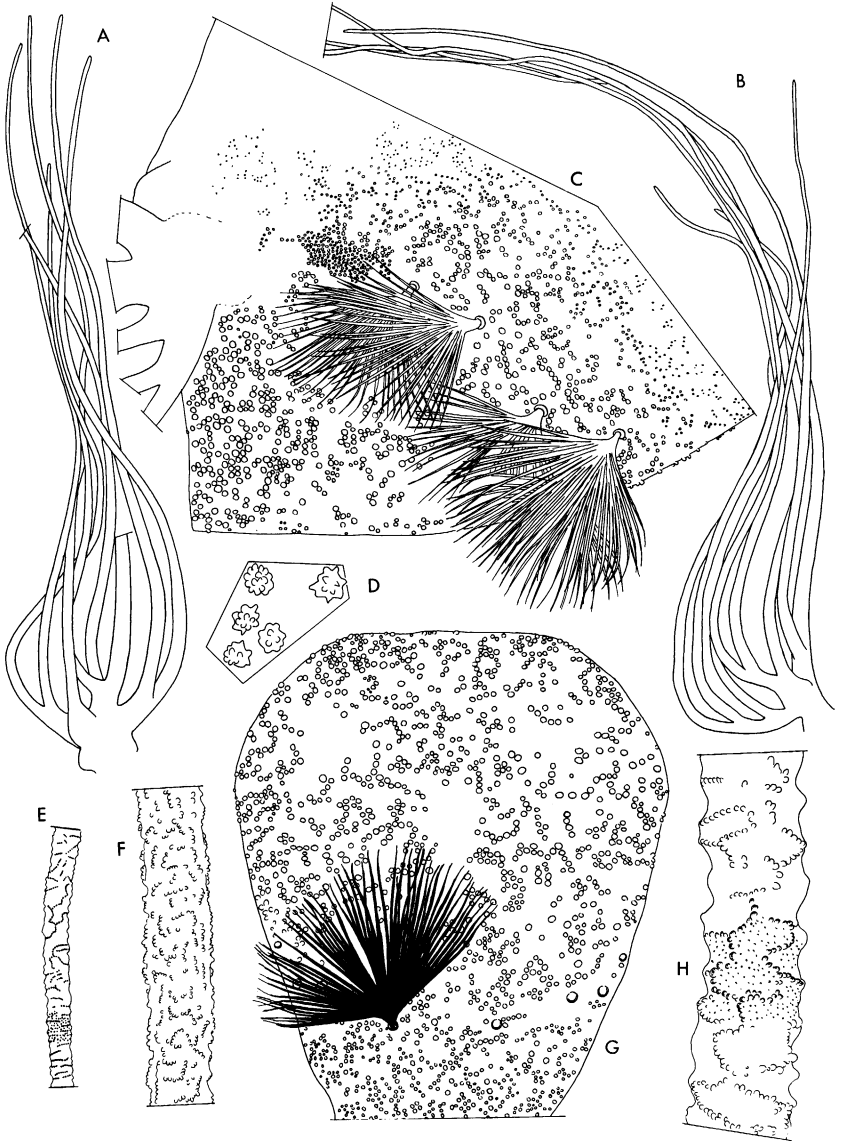


FIG. 13. *Simulium bicoloratum*. A, B. Respiratory organ, upper branch on left. C. Portion of thorax, with base of respiratory organ, trichomes and platelets; pigment of trichomes not shown. D. Platelets, high magnification. E, F. Portions of filaments of respiratory organ, high magnification. G. Fronto-clypeus of male, with trichome and insertions of trichomes, and platelets. H. Portion of filament of respiratory organ, high magnification. All specimens from Peru (Patiwayco).

Calamancha, 3 kilometers east of Papallacta, 2900 meters, fast mountain stream running over rocks and boulders, 10 meters wide, on rock surfaces (P. and B. Wygodzinsky, H. Pérez; A.M.N.H.), several larvae and pupae. Zamora: Loja-Zamora road, 2000–2500 meters, March 27, 1965 (L. Peña; C.N.C.), one female. Colombia: Cauca: Popayán-Páramo de Puracé road, 2500 meters, clear stream, 1 meter wide, rocky bottom, on grasses and rocks in strong current, August 17, 1967 (P. and B. Wygodzinsky; A.M.N.H.), several larvae and pupae. Tolima: Ibagué-Armenia road, east slope of range, 2400 meters, clear mountain stream, 16° C., on trailing grass blades near shore, August 14, 1967 (P. and B. Wygodzinsky; A.M.N.H.), three pupae. Cundinamarca: 3 kilometers south of Chipaque, 2400 meters, small stream in pasture, 16° C., on blades of grass and other submerged plants, July 30, 1967 (P. and B. Wygodzinsky; A.M.N.H.), one pupa; Sibaté-Aguadita road, 2270 meters, clear mountain stream running among gravel and boulders, two meters wide, 14° C., July 5 and 25, 1967 (P. and B. Wygodzinsky; A.M.N.H.), many larvae and pupae, 12 females and 14 males, reared; *idem*, human bait (P. and B. Wygodzinsky; A.M.N.H.), one female. Venezuela: Mérida: Mucubají-Santo Domingo road, 3400 meters, torrential stream tumbling over rocks and boulders in small valley, 3 meters wide, 15° C., on undersurface of large stones, February 20–26, 1968 (P. and B. Wygodzinsky, M. Cormons; A.M.N.H.), one female, reared; Apartaderos-Santo Domingo road, 3050 meters, stream in pasture with gravelly and rocky bottom, about 5 meters wide, 13° C., on undersurface of large stones, February 18, 1968 (P. and B. Wygodzinsky, M. Cormons; A.M.N.H.), several pupae, three males, reared.

The types of *Simulium bicoloratum* and *Simulium gaudeatum* were also examined.

DISCUSSION: This species is somewhat variable, especially in regard to the extension and intensity of the central portion of the dark pattern on the scutum of the female. Most frequently, the central portion of the dark area is black (fig. 9J) as are the lateral areas; such is the case in the type of *bicoloratum* and in most other specimens now examined, many of them reared from pupae. In other individuals the central dark area changes from black to orange to a varied degree, as does the posterior central dark spot of the scutum (fig. 9I). Such specimens have been caught in Bolivia together with typical ones, and have been reared in Peru from pupae indistinguishable from those corresponding to adults of the typical color. The type of *Simulium gaudeatum* collected in the same semiarid area of western Peru where our reared material was obtained, belongs to this lighter form. Because there are no differences in the larvae and pupae

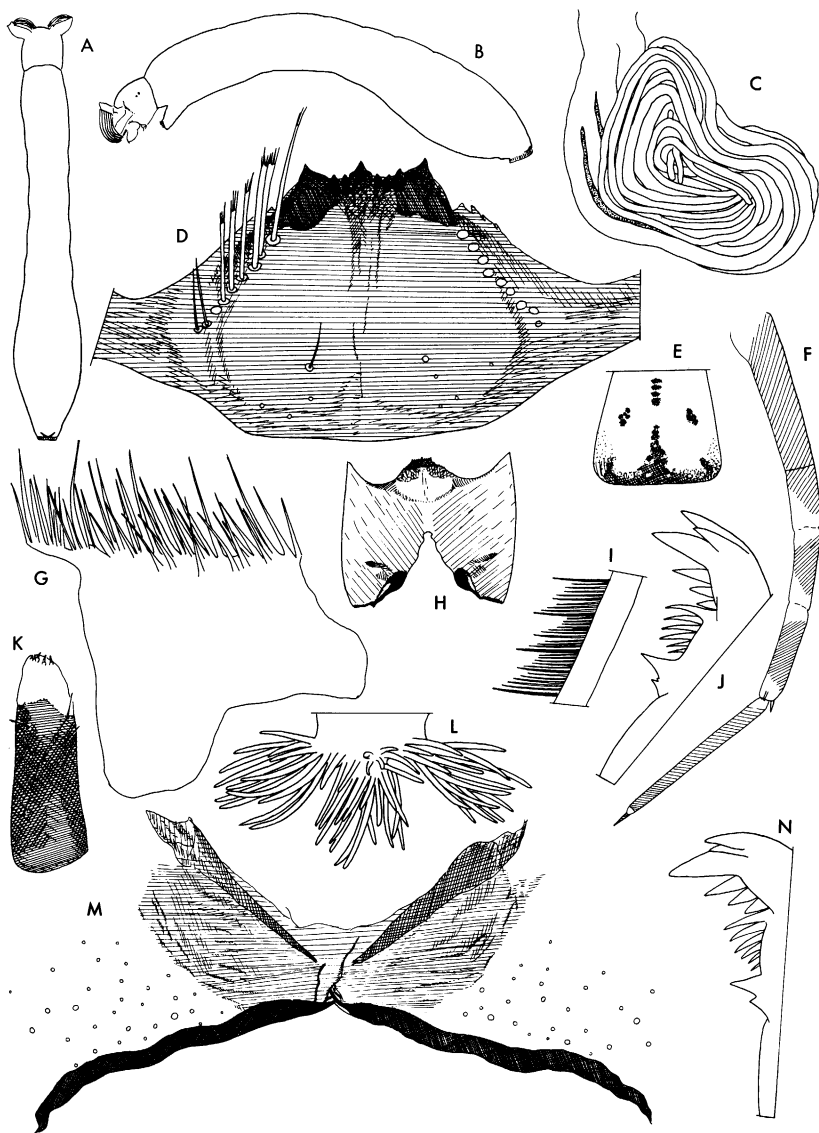


FIG. 14. *Simulium bicoloratum*, larva. A. Habitus, dorsal. B. Habitus, side view. C. Respiratory histoblast. D. Hypostomium. E. Portion of cephalic apotome, with pattern. F. Antenna, with pattern. G. Lateral sclerite of pseudopod. H. Head, under surface. I. Teeth of rays of mouth fan. J. Apex of mandible. K. Maxillary palp. L. Anal gill. M. Anal sclerite, with insertions of perianal setae. N. Apex of different mandible. Drawings made from Colombian specimens (Sibaté-Aguadita road).

and no differences in the morphology of the adults of these two forms, and as they are sympatric in at least part of their range, I conclude that *gaudeatum* is synonymous with *bicoloratum*.

As mentioned in the description, some variation is found in the extension of the yellow color of the tergum of the sixth abdominal segment of the female; wide variations are found in this respect in each population.

Variation in the color of the legs of the males, as observed in this species, has been observed before in other brightly colored South American *Simulium*, such as *S. ignescens* Roubaud, *S. romanai* Wygodzinsky and *S. adolfotutzi* Wygodzinsky, as shown by Wygodzinsky (1951).

### ***Simulium cormonsi*, new species**

Figures 15A, B; 16A–G, I, J

DIAGNOSIS: This species can be distinguished from *S. bicoloratum* by the presence of only six respiratory filaments in the pupa, and by slight differences in the shape of the genitalia of both sexes.

DESCRIPTION: MALE AND FEMALE: Size and color as in *bicoloratum*.

Structure of head and its appendages as in *bicoloratum*, but fronto-ocular triangle of female (fig. 16D) wider than high. Thorax, wings, and legs as in *bicoloratum*; Sc of male with about 20 setae.

Genitalia similar to those of *bicoloratum*. Female with paraproct (fig. 16B) distinctly longer and narrower than in *bicoloratum*. Male with distimere (fig. 16F) slightly narrower, ventral plate (fig. 16C) with lateral constriction more pronounced and apical half narrower, and median sclerite (fig. 16I) more deeply incised.

PUPA: Cocoon (fig. 15A, B) and pupa as in *bicoloratum*, but respiratory organ longer, 3 mm. long, and with only six filaments (fig. 16E, G, J) arising from three short main branches. Cocoon slightly thinner than in *bicoloratum*, faintly translucent when observed in alcohol. Trichomes as in *bicoloratum*.

LARVA: Not known.

MATERIAL EXAMINED: *Venezuela*: Mérida: Mucubají-Santo Domingo road, 3400 meters, torrential stream tumbling over rocks and boulders in small valley, stream 3 meters wide, 15° C., on undersurface of stones, February 20–26, 1968 (P. and B. Wygodzinsky, M. Cormons; A.M.N.H.), one male holotype, two male paratypes, all reared, one pharate male and one pharate female, paratypes; Mucubají-Santo Domingo road, 3050 meters, stream in pasture with gravelly and rocky bottom, about 5 meters wide, 13° C., on undersurface of large stones, February 18, 1968 (P. and B. Wygodzinsky, M. Cormons; A.M.N.H.), one female allotype, reared, many pupae.

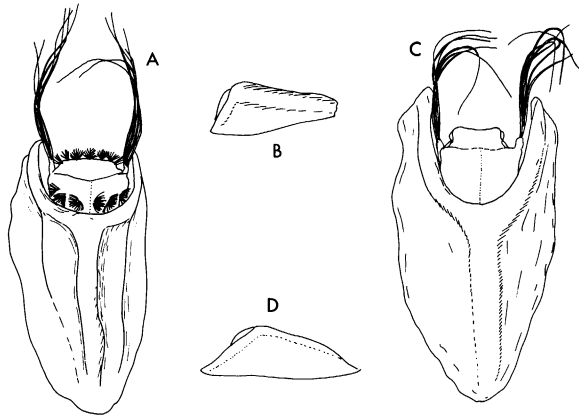


FIG. 15. A, B. *Simulium cormonsi*. A. Pupa with cocoon, dorsal view. B. Cocoon, side view. C, D. *Simulium jaimeramirezi*. C. Pupa and cocoon, seen from above. D. Cocoon, side view.

**ETYMOLOGY:** This species is named for Mr. Matthew Cormons, in recognition of his help in the field and in the laboratory.

***Simulium jaimeramirezi*, new species**

Figures 15C, D; 16H

**DIAGNOSIS:** This species can be distinguished from *S. bicoloratum* by the presence of only six respiratory filaments in the pupa, and from *bicoloratum* and *cormonsi* by the faintly pigmented, smaller cephalic and thoracic trichomes of the pupa, and the strongly oblique anterior border of the cocoon.

**DESCRIPTION: PHARATE MALE AND FEMALE:** Color and structure, including genitalia, similar to those of *bicoloratum*, as far as discernible.

**PUPA:** Cocoon wall pocket-shaped. Anterior border deeply emarginate (fig. 15C), strongly oblique in lateral view (fig. 15D). Cocoon very thick, its color and structure as in *bicoloratum*, but slightly translucent when observed in alcohol, and upper surface with only median longitudinal ridge. Length of cocoon along center of dorsal surface, 2.9–3.2 mm., along sides of ventral surface, 4.0–4.4 mm., viz., distinctly longer than in *bicoloratum*. Length of body of pupa 2.8–3.7 mm., length of respiratory organ 1.9–2.8 mm. Platelets on head (fig. 16H) much less numerous than in foregoing species. Trichomes of head and thorax light brown in color, distributed as in *bicoloratum* and *cormonsi* but considerably smaller (fig. 16H), not conspicuous when observed under low power.



FIG. 16. A-G. *Simulium cornonsi*. A. Portion of head of female pupa with ocular trichome, insertions of facial and frontal trichomes, and with platelets of right half of fronto-clypeus. B. Cercus and paraproct. C. Ventral plate. D. Fronto-ocular triangle. E. Respiratory organ of pupa, upper branch on right. F. Paramere. G. Base of respiratory organ, upper branch on left. H. *S. jaimeramirezi*, fronto-clypeus of male pupa, with platelets, trichomes, and insertions of trichomes. I, J. *S. cornonsi*. I. Median sclerite. J. Base of respiratory organ of pupa, upper branch on right.

LARVA: Not known.

MATERIAL EXAMINED: *Venezuela*: Mérida: Mucubají-Santo Domingo

road, 3400 meters, torrential stream tumbling over rocks and boulders in small valley, stream 3 meters wide, 15° C., on undersurface of stones, February 20–26, 1968 (P. and B. Wygodzinsky, M. Cormons; A.M.N.H.), one pharate male, holotype, one pharate female, allotype, one pharate male, paratype, numerous pupae; Mucubají-Santo Domingo road, 3050 meters, stream in pasture with rocky bottom, about 5 meters wide, 13° C., on undersurface of stones, February 18, 1968 (P. and B. Wygodzinsky, M. Cormons; A.M.N.H.), four pupae.

ETYMOLOGY: This species is named for Mr. Jaime Ramírez Pérez, the Venezuelan entomologist.

CONSIDERATIONS ON *Simulium bicoloratum*  
AND RELATED SPECIES

DISCUSSION: *Simulium bicoloratum* (as *Ectemnaspis macca*) is the type of *Ectemnaspis* Enderlein, 1934. Stone (1963), who knew only the female of this species, considered *bicoloratum* to be closely related to *Simulium pertinax* Kollar, a species very similar to *Simulium flavifemur* (Enderlein). *Simulium flavifemur* is the type species of *Chirostilbia* Enderlein, 1921, and therefore Stone (*loc. cit.*) concluded that he would place *Ectemnaspis* as a synonym of *Simulium* (*Chirostilbia*).

A comparison of the redescription of *Simulium bicoloratum* given in the present paper and the careful redescription of *Simulium pertinax* by D'Andretta and D'Andretta (1950) reveals several important differences between these two species. *Simulium pertinax* differs from *bicoloratum* and its close allies by its rather uniformly black thorax and abdomen in both sexes, the presence of scales on the scutum arranged in lines, the differently shaped ventral plate of the genitalia of the male and the comparatively much shorter basimere and distimere, the shoe-shaped cocoon of the pupa with its well-developed anteroventral collar, and, in the larva, the differently-shaped lateral sclerites of the pseudopod. These characters are on the level of those possibly indicating subgeneric difference. I therefore prefer to retain *Simulium* (*Ectemnaspis*) as a valid subgenus for the time being.

The question now arises as to the scope of *Simulium* (*Ectemnaspis*). *Simulium bicoloratum*, *S. cormonsi*, and *S. jaimeramirezi*, in addition to their over-all similarity, all agree in the unique surface structure of the branches and filaments of the pupal respiratory organ, and the presence of well-developed ocular trichomes. These apomorphic features are not known from any otherwise similar forms. A species probably closely related to the three above is Lewis's (1963) *Simulium* sp. C, also from Venezuela. It agrees with typical *Ectemnaspis* in the general structure

and color of its cocoon and the presence of large fan-shaped trichomes that "form a conspicuous fence-like line across the thorax," according to Lewis (*loc. cit.*). *Simulium* sp. C also agrees with typical *Ectemnaspis* in the

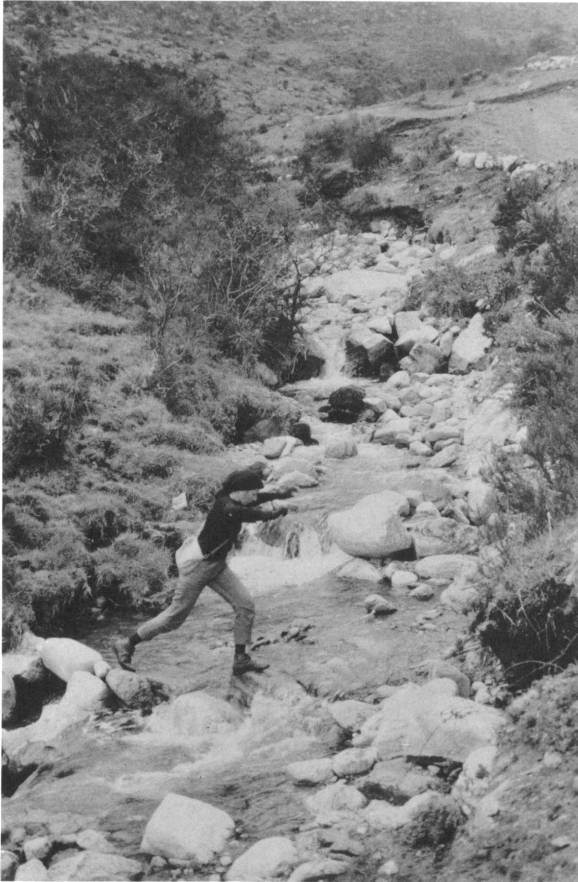


FIG. 17. Stream at 3400 meters on Mucubají-Santo Domingo road, Mérida, Venezuela. *Simulium bicoloratum*, *S. cornonsi* and *S. jaimeramirezi* were collected here, in addition to several species of *Gigantodax*.

general structure of the genitalia in both sexes, but differs in the pupal respiratory organ that lacks a specialized surface structure and the branches of which are not strongly divergent at their base, the presence of denticles on the cibarium of the female, and the lack of dark pigment on the scutum of both sexes.

*Simulium romanai* Wygodzinsky and *Simulium adolfolti* Wygodzinsky, from Argentina, agree with *S. bicoloratum* and its closest allies in the peculiar structure and color of the cocoon, the presence of multiramous trichomes in the pupa, certain similarities in the color pattern of the adult, and the general structure of the genitalia of both sexes. The respiratory organ of the pupae of the Argentinian species is more plesiomorphic and is more similar to that of Lewis's *Simulium* sp. C, as is the cibarium of the female provided with denticles.

It is probably no exaggeration to state that only a fraction of the extant South American *Simulium* are adequately described or even named. A final decision on the status of the *Ectemnaspis-Chirostilbia* complex and probably on many other proposed or potential subgenera cannot be made until a more adequate sampling of the South American species of *Simulium* becomes available.

BIOLOGY: Larvae and pupae of *bicoloratum*, *cormonsi*, and *jaimeramirezi* were found by the author exclusively in permanent streams that could be classified as somewhat between "young" and "adolescent," according to the terminology used by Dalmat (1955). Irrigation ditches, intermittent streams, or "infant" streams, "mature" and "old" streams were never found to harbor representatives of this group, although I collected many other blackfly species in all of them. Figure 17 shows a stream in Venezuela where all the three species named above were collected together. Like all other streams of its type, the walls were from steeply to moderately inclined. The total width of the bed was from 3 to 5 meters, although the actual flow was much narrower during the dry season when collecting was done. There were many rapids and small falls, and the stream bed consisted of a mixture of coarse sand, pebbles, and small and large stones deposited between numerous large rocks.

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