AMERICAN MUSEUM
Novitates

PUBLISHED BY
THE AMERICAN MUSEUM
OF NATURAL HISTORY
CENTRAL PARK WEST AT 79TH STREET
NEW YORK, N.Y. 10024 U.S.A.

NUMBER 2670 FEBRUARY 5, 1979

PEDRO WYGODZINSKY AND SIXTO COSCARÓN

Description of a Black Fly of the Subgenus *Simulium* (*Pternaspatha*) from the High Andes of Ecuador (Diptera, Simuliidae)

AMERICAN MUSEUM
Novitates

PUBLISHED BY THE AMERICAN MUSEUM OF NATURAL HISTORY
CENTRAL PARK WEST AT 79TH STREET, NEW YORK, N.Y. 10024

Number 2670, pp. 1-9, figures 1-5 February 5, 1979

Description of a Black Fly of the Subgenus Simulium (*Pternaspatha*) from the High Andes of Ecuador (Diptera, Simuliidae)

PEDRO WYGODZINSKY[1] AND SIXTO COSCARÓN[2]

ABSTRACT

Simulium cotopaxi, new species, collected between 3500 and 4400 meters in the Ecuadorian Andes is described. It shares many derived characters with members of the *nemorale* group of *Simulium* (*Pternaspatha*), but differs by the unique pattern of the scutum of the female and the posteriorly emarginated paraproct, as well as by the extraordinarily enlarged scapus and pedicellus of the antenna of the male. The new species was found more than 1000 km. north of the previously known northern limit of the subgenus.

INTRODUCTION AND ACKNOWLEDGMENTS

The present paper is part of a series of contributions to the knowledge of the black flies of cool and cold temperate South America. Most of the fieldwork for this project was done by the authors in Patagonia, Chile, and Argentina, and in the Andean countries from Bolivia to Venezuela, at elevations up to almost 5000 meters. Financial assistance for the research leading to this paper was obtained from the National Science Foundation (Grants GB-5852 and GB-8783). Mrs. Betty Wygodzinsky assisted ably in the fieldwork, and Ms. Nelida R. Caligaris produced most of the drawings. Dr. D. M. Wood made available material collected by him and deposited in the Canadian National Collection of Insects, Agriculture Canada, Ottawa. We thank all of them.

Simulium (Pternaspatha) cotopaxi,
new species

DIAGNOSIS: A species of *Simulium* (*Pternaspatha*) differing from the other species of the subgenus, among other characters, by the unique pattern of the scutum of the female (figs. 1D, E; 2C), the posteriorly emarginated paraproct, (not emarginated in other species), as well as the extraordinarily enlarged scapus and pedicellus of the antennae of the male, which together are as long as the flagellum (much shorter than flagellum in the other species).

DESCRIPTION: Female: Wing length 3.8-4.2 mm. Head with eyes black. Clypeus, frons, and occiput dark brown, with silver gray pru-

[1]Curator, Department of Entomology, the American Museum of Natural History.
[2]Research Associate, Department of Entomology, the American Museum of Natural History; Professor of Zoology, Universidad de La Plata, La Plata, Argentina; National Research Council Career Investigator.

 ISSN 0003-0082 / Price 70 cents

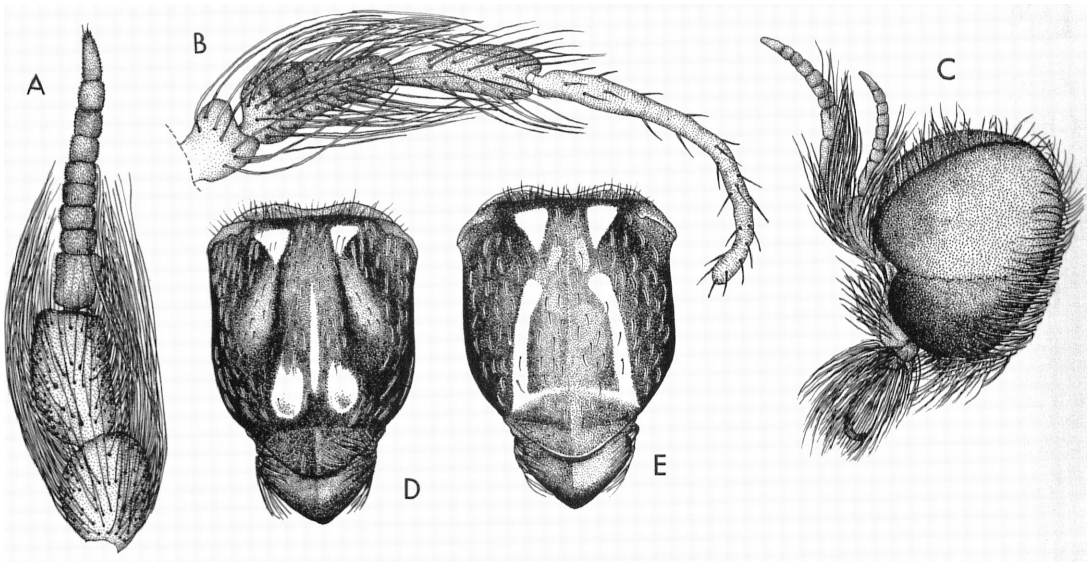

FIG. 1. *Simulium cotopaxi*. A-C. Male. A. Antenna. B. Maxillary palp. C. Head, side view. D, E. Female, Scutum and scutellum, with different incidence of illumination.

inosity. Antennae and palpi black, their setae from dark brown to black. Scutum black, with variable color pattern according to the incidence of light: in some instances (fig. 1D) almost entirely black, with 1+1 triangular anterosubmedian and 1+1 submedian spots on posterior third silver gray, and 1+1 sublateral and one median longitudinal stripe of the same color; with different illumination (fig. 1E) scutum with 1+1 anterosubmedian triangular silver spots and 1+1 obliquely longitudinal silvery stripes beginning somewhat before middle of scutum and connected posteriorly by a transverse band. With still different illumination (fig. 2C) central portion of scutum almost entirely silvery, with 1+1 anterior and 1+1 submedian spots appearing black. Scutellum dark brown, narrowly margined with lighter along hind border. Metanotum velvety grayish brown. Setae of scutum and scutellum from brass to golden colored. Pleura blackish. Wings hyaline, iridescent; veins grayish brown; hairs from yellowish gray to brown. Stem of halteres light brown, knob pale yellow. Legs (fig. 2H-J) grayish brown, with coxae, apices of femora and tibiae, apex of basitarsi and the remaining tarsomeres, darkened. Setae of legs large and very numerous, producing overall light-colored appearance of legs. Abdomen black, with 1+1 silver gray spots on tergites II-VII, most conspicuous on segments II and VI-VII (fig. 2N). Terminal tergites from dull to slightly polished. Ventral surface of abdomen blackish.

Frons without median sulcus (fig. 2B). Frontal angle 125 degrees. Fronto-ocular triangle as deep as wide at base (fig. 2G). Shape of articles of antennae shown in figure 2A; setae not unusually elongate or numerous. Maxillary palp as shown in figure 2D; apical segment slightly over twice as long as penultimate. Sensory vesicle of maxillary palp slightly wider than half the diameter of third segment. Cibarium (fig. 2F) with margin widely rounded, without denticles or projections; dorsolateral arms more heavily sclerotized than center of margin. Maxillae and mandibles serrate on both edges. Maxillae with approximately 28, mandibles with 42-47 teeth.

Scutum and scutellum with scattered simple setae.

Sc with 12-15 hairs. R_1 with hairs and spiniform setae arranged in one or two irregular rows (as in fig. 3A).

Shape and pigment pattern of legs shown in figure 2H-J. Calcipala (fig. 2E) slightly less than half as wide as basitarsus; pedisulcus nor-

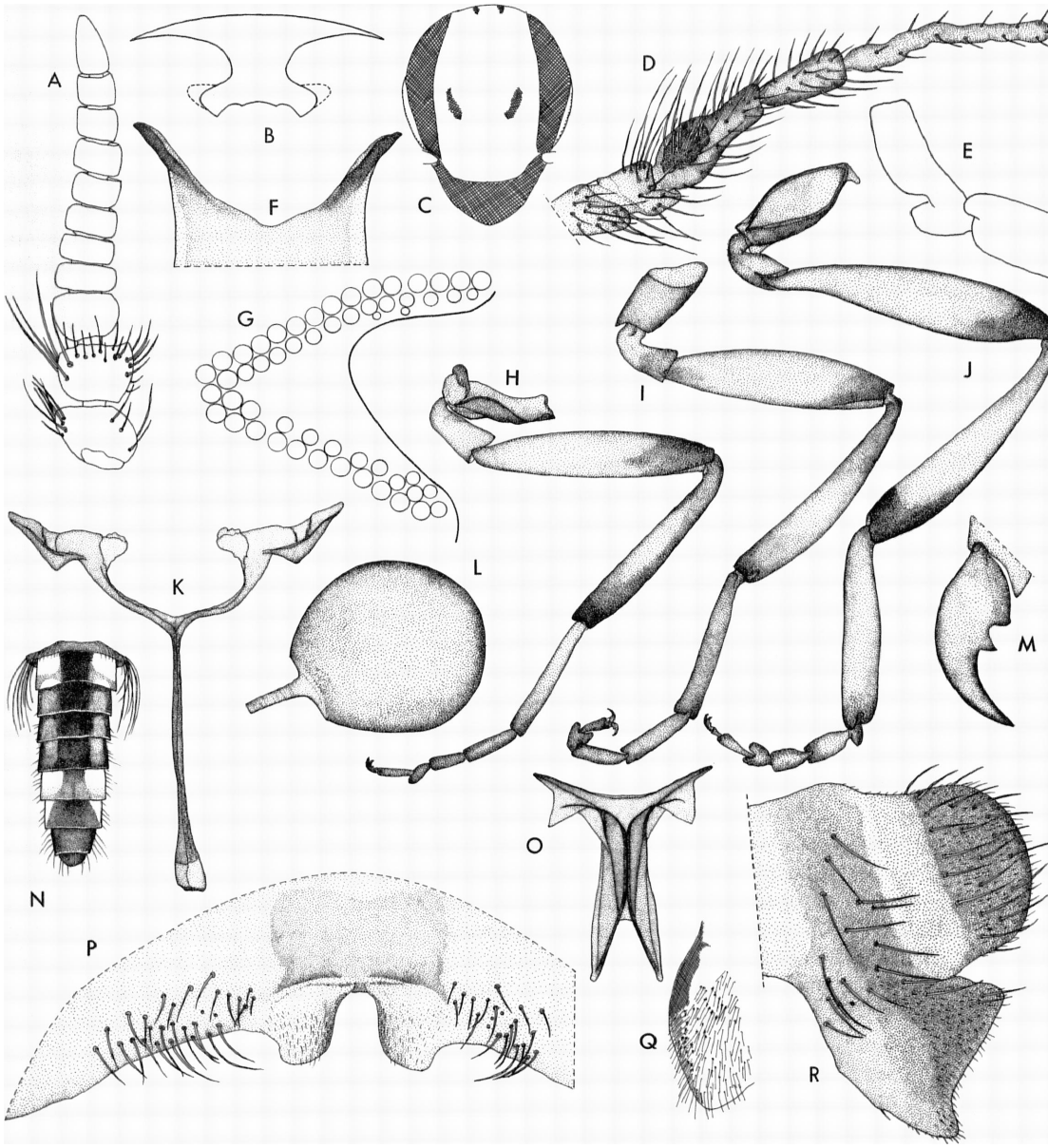

FIG. 2. *Simulium cotopaxi*, female. A. Antenna, setae of flagellum not shown. B. Frons. C. Scutum and scutellum, incidence of light different from that shown in figure 1D, E. D. Maxillary palp. E. Calcipala and pedisulcus. F. Cibarium. G. Fronto-ocular triangle. H. Fore-leg. I. Mid-leg. J. Hind leg. K. Genital fork. L. Spermatheca. M. Claw. N. Abdomen with color pattern, dorsal view. O. Furcasternum. P. Eighth urosternite with gonapophyses. Q. Detail of gonapophysis, with microtrichia. R. Cercus and paraproct.

mal (fig. 2E, J). Claws with well-developed triangular process subbasally (fig. 2M).

Furcasternum as illustrated (fig. 2O). Eighth urosternite as illustrated (fig. 2P). Gonapophyses divergent, their inner margin conspicuously sclerotized, their disc with very

numerous microtrichia (fig. 2P,Q). Cerci and paraprocts as shown in figure 2R; cerci low; paraprocts narrowly and shortly projecting apically, their posterior border emarginated. Genital fork as illustrated (fig. 2K); stem slender, heavily pigmented. Spermatheca (fig. 2L) subglobular, pigmented, except circular area of insertion of spermathecal duct; inner surface of spermatheca with faintly visible slender spicules.

MALE: Wing length 3.6-3.8 mm.

Head black; eyes dark brown to black; clypeus black with silvery pruinosity; antennae and palpi black, their hairs also black. Scutum entirely black, with certain illumination anterior margin appearing gray with 1+1 short submedian posteriorly directed gray projections, or with narrow silver gray band along margins of entire sclerite. Setae of scutum and scutellum colored as in female. Color of metanotum, pleura, wings and legs as in female. Abdomen (fig. 3F) sooty black, with 1+1 silver gray spots each on segments II, VI, and VII, the one on II the largest, the one on VII the smallest.

Holoptic. Head strongly hairy (fig. 1C); row of hairs between eyes. Antennae 11-segmented. Scapus and pedicellus (fig. 1A) extraordinarily enlarged, combined about as long as flagellum, and much wider than articles of the latter. Setae of scapus and pedicellus unusually numerous and long, surpassing level of middle of flagellum. Maxillary palpus as shown in figure 1B, with setae of third and to a lesser degree also fourth segment unusually long and numerous. Fifth article slightly over twice as long as penultimate. Sensory vesicle smaller than in female, details of its structure shown in figure 3B.

Setae of thorax as in female. Wings as in female, but Sc either without hairs (fig. 3A) or with at most four. Shape and pigment pattern of legs shown in figure 3D, E, H. Posterior basitarsus (fig. 3H) strongly widened, about three times as long as wide. Calcipala small, one-fourth as wide as basitarsus apically (fig. 3I).

Genitalia with basimere and distimere (fig. 3C, J) subtrapezoidal; distimere shorter than basimere, as long as wide at its base, distal margin truncate and slightly concave. Apical spine short, situated on slight projection of inner apical angle (fig. 3J). Median sclerite with apical half widened and deeply incised (fig. 3K). Endoparameres (fig. 3K) with numerous spinelike processes. Membrane of aedeagus with numerous minute cuticular spicules (fig. 3K). Ventral plate (fig. 3G) wider than long.

PUPA: Cocoon (fig. 4A, B) light brown, slipper-shaped, translucent; fabric of cocoon very uniform, parchment-like, individual threads difficult to perceive. Anterior border of cocoon reinforced, opening of cocoon subcircular. Length of cocoon along dorsal surface 3.2-3.7 mm., along ventral surface 4.5-4.8 mm. Cephalopterothecal length 2.8-3.0 mm., of entire pupa 3.7-4.7, of gills 3.0-3.5 mm.

Gills brown, darkest on basal half or third, consisting of six slender filaments (figs. 4A, B, H, I). Primary trunk very short, divided at short distance from its base into two secondary branches. Ventral secondary branch divided again into two filaments. Dorsal secondary branch divided twice, giving rise to four respiratory filaments. All six respiratory filaments forward directed, of subequal length, forming a very tight bundle. Surface of filaments with minute granules arranged in a roughly spiral pattern, apex of filaments from conical (fig. 4C) to rounded. Head, thorax and abdomen light brown, with frontoclypeus, antennal sheaths and exposed portion of thorax dark brown, heavily sclerotized. Platelets of head and thorax (fig. 4E, G) delicately and abundantly spinulose. Shape of frontoclypeus of female and male as shown in figure 4F, J, K, that of male comparatively wider (fig. 4F, K). Frontoclypeus with 1+1 facial and 2+2 frontal trichomes, the latter very small (fig. 4D, G), from simple to bearing up to eight branches. Thorax (fig. 4H) with 5-6+5-6 trichomes, also very small, with up to eight branches (fig. 4E).

Abdomen as illustrated (fig. 4L). Tergites III and IV with 4+4 simple hooks. Tergites VI-VIII or IX anteriorly with area of minute scale-like cuticular structures. Apex of abdomen without terminal spines or processes. Sternites V-VII with 2+2 hooks, closely approximate on V, distant on VI and VII. Hooks from simple to trifid. Sternites V-VIII each with 1+1 fields

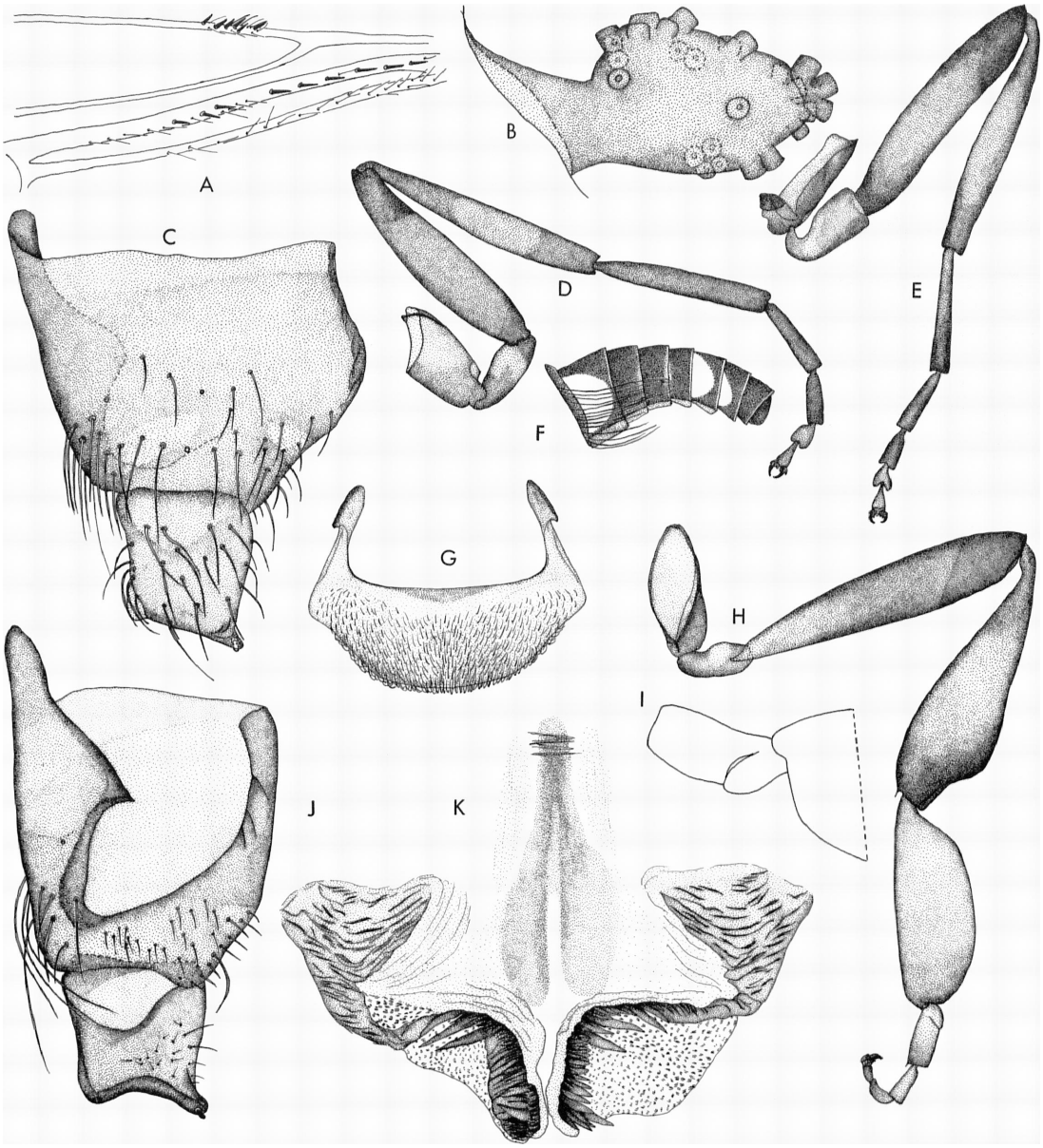

FIG. 3. *Simulium cotopaxi*, male. A. Detail of wing, with setae on C shown only partially. B. Sensory vesicle of maxillary palp. C. Basimere and distimere, under surface. D. Fore leg. E. Mid-leg. F. Abdomen with color pattern, side view. G. Ventral plate. H. Hind leg. I. Calcipala and pedisulcus. J. Basimere and distimere, upper surface. K. Median sclerite, endoparamere and membrane of aedeagus.

of minute scale-like cuticular processes. Apex of abdomen (fig. 4M) without pair of hooks or denticles.

LARVA: Length of mature larva 8.0-8.5 mm.; width of head capsule 0.8 mm. General body color light yellow brown, tinged with greenish; head dark brown.

General body shape shown in figure 5A, B; abdomen gradually widened posteriorly, not abruptly truncate at tip. Ventral papillae absent.

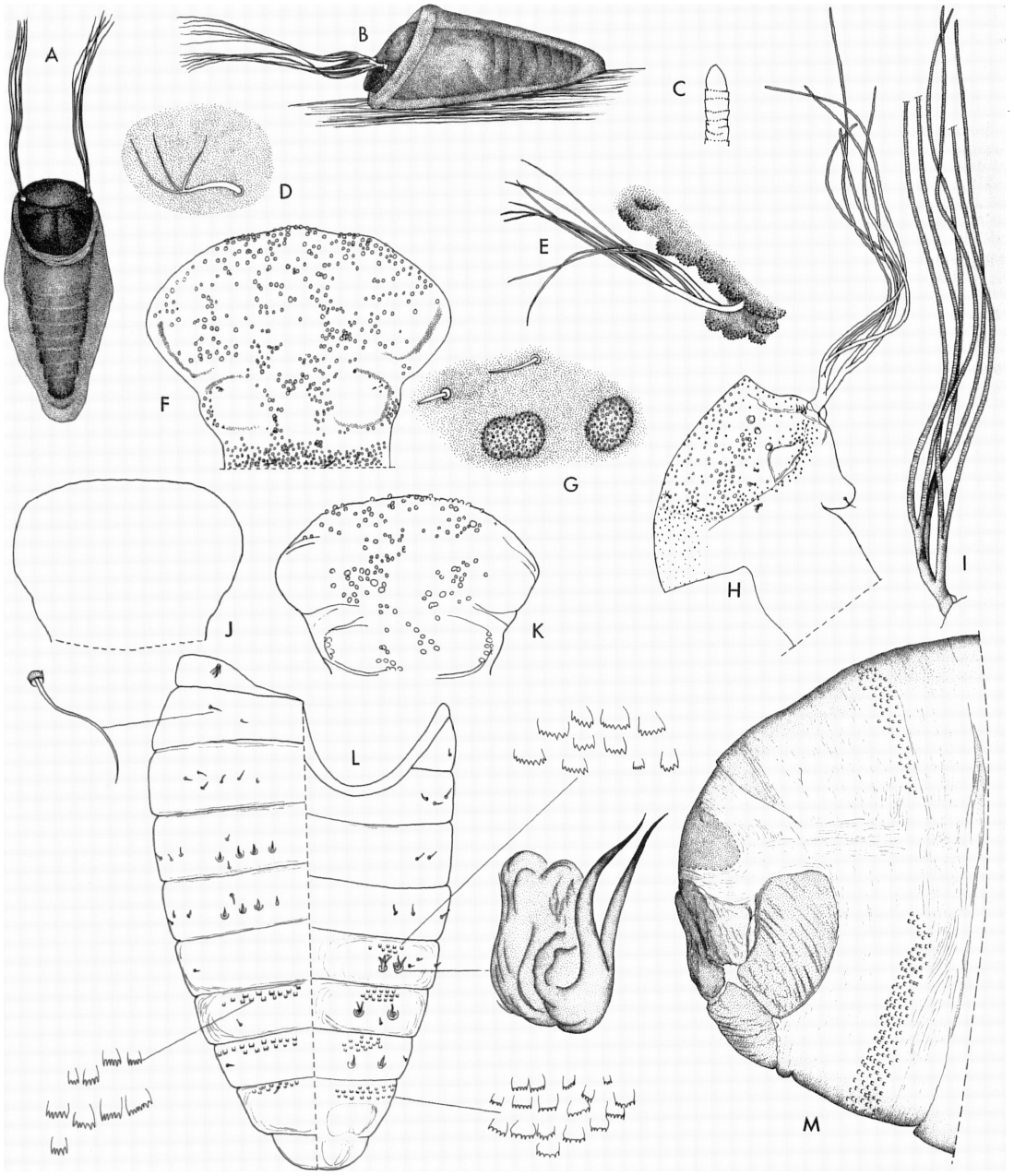

FIG. 4. *Simulium cotopaxi*, pupa. A. Pupa in cocoon, dorsal view. B. Idem, lateral aspect. C. Apex of respiratory filament. D. Trichome of frontoclypeus. E. Trichome and platelets of thorax. F. Frontoclypeus of male. G. Trichomes and platelets of frontoclypeus. H. Thorax with gill. I. Gill. J. Outline of frontoclypeus of female. K. Frontoclypeus of male. L. Chaetotaxy of abdomen; tergites to the left, sternites to the right. M. Apex of abdomen.

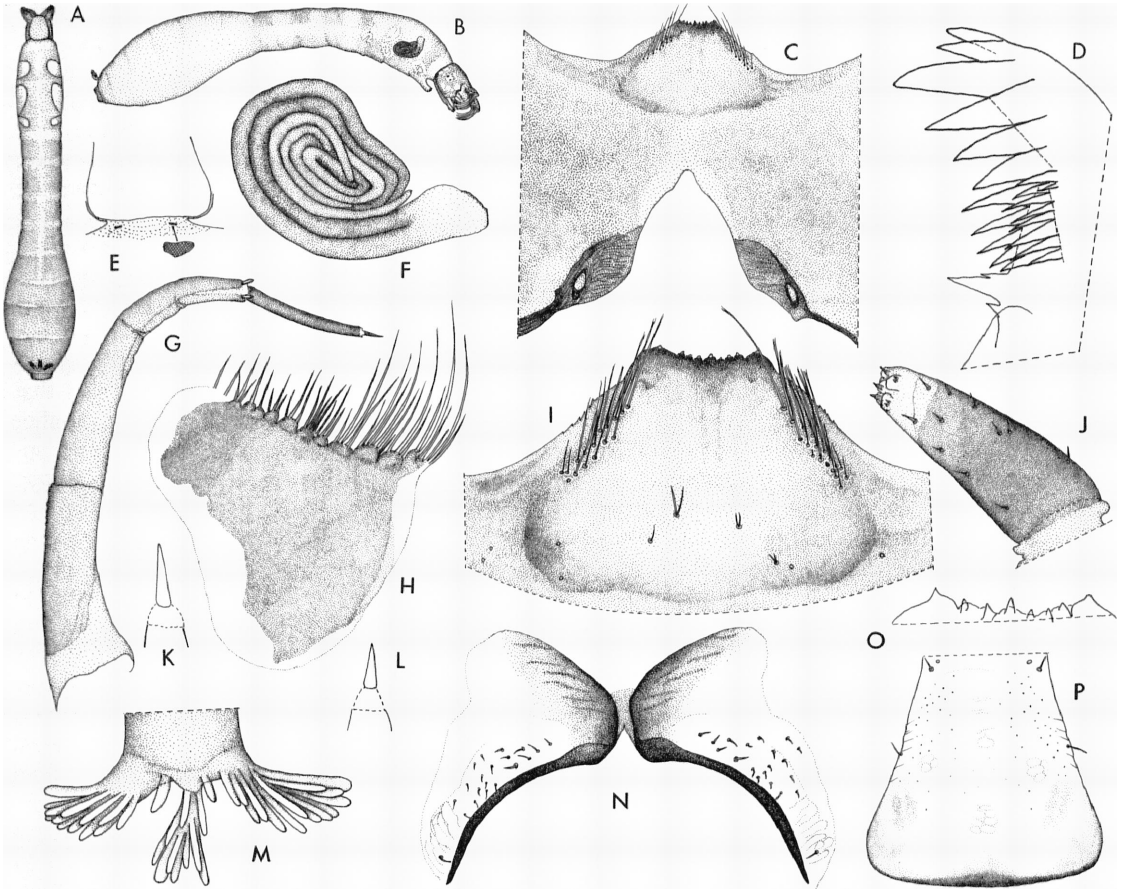

FIG. 5. *Simulium cotopaxi*, larva. A. General aspect, dorsal view. B. Idem, side view. C. Portion of head, seen from below. D. Apex of mandible. E. Portion of cephalic apotome, with cervical membrane. F. Gill histoblast. G. Antenna. H. Lateral sclerite of proleg. I. Hypostomium. J. Maxillary palp. K, L. Apical sensilla of antennae. M. Anal gills. N. Anal sclerite. O. Teeth of hypostomium. P. Cephalic apotome.

Cephalic apotome as shown in figure 5E, P; spots positive, feeble, darkest along posterior margin. Cervical sclerites (fig. 5E) minute, remote from each other. Antennae as shown in figure 5G, faintly pigmented, third article the darkest. Second antennal article with two distinct constrictions. Apical sensilla as shown in figure 5K, L. Ratio of antennal segments 1:1.4-1.7:0.8. Large fan of mouth brush with approximately 40 rays. Toothing of mandible shown in figure 5D. Maxillary palp as shown in figure 5J. Hypostomium as shown in figure 5I, O, with median and lateral teeth equally prominent. Hypostomial setae (fig. 5I) in two or three irregular rows, each group consisting of 12-18 setae. Disc of hypostomium with a few scattered simple or bifid setae. Gular cleft slightly deeper than length of postgenal bridge (fig. 5C).

Gill histoblast shown in figure 5F. Lateral sclerite of proleg shown in figure 5H, setae arranged in three or four on prominent tubercles. Body of larva glabrous, except some setae near anal region and isolated ones scattered over rest of body. Posterior circlet with approximately 90 rows of 16 hooklets each. Anal

sclerite shown in figure 5N. Anal gills (fig. 5M) arranged in three lobes, each lobe with 11-14 lobules.

MATERIAL EXAMINED: ECUADOR: Tungurahua: stream along road from Ambato to Guaranda, 3500-3550 m., Aug. 11, 1969 (P. and B. Wygodzinsky; AMNH), one male, holotype, one female, allotype, two males, one female, paratypes, all reared; numerous pupae, one larva; stream near road along northwest slope of Mt. Chimborazo, 3600 m., Aug. 11, 1969, (P. and B. Wygodzinsky; AMNH), three pupae. Cotopaxi: near bridge over Río Sumbahua, highway from Pujili to Quevedo, 3500 m., July 29 to Aug. 15, 1969 (P. and B. Wygodzinsky; AMNH), two males and four females, pinned, one male and one female, on slides, paratypes, all reared, numerous pupae, three larvae on slides, three in alcohol; *idem* (P. and B. Wygodzinsky; Museo de La Plata), three males and three females, paratypes, reared, pinned, and 11 pupae and three larvae, in alcohol and on slides; *idem*, 3700 m., July 29, 1969 (P. and B. Wygodzinsky; AMNH), one larva. Pichincha: Río Pita, 2700 m., July 25, 1969, (B. and P. Wygodzinsky; AMNH), one female, reared, paratype; 0° 17′ S lat., 78° 13′ W long., 4400 meters, March 1-7, 1976 (G. and M. Wood; Canadian National Collection), two females.

ETYMOLOGY: This species is named for the volcano Cotopaxi in Ecuador, near which some of the material of this species was collected.

BIOLOGY: The mouthparts of the female of this species are normally developed, and it can therefore be presumed to be hematophagous. The first author of this paper spent hours at a stream where the species was breeding but was not bitten.

Larvae and pupae of *S. cotopaxi* were found exclusively in streams intermediate between "young" and "adolescent," according to the terminology used by Dalmat (1955). These streams were 2 to 5 meters wide, their walls were from steeply to moderately inclined, there were many small rapids and falls, and the stream bed consisted of a mixture of pebbles, stones, and boulders. Wygodzinsky (1971, fig. 17) illustrated a similar stream. The water temperature was 11°C.

Pupae were mostly found attached to the sides and under surface of large stones and boulders. Only in one case were the pupae found attached to blades of grass trailing in fast flowing water. The cocoons were strongly adhering to the substrate and difficult to remove; they were in all cases isolated, not forming aggregations.

DISCUSSION: There are relatively few Simuliinae at high elevations in the Andes, the most speciose assemblage being the subgenus *Simulium* (*Pternaspatha*). Species of this genus were known to occur from Tierra del Fuego to central Peru, at a latitude slightly north of that of Lima. Intensive fieldwork by the first author in Ecuador, Colombia, and Venezuela had apparently failed to turn up *Simulium* (*Pternaspatha*) although black flies of other groups are an important element in the high Andean rithron communities in these countries (Coscarón and Wygodzinsky, 1972). However, a recent reinterpretation has suggested to us that a species of *Simulium* occurring in the Ecuadorian highlands between 3500 and 4000 meters shares, in addition to an overall similarity, certain specialized structural characters with species of *Pernaspatha*. These synapomorphic characters are:

1. In the male, very numerous long setae on the basal segment of the maxillary palp and on the scapus and pedicellus of the antennae.
2. Conspicuously widened posterior basitarsus in the male.
3. Calcipala of male very small.
4. Hypostomial setae of larva arranged in several rows.
5. Gill filaments of pupa forming tight, forwardly directed bundle.
6. Absence of hooks or denticles at apex of abdomen of pupa.

The general structure of the genitalia in both sexes and the absence of denticles on the cibarium are also shared, but are probably symplesiomorphic.

The first character mentioned above does not occur in all species of *Pternaspatha* but is well developed in many, such as *luchoi* Coscarón and Wygodzinsky, *herreri* Wygodzinsky and

Coscarón, and *prodexargenteum* (Enderlein), all species found at high altitudes. A comparable development of the hairs of male antennae and palpi has occurred independently in certain high altitude species (as yet undescribed) of the Andean prosimuliine genus *Gigantodax*.

The widened posterior basitarsus of the male is found in many but not all *Pternaspatha*, but occurs occasionally also in other *Simulium*.

The very small calcipala of the male is found in several *Pternaspatha* and even tends to obsolescence in others.

The arrangement of the hypostomial setae of the larva in several rows instead of one is a typical character of *Pternaspatha*, and quite rare in the Simuliinae. The same is true for the frequent arrangement of the gills of the pupa into a tight, forwardly directed bundle, as well as for the absence of a pair of hooks or heavily sclerotized denticles at the apex of the abdomen of the pupa.

The autapomorphic characters that assist in defining *S. cotopaxi* and that distinguish it from the formerly described species of *Pternaspatha* are the more complex pattern of the scutum of the female, the paraproct, which conspicuously projects ventrally and has its posterior border emarginated, and, of course, the greatly enlarged scapus and pedicellus of the male. Pupae of *S. cotopaxi* are mostly found on the underside of large rocks and boulders; in the described *Pternaspatha*, pupae are in most cases attached to leaves of aquatic plants and to small branches, to grass blades trailing in the current, and to the surface of small stones. All these autapomorphic characters can easily be imagined to have derived from those of typical *Pternaspatha*.

Although each of the synapomorphic characters discussed above can be imagined to have arisen independently in *Pternaspatha* and in *S. cotopaxi*, (perhaps due to some as yet unknown common factor inherent in the high altitude where these insects occur) it is more parsimonious to assume that *Simulium cotopaxi* has certain derived characters in common with the formerly known *Pternaspatha* because all share a common recent ancestor not shared by other species. We therefore include *cotopaxi* in the subgenus *Simulium* (*Pternaspatha*).

Coscarón and Wygodzinsky (1972) have divided *Pternaspatha* into two species groups. The *nigristrigatum* group is characterized by the apically tuberculate distimere (an apomorphy) and symplesiomorphically by the filiform multibranched trichomes of the head and thorax. The *nemorale* group is defined apomorphically by a trend toward a modification of the trichomes and plesiomorphically by an apically smooth distimere. *Simulium cotopaxi* fits the definition of the *nemorale* group: its distimere is smooth apically and the trichomes are modified if a secondary reduction in number (5-6 on the thorax as against over 100 in many species of the subgenus) is considered a modification and not a plesiomorphic character state.

The area in northern Ecuador where *cotopaxi* was collected is more than 1000 km. distant from the northernmost locality where *Pternaspatha* was obtained formerly. No collecting of high mountain black flies has been carried out between these two areas; it would be highly desirable to fill out this gap.

LITERATURE CITED

Coscarón, Sixto, and Pedro Wygodzinsky
1972. Taxonomy and distribution of the black fly subgenus *Simulium* (*Pternaspatha*) Enderlein (Simuliidae, Diptera, Insecta). Bull. Amer. Mus. Nat. Hist., vol. 147, pp. 199-240.

Dalmat, Herbert T.
1955. The blackflies (Diptera, Simuliidae) of Guatemala and their role as vectors of onchocerciasis. Smithsonian Misc. Coll., vol. 125, vii + 425 pp.

Wygodzinsky, Pedro
1971. Descriptions and redescriptions of species of the blackfly genus *Simulium* from the northern Andes (Simuliidae, Diptera). Amer. Mus. Novitates, no. 2447, 38 pp.