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SIMULIUM (*PTERNASPATHA*)
ENDERLEIN (SIMULIIDAE,
DIPTERA, INSECTA)

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ABSTRACT

Simulium (*Pternaspatha*) EXTENDS from Tierra del Fuego north to an area somewhere between central Peru and northern Ecuador; the northern limit of the subgenus probably coincides with that of the *puna* formation of the high Andes. The subgenus is now divided into the *nigristrigatum* and *memorale* species groups; some formerly proposed groups are suppressed.

New locality records are given for several species, and *Simulium* (*Pternaspatha*) *pulchrum* and *prodexargenteum* are redescribed. *Simulium punctativentris* is synonymized with *S. simile*. New species are *horcochuspi* [Argentina] (*nigristrigatum* group) and *bordai* [Bolivia], *hectorvargasi* [Chile], *quechuanum* [Chile and Argentina] and *stelliferum* [Chile] (*memorale* group).

RESUMEN

El subgénero *Simulium* (*Pternaspatha*) se extiende desde Tierra del Fuego hasta algún punto de las grandes alturas de la Cordillera de los Andes entre el centro del Perú y el norte de Ecuador. Posiblemente, el límite norte del subgénero coincide con el de la formación de la *puna* en la Cordillera. El subgénero se divide en dos grupos de especies, el grupo *nigristrigatum* y el grupo *memorale*. Se presentan claves ilustradas para la determinación específica de larvas,

pupas y adultos de ambos sexos. Se dan localidades nuevas para varias especies; se sinonimiza *S. punctativentris* con *S. simile*. Se describen *Simulium* (*Pternaspatha*) *pulchrum* y *prodexargenteum*, y se describen como nuevas *horcochuspi* [Argentina] (grupo *nigristrigatum*), y *bordai* [Bolivia], *hectorvargasi* [Chile], *quechuanum* [Chile y Argentina] y *stelliferum* [Chile] (grupo *memorale*).

INTRODUCTION

THE SUBGENUS *Simulium* (*Pternaspatha*) Enderlein, 1930, is an important element of the black fly fauna of cool and cold temperate South America. *Pternaspatha* was revised by Wygodzinsky and Coscarón (1967). Since that review was published, many additional specimens were collected by Sixto Coscarón and also others were received for study from various sources. We can now report new localities for many species, redescribe several named but poorly known *Pternaspatha*, and describe several new species.¹ Among the last there is one, *Simulium stelliferum*, with a structural feature unique in the family, viz., the stellate trichomes of the pupal thorax (fig. 1).

The taxonomic treatment of the species is preceded by keys to the known larvae, pupae, and adults of *Pternaspatha*, based on similar

keys published by Wygodzinsky and Coscarón (1967). In order to facilitate use of the keys, certain illustrations have been taken from our 1967 paper and are reproduced herein; in addition, there are a great number of new drawings for known and new species. The keys will help in the identification of specimens, but, as many undescribed *Pternaspatha* undoubtedly exist, caution in accepting the results of any identification is advisable. Furthermore, because morphological and chromatic differences separating larvae and adult males and females of *Pternaspatha* are often only slight or difficult to interpret, identification of pupae should, whenever possible, complement any results obtained from the determination of larvae or adults.

In the systematic treatment, all species of *Pternaspatha* are listed alphabetically under the heading of their respective species group, together with such notes, redescriptions, or de-

¹The present paper was presented at the First Latin American Congress of Entomology, in Cusco, Peru, April, 1971.

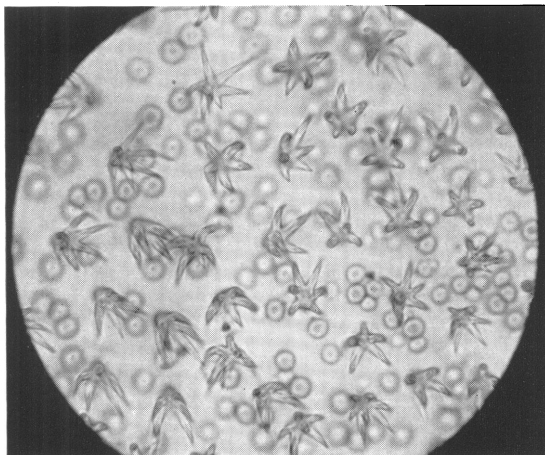


FIG. 1. *Simulium stelliferum*. Trichomes and platelets of thorax of pupa.

scriptions, as are deemed necessary. Literature citations are restricted to the mention of the treatment of each species in our revision (Wygodzinsky and Coscarón, 1967), in which detailed synonymies can be found. Only in a few cases have we preferred to list the whole synonymy of the species instead of forcing the reader to piece it together himself.

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Considerable help in the field was given in Chile by Dr. R. Cortés, and Agricultural Engineer H. Vargas of the Universidad del Norte, Arica, and Dr. R. Gonzalez and Mr. L. Peña of the Universidad de Chile, Santiago; in Bolivia, by Mr. M. Borda of the Instituto Bacteriológico, La Paz.

Most of the material collected by Sixto Coscarón is in the entomological collection of the American Museum of Natural History, but some specimens will be deposited in the Museo de La Plata and the Instituto Nacional de Microbiología, both in Argentina. Material collected by Mr. Peña is in the Museo Nacional de Historia Natural, Santiago, Chile, or his private collection. We have also studied material from other collections, namely, the Canadian

National Collection, lent by Drs. G. Shewell and B. Peterson, the collection of the California Academy of Sciences, lent by Dr. P. Arnaud, and the California Insect Survey, University of California, Berkeley, lent by Dr. E. Schlinger, and the Zoological Institute of the University of Lund, Sweden, from Dr. E. Dahl.

Our thanks are due to all individuals and institutions mentioned above.

All illustrations were made by the authors.

ABBREVIATIONS

AMNH, the American Museum of Natural History

CAS, California Academy of Sciences

CIS, University of California, Berkeley

CNC, Canadian National Collection

INM, Instituto Nacional de Microbiología

MLP, Museo de La Plata

MNHN, Museo Nacional de Historia Natural

ULUND, Zoological Institute of the University of Lund, Sweden

DISTRIBUTION

The authors have personally collected black flies along the Andean chain from Tierra del Fuego to Venezuela and have had access to much material obtained by others from that area. Specimens of *Pternaspatha* constitute a typical and abundant element of the rithron (Illies, 1961) from Tierra del Fuego to a latitude slightly north of that of Lima, Peru. We have not collected in northern Peru or southern Ecuador, but have done extensive field work in areas of northern Ecuador, Colombia, and Venezuela where *Pternaspatha* would be expected to be found if it existed there. Not a single specimen was encountered, even though other blackflies were abundant. We are therefore reasonably sure that the northern limit of the range of *Pternaspatha* lies somewhere between central Peru and northern Ecuador. It is tempting to associate the northern limit of *Pternaspatha* with certain orographic features such as the Marañon gap, which widely interrupts the lofty heights of the north-south ranges to which *Pternaspatha* is restricted at these latitudes; one might assume that this gap would stop the northward spread of the subgenus. However, the primarily Andean black fly genus *Gigantodax*, which occurs wherever *Pternaspatha* is found, extends all the way from Tierra del Fuego into Mexico and obviously has not been hindered in its dispersal by the Marañon gap.



FIG. 2. Rio Olacapato, at 4000 m. altitude in the puna of the province of Salta, Argentina, where *Simulium prodexargenteum* was collected.

It is our assumption that the range of *Pternaspatha* is determined by ecological requirements. In the northern portion of its range, *Pternaspatha* occurs only above 2000 m. altitude, and its area coincides roughly with a life zone known as puna, characterized by an arid (figs. 2, 3) to moist climate, with considerable daily and annual temperature fluctuations. Farther north, at the high altitudes where black flies are found, a quite different life zone is dominant, the páramos, which are permanently humid and show only slight daily and annual temperature fluctuations.

SYSTEMATICS

In our earlier revision (Wygodzinsky and Coscarón, 1967) we arranged the then-known species of *Pternaspatha* in four species groups, with one being divided into two subgroups. The species described or redescribed in the present paper shed new light on the morphological diversity of the subgenus. Species bridging the division between two of our groups have been found: *S. (P.) stelliferum*, *luchoi*, and *prodexargenteum* possess characters of both our *nemorale* and *albilineatum* group. These groups are thus not tenable in their present form. We also now believe that the possession, by a single or two closely related species, of striking autapomor-

phic characters, such as the ribbon-like trichomes of the pupae of *simile* and *pulchrum*, or the presence of setae on the base of R in *annulatum*, are not by themselves sufficient to oppose cladistically the species bearing such characters to all those otherwise agreeing with them morphologically. We are therefore here dividing the subgenus *Pternaspatha* into two species groups, as follows:

The *nigristrigatum* group that contains the former *nigristrigatum* and *illiesi* subgroups and can be defined as follows: Distimere tuberculate apically; abdominal terga III–V of female each with 1+1 large white spots; trichomes of pupal thorax invariably slender, hairlike, with numerous branches. The following species, among them the type species of *Pternaspatha*, are included: *bachmanni*, *deagostinii*, *dureti*, *horcochuspi*, *huemul*, *limay*, *nigristrigatum*, *pichi*, *pulchrum*, *simile*, *strigidorsum*, and *walterwittmeri*.

The *nemorale* group that contains the former *nemorale*, *annulatum*, and *albilineatum* groups is defined as follows: Distimere smooth apically; only some of abdominal terga III–V with paired large white spots, or all black; trichomes of pupal thorax rarely as in *nigristrigatum* group, in most species simple or bifid, hairlike, lanceolate, spatulate, or stellate. The following species are included: *albicinctum*, *albilineatum*, *annulatum*, *bar-*



FIG. 3. Stream near Rosario de Coyaguaima, at 4700 m. altitude in the province of Jujuy, Argentina, from which *Simulium prodexargenteum* was collected.

batipes, *bordai*, *caprii*, *hectorvargasi*, *herrerii*, *luchoi*, *nemorale*, *prodexargenteum*, *quechuanum*, *stelliferum*, and *yacuchuspi*.

The clearly apomorphic character of the apically tuberculate distimere suggests that the *nigristrigatum*-group is monophyletic. No synapomorphic character is found in all members of the *nemorale* group, and future analysis may well show this group to be paraphyletic, with some of its components more closely related to the *nigristrigatum* group than to the remainder of the *nemorale* group.

KEY TO THE KNOWN LARVAE OF *Simulium*
(*Pternaspatha*)

1. Postgenal bridge extremely reduced, its length about one-fifth or less of depth of postgenal cleft as measured from level of posterior tentorial pits to apex of postgenal cleft (figs. 6A; 20N) 2
Postgenal bridge much larger, about one-half of depth of postgenal cleft or larger (figs. 15N; 16G; 21Q; 25J) 8
2. Anal gills with three simple lobes, at most with one pair of secondary lobules 3
Anal gills with about three pairs of secondary lobules on each main lobe 6
3. Anal gills with only three simple lobes 4
Anal gills with one secondary lobule close to base of lateral main lobes, or with two pairs on middle main lobe 5

4. Cephalic apotome very light colored, only slightly darkened at posterior margin (fig. 10I) (some) . . . *pulchrum*
Cephalic apotome with over-all light or medium brown pigment, also perceptibly darkened at hind border (fig. 20L) *prodexargenteum*
5. Anal gills with one secondary lobule close to base of each of the lateral lobes; first two antennal segments extremely light colored; hypostomial setae arranged in one, rarely two, irregular series, with from six to eight setae on each side *bachmanni*
Anal gills with two secondary lobules on middle main lobe; first two antennal segments distinctly pigmented; hypostomial setae arranged in from one to three rows, with about 14–18 setae on each side *pulchrum*
6. Maximum length about 6.7 mm.; maximum width of cephalic capsule about 0.6 mm., number of anal hooks in each row approximately 17 *limay*
Maximum length greater than 7.5 mm., maximum width of cephalic capsule more than 0.7 mm.; number of anal hooks in each row 18 or more 7
7. Maximum length 8 mm.; maximum width of cephalic capsule 0.75 mm.; postgenal cleft approximately as wide at base as deep; number of anal hooks in each row about 25–28 *deagostinii*
Maximum length 9 mm.; maximum width of cephalic capsule 0.8 mm.; postgenal cleft

- wider at base than deep; number of anal hooks in each row 18–19 *simile*
8. Lobes of anal gills each with 16–20 very long and slender lobules (fig. 11J) *yacuchuspi*
Lobes of anal gills with fewer or without secondary lobules 9
9. Postgenal bridge about as long as postgenal cleft (fig. 16G) *herreri*
Postgenal bridge much shorter, about half as long as post-genal cleft (figs. 15N; 21Q; 25J) 10
10. Lobes of anal gills simple, without secondary lobules 11
Lobes of anal gills with secondary lobules . . 17
11. Base of anal sclerite with scalelike cuticular structures, from simple to trifid *nemorale*
Base of anal sclerite without cuticular structures, or only with simple spicules (fig. 25M, O) . . 12
12. Sclerotized area between anterior and posterior arms of anal sclerite extensive (figs. 21O; 25M, O); base of anal sclerite with simple spicules (fig. 25M, O) 13
Sclerotized area between anterior and posterior arms of anal sclerite comparatively narrow (fig. 5I); base of anal sclerite lacking spicules 15
13. Anterior half of cephalic apotome conspicuously lighter than basal portion of sclerite (fig. 25F, G) (some) . . . *stelliferum*
Pigmentation of cephalic apotome not with strong contrasts. 14
14. First marginal tooth of mandible about four times as long as second (fig. 21P) . . *quechuanum*
First marginal tooth of mandible about twice as long as second (fig. 15M) *hectorvargasi*
15. Pattern of cephalic apotome positive; maximum size of mature larva, 7 mm. *pichi*
Pattern of cephalic apotome negative; size of mature larva 8 mm. or more 16
16. Third antennal segment shorter than first . *dureti*
Third antennal segment about as long as first (fig. 5J) *horcochuspi*
17. Base of anal sclerite lacking spicules or scalelike cuticular structures 18
Base of anal sclerite with scalelike cuticular structures 19
18. Sclerotized area between anterior and posterior arms of anal sclerite comparatively small (similar to fig. 5I) *annulatum*
Sclerotized area between anterior and posterior arms of anal sclerite extensive (fig. 25M, O) (some) . . . *stelliferum*
19. Crochet ring with not more than 70 rows of hooks; third antennal segment as long as first; pattern of cephalic apotome as shown in figure 11C. *albilineatum*
Crochet ring with 80 rows of hooks or more; third antennal segment slightly but distinctly

- shorter than first; pattern of cephalic apotome different 20
20. Spicules at base of anal sclerite not numerous (fig. 25M, O) (some) . . . *stelliferum*
Spicules at base of anal sclerite much more numerous 21
21. Pattern of cephalic apotome as shown in figure 11D *barbatipes*
Pattern of cephalic apotome difficult to perceive, about as shown in figure 12F *caprii*

Simulium (*Pternaspatha*) *albicinctum*, *bordai*, *hue-mul*, *luchoi*, *nigristrigatum*, *schoenemanni*, *strigidorsum*, and *walterwittmeri* are not included in this key because their larvae are not known.

KEY TO THE KNOWN PUPAE OF *Simulium* (*Pternaspatha*)

1. Respiratory organs with eight filaments . . . 2
Respiratory organs with six filaments . . . 17
2. Lower or both filaments of ventral primary branch of respiratory organ sharply diverging from remaining filaments, closely adhering to body of pupa (figs. 16A; 17T; 20D) . . . 3
All filaments of respiratory organs approximately parallel, at least on apical half 6
3. Many trichomes of head and thorax shortly lanceolate, generally bifid (fig. 17N, R) . *luchoi*
Trichomes of head and thorax not as above . . 4
4. Trichomes of thorax elongate-lanceolate, numbering about 250+250 (fig. 16F)
 (some) . . . *herreri*
Trichomes of thorax slender hairlike, simple or branched, their number not more than 25+25 5
5. Trichomes of thorax numbering about 22+22, with numerous branches (fig. 7C); base of frontoclypeus of male pupa with numerous platelets (fig. 7I) *huemul*
Trichomes of thorax numbering about 12+12, simple or bifid (fig. 20A); frontoclypeus of male pupa lacking platelets . *prodeuxargenteum*
6. Trichomes of head and thorax very short, a few branched but most simple, from hairlike to spinelike, those of thorax concentrated in a transverse row at base of exposed portion (fig. 12D) *nemorale*
Trichomes of head and thorax much longer, their arrangement not as above 7
7. Trichomes of head and thorax very numerous, flattened, their branches ribbon-like (figs. 8, 9) 8
Trichomes of head and thorax not as above . . 9
8. Length of cocoon along base, 5.2–6.8 mm.; clypeus (fig. 10R) with about 400 platelets, with cephalic platelets not surpassing area of facial trichomes, this region reinforced by sclerotized edge; thoracic trichomes not num-

- bering more than 250+250, average number 140+140 *simile*
 Length of cocoon along base, 3.8–4.5 mm.; clypeus (fig. 10Q) with about 800 platelets; cephalic platelets surpassing area of facial trichomes, this region smooth, not reinforced at edges; thoracic trichomes numbering not more than 130+130, average number 70+70 *pulchrum*
9. Disc of exposed portion of thorax without platelets, or platelets only along area adjacent to rim of aperture of cocoon (figs. 12C; 15A) . . .10
 Disc of exposed portion of thorax with numerous platelets (fig. 7A)13
10. Frontal trichomes reduced to minute cones (fig. 15H); thorax with about 150+150 trichomes *hectorvargasi*
 Frontal trichomes normally developed, hairlike; thorax with fewer than 100+100 trichomes11
11. Thorax with about 70+70 trichomes (fig. 12C), these trichomes either simple or, frequently, with two or three branches *caprii*
 Thorax with not more than 20+20 trichomes, these generally with four or more branches (fig. 7D, M)12
12. Thorax with about 20+20 trichomes (fig. 7M); origin of filaments of ventral primary branch of respiratory organ generally situated below level of origin of upper filaments of dorsal primary branch (fig. 7E). . . *walterwittmeri*
 Number of trichomes of thorax much smaller than above (fig. 7D); origin of filaments of ventral primary branch generally situated at or above level of origin of upper filaments of dorsal primary branch (fig. 7B) . . . *bachmanni*
13. Trichomes of thorax lacking from anterior portion of sclerite (fig. 7A)14
 Trichomes of thorax practically covering all of exposed surface of sclerite (similar to figure 13A)15
14. Thorax with about 20+20 trichomes; platelets of frontoclypeus sparse, their surface minutely spinose; male pupa with platelets only at base of clypeus *limay*
 Thorax with about 60+60 trichomes (fig. 7A); platelets of clypeus more numerous, their surface smooth; male pupa with clypeus entirely covered by platelets *pichi*
15. Cocoon with leaden sheen; surface of platelets of frontoclypeus smooth; frontal trichomes (fig. 5C) arranged in groups of three or four, distinctly separated from facial trichomes which are single; ocular trichomes (fig. 5C) single or in groups of two; trichomes of thorax most frequently with from one to three branches (fig. 5F) *horcochuspi*
 Cocoon without leaden sheen; platelets of frontoclypeus more or less distinctly tuberculate; frontal trichomes (fig. 4A, B) more numerous, contiguous with facial trichomes which number more than one; ocular trichomes (fig. 4A, B) numbering more than two; trichomes of thorax most frequently with more than three branches (fig. 4C)16
16. Second division of median primary branch of respiratory organ situated much apicad of level of second division of dorsal primary branch (fig. 4H); facial trichomes situated in depression limited by strongly sclerotized ridges (fig. 4B) *deagostinii*
 Second division of median primary branch of respiratory organ generally not situated distinctly apicad of level of second division of dorsal primary branch (fig. 4D); facial trichomes not situated in distinct depression (fig. 4A) *dureti*
17. One or both filaments of ventral primary branch of respiratory organ sharply diverging from remaining filaments, downward and backwardly directed (figs. 11N; 16E; 21K) . . .18
 Filaments of respiratory organ approximately parallel, or, if one of both filaments of ventral branch somewhat diverging, then not backwardly directed (figs. 13C, F; 24D, F) . . .20
18. All thoracic trichomes long, hairlike (fig. 11F) or elongate-lanceolate (fig. 16F)19
 Thoracic trichomes both hairlike, simple or branched, or, most frequently, spatulate (fig. 21N) *quechuanum*
19. Both filaments of ventral primary branch of respiratory organ sharply diverging from remaining filaments (fig. 16E); conspicuous areas of platelets at base of frontoclypeus on each side (fig. 16C); trichomes of thorax elongate-lanceolate, subequal (fig. 16F) . *herreri*
 Generally only lower filament of primary ventral branch of respiratory organ diverging from remaining filaments (fig. 11N); no platelets in area mentioned; trichomes of thorax slender, hairlike, long and short (fig. 11F) . . *yacuchuspi*
20. Most thoracic trichomes roughly stellate (figs. 1; 24B, E; 25A, B) *stelliferum*
 Thoracic trichomes not stellate21
21. Thoracic trichomes both long, hairlike, and shortly lanceolate (fig. 11E) . . . *barbatipes*
 All thoracic trichomes hairlike, simple or branched (figs. 11A; 12A; 13A)22
22. Practically all thoracic trichomes simple (fig. 12A) *annulatum*
 Many thoracic trichomes branched (figs. 11A; 13A)23
23. Thoracic trichomes (fig. 11A) simple or bifid, only rarely with more than two branches; average length of trichomes 0.06 mm., their number 250–300 on each side. . . *albilineatum*

Thoracic trichomes (fig. 13A, D, E) practically never simple, generally with more than two branches; average length of trichomes 0.09–0.11 mm., their number 120–170 on each side *bordai*

Simulium (*Pternaspatha*) *albicinctum*, *nigristrigatum*, *schoenemanni*, and *strigidorsum* are not included in the above key because their pupae are not known.

KEY TO THE KNOWN MALES OF *Simulium*
(*Pternaspatha*)

1. Basal portion of R bare (fig. 12B) 2
Basal portion of R setose *annulatum*
2. Calcipala absent (fig. 19J, M) 3
Calcipala present, although in some species very small 8
3. Hind tibiae conspicuously darkened at base (fig. 19D, F) 4
Hind tibiae not conspicuously darkened at base 5
4. Abdomen with paired silvery spots on terga II–VII (fig. 19C); distimere with apical surface smooth (similar to fig. 14N) . . . *prodexargenteum*
Abdomen with paired silvery spots only on segments II, VI, and VII; apical surface of distimere granulose (similar to fig. 7J) . . *deagostinii*
5. Hind basitarsus less than four times as long as wide 6
Hind basitarsus at least four times as long as wide 7
6. Paired silvery spots on abdominal terga II and VI *nigristrigatum*
Paired silvery white spots on abdominal terga II, VI, and VII *bachmanni*
7. Wing length, 2.8 mm.; setae of scutum brass colored; tergum VII with central black spot and gray sides; pattern of legs similar to that shown in figure 7L; posterior basitarsus five times as long as wide *limay*
Wing length, 2.4 mm.; setae of mesonotum silvery; tergum VII almost completely black; color pattern of legs similar to that shown in figure 7F; hind basitarsus four times as long as wide *walterwittmeri*
8. Apical surface of distimere smooth (fig. 14N) . . 9
Apical surface of distimere tuberculate (fig. 7J) 19
9. Base of hind tibia conspicuously darkened (figs. 14M; 17G; 19D, I; 23C) 10
Base of hind tibia not conspicuously darkened *barbatipes*
10. Hairs and spines on R_1 and R_s arranged in one or two irregular rows (as in female, fig. 12B); hind basitarsus narrower, about four times as long as wide 11
Hairs and spines on R_1 and R_s arranged in a single row (fig. 16B); hind basitarsus wider, not more than 3.5 times as long as wide . . . 13
11. Wing length, more than 3.5 mm. *nemorale*
Wing length, less than 3.5 mm. 12
12. Wing length, 2.7–2.9 mm.; hind basitarsus narrower (4.3–5.5 times as long as wide) (fig. 23C) *stelliferum*
Wing length, 3.3 mm.; hind basitarsus wider (3.8–4.0 times as long as wide) *caprii*
13. Abdominal terga III–V entirely black, or III with 1+1 minute light colored spots (fig. 14R, S) 14
Abdominal tergum III or V with distinct paired silvery white spots (figs. 11K; 16H; 19C) . . 17
14. Basal three-fifths of posterior femur whitish, sharply contrasting with dark apex (fig. 17G); posterior basitarsus less than three times as long as wide (fig. 17G) 15
Basal three-fourths of hind femur light brown (fig. 14M); posterior basitarsus at least three times as long as wide (fig. 14M) 16
15. Calcipala very small, subtriangular (fig. 17K) *luchoi*
Calcipala somewhat larger, distinctly rounded (fig. 11H) *albicinctum*
16. Calcipala very small (fig. 21G) *quechuanum*
Calcipala larger (fig. 14Q) *hectorvargasi*
17. Hairs of abdomen silvery; tergum III uniformly dark, but V with 1+1 distinct white spots (fig. 16H); dark spot at bases of fore and mid femora short *herreri*
Hairs of abdomen light brass colored; tergum III with 1+1 small but distinct silvery white spots at hind border, about half as high as height of segment; spot at bases of fore and mid femora narrowly elongate 18
18. Posterolateral margins of abdominal terga IV and V narrowly bordered with silver or white (fig. 19C) *prodexargenteum*
Posterolateral margin of abdominal terga IV and V without light colored areas (fig. 11K) except rarely on V . . . *albilineatum*; *yacuchuspi*
19. Calcipala very small (similar to fig. 4I) 20
Calcipala well developed (similar to fig. 10N) 22
20. Abdominal terga III–V entirely black; hind basitarsus less than four times as long as wide 21
Abdominal terga III–V each with 1+1 silvery white spots, those on III and V large, those on IV minute; hind basitarsus about five times as long as wide *huemul*
21. Wing length, 3 mm.; hind basitarsus wide, 3.2–3.4 times as long as wide; under certain angles of illumination, at least anterior third of scutum grayish *dureti*
Wing length, 2.3–2.6 mm.; hind basitarsus narrower, 3.8 times as long as wide; only

- about one-fifth of anterior portion of scutum gray *pichi*
22. Length of wing, 2.8–3.0 mm.; abdomen with small but distinct paired light-colored spots on tergum III (fig. 10M) *simile*
- Length of wing, 2.6–2.7 mm.; tergum III lacking any trace of white spots *pulchrum*

The males of *Simulium* (*Pternaspatha*) *bordai*, *schoenemanni*, and *strigidorsum* are not known and have therefore not been included in the keys. The male of *horcochuspi* is only known from a not too well-preserved pharate specimen and also has not been included; if better known, it might key out with *deagostinii*.

KEY TO THE KNOWN FEMALES OF *Simulium*
(*Pternaspatha*)

1. Basal portion of R bare (fig. 12B) 2
Basal portion of R setose *annulatum*
2. Abdomen (fig. 7G) dull silver-gray, terga II–V each with one relatively small, central, velvety black spot, and with lateral dark spots absent; calcipala very small *strigidorsum*
Abdominal terga II–V with more extensive dark markings; calcipala absent or present 3
3. Calcipala absent (figs. 18L, M; 19J–M) 4
Calcipala present although in some species very small 10
4. Terga IV and V with 1+1 large silver-white spots (fig. 7H) 5
Terga IV and V without such spots, entirely black, although in some specimens narrowly margined with white along hind borders (fig. 18J, K) *prodexargenteum*
5. Claws with subbasal tooth (fig. 7K) 6
Claws without tooth (fig. 5A) *horcochuspi*
6. Paraprocts truncate on free extremity (fig. 4F) 7
Paraprocts with free extremity strongly salient (fig. 4G) 8
7. Wing length, approximately 3 mm.; fore and mid femora light brown, not conspicuously darkened apically; terga VIII and IX almost entirely black *limay*
Wing length, approximately 2.5 mm.; fore and mid femora conspicuously darkened at apex; terga VIII and IX silver colored, with VIII faintly darkened at center *bachmanni*
8. Femora dark brown; dark portion of hind tibia occupying at least apical half of article; light-colored spots of abdominal terga III–V not attaining anterior border of terga (fig. 7H) *nigristigatum*
Not all femora uniformly dark brown; dark region of hind tibia occupying less than apical fourth of article; light-colored spots of abdominal terga III–V attaining anterior portion of terga 9
9. Wing length, 3.4 mm.; femora and tibiae of mid and hind legs distinctly darkened at base and apex *deagostinii*
Wing length, 2.6 mm.; femora and tibiae of mid and hind legs darkened at apex but not at base *walterwittmeri*
10. Tergum III without paired light-colored spots, thus terga III–V entirely dark except in some species with narrow white line along lateral portions of hind margin (fig. 22O, P); central light-colored line of scutum invisible or only faintly perceptible 11
Tergum III with paired gray or white spots (figs. 14G, H; 17M; 18J), in some specimens small but in all cases perceptible; central light-colored line of scutum invariably clearly visible 12
11. Bases of tibiae conspicuously pigmented, but apex of hind basitarsus lacking conspicuous pigment (fig. 12E); terga III–V entirely dark; paraprocts roundly salient, cerci relatively high (fig. 12H) *caprii*
Bases of tibiae lacking distinct pigment, with hind basitarsus conspicuously pigmented on apical third (fig. 22K); posterior border of terga III–V narrowly bordered with gray (fig. 22O); paraprocts very short and truncate, cerci relatively low (fig. 22N) *stelliferum*
12. Terga IV and V lacking paired gray or white spots, only in some cases their hind margins narrowly bordered with white laterally (figs. 11M; 14H; 17M; 18J); tibiae with distinct dark basal or subbasal annulus 13
Terga IV and V, in some cases only tergum V, with paired light-colored spots of varied sizes (figs. 10F, O; 11L; 12I; 16D; 21B, C); tibiae with or without dark subbasal or basal annulus 17
13. Calcipala obsolescent (figs. 18L; 19L, M) (some) . . . *prodexargenteum*
Calcipala distinct (figs. 11H; 14J, Q; 17E) . . . 14
14. Dark area separating white spots on abdominal tergum II very narrow, acuminate anteriorly (fig. 11M); tergum VI entirely silver-white *albicinctum*
Dark area separating white spots on abdominal tergum II wide (figs. 14H; 17M), widened anteriorly or as wide anteriorly as posteriorly; tergum VI dark at center and laterally . . . 15
15. Setae and spines on R₁ arranged in several irregular rows (fig. 12B) *memorale*
Setae and spines on R₁ arranged in a single row (similar to fig. 16B) 16
16. Calcipala very small, narrowly triangular (fig. 17E) *luchoi*
Calcipala larger, rounded (fig. 14J) *hectorvargasi*

17. Tibiae not conspicuously darkened at base (fig. 4E)18
Tibiae conspicuously darkened at base22
18. Paired, light-colored spots on tergum III distinct, on IV and V very small, in some cases difficult to perceive (fig. 11L); basal segments of antennae distinctly orange-colored, conspicuously contrasting with darker remainder of antenna; wing length, 3.1–3.9 mm. . . *barbatipes*
Paired, light-colored spots on terga III–V larger, all distinct (fig. 10F); basal segments of antenna grayish, not strongly contrasting with remainder of antenna; wing length, 2.5–3.6 mm.19
19. Calcipala well developed (fig. 10N)20
Calcipala minute (fig. 4I)21
20. Wing length, 3.2–3.5 mm.; posterior tibia with pigment often only at its extreme apex . . *simile*
Wing length, 2.6–2.8 mm.; pigment of hind tibiae always more widely extended, on apical two-fifths of segment (fig. 10E) . . . *pulchrum*
21. Fronto-ocular triangle longer than wide; wing length greater than 3 mm.; Sc with approximately 10 hairs. *dureti*
Fronto-ocular triangle not longer than wide; wing length, 3 mm. or less; Sc without or with at most one or two hairs *pichi*
22. Setae and spines on R_1 and setae on R_s arranged in several irregular rows (fig. 12B); white spots on terga IV and V faint, narrowly elongate (fig. 12I) *nemorale*
Setae and spines on R_1 and setae on R_s arranged in a single row, as in male (fig. 16B); white spots on terga IV and/or V generally distinct, rounded or rectangular (fig. 16D)23
23. Paired white spots on tergum V as large as those on tergum III (fig. 11B) *albilineatum*
Paired white spots on tergum V distinctly smaller than those on tergum III (figs. 16D, 21C) . . .24
24. Tooth of claws exceptionally small (fig. 11G); central area of eighth sternum lighter than lateral portions; paraprocts pointed (fig. 11I) *yacuchuspi*
Tooth of claws normally developed (fig. 21A); central area of eighth sternum darker than lateral portions; paraprocts broadly rounded (fig. 21F)25
25. Abdomen (fig. 16D) with paired silver-white spots of tergum III only slightly surpassing posterior half of tergum anteriorly; tergum IV with 1+1 small whitish spots; central whitish area of tergum VI not bisected longitudinally by black stripe *herreri*
Abdomen (fig. 21B, C) with paired whitish spots of tergum III coming close to anterior border of tergum; tergum IV lacking spots; light-colored whitish area of tergum VI bisected longitudinally by dark stripe

. *quechuanum*

The females of *Simulium* (*Pternaspatha*) *bordai* and *huelmul* are not known and therefore not included in the key; *Simulium* (*Pternaspatha*) *schoenemanni* is not included because of lack of sufficient data.

Nigristrigatum GROUP

Simulium (*Pternaspatha*) *bachmanni* Wygodzinsky and Coscarón
Figure 7B, D, J, K

Simulium (*Pternaspatha*) *bachmanni* WYGODZINSKY AND COSCARÓN, 1967, p. 58.

MATERIAL EXAMINED: Argentina: Neuquén: Neuquén, Río Limay, January 23, 1968 (S. Coscarón; AMNH, INM), numerous females and males, all reared, pupae and larvae; *ibid.*, January 14, 1969 (S. Coscarón; INM), pupae and larvae.

The aquatic instars were found on branches and leaves of the willow, *Salix humboldtiana*.

Simulium (*Pternaspatha*) *deagostinii* Coscarón and Wygodzinsky
Figure 4B, H

Simulium (*Pternaspatha*) *deagostinii*: WYGODZINSKY AND COSCARÓN, 1967, p. 61.

MATERIAL EXAMINED: Argentina: Tierra del Fuego: 40 km. NW of Porvenir (M. E. Irwin, E. I. Schlinger; CIS), 20 males. Chubut: Río Senguerr, 10 km. east of Lago Fontana, February 15, 1961 (S. Coscarón; INM), pupae; Río Medio near El Bolsón [Río Negro], November 28, 1950 (P. Wygodzinsky; AMNH), one pupa.

Simulium (*Pternaspatha*) *dureti* Wygodzinsky and Coscarón
Figure 4A, C–E, I

Simulium (*Pternaspatha*) *dureti* WYGODZINSKY AND COSCARÓN, 1967, p. 62.

MATERIAL EXAMINED: Argentina: Jujuy: Quebrada de Humahuaca north of Humahuaca, 3300 m., October 22, 1968, flying (Coscarón; AMNH, INM), two males, four females; Río Yavi, 3400 m., October 23, 1968 (S. Coscarón; AMNH, INM), pupae and larvae; Río Yavi Chico, 3700 m., October 24, 1968 (S. Coscarón; INM), pupae and larvae; Orosmayo, 3900 m.,

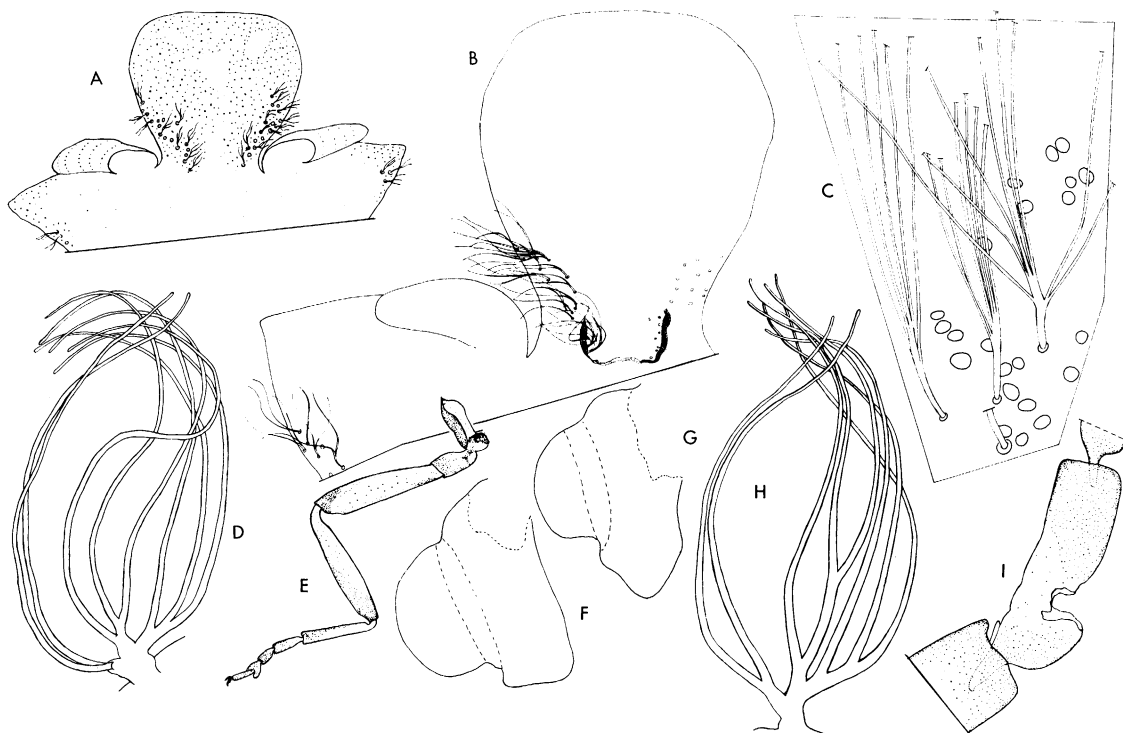


FIG. 4. A. *Simulium dureti*, portion of head of pupa. B. *Simulium deagostinii*, portion of head of pupa. C-E. *Simulium dureti*. C. Platelets and trichomes of thorax of pupa, high magnification. D. Respiratory organ of pupa; ventral primary branch at left. E. Midleg of female. F. *Simulium limay*, cercus and paraproct. G. *Simulium walter-wittmeri*, cercus and paraproct. H. *Simulium deagostinii*, respiratory organ of pupa. I. *Simulium dureti*, female, apex of hind basitarsus, with second tarsal segment.

November 3, 1968 (S. Coscarón; INM), one pupa.

For comparative purposes, details of some thoracic trichomes are illustrated here (fig. 4C).

The specimens from Río Yavi and Río Yavi Chico were found associated with *Simulium* (*Pternaspatha*) *barbatipes*.

Simulium (*Pternaspatha*) aff. *dureti*

MATERIAL EXAMINED: Argentina: San Juan: Tocota, 2800 m., November 6, 1967 (S. Coscarón; AMNH), one pharate male, one pupa, several larvae.

This species is close to *Simulium dureti* but not identical with it. The pharate male differs from that of *dureti* in lacking a calcipala and the narrow hind basitarsus, which is five times as long as wide. The chaetotaxy of the pupa is as in *dureti*, viz., the facial and frontal trichomes of the head are very numerous and form a continuous group, and the branches of all trichomes are

very numerous, but the respiratory organ is as in *deagostinii* or *horcochuspi*, viz., the second division of the median primary branch is situated apicad of the level of the second division of the dorsal primary branch. The larva is as in *dureti*.

***Simulium horcochuspi*, new species**

Figure 5

DIAGNOSIS: See keys for diagnostic characters.

FEMALE: Wing length, 2.9–3.6 mm.

Color of head and thorax as in *nemorale*. Adpressed setae of scutum silvery, not very dense; over-all color of dark portions of scutum distinctly blackish. Scutellum and metanotum gray. Pleural tuft silvery white. Color of wings and halteres as in *dureti*. Color of legs as in *dureti*, but light-colored areas of femora brownish instead of white. Color pattern of abdomen much as in *dureti*.

Head and its appendages and general shape



FIG. 5. *Simulium horcochuspi*. A, B. Female. A. Claw. B. Apex of hind basitarsus, with base of second tarsal segment. C-H. Pupa. C. Anterior portion of head; platelets not shown. D. Base of respiratory organ; ventral branch at right. E. Portion of frontoclypeus of male, with platelets, frontal and facial trichomes. F. Portion of thorax, with platelets and trichomes, high magnification. G. Portion of frontoclypeus of female, with platelets and frontal trichomes. H. Base of different respiratory organ; ventral branch at left. I, J. Larva. I. Anal sclerite, schematic. J. Antenna.

of legs as in *dureti*. Calcipala absent (fig. 5B). Claw without tooth, only with occasional slight angular projection in place of tooth (fig. 5A). Genitalia as in *dureti*.

MALE: Color of body unknown; color pattern of legs as in *dureti*.

General structure as in *dureti*, including genitalia. Apex of distimere granulose. Hind basitarsus not measured, apparently slightly narrower than in *dureti*. Calcipala absent.

PUPA: Pupae single or forming groups. Cocoon as in *dureti*, viz., shoe-shaped with large anteroventral bridge. Cocoon very thin, translucent, with conspicuous leaden sheen. Cocoon closely woven; individual threads difficult to perceive; rim of aperture slightly reinforced.

Sides of cocoon covering basal half or two thirds of respiratory organs. Length of cocoon at dorsum along middle to border of aperture 2.4–3.4 mm.; maximum length along base to anterior border of anteroventral bridge, 4.6–5.2 mm.

Length of body of pupa, 2.9–3.2 mm.; length of respiratory organs, 1.5–1.8 mm., viz., about half as long as pupa proper.

Respiratory organs (fig. 5D, H) with eight filaments, arising from three primary branches; their arrangement much as in *dureti*, but second division of median primary branch situated distinctly apicad of level of second division of dorsal primary branch.

Frontoclypeus covered with small platelets,

more numerous in male (fig. 5E) than in female (fig. 5G); surface of platelets smooth. Head with 3(-4)+3(-4) frontal, 1+1 facial and 1-2+1-2 ocular trichomes; these trichomes hairlike, with 1-4 branches.

Exposed portion of thorax covered with very numerous platelets forming irregular groups (fig. 5F) and long hairlike trichomes. Number of trichomes 75-85+75-85, each with from one to three, rarely four, branches, most frequently two. Average length of trichomes, 0.25 mm.

Abdomen as in *dureti*.

LARVA: Maximum length of mature larva, 8 mm.; maximum width of head capsule, 0.75 mm. General body color whitish, but almost entire body with very intense dark brown hypodermal pigment. Pattern of cephalic apotome negative, similar to that of *dureti*. General body shape as in *dureti*.

Antennae as shown in figure 5J, similar to those of *dureti*, but third segment not shorter than first. Mouthfans, maxillary palp, mandibles, hypostomium, and gular cleft as in *dureti*. Anal sclerite (fig. 5I), crochet ring, and anal gills as in *dureti*.

MATERIAL EXAMINED: Argentina: Jujuy: Río Rosario, 25 km. south of Rosario de Coyaguaima, 4000 m., November 5, 1968 (S. Coscarón; MLP), one female, holotype, one male, allotype, both pharate; *idem* (S. Coscarón; AMNH, MLP), 12 females captured while flying, pupae and larvae; Río Coyaguaima, 4200 m., November 4, 1968 (S. Coscarón; AMNH, INM), eight females; tributary of Río Rosario, 10 km. northwest of Turilari, 3900 m., November 5, 1968 (S. Coscarón; INM), pupae and larvae; 5 km. northwest of Turilari, 4000 m., November 5, 1968, attempting to bite (S. Coscarón; AMNH, INM), very numerous females.

ETYMOLOGY: From *horco*, mountain and *chuspi*, fly, from Quechua, the language of the Incas, still widely spoken in the high Andes.

DISCUSSION: *Simulium horcochuspi* belongs to the *nigristrigatum* group. It seems to be closest to *deagostinii*, from Tierra del Fuego, and to *dureti*, found in the Argentinian province of Jujuy, as is *horcochuspi*. *Simulium horcochuspi* seems to be restricted to the basin of the Río Rosario in the high, arid *puna* of Jujuy.

The female of *horcochuspi* differs from the two related species mentioned, and indeed from all *Simulium* (*Pternaspatha*) by the absence of a

process on the claws of the female. It differs further from *dureti*, with which it might possibly be found together, by the absence of a calcipala and by the light-colored area of the anterior portion of the scutum which is much less extensive than in *dureti*. The male of *horcochuspi*, which is known only from a pharate specimen, cannot now be distinguished from that of *deagostinii*, but differs from that of *dureti* by the absence of a calcipala. The pupa of *horcochuspi* is characterized by the leaden sheen of its cocoon which distinguishes it immediately from the two other species. Further differential characters mostly relating to the number and structure of its cephalic and thoracic trichomes serve to distinguish *horcochuspi* from *dureti* and *deagostinii*, as shown in the key.

Simulium (*Pternaspatha*) *huemul* Wygodzinsky and Coscarón

Figure 7C, I

Simulium (*Pternaspatha*) *huemul* WYGODZINSKY AND COSCARÓN, 1967, p. 67.

Simulium (*Pternaspatha*) *limay* Wygodzinsky

Figures 4F, 6, 7L

Simulium (*Pternaspatha*) *limay*: WYGODZINSKY AND COSCARÓN, 1967, p. 69.

The original description (Wygodzinsky, 1958) is sufficient to recognize this species; it is also partially illustrated in Wygodzinsky and Coscarón (1967).

It may be added here that the frontoclypeus of the male pupa of *limay* has tubercles only on its basal half, as in *Simulium huemul*, whereas the frontoclypeus of the female pupa has tubercles on its entire surface.

The larva of *limay* was not known before; its description is now given here.

LARVA: Length of mature larva, 6.7-7.5 mm.; maximum width of head capsule, 0.7 mm. General body shape much as in *annulatum*.

Color of larva dark brownish green, except unpigmented undersurface of posterior half of body. Head dark brown, pigment pattern of cephalic apotome as shown in figure 6B. Body integument with isolated short hairs, more numerous in area of anal sclerite. Antennae (fig. 6E) with third segment darkest, second segment with one or two small unpigmented areas. Ratio of length of segments I-III, 1/1.5/0.9.

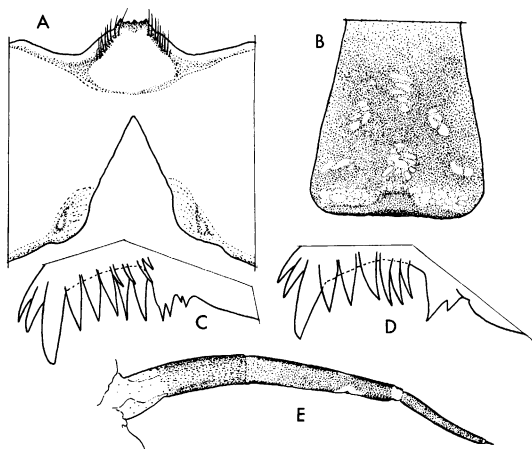


FIG. 6. *Simulium limay*, larva. A. Undersurface of head, as seen in slide preparation. B. Cephalic apotome. C, D. Apical portion of mandible. E. Antenna.

Mouth brushes with 39–45 rays. Toothings of mandibles as shown in figures 6C, D. Maxillary palp much as in *annulatum*. Anterior border of hypostomium strongly pigmented; hypostomial setae arranged in one or two irregular rows, with 14–16 setae in each group. Gular cleft (fig. 6A) very deep, five times as deep as length of hypostomial bridge.

Anal sclerite much as in *annulatum*. Crochet ring with approximately 95 rows, each composed of 17 hooks. Anal gills with three primary lobes, each with about six lobules; median primary lobe simple in some specimens.

MATERIAL EXAMINED: Argentina: Río Negro: Río Medio, El Bolsón, November 28, 1950 (P. Wygodzinsky; AMNH), one pupa, larvae. Neuquén: Arroyo Chacabuco, north of Lake Nahuel Huapi, February 16, 1967 (S. Coscarón; AMNH), two females, reared, pupae and larvae; *ibid.*, January 18, 1968 (S. Coscarón; INM), one female, reared, pupae and larvae; Arroyo Huemul, at Highway j, January 18, 1968, associated with *Cnesia dissimile* (S. Coscarón; AMNH), larvae; Río Limay, 30 km. northeast of Confluencia, October 24, 1970 (S. Coscarón; AMNH), pupae and larvae; tributary of Río Limay, 30 km. northeast of Confluencia, October 24, 1970 (S. Coscarón; AMNH), larvae; Arroyo Chapelco Chico, February 21, 1967 (S. Coscarón; AMNH), one male, reared, larvae; Arroyo Chapelco Grande, October 20, 1970 (S. Coscarón; AMNH), pupae and larvae; Río Chapelco Grande, at Highway d, January

19, 1968 (S. Coscarón; INM and AMNH), five males, five females, all reared, pupae and larvae; small stream 3 km. south of crossing of Highway d over Río Aluminé, October 19, 1970 (S. Coscarón; AMNH), larvae; stream 1 km. west of crossing mentioned, October 19, 1970 (S. Coscarón; AMNH), pupae and larvae; stream east of Lake Huachulafquen, January 12, 1968 (S. Coscarón; INM), one male, reared, pupae and larvae; Arroyo Rahue, at Highway g, January 9, 1968 (S. Coscarón; INM), pupae and larvae; stream near El Manzano, January 10, 1968 (S. Coscarón; INM), pupae and larvae; Río Llao-Llao, near Espinazo del Zorro, January 9, 1968 (S. Coscarón; INM), two males and three females, reared, pupae and larvae; Río Picún Leufú, on Highway 40, January 9, 1967 (S. Coscarón; AMNH), pupae and larvae. *Ibid.*, October 19, 1970 (S. Coscarón; AMNH), one female, reared, pupae and larvae; Arroyo Nireco, January 9, 1968 (S. Coscarón; INM), one male, one female, reared, one pupa, larvae; Arroyo Puipocón, Aluminé, January 10, 1968, with *Simulium annulatum* and *Simulium simile* (S. Coscarón; INM), pupae and larvae; Arroyo Milla Michuco, Chos-Malal, January 20, 1968 (S. Coscarón; MLP), one male, reared, pupae and larvae; Espinazo del Zorro, January 9, 1968 (S. Coscarón; INM), four males, two females, reared, pupae and larvae. San Juan: Barreal, November 6, 1967 (S. Coscarón; AMNH), four females, reared, pupae, larvae.

Simulium (Pternaspatha) nigristrigatum (Enderlein)
Figure 7H

Simulium (Pternaspatha) nigristrigatum: WYGODZINSKY
AND COSCARÓN, 1967, p. 69.

Simulium (Pternaspatha) pichi Wygodzinsky and
Coscarón
Figure 7A

Simulium (Pternaspatha) pichi WYGODZINSKY AND
COSCARÓN, 1967, p. 70.

Simulium (Pternaspatha) pulchrum Philippi
Figures 8, 10A-J, N-Q

Simulium pulchrum: PHILIPPI, 1865, p. 633. KERTÉSZ,
1902, p. 290. SILVA FIGUEROA, 1917, p. 30. PINTO,
1931, p. 729. VARGAS, 1945, p. 187. SMART, 1945,
p. 512. STUARDO ORTÍZ, 1946, p. 42. VULCANO,
1967, p. 19.



FIG. 7. A. *Simulium pichi*, portion of thorax of pupa. B. *Simulium bachmanni*, respiratory organ of pupa; ventral primary branch at right. C. *Simulium huemul*, portion of thorax of pupa; platelets not shown. D. *Simulium bachmanni*, portion of thorax of pupa. E, F. *Simulium walterwittmeri*. E. Respiratory organ of pupa; ventral primary branch at right. F. Hind leg, female. G. *Simulium strigidorsum*, pattern of abdomen of female, dorsal. H. *Simulium nigristriatum*, pattern of abdomen of female, dorsal. I. *Simulium huemul*, frontoclypeus of male pupa. J, K. *Simulium bachmanni*. J. Distimere. K. Claw of female. L. *Simulium limay*, hind leg of female. M. *Simulium walterwittmeri*, portion of thorax of pupa.

Simulium (*Pternaspatha*) *pulchrum*: WYGODZINSKY AND COSCARÓN, 1967, p. 115.

Simulium (*Pternaspatha*) *simile*: WYGODZINSKY AND COSCARÓN, 1967, p. 79 (only text, not synonymy).

FEMALE. Length of wing, 2.6–2.8 mm.

Color of head, thorax and abdomen (fig. 10F, O) as in *simile*. Color pattern of legs (fig. 10E, G, H) as in *simile*, but over-all color somewhat darker, and extension of dark areas at apex of hind tibia larger.

General morphology of head as in *simile*. Fronto-ocular triangle as shown in figure 10A, slightly deeper than wide. Shape and proportions of antennal segments as shown in figure 10B. Diameter of sensory vesicle of third seg-

ment of maxillary palp equal to half the width of segment; details of its structure as shown in figure 10C. Maxillae with 25–26, mandibles with 38–41 teeth. Calcipala (fig. 10N) and claws as in *simile*. Wings as in *simile*.

General structure of genitalia as in *simile*, but paraproct less salient (fig. 10P).

MALE: Length of wing 2.6–2.7 mm.

Color of head and its appendages, thorax, wings, and halteres as in *simile*. Legs much as in *simile*, although somewhat darker. Abdomen velvety black dorsally, except dark gray on tergum IX. Terga II, VI and VII with 1+1 large, silvery white spots; terga III–V entirely black.

Antennae as shown in figure 10D. Maxillary palpi and legs as in *simile*; hind basitarsus five times as long as wide. Genitalia as in *simile*.

PUPA: Structure of cocoon as in *simile*; its length dorsally, 2.2–2.7 mm., maximum length along its base, 3.8–4.5 mm. Length of body of pupa, 2.5–3.2 mm., of respiratory organs, 1.1–1.3 mm. Structure of respiratory organs as in *simile*.

Head of pupa light brown. Chaetotaxy of head (fig. 10Q) much as in *simile*. Platelets of frontoclypeus (fig. 10Q) more numerous than in *simile*, distinctly surpassing level of frontal trichomes, attaining level of uppermost facial trichomes. Protuberances of platelets not pointed (fig. 10J). Depression of area of facial trichomes only faintly marked or not at all.

Thorax of pupa much as in *simile*, but trichomes (fig. 8) less numerous (normally 70–90, occasionally up to 130, on each side), but platelets more numerous. Length of trichomes 0.15–0.28 mm., much shorter than in *simile*. Abdomen as in *simile*.

LARVA: Length of mature larva, 5.6–6.0 mm.; maximum width of head capsule, 0.8 mm. General body shape as in *simile*.

Color light greenish brown, head light brown; cephalic apotome very light, dark pigment restricted to base (fig. 10I). General aspect of antennae as in *simile*; ratio of length of segments I–III, 1/1.5/1.1. Mouth brushes with 29–33 rays. Maxillary palpi, hypostomium, postgenal

cleft and anal sclerite as in *simile*. Crochet ring with 85–100 rows of about 16 hooks each. Anal gills in most specimens with three simple primary lobes, with one pair of secondary lobules in specimens from the province of Aconcagua, and two pairs of secondary lobules on each primary lobe in specimens from the southern part of the range of the species.

MATERIAL EXAMINED: *Chile:* Cautín: 10 km. east of Pucón, 600 m., February 2, 1967 (S. Coscarón; AMNH), larvae. Ñuble: Río Ñuble, 6 km. north of Chillán, 400 m., January 30, 1967 (S. Coscarón; AMNH), one male, four females, reared, pupae and larvae. Talca: Río Maule, highway between Talca and Linares, 400 m., January 28, 1967 (S. Coscarón; AMNH, INM), three males, three females, reared, pupae and larvae. Curicó: Río Teno, 300 m., January 28, 1967 (S. Coscarón; AMNH, INM), one male, one female, reared, pupae and larvae; Río Lontué, 5 km. south of Curicó, 400 m., January 28, 1967 (S. Coscarón; AMNH), four males and three females, reared, pupae and larvae. Colchagua: Chimborango, in irrigation ditch, 450 m., January 28, 1967 (S. Coscarón; AMNH) one larva. O'Higgins: Río Codegua, near Panamerican highway between Hospital and Rancagua, 400 m., January 27, 1967 (S. Coscarón; AMNH), larvae; Bosque de los Conservadores, 1100 m., March 1–4, 1962 (L. Peña; CNC), 10 males, one female. Santiago: Quebrada de La Plata, Maipú, 510 m., April 23,

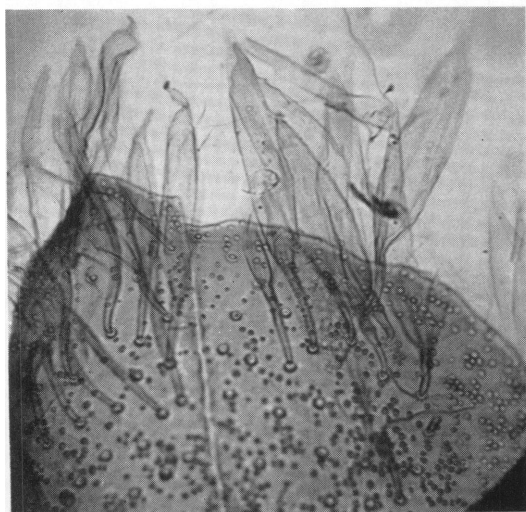


FIG. 8. *Simulium pulchrum*. Trichomes of thorax of pupa.

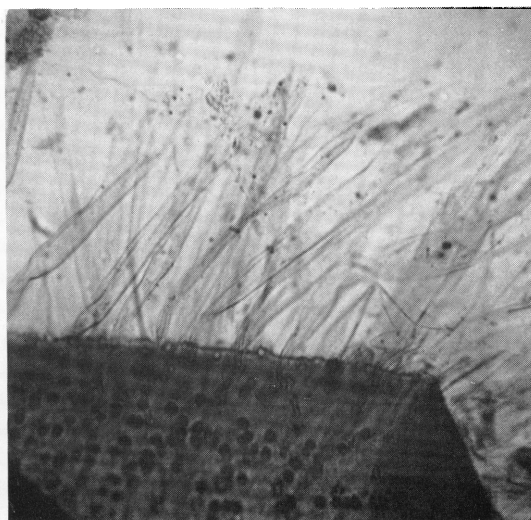


FIG. 9. *Simulium simile*. Trichomes of thorax of pupa.

1966, in Malaise trap (M. E. Irwin; CIS), 30 females; La Rinconada, 550 m., March 27, 1966 (M. E. Irwin; CIS), three males, 12 females; Pomaire, 400 m., January 27, 1967, on willow branches trailing in irrigation ditch (S. Coscarón; AMNH), two females, reared, pupae and larvae. Aconcagua: Catemu, Río Aconcagua, January 24, 1967, 500 m. (S. Coscarón; AMNH), 10 males and 15 females, reared, pupae and larvae.

DISCUSSION: *Simulium pulchrum* is closely related to *S. simile*, from which it can be distinguished as shown in table 1.

BIOLOGY: The larvae and pupae of this species were found attached to stems of grasses (such as *Scirpus* sp.) trailing in the water, or to branches of trees like *Salix* trailing in the stream, but only rarely to rocks. The species was collected mostly in large, fast-flowing streams or irrigation ditches. The species prefers clear streams, with only occasional turbidity. This is a lowland species in Central Chile, collected generally between 400–800 meters; the highest elevation recorded was 1100 meters; the closely related *S. simile* is a species found generally at much higher altitudes than *pulchrum*.

Simulium (Pternaspatha) simile Silva Figueroa
Figures 9, 10K-M, R

Simulium simile SILVA FIGUEROA, 1917, p. 33. PINTO, 1931, p. 730. VARGAS, 1945, p. 196. BEQUAERT, 1945, p. 114. STUARDO ORTÍZ, 1946, p. 41. WYGODZINSKY, 1949, p. 304; 1958, p. 133. STONE, 1962, p. 207.

Simulium (Simulium) simile: EDWARDS, 1931, p. 153. ORFILA, 1939, p. 1534.

Acropogon simile: ENDERLEIN, 1934, p. 280.

Simulium (Pternaspatha) simile: WYGODZINSKY AND COSCARÓN, 1967, p. 79 (only synonymy).

[*Simulium (Pternaspatha)*] *simile*: STONE, 1963, p. 17.

Simulium figueroa SMART, 1944, p. 133 (unnecessary emendation); 1945, p. 505. VARGAS AND DÍAZ, 1953, p. 141. VULCANO, 1967, p. 11.

Simulium illiesi WYGODZINSKY AND COSCARÓN, 1967, p. 75 (new synonymy).

Acropogon punctativentris ENDERLEIN, 1936, p. 118 (new synonymy).

Simulium punctativentris: SMART, 1945, p. 512. VARGAS, 1945, p. 188. STUARDO ORTÍZ, 1946, p. 41. VULCANO, 1967, p. 19.

Simulium (Pternaspatha) punctativentris: WYGODZINSKY AND COSCARÓN, 1967, p. 115.

Simulium barbatipes: VARGAS AND DÍAZ, 1953, p. 141 (part).

This species was described in detail by

TABLE 1
DIFFERENCES BETWEEN *Simulium pulchrum* AND
Simulium simile
(All measurements are in millimeters.)

| Character | <i>pulchrum</i> | <i>simile</i> |
|--|----------------------|--|
| ADULTS | | |
| Wing length, female | 2.6–2.8 | 3.2–3.5 |
| Wing length, male | 2.6–2.7 | 3.2–3.5 |
| Darkened portion of posterior tibia of female | apical fifth | apical two-fifths |
| Tergum III of abdomen of male | black | with 1 + 1 small whitish spots |
| Terga IV and V of abdomen of male | black | with 1 + 1 very small whitish spots |
| PUPAE | | |
| Length of cocoon, dorsally | 2.2–2.7 | 3.3–4.5 |
| Length of cocoon, ventrally | 3.8–4.5 | 5.2–6.8 |
| Length of body of pupa | 2.5–3.2 | 3.2–4.5 |
| Length of respiratory organs | 1.1–1.3 | 1.8–2.0 |
| Number of platelets of clypeus | ±800 | ±400 |
| Shape of projections of platelets | not pointed | pointed |
| Area of facial trichomes | almost smooth | distinct impression limited by carinae |
| Length of thoracic trichomes | 0.15–0.3 | 0.3–0.5 |
| Maximum number of trichomes of thorax | 130 + 130 | 250 + 250 |
| Average number of trichomes of thorax | 70 + 70 | 140 + 140 |
| LARVAE | | |
| Color of head | light brown | dark brown |
| Color of body | light greenish brown | dark greenish gray |
| Maximum length | 6.0 | 9.0 |
| Maximum width of head capsule | 0.6 | 0.8 |
| Number of rows in crochet ring | 85–100 | 95–118 |
| Number of hooks per row | 14–17 | 18–19 |
| Number of hypostomial setae | 13–18 | 21–24 |
| Number of secondary lobules to each primary lobe of anal gills | 1 or 2 | 3, rarely 4 |

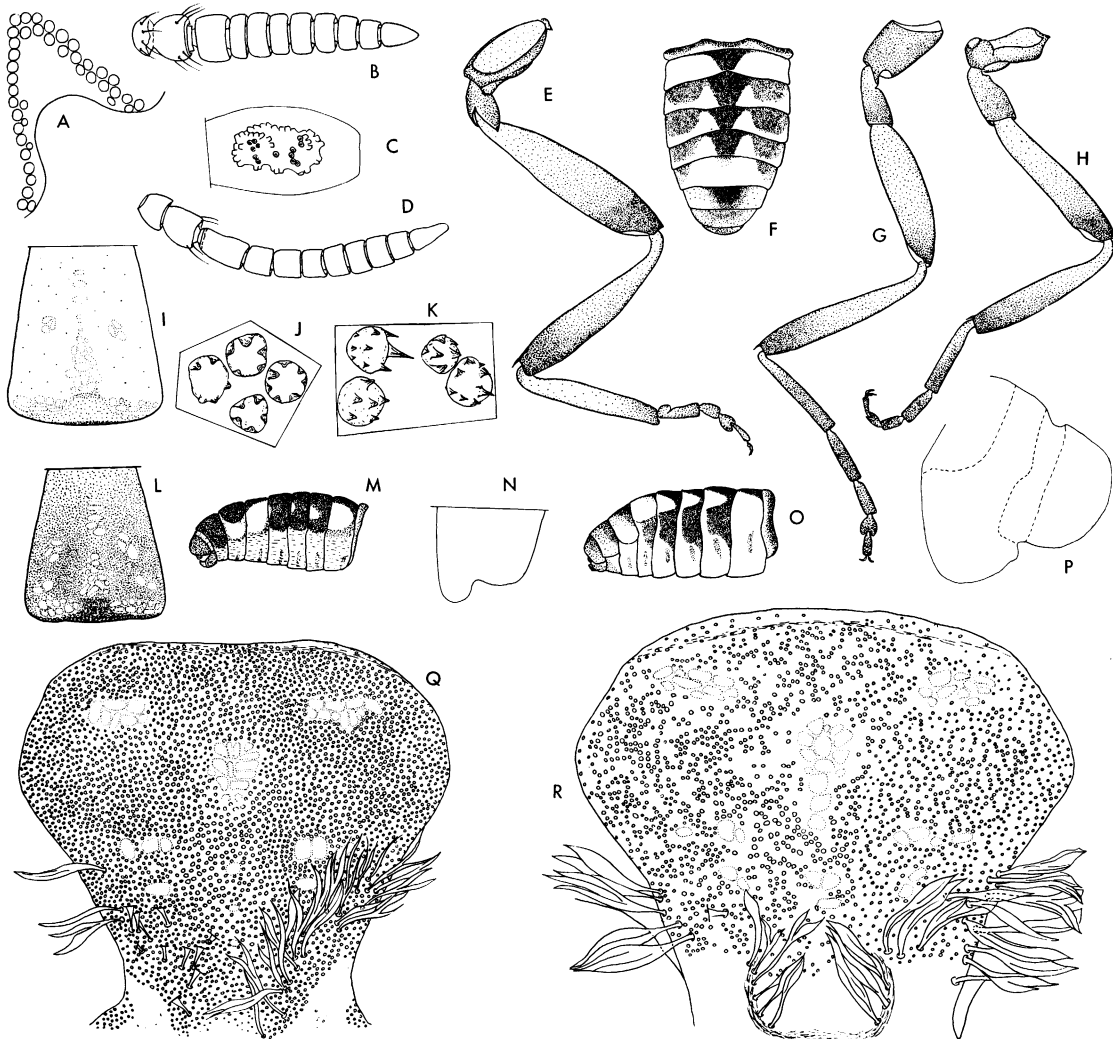


FIG. 10. A-J. *Simulium pulchrum*. A-C. Female. A. Fronto-ocular triangle. B. Antenna. C. Base of third segment of maxillary palp, with sensory vesicle. D. Antenna of male. E-H. Female. E. Hind leg. F. Color pattern of abdomen, dorsal. G. Foreleg. H. Midleg. I. Cephalic apotome of larva. J. Platelets of frontoclypeus of pupa. K-M. *Simulium simile*. K. Platelets of frontoclypeus of pupa. L. Cephalic apotome of larva. M. Color pattern of abdomen of male, lateral. N-Q. *Simulium pulchrum*. N. Apex of hind basitarsus of female. O. Color pattern of abdomen of female, lateral. P. Cercus and paraproct. Q. Frontoclypeus of pupa. R. *Simulium simile*, frontoclypeus of pupa.

Wygodzinsky and Coscarón (1967) as *S. (P.) illiesi*.

ADDITIONAL DESCRIPTION: Female: Length of wing, 3.2-3.5 mm.

Head blackish; antennae, palpi, and labrum piceous; scapus and pedicellus dark orange. Frons and clypeus gray pollinose. Pilosity of antennae very short, that of palpi, clypeus, frons, and occiput somewhat longer, silvery gray.

Scutum as in *Simulium nemorale*. Hairs of

thorax silvery gray. Adpressed setae of scutum very dense, somewhat obliterating pattern. Scutellum, metanotum, pleura, and sterna dark gray; pleura with silver pollinosity. Wings hyaline; veins light brown; hairs and spines blackish; tufts at base of wings from light brown to silvery gray. Stem of halteres light brown, their knob whitish. Color of abdomen as described and illustrated by Silva Figueroa (1917). Chaetotaxy of wings as in male.

PUPA: Platelets of frontoclypeus at base not distinctly surpassing area of frontal trichomes (fig. 10R). Platelets in many cases with sharply pointed protuberances (fig. 10K). Area of facial trichomes with conspicuously marked depression (fig. 10R); borders of depression heavily sclerotized. Length of trichomes of thorax (fig. 9) 0.3–0.5 mm.

LARVA: Body dark greenish gray. Head dark brown; pattern of cephalic apotome as illustrated (fig. 10L). Hypostomial setae arranged in 2–3 irregular rows, with a total of 21–24 setae on each side. Crochet ring with 95–118 rows, each composed of 18–19 hooks. Anal gills with three primary lobes, each bearing three pairs of long secondary lobules; median pair in some cases with four pairs of secondary lobules.

MATERIAL EXAMINED: *Chile:* Bío-Bío: El Abanico, December 30, 1950 (E. Ross and Michelbacher; CAS), eight females. Curicó: Cajón del Río Claro, southeast of Los Quenes, 1000–1200 m., October 9, 1966 (E. Schlinger; CIS), one female. Santiago: Cajón del Maipo, El Manzano, 1000 m., January 22, 1967 (S. Coscarón; AMNH), pupae and larvae; El Alfalfal, 1460 m., June 9–10, 1962 (L. Peña; AMNH), three males. Aconcagua: Puente Juncal, on International Highway, 10 km. west of El Portillo, 2500–3000 m., January 17, 1967 (S. Coscarón; AMNH), pupae and larvae; Piscicultura, 1800 m., January 17, 1967 (S. Coscarón; AMNH), two males, one female, all reared, pupae and larvae; *ibid.*, October 5, 1967 (S. Coscarón; AMNH), one male, one female, both reared, pupae and larvae. Coquimbo: Hacienda Illapel, 2500 m. (L. Peña; CNC), one female; Hacienda Illapel, Illapel, November 13, 1963 (G. F. Edmunds; CNC), one pupa; International Highway 5 km. east of Guanta, 2000 m., October 24, 1967 (S. Coscarón; AMNH); three males, one female, all reared, pupae and larvae; International Highway southeast of Guanta, 2500 m., October 24, 1967 (S. Coscarón; AMNH), six females; 2 km. west of Guanta, 1900 m., October 25, 1967 (S. Coscarón; AMNH), 10 females. Tarapacá: 3 km. east of Zapahuire, 11,000 ft., September 29, 1966 (M. E. Irwin; CIS), one female. *Argentina:* Río Negro: Bariloche, Cerro Catedral, Arroyo La Cascada, 1400 m., February 2, 1967 (S. Coscarón; AMNH), two males, two females, all reared, pupae and larvae;

Río Ñirihuau, near Lake Nahuel Huapí, October 24, 1970 (S. Coscarón; AMNH), three females, reared, pupae and larvae; small stream on the shores of Río Manso, October 22, 1970 (S. Coscarón; AMNH), one female, reared, pupae. Neuquén: Aluminé, Arroyo Puipocón, 1400 m., January 10, 1968 (S. Coscarón; MLP), three males, one female, all reared, pupae and larvae; Río Limay, 30 km. northwest of Confluencia, October 24, 1970 (S. Coscarón; AMNH), pupae.

DISCUSSION: This species was described from Apoquindo, near Santiago de Chile. Apoquindo is now fully urbanized, and all potential black-fly breeding habitats have been destroyed. However, the first author has collected at comparable localities near the foot of the Andes, and the species there obtained agrees fully with the original description of *simile*, and with a paratype kept in the Museo Nacional de Historia Natural in Santiago, which we have examined. We now realize that we redescribed (Wygodzinsky and Coscarón, 1967) *simile* as *illiesi*; we were led to this error mainly because we had no fully developed females of what we described as *illiesi*. Additional reared material makes the correction now possible.

Simulium simile is very close to *Simulium pulchrum* Philippi redescribed below. The differences between these two species are indicated in our keys, and summarized in a table given under the heading of *pulchrum*. These species also differ in habitat preferences: *simile* is a medium to high altitude species which prefers colder, very fast-flowing streams, and *pulchrum* inhabits lowland streams with higher temperature.

Acropogon punctativentris Enderlein is here synonymized with *simile* because the description of the former, regarding not only color but also wing length, agrees fully with *simile*. We have been unable to trace the type of *punctativentris* and assume that it has been lost.

Simulium (Pternaspatha) strigidorsum (Enderlein)
Figure 7G

Simulium (Pternaspatha) strigidorsum: WYGODZINSKY
AND COSCARÓN, 1967, p. 74.

MATERIAL EXAMINED: *Argentina:* Chubut: Alto Río Senguerr, February 15, 1964 (J. Bejarano; INM), one female.

This is the southernmost locality for this

species, which was originally described from Juliaca, Peru and later found in Mendoza, Argentina.

Simulium (Pternaspatha) walterwittmeri
Wygodzinsky
Figures 4G, 7E, F, M

Simulium (Pternaspatha) walterwittmeri: WYGODZINSKY
AND COSCARÓN, 1967, p. 75.

Nemorale GROUP

Simulium (Pternaspatha) albicinctum (Enderlein)
Figure 11H, M

Simulium (Pternaspatha) albicinctum: WYGODZINSKY AND
COSCARÓN, 1967, p. 94.

Simulium (Pternaspatha) albilineatum (Enderlein)
Figure 11A-C

Simulium (Pternaspatha) albilineatum: WYGODZINSKY
AND COSCARÓN, 1967, p. 95.

Simulium (Pternaspatha) annulatum Philippi
Figure 12A, J, K

Simulium (Pternaspatha) annulatum: WYGODZINSKY AND
COSCARÓN, 1967, p. 89.

All specimens examined agree well with our redescription (Wygodzinsky and Coscarón, 1967), except some pupae from the Rápidos de Petrohué, Chile. Among 57 pupae, 52 had the normal complement of six filaments to their

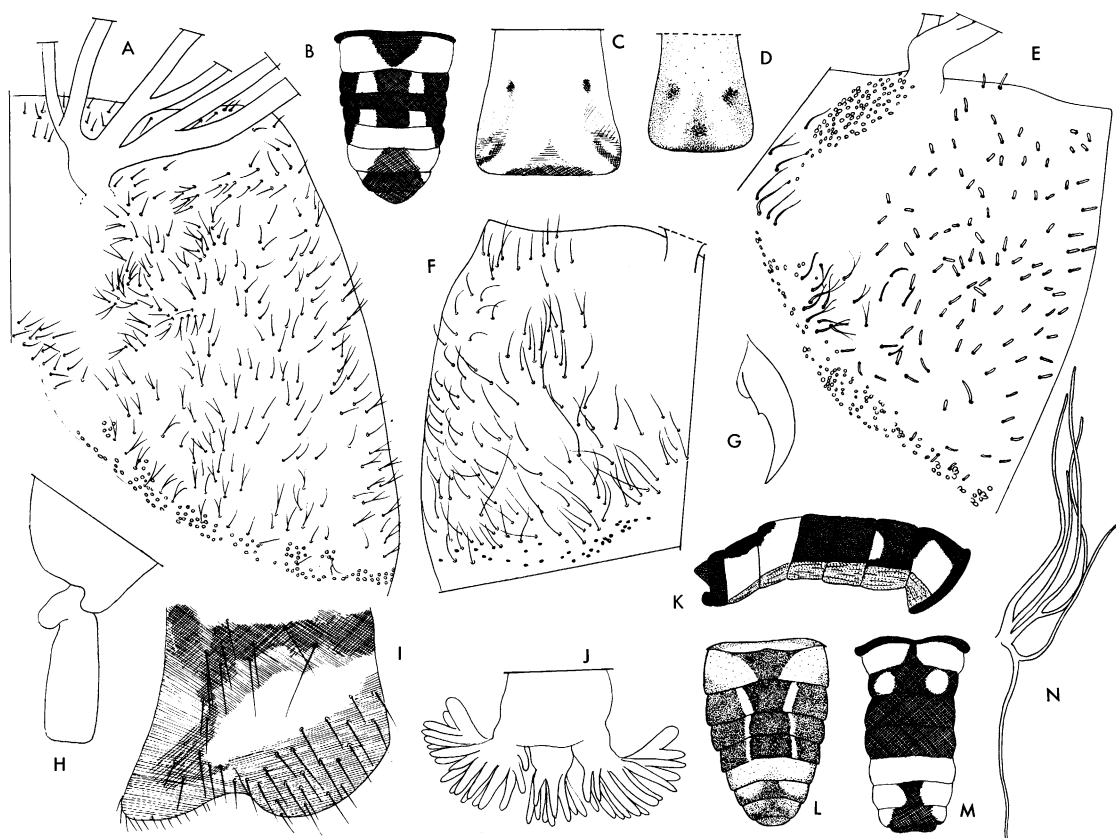


FIG. 11. A-C. *Simulium albilineatum*. A. Portion of thorax of pupa. B. Color pattern of abdomen of female, dorsal. C. Cephalic apotome of larva. D, E. *Simulium barbatipes*. D. Cephalic apotome of larva. E. Portion of thorax of pupa. F, G. *Simulium yacuchuspi*. F. Portion of thorax of pupa. G. Claw of female. H. *Simulium albicinctum*, male, apex of hind basitarsus, with second tarsal segment. I-K. *Simulium yacuchuspi*. I. Cercus and paraproct of female. J. Anal gills of larva. K. Color pattern of abdomen of female, lateral. L. *Simulium barbatipes*, color pattern of abdomen of female, dorsal. M. *Simulium albicinctum*, color pattern of abdomen of female. N. *Simulium yacuchuspi*, respiratory organ of pupa; ventral primary branch at right.

respiratory organs, but five specimens had eight filaments each; however, two of these eight filaments were obviously abnormal, viz., much shorter than the others (fig. 12J, K).

MATERIAL EXAMINED: *Chile:* Llanquihue: Petrohué: 100 m., *Nothofagus* forest, November 15, 1966, Malaise trap (M. E. Irwin, E. I. Schlinger; CIS), 42 females; Petrohué, north-west shore of Lake Chapo, November 15, 1966 (E. I. Schlinger; CIS), 37 females; Petrohué, December 26, 1948, among grass and swept from bushes (E. Dahl; ULUND), 12 females; Rápidos de Petrohué, February 9, 1967 (S. Coscarón; AMNH, INM), nine males and three females, reared, pupae and larvae; Ensenada, February 8, 1967, biting and inside hotel (S. Coscarón; AMNH), 30 females; *ibid.*, January 13–15, 1962 (L. Peña; CNC), 42 females; Volcán Osorno, among bushes on volcanic ash, December 27, 1948 (E. Dahl; ULUND), two females. Osorno: Río Rahue, February 5, 1967 (S. Coscarón; AMNH), three males and seven females, reared, pupae and larvae. Cautín: Pucón, February 15, 1967, (S. Coscarón; AMNH), two males, reared, pupae and larvae; 2 km. southeast of Villarica, 140 m., December 18, 1966 (E. I. Schlinger, M. E. Irwin; CIS), one female. Malleco: Río Malleco, Puente Santa Helena, January 30, 1967 (S. Coscarón; AMNH), one male and three females, reared, pupae and larvae. Concepción: Salto de Laja, November 8, 1966 (E. I. Schlinger; CIS), one male, one female; *ibid.*, November 26, 1948 (E. Dahl, ULUND), 18 females. Linares: Río Achibueno, January 29, 1967 (S. Coscarón; AMNH, INM), three males, one female, reared, pupae and larvae; Río Perquilaufquen, between Parral and Cauquenes, January 29, 1967 (S. Coscarón; AMNH), one male and two females, reared, pupae; Río Longaví, January 29, 1967 (S. Coscarón; AMNH, INM), nine males and three females, reared, larvae; Río Ñuble, 6 km. north of Chillán, January 30, 1967 (S. Coscarón; AMNH), one male and six females, reared, pupae and larvae; Río Longaví, January 29, 1967 (S. Coscarón; AMNH, INM), nine males and three females, reared, pupae and larvae. Colchagua: Curicó, Río Teno, January 28, 1967 (S. Coscarón; AMNH), one female, reared, pupa. Santiago: El Canelo, November 1, 1967 (S. Coscarón; AMNH), pupae. *Argentina:* Río Negro: Bariloche, 3.7 km. south of Puerto

Moreno, 800 m., November 17, 1966 (M. E. Irwin and E. I. Schlinger; CIS); Bariloche, Río Ñirihuau, October 14, 1970 (S. Coscarón; AMNH), pupae. Neuquén: Río Pichi Traful, February 17, 1967, associated with *Simulium limay* and *Cnesia dissimile* (S. Coscarón; AMNH), one female, reared, pupae and larvae; Río Limay Chico, 5 km. south of Estancia Chacabuco, October 24, 1970, in flight at 1 PM (S. Coscarón; AMNH).

Simulium (Pternaspatha) barbatipes (Enderlein)

Figure 11D, E, L

Simulium (Pternaspatha) barbatipes: WYGODZINSKY AND COSCARÓN, 1967, p. 99.

MATERIAL EXAMINED: *Chile:* O'Higgins: Brazo Río Pangal, October 9, 1967 (S. Coscarón; AMNH), pupae and larvae. Santiago: Cajon del Maipo, between San José de Maipo and El Manzano, January 22, 1967, associated with *S. simile* (S. Coscarón; AMNH), pupae and larvae; San José de Maipo, January 22, 1967 (S. Coscarón; AMNH), pupae and larvae. Aconcagua: Puente El Peñón, near El Portillo, International Highway, January 17, 1967 (S. Coscarón; AMNH), pupae and larvae; Piscicultura, 1800 m., January 17, 1967, October 5, 1967, associated with *Simulium simile*, (S. Coscarón; AMNH, INM), numerous males and females, reared, pupae and larvae. *Argentina:* Neuquén: Arroyo Milla Michuco, Chos-Malal, January 20, 1968 (S. Coscarón; INM), pupae. Mendoza: Río Piccuta, 10 km. east of Puente del Inca, January 17, 1967 (S. Coscarón; INM), one pupa; Arroyo Sargento, January 17, 1967 (S. Coscarón; AMNH), one pupa, one larva. San Juan: Tocota, 2800 m., November 6, 1967 (S. Coscarón; AMNH), one male, reared; Las Hornillas, 2400 m., November 5, 1967 (S. Coscarón; AMNH), three males, reared, pupae and larvae; Arroyo Gendarmería, Puesto Alvarez Condarco, 2400 m., November 5, 1967, associated with *Simulium rubiginosum* (S. Coscarón; AMNH), three males, reared, pupae and larvae. Jujuy: Yavi, 3400 m., October 24, 1968, with *S. dureti* (S. Coscarón; INM), pupae and larvae; Arroyo Lecho, Yavi, 3400 m. October 24, 1968 (S. Coscarón; INM), two pupae. *Bolivia:* La Paz: Road from La Paz to the Yungas of La Paz, approximately 4200 m., October 27, 1968 (S. Coscarón; INM), pupae and larvae.

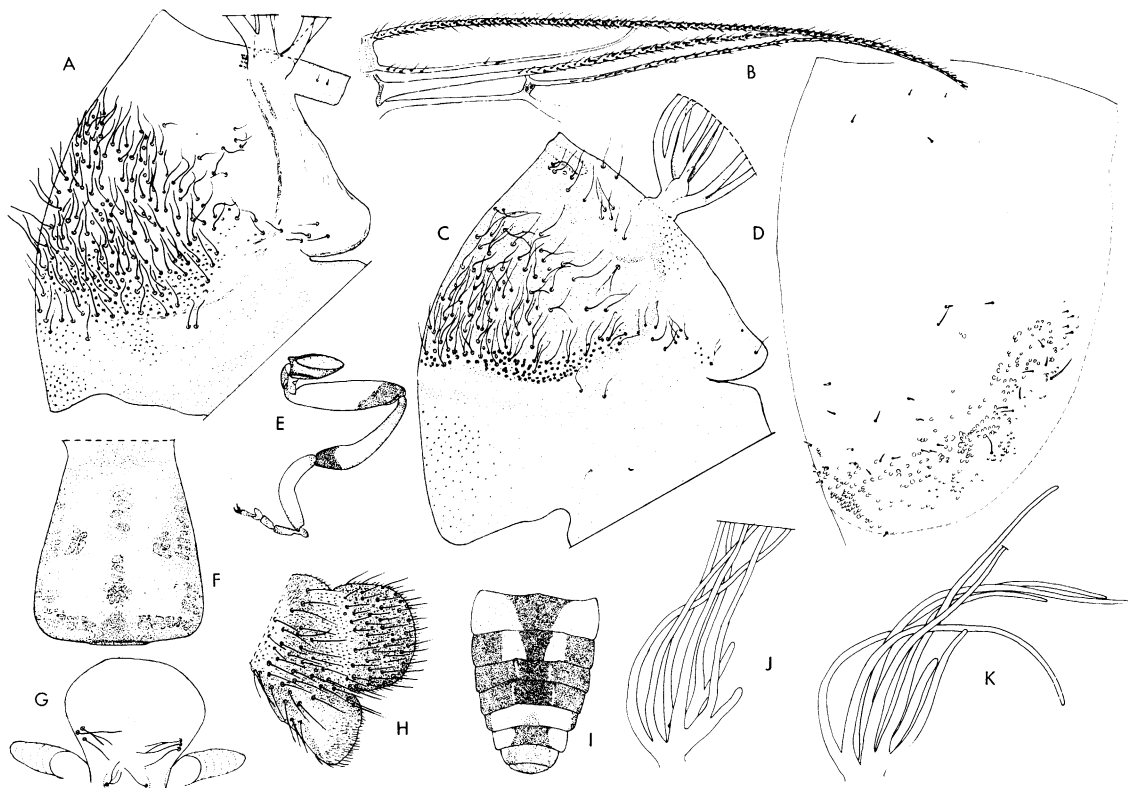


FIG. 12. A. *Simulium annulatum*, portion of thorax of pupa. B. *Simulium nemorale*, anterior portion of wing, female. C. *Simulium caprii*, portion of thorax of pupa. D. *Simulium nemorale*, anterior portion of head of pupa. E-H. *Simulium nemorale*. E. Hind leg of female. F. Cephalic apotome of larva. G. Anterior portion of head of pupa. H. Cercus and paraproct of female. I. *Simulium nemorale*, color pattern of abdomen of female. J, K. *Simulium annulatum*, respiratory organs of pupae, abnormal specimens.

***Simulium (Pternaspatha) bordai*, new species**
Figure 13

DIAGNOSIS: The diagnostic characters are shown in the key to the pupae of *Simulium* (*Pternaspatha*).

DESCRIPTION: Male and female, unknown.

PUPA: Cocoon as in *albilineatum*, viz., slipper-shaped, with short anteroventral bridge, only slightly raised from substrate. Cocoon light brown, its surface smooth, with threads not clearly perceptible. Rim of aperture distinctly reinforced. Length of cocoon dorsally, 4.5 mm.; maximum length as seen from below, 5.6 mm.

Respiratory organs about 2.5 mm. long, with six filaments arising from three very short primary branches (fig. 13C, F), with two filaments to each branch. Filaments approximately parallel, only slightly diverging at base. Dorsal filament of dorsal branch conspicuously wider

on basal portion than remaining filaments. Filaments gradually tapering toward rounded tip. Surface structure of branches and filaments as usual for subgenus.

Head and thorax dark brown. Frontoclypeus (fig. 13B) without platelets. 3+3 frontal, 1+1 facial and 1+1 ocular trichomes, in shape of long bifid or trifid, very rarely simple, setae. Facial trichomes inserted in distinct depression delimited by conspicuously sclerotized ridges (fig. 13B).

Disc of thorax without platelets, the latter restricted to area adjacent to aperture of cocoon and at insertion of respiratory organs (fig. 13A). Trichomes occupying disc of thorax (fig. 13A), in shape of setae with three to six branches (fig. 13D, E), from rather short and stout to long and slender, rather uniform or varied. Number of

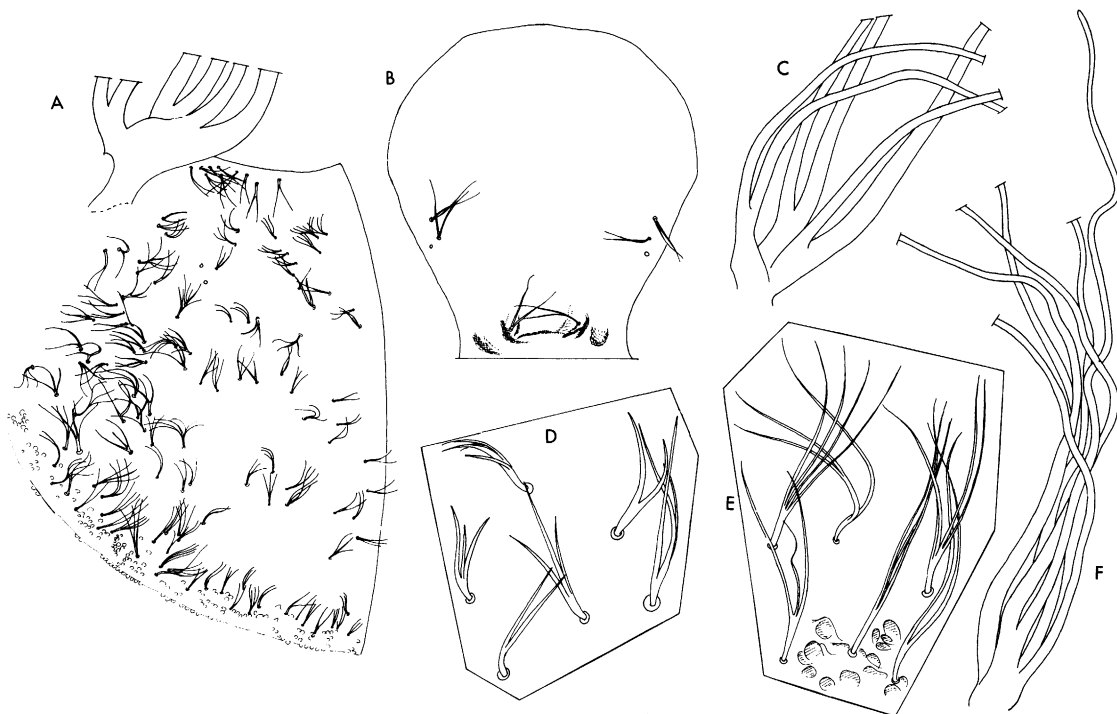


FIG. 13. *Simulium bordai*, pupa. A. Portion of thorax. B. Frontoclypeus. C. Basal portion of respiratory organ; ventral primary branch at left. D. Trichomes of disc of thorax. E. Trichomes and platelets of posterior margin of exposed portion of thorax. F. Respiratory organ; ventral primary branch at right.

trichomes approximately 120–170+120–170; their average length 0.09–0.11 mm.

Onchotaxy of abdomen as usual for subgenus.

MATERIAL EXAMINED: Bolivia: La Paz: Río La Cumbre, road from La Paz to Yungas de La Paz, east slope of range, October 29, 1968 (S. Coscarón and M. Borda) one pupa, holotype (MLP), three pupae, paratypes (AMNH); road from La Paz to Yungas de La Paz, west slope, between 3600 and 4500 m., October 29, 1968 (S. Coscarón; INM), one pupa. All specimens were found on rocks in cold, clear streams.

ETYMOLOGY: Named for Mr. Mario Borda, entomologist of the Bacteriological Institute of La Paz, Bolivia, in acknowledgment of his assistance on the field trip that led to the discovery of this species.

DISCUSSION: This species is described and named even though only its pupa is known, because the latter is conspicuously different from that of any other described species. The pupa of *bordai* agrees in many respects with that of *albineatum* but differs from it by the

characters mentioned in the key and shown in our illustrations.

Simulium (Pternaspatha) caprii Wygodzinsky and Coscarón

Figure 12C, E–H

Simulium (Pternaspatha) caprii WYGODZINSKY AND COSCARÓN, 1967, p. 79.

***Simulium (Pternaspatha) hectorvargasi*,
new species
Figures 14, 15**

DIAGNOSIS: The diagnostic characters are contained in the keys to the species of the subgenus. The most remarkable feature of the species is the extreme reduction of the frontal trichomes of the pupa.

FEMALE: Length of wing, 3.3–3.5 mm.

Color of head with appendages, thorax, wings, and halteres as in *herrerri*. Legs brown, their pattern as shown in figure 14C–E. Pattern of abdomen as shown in figure 14G, H.

Frons and fronto-ocular triangle much as in *herrerri*; frontal angle 115 degrees. Shape and

proportions of antennal segments as shown in figure 14B. Maxillary palp as illustrated (fig. 14A). Sensory vesicle half as wide as third article of palp, its structure as in *herreri*. Maxillae with 25–29, mandibles with 38–40 teeth.

Wings as usual for the subgenus. Sc glabrous or with one to four setae on central portion. Basal section of R glabrous. Setae and spines on R_1 and setae on R_5 arranged in one irregular row. Shape and proportions of leg segments as shown in figure 14C–E. Calcipala (fig. 14J) distinct but small, wider than high. Claws with tooth well developed (fig. 14I). Genitalia

much as in *herreri*; cercus and paraproct as shown in figure 14F.

MALE: Length of wing, 3.3–3.5 mm.

Color of head and its appendages very similar to that of *herreri*. Leg pattern as shown in figure 14K–M. Abdomen (fig. 14R, S) velvety black dorsally, especially intense on terga III–V. Terga II, VI, and VII with 1+1 large sublateral silvery white spots. Tergum III with 1+1 very small whitish spots, not easily perceptible in every specimen. Terga III–V narrowly lighter along hind border.

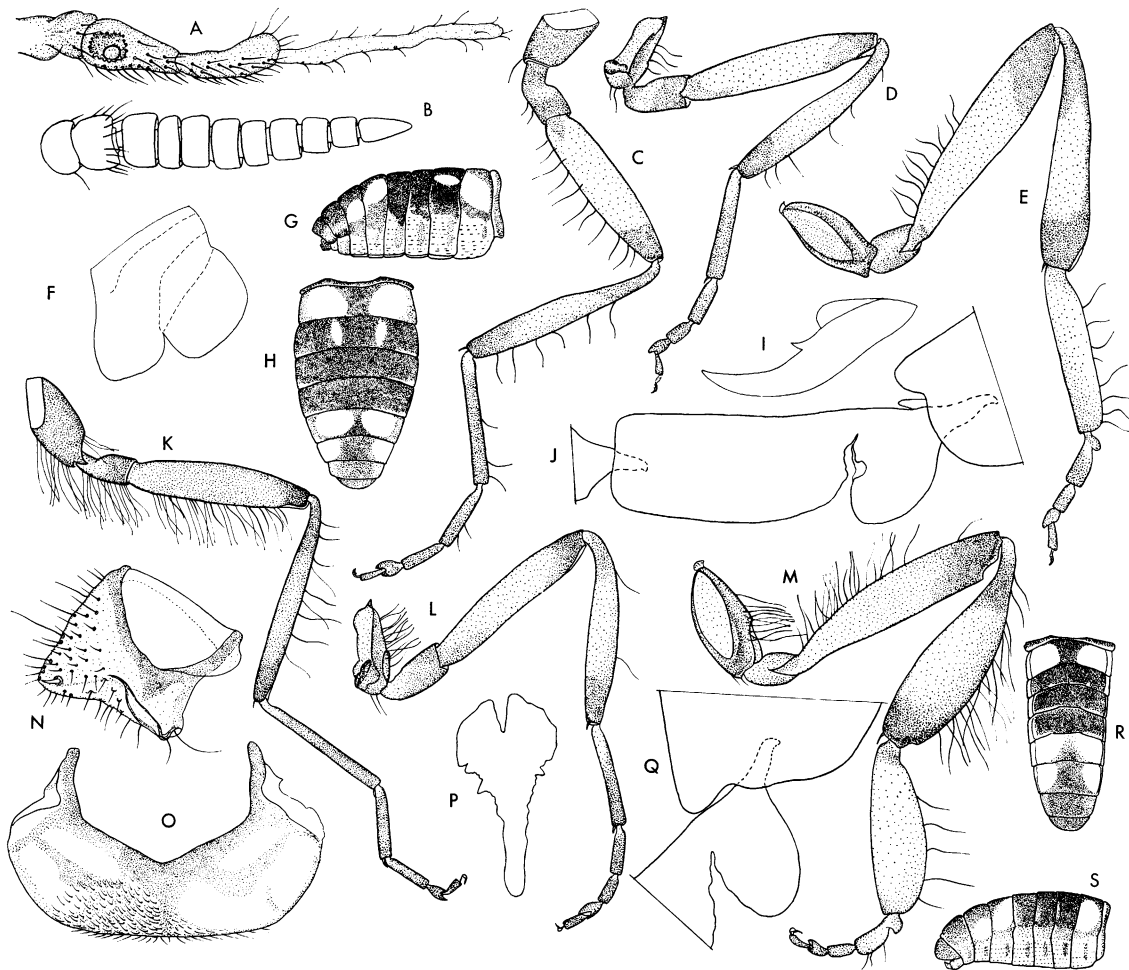


FIG. 14. *Simulium hectorvargasi*. A–J. Female. A. Maxillary palp. B. Antenna. C. Foreleg. D. Midleg. E. Hind leg. F. Outline of cercus and paraproct. G. Pattern of abdomen, lateral. H. Pattern of abdomen, dorsal. I. Claw. J. Apex of hind basitarsus, with second tarsal segment. K–S. Male. K. Foreleg. L. Midleg. M. Hind leg. N. Distimere. O. Ventral plate. P. Median sclerite. Q. Apex of posterior basitarsus, with base of second tarsal segment. R. Pattern of abdomen, dorsal. S. Pattern of abdomen, lateral.

Structure of head, antennae and palpi as in *herreri*, appendages with very long setae as in that species.

Chaetotaxy of wings as in female, but Sc invariably lacking hairs. Shape and proportions of segments of legs as shown in figure 14K–M. Calcipala present, small (fig. 14Q). Hind basitarsus 3.1–3.5 times as long as wide.

Genitalia (fig. 14N–P) much as in *memorale*; apex of dististyle smooth.

PUPA: Cocoon (fig. 15E, F) wall pocket-shaped, with extremely short anteroventral bridge, not raised from substrate. Cocoon dark brown, closely woven, surface smooth but with threads distinctly perceivable with moderate magnification. Rim of aperture distinctly reinforced. Length of cocoon dorsally 3.7–4.2 mm., maximum length along base, 4.5 mm.

Length of pupa, 3.5–3.8 mm.; length of respiratory organs, 2.5–2.8 mm.

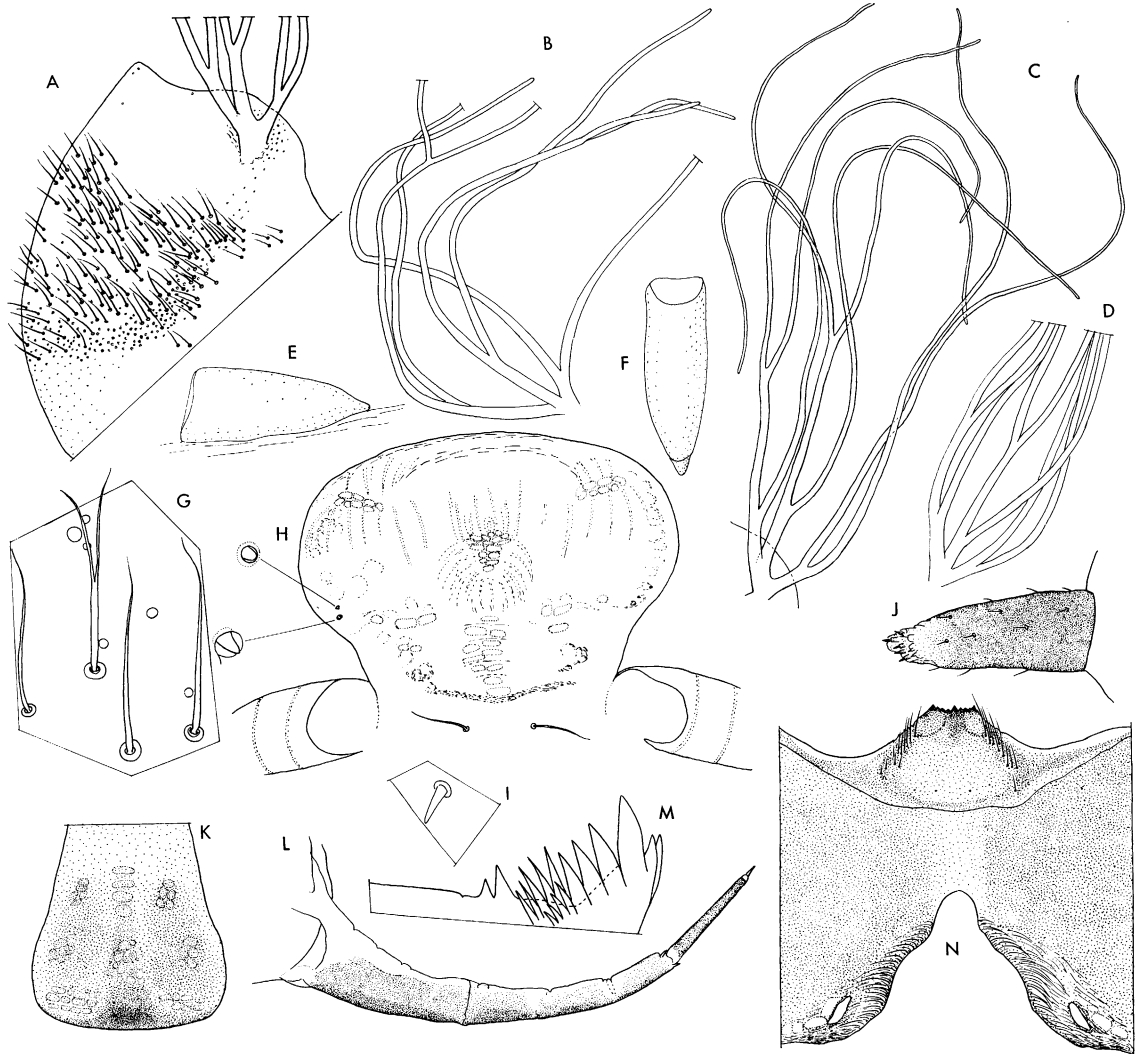


FIG. 15. *Simulium hectorvargasi*. A–I. Pupa. A. Portion of thorax. B. Portion of respiratory organ; ventral primary branch at right. C. Respiratory organ; ventral primary branch at right. D. Basal portion of respiratory organ; ventral primary branch at right. E. Cocoon, lateral. F. Cocoon, dorsal. G. Thoracic trichomes, high magnification. H. Frontoclypeus, with frontal spines shown with high magnification. I. Ocular trichome, high magnification. J–N. Larva. J. Maxillary palp. K. Cephalic apotome. L. Antenna. M. Apex of mandible. N. Under-surface of head, as seen on slide mount.

Respiratory organs (fig. 15B–D) with eight filaments arising from three main branches, more or less parallel-sided or spreading on basal half. Ventral branch divided rather close to its base. Median and dorsal branches divided at a slightly larger distance from their base and again at a considerable and rather variable distance. Filaments gradually tapering toward rounded tip. Surface structure of branches and filament as usual for subgenus.

Head and thorax light brown. Frontoclypeus (fig. 15H) without platelets. 2+2 frontal trichomes, in shape of very short cones (fig. 15H); 1+1 facial trichomes in shape of long setae (fig. 15H); 1+1 ocular trichomes in shape of short spine (fig. 15I). Facial trichomes inserted basad of faint but perceptible transversal ridge (fig. 15H).

Disc of thorax without platelets, the latter restricted to area adjacent to aperture of cocoon and at insertion of respiratory organs (fig. 15A). Trichomes occupying large part but not all of free surface of thorax (fig. 15A), mostly simple hairlike, very rarely bifid (fig. 15G); their number approximately 150+150, their length, 0.9–0.12 mm. Onchotaxy of abdomen as usual for subgenus.

LARVA: Maximum length of mature larva, 6.0–6.5 mm.; width of head capsule, 0.5–0.6 mm. General body shape as in *herrerri*.

Head light brown; pattern of cephalic apotome as shown in figure 15K; in some cases more light colored.

Antennae (fig. 15L) with third segment darkest; second with two constrictions accompanied by unpigmented areas. Ratio of lengths of segments I–III, 1/1.2–1.4/0.6–0.7. Mouth brushes with approximately 45 rays. Toothing of mandible as shown in figure 15M; first marginal tooth twice as large as second. Shape and pigmentation of maxillary palp as shown in figure 15J. Structure and pigmentation of hypostomium as shown in figure 15N; median tooth as prominent as lateral ones. Hypostomial setae in one or two irregular rows, with 8–15 setae in each group. Disc of hypostomium with a few short hairs. Gular cleft as illustrated (fig. 15N), about twice as deep as length of postgenal bridge.

Anal sclerite as in *herrerri*, but spicules more numerous, all simple. Crochet ring with 75–80 rows, composed of 15–18 hooks each. Anal gills with three simple lobes.

MATERIAL EXAMINED: Chile: Tarapacá: 5 km. east of Putre, 3200 m., October 13, 1967 (S. Coscarón and H. Vargas; AMNH, INM), one female, holotype, one male, allotype, 17 females and 21 males, paratypes, all reared, pupae and larvae; 4 km. west of Putre, 3000 m., October 13, 1967 (S. Coscarón and H. Vargas; INM), pupae and larvae; Quebrada de Tarapacá, 3500 m., April 19, 1969 (L. Peña; col. Peña), two pupae.

DISCUSSION: This species is among those that form a link between our former *albilineatum* and *nemorale* groups. *Simulium hectorvargasi* agrees with the species of the former *albilineatum* group in the relatively wide hind basitarsus of the male, but differs from those species by the pupal respiratory organ which has eight filaments, as in the former restricted *nemorale* group. The combination of the characters of this species serves to distinguish it from all other species of the *nemorale* group as understood now.

ETYMOLOGY: Named for Mr. Hector Vargas, entomologist of the Universidad del Norte, Arica, Chile, whose help in collecting this and other species is deeply appreciated.

BIOLOGY: Larvae and pupae of this species were collected on blades of grass and aquatic vegetation in fast-flowing streams with crystal clear water. The temperature of the water was very low; ice formed in the mornings in shallow spots.

The area in which this species was collected is typical *puna*. In the creek east of Putre, *S. hectorvargasi* was found together with *S. quechuanum*, new species, and an undescribed simuliid near *Gigantodax* Enderlein; in the stream west of Putre, *Simulium quechuanum* and *Gigantodax bolivianum* were also obtained.

Simulium (Pternaspatha) herrerri Wygodzinsky and Coscarón
Figure 16

Simulium (Pternaspatha) herrerri WYGODZINSKY AND COSCARÓN, 1967, p. 104.

Simulium (Pternaspatha) luchi, new species
Figure 17

DIAGNOSIS: The diagnostic characters are mentioned in the keys to the species of the subgenus.

FEMALE: Length of wing, approximately 3.5 mm.

Color of head, thorax, wings, and halteres

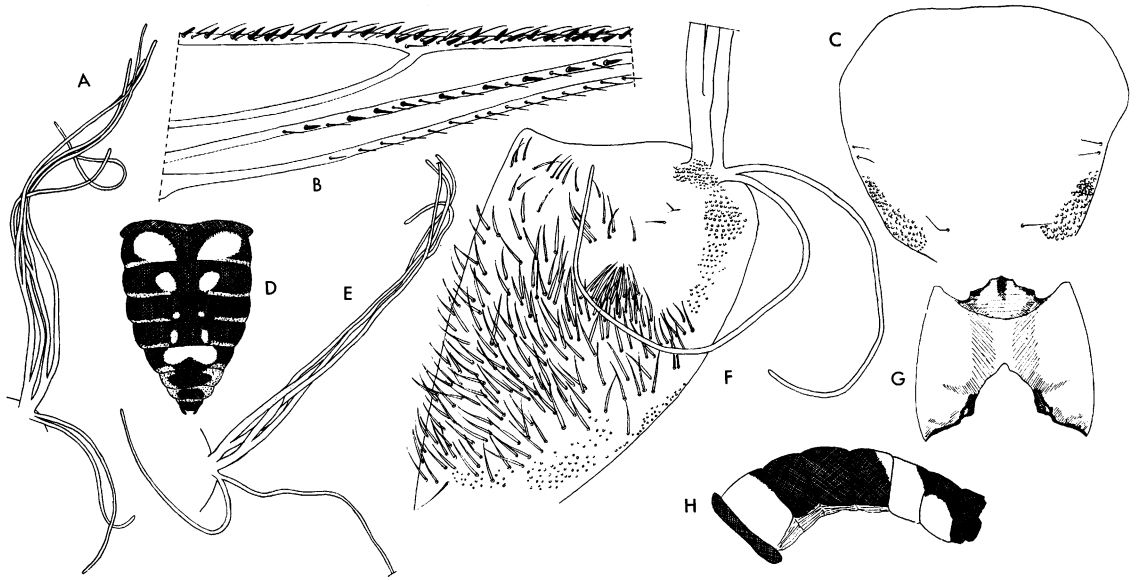


FIG. 16. *Simulium herreri*. A. Respiratory organ of pupa, eight filaments. B. Portion of anterior area of wing of male. C. Frontoclypeus of pupa. D. Color pattern of abdomen of female, dorsal. E. Respiratory organ of pupa, six branches. F. Portion of thorax of pupa. G. Head of larva, seen from below. H. Pattern of abdomen of male, lateral.

as described for *herreri*. Color pattern of fore and mid legs as illustrated for male, of hind legs as shown in figure 17B. Abdomen (fig. 17M) dark gray; first tergum black; terga II–VIII velvet black at center, extension of black areas as illustrated, that on second tergum widened anteriorly. Terga II, III, VI, VII, and VIII with 1+1 sublateral silver-white spots, large on II and VI, smaller on III, VII, and VIII.

Fronto-ocular triangle as shown in figure 17A; frontal angle 115 degrees. Antennae as in *hectorvargasi*. Sensory vesicle of maxillary palp as shown in figure 17J, comparatively elongate. Maxillae with 22–23 teeth; mandibles not examined.

Wings as usual for the subgenus; chaetotaxy of wings as in *hectorvargasi*. Hind legs as shown in figure 17B. Calcipala distinct but small, sub-triangular (fig. 17E). Claws with distinct tooth (fig. 17F).

Genitalia as shown in figure 17C, D. Central portion of eighth sternum (not shown) darker than peripheral areas.

MALE: Length of wing, 3.3 mm.

Color of head, thorax, and abdomen much as in *herreri*. Color pattern of legs as shown in figure 17G, P, Q.

Structure of head, antennae (fig. 17H) and

palpi (fig. 17I) as in *herreri*; appendages with long setae as in that species (fig. 17H).

Chaetotaxy of wing as in female, but Sc glabrous. Shape and proportions of segments of legs as in figure 17G, P, Q. Calcipala present but very small (fig. 17K). Hind basitarsus slightly less than three times as long as wide.

Abdomen with numerous long hairs. Genitalia as in *hectorvargasi*; distimere smooth (fig. 17L).

PUPA: Cocoon slipper-shaped, anteroventral bridge distinct, slightly elevated from substrate; general aspect of cocoon much as in *S. quechuanum*. Cocoon light brown, translucent; surface smooth, but with individual threads distinctly perceptible. Rim of aperture faintly reinforced. Length of cocoon dorsally, 3.3 mm., maximum length along base, 4.0–4.5 mm.

Length of pupa, 3.5 mm.; length of respiratory organs, 2.0 mm. Respiratory organs composed of eight filaments arranged as shown in figure 17T. All filaments lying closely together except ventralmost filament, which is sharply ventrally and backwardly bent, situated inside cocoon. Surface structure of branches and filaments as usual for subgenus.

Head and thorax light brown. Frontoclypeus (fig. 17S) without platelets, with 2+2 frontal, 1+1 facial, and 1+1 ocular trichomes. Facial



FIG. 17. *Simulium luchoi*. A-F. Female. A. Fronto-ocular triangle. B. Hind leg. C. Genital fork. D. Cercus and paraproc. E. Apex of hind basitarsus, with base of second tarsal segment. F. Claw. G-I. Male. G. Portion of hind leg. H. Antenna. I. Maxillary palp. J. Third segment of maxillary palp of female with sensory vesicle. K. Apex of hind basitarsus of male, with base of second tarsal segment. L. Paramere. M. Female, color pattern of abdomen, dorsal. N, O. Pupa. N. Portion of thorax. O. Platelets, high magnification. P, Q. Male. P. Midleg. Q. Foreleg. R. Trichomes of thorax of pupa, high magnification. S. Frontoclypeus of pupa with some trichomes, high magnification. T. Respiratory organ of pupa; ventral primary branch at right.

and ocular trichomes much longer than frontal trichomes; all trichomes slender, hairlike, simple, or with one or two branches (fig. 17S). Facial trichomes situated in depression limited by conspicuous ridges.

Thorax (fig. 17N) with disc smooth; platelets forming band adjacent to aperture of cocoon; these platelets frequently somewhat pointed (fig. 17O). Thorax with 30+30 to 50+50 trichomes (fig. 17R), most shortly lanceolate, simple or divided, with some simple or branched

hairlike setae interspersed. Onchotaxy of abdomen as usual for subgenus.

LARVA: not known.

MATERIAL EXAMINED: Chile: Tarapacá: Inchucareja, 30 km. east of Alto Chiapa, 4100 m., April 25, 1969 (L. Peña; MNHN), one female, holotype, one male, allotype, both reared; *idem* (L. Peña, AMNH), one male, one female, paratypes, reared, several pupae.

ETYMOLOGY: Named for its collector, Mr. Luis "Lucho" Peña, who has done so much, in

many ways, to further our studies of Chilean black flies.

DISCUSSION: The female of *S. luchoi* is very similar to that of *S. hectorvargasi*; the only reliable differential character is found in the relative size of the calcipala as mentioned in the key. The male of *luchoi* is very close in structure and color to the males of *albicinctum*, *hectorvargasi*, and *quechuanum*; minor characters of the structure and coloring of the hind legs, as indicated in the key, may make specific identification possible. The pupa of *luchoi* can be distinguished by the structure and number of its thoracic trichomes from the other species with eight branches to their respiratory organs, and with one or two of these branches sharply diverging.

Simulium (Pternaspatha) nemorale Edwards

Figure 12B, I

Simulium (Pternaspatha) nemorale: WYGODZINSKY AND COSCARÓN, 1967, p. 83.

MATERIAL EXAMINED: Argentina: Río Negro: Río Guillermo, near crossing of Tronador highway, January 24, 1971 (S. Coscarón; MLP), pupae and larvae. Neuquén: Correntoso, February 14, 1967 (S. Coscarón; AMNH), pupae and larvae; Ruca Malen, February 17, 1967 (S. Coscarón; AMNH), pupae; 40 km. south of San Martín de los Andes, February 17, 1967 (S. Coscarón; AMNH), one pupa; Río Chachil, Parque Lanin, January 16, 1968 (S. Coscarón; INM), one pupa; Cuesta Santa Julia, 1080 m., December 17, 1966, on meadow (E. M. Irwin, E. I. Schlinger; CIS), one female.

OBSERVATIONS: Wygodzinsky and Coscarón (1967) redescribed this species in detail. Their illustration of the pupal thorax (their fig. 21G) is somewhat confusing; a new illustration (fig. 12D) is presented here, showing the trichomes and tubercles as characteristic for this species.

Simulium (Pternaspatha) prodexargenteum

(Enderlein)

Figures 18–20

Simulium (Pternaspatha) prodexargenteum: WYGODZINSKY AND COSCARÓN, 1967, p. 109.

FEMALE: Length of wing, 2.9–3.2 (3.3–3.7)¹ mm.

Color of head and thorax and their append-

ages much as in *S. dureti*. Pattern of legs as shown in figure 18G–I. General color of abdomen gray, pattern as shown in figure 18J, K. Terga II–V velvety black at center. Terga II and III with 1+1 large, sublateral, silver-white spots; IV and V at sides of posterior border narrowly silver-white; VI almost entirely white dorsally, slightly darker at center and at sides, silver-gray sublaterally; VIII and IX dark gray.

Frons as shown in figure 18C; frontal angle 115 degrees. Fronto-ocular triangle as shown in figure 18A. Shape and proportions of antennal segments as shown in figure 18B. Maxillary palp as illustrated (fig. 18D); sensory vesicle over half as wide as third article of palp, its tubercles as shown in figure 18F. Maxillae with 28–29, mandibles with 37–43 teeth.

Wings as usual for the subgenus. Sc with two to five scattered setae; basal section of R glabrous; setae and spines on R₁ and setae on R_s arranged in one single row. Shape and proportions of leg segments as shown in figure 18G–I. Calcipala obsolescent (fig. 18L) or absent (fig. 18M). Claws with distinct tooth (fig. 18E).

Eighth sternum, gonapophyses, genital fork, and spermatheca as in *dureti*. Paraproct and cerci as shown in figure 18N; cerci darker than paraprocts, the latter of peculiar shape.

MALE: Length of wing, 3.0 (3.1) mm. Color as described by Wygodzinsky and Coscarón (1967); color pattern of legs as shown in figure 19D, F–I; abdomen as shown in figure 19C.

Shape and proportions of antennal segments as shown in figure 19B; scapus and pedicellus with very long hairs. Maxillary palp as illustrated (fig. 19A); basal articles with very long setae; diameter of sensory vesicle less than half the width of third article of palp. Detailed structure of sensory vesicle as shown in figure 19E. Chaetotaxy of wing veins as in female. Shape and proportions of leg segments as shown in figure 19D, F–I. Calcipala obsolescent (fig. 19K, L) or absent (fig. 19J, M). Hind basitarsus 3.0–3.6 times as long as wide. Genitalia as in *S. herreri*; apex of distimere smooth.

PUPA: Cocoon (fig. 20C, E) wall-pocket shaped, but with very short anteroventral bridge. Color light brown; when observed in liquid, with distinct leaden sheen. Cocoon closely woven, threads not individualized, texture somewhat parchment-like. Surface of cocoon smooth, in some specimens with adhering

¹See Discussion p. 231 for explanation of measurements given in parentheses.

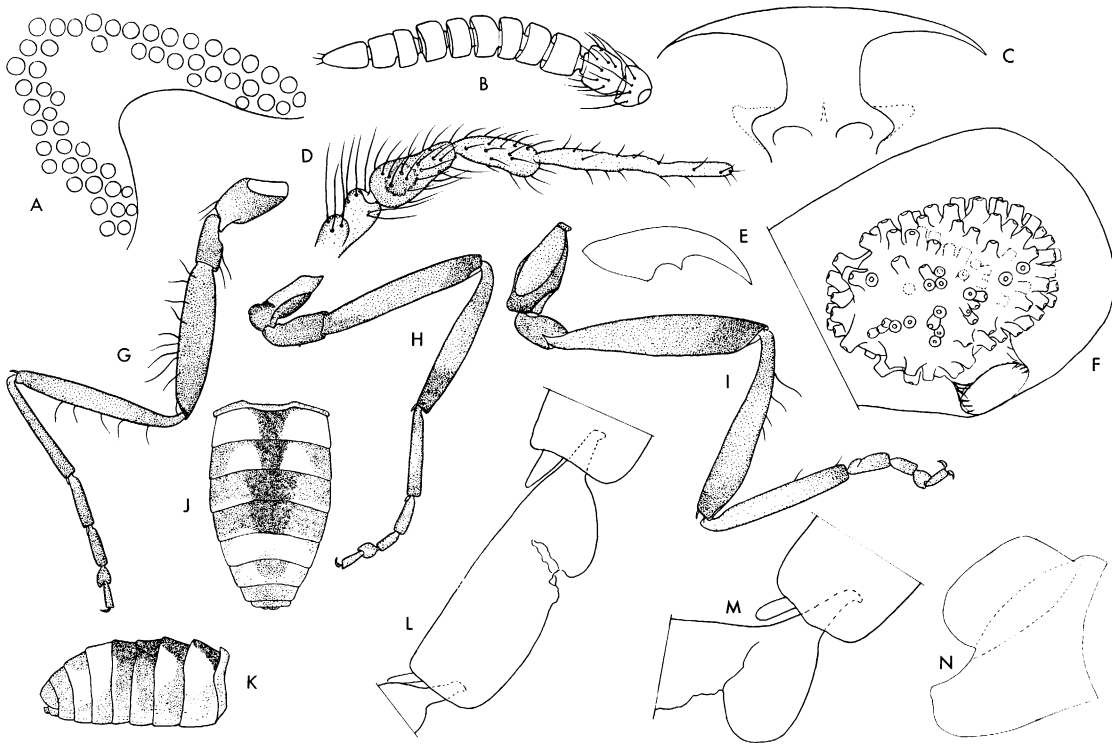


FIG. 18. *Simulium prodexargenteum*, female. A. Fronto-ocular triangle. B. Antenna. C. Frons. D. Maxillary palp. E. Claw. F. Sensory vesicle of maxillary palp, high magnification. G. Foreleg. H. Midleg. I. Hind leg. J. Color pattern of abdomen, dorsal. K. Color pattern of abdomen, lateral. L. Apex of hind basitarsus, with second tarsal segment. M. *idem*, different specimen. N. Outline of cercus and paraproct.

foreign particles. Rim of aperture slightly reinforced. Length of cocoon dorsally along middle, 2.5–3.0 (3.2–3.5) mm.; maximum length along base 3.2–3.8 (4.2–4.5) mm.

Length of pupa 2.5–2.7 (3.6–3.7) mm. Length of respiratory organs 1.8 (2.5) mm., viz., distinctly shorter than both cocoon and pupa proper.

Respiratory organs from light to dark brown, with eight filaments inserted on three main branches (fig. 20A, D, F). Filaments of dorsal and median branches and dorsal filament of ventral branch diverging at base, approaching near apex; lower filament of ventral branch sharply diverging from rest of filaments, ventrally and backwardly curved. All primary branches very short, divisions of branches variable but all very close to common trunk. Structure of filaments as usual for subgenus.

Head and thorax of pupa from light to dark brown. Frontoclypeus (fig. 20B) without platelets, and with 3+3 simple, hairlike, short frontal, 1+1 in some cases bifid facial, and

1+1 simple hairlike ocular trichomes. Facial trichomes inserted in, or basad of, area of low irregular ridges. Thorax with platelets restricted to margin of exposed area (fig. 20A), attaining base of respiratory organ. Trichomes numbering approximately 10+10 (14+14), in shape of short simple or bifid setae (fig. 20A). Onchotaxy of abdomen as in *S. herreri*.

LARVA: Length of mature larva, 4.5–4.7 (6.7) mm.; width of head capsule, 0.48 (0.7) mm. General body shape as shown in figure 20G.

Color of larva greenish brown, head light brown. Cephalic apotome as shown in figure 20L; pattern elements very faint, but sclerite distinctly darkened near hind margin. Antennae (fig. 20H) dark brown, with constrictions of second segment accompanied by light colored areas. First segment conspicuously rugose longitudinally. Ratio of length of segments I–III, 1/1.4–1.8/0.9–1.0. Mouth brushes with 30–40 (39–50) rays in large fan; teeth of rays of large fan as shown in figure 20I. Toothing of

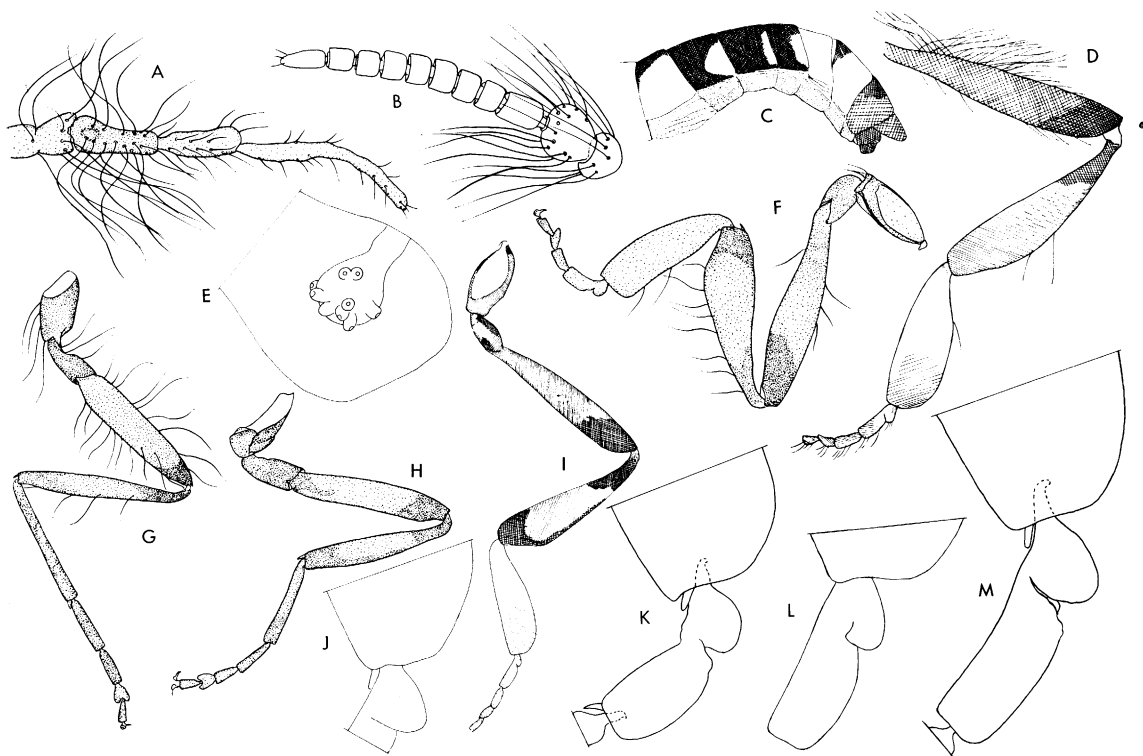


FIG. 19. *Simulium prodexargenteum*, male. A. Maxillary palp. B. Antenna. C. Color pattern of abdomen, lateral, type. D. Hind leg, type. E. Base of third segment of maxillary palp, with sensory vesicle. F. Hind leg. G. Foreleg. H. Midleg. I. Hind leg, different specimen. J-M. Apex of hind basitarsus, with second tarsal segment, different specimens, L, the type.

mandible as shown in figure 20K. Shape of maxillary palp as in figure 20J. Anterior border of hypostomium strongly pigmented; median tooth as prominent or more prominent than lateral teeth. Marginal serration distinct. Hypostomial setae arranged in one or two very irregular rows (fig. 20M), with 8-12 (14-17) setae in each group. Disc of hypostomium with a few short hairs. Gular cleft (fig. 20N) pointed, deep, its depth equal to five times the length of postgenal bridge.

Anal sclerite much as in *S. dureti*; perianal hairs few in number; scales at base of anal sclerite from inconspicuous to distinct. Crochet ring with approximately 78 (95) rows, each composed of 14-15 (16-17) hooks. Anal gills with three simple lobes.

MATERIAL EXAMINED: *Argentina*: Salta: Río Olacapato, between Olacapato and San Antonio de los Cobres, 4000 m., November 5, 1968, in stream on stones (S. Coscarón; AMNH, INM), two females, three males, reared, pupae and

larvae; *idem*, 4150 m., flying around human beings (S. Coscarón; AMNH, INM), 14 females. Jujuy: Orosmayo, 3980 m., on leaves of *Potamogeton* sp. in small, clear creek, water temperature 12° C., November 3, 1968 (S. Coscarón; AMNH, INM), six females, four males, reared, pupae and larvae; near Mina Pirquitas, 3900 m., November 3, 1968 (S. Coscarón; AMNH, INM), one female, reared, pupae and larvae; near Rosario de Coyaguaima, 4700 m., November 4, 1968 (S. Coscarón; INM), pupae and larvae; *idem*, 4300 m. (Coscarón; AMNH), pupae and larvae. *Bolivia*: La Paz: Río La Cumbre, on road to Yungas de la Paz, 3200 m., October 27, 1968 (Coscarón; INM), one pupa.

DISCUSSION: The material studied is homogeneous regarding morphological features but heterogeneous regarding some meristic characters. The two largest lots examined, viz., those from Orosmayo (Jujuy) and from the vicinity of Olacapato (Salta) differ clearly in size, with the Orosmayo specimens smaller, as in the above

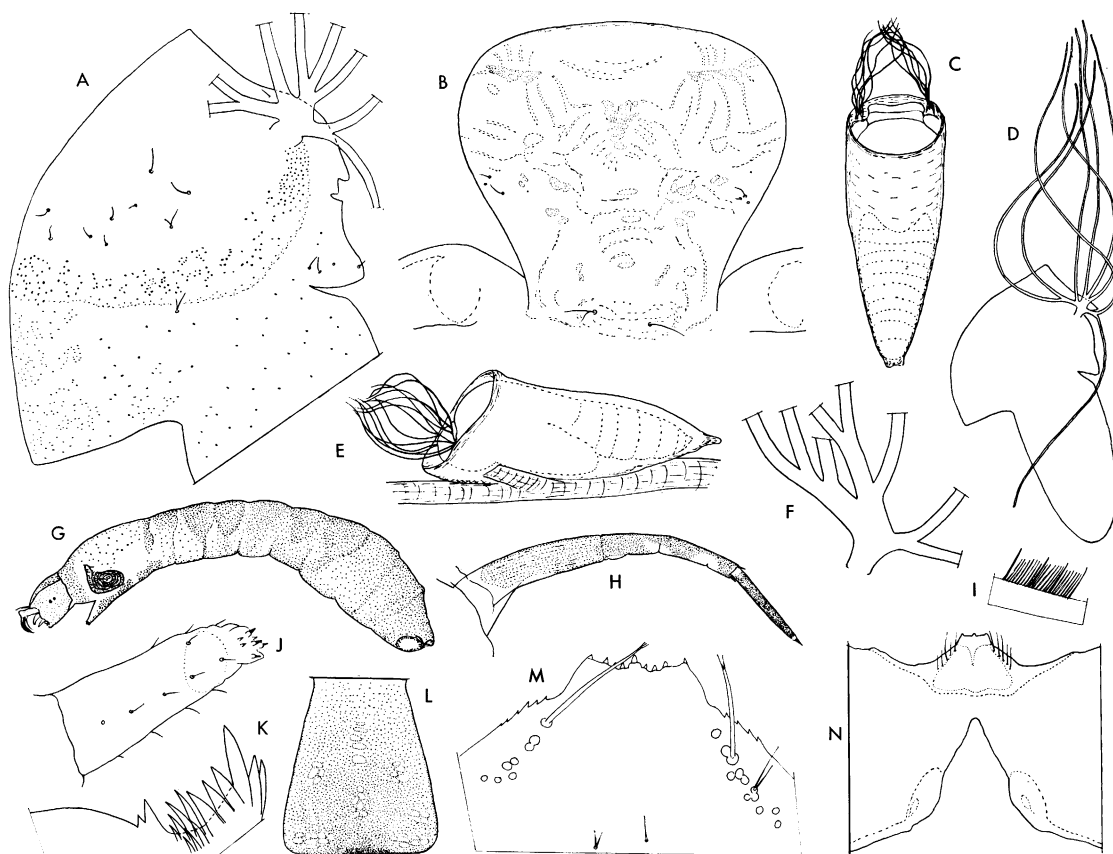


FIG. 20. *Simulium prodexargenteum*. A-F. Pupa. A. Portion of thorax. B. Frontoclypeus. C. Cocoon, with pupa, dorsal. D. Portion of thorax with respiratory organ. E. Cocoon with pupa, lateral. F. Base of different respiratory organ; ventral branch at right. G-N. Larva. G. Larva, lateral. H. Antenna. I. Teeth of ray of cephalic fan. J. Maxillary palp, pigment not shown. K. Apex of mandible. L. Cephalic apotome. M. Portion of hypostomium. N. Undersurface of head capsule, as seen in slide preparation.

redescription, and the Olacapato specimens larger (measurements in parentheses). Individuals from other lots (Mina Pirquitas and Rosario de Coyaguaima, 4300 m.) are intermediate in size, and those from a fifth lot (Rosario de Coyaguaima, 4700 m.) the largest of all. Table 2 shows a few representative measurements to illustrate the size range encountered.

All locations mentioned are close together except Olacapato, which is situated at about 150 km. south of the others; no geographical pattern of variability thus emerges. It may be significant, though, that the largest measurements were obtained from the lot collected at the highest altitude. The differences between the populations examined are only meristic, and as such differences by themselves do not necessarily

TABLE 2
MEASUREMENTS OF COCOONS OF *Simulium prodexargenteum* FROM DIFFERENT LOCALITIES
(All measurements are in millimeters.)

| Locality and Altitude | Length of Cocoon Dorsally | Length of Cocoon Ventrally |
|----------------------------------|---------------------------|----------------------------|
| Oros mayo 3980 m. | 2.5-3.0 | 3.2-3.8 |
| Rosario de Coyaguaima 4300 m. | 2.5-2.9 | 3.6 |
| Mina Pirquitas 3960 m. | 3.0-3.5 | 3.7-4.3 |
| Olacapato 4000 m. | 3.2-3.5 | 3.7-4.3 |
| Rosario de Coyaguaima 4700 m. | 3.5-4.0 | 4.7-5.0 |

indicate specific differences in the Simuliidae, we consider all specimens examined as belonging to one species.

The males of this material agree in all basic characters with *Simulium* (*Pternaspatha*) *prode-x-argenteum* (Enderlein), as redescribed by Wygodzinsky and Coscarón (1967). This species, based on a single male, was recorded from "Hoch-Peru" [High Peru]. The Argentinian and Bolivian *puna* from which our material was collected, is considered as a geographical and ecological continuation of the Peruvian *puna* that occupies High Peru, and at least one other *Pternaspatha*, *Simulium* (*Pternaspatha*) *barbatipes* (Enderlein), is known to have a range extending from the Chile and the Argentinian *puna* to the highlands of central Peru.

***Simulium* (*Pternaspatha*) *quechuanum*,**
new species
Figure 21

DIAGNOSIS: The diagnostic characters can be found in the keys to the species.

FEMALE: Length of wing, 3.2–3.7 mm.

Color of head with appendages, thorax, wings, and halteres as in *herrerii*. Color pattern of legs as illustrated for *hectorvargasi* (fig. 14C–E). Abdomen (fig. 21B, C) black, with 1+1 large silvery white spots on terga II, VI, and VII; Terga III and V, and in some specimens also IV, with 1+1 smaller silver-white spots; posterior margins of these terga very narrowly white at sides. Terga VIII and IX dark gray.

Frons and fronto-ocular triangle as in *herrerii*; frontal angle 115 degrees. Antennae and mouthparts much as in *hectorvargasi*; maxillae with 24–26, mandibles with approximately 35 teeth. Wings as in *hectorvargasi*. Shape and proportions of leg segments as in *hectorvargasi*. Calcipala very small but distinct (fig. 21H), wider than long. Claws with distinct tooth (fig. 21A). Genitalia similar to those of *herrerii*. Genital fork as shown in figure 21D; cercus and paraproct as shown in figure 21F; paraproct broadly rounded.

MALE: Length of wing, 3.5 mm.

Color and structure extremely similar to those of *hectorvargasi*, but calcipala smaller (fig. 21G); apex of distimere smooth.

INTERSEX: General aspect, color, and most morphological characters as in females, but genital fork (fig. 21E) shorter and stouter;

legs with hind basitarsus distinctly widened, and claws of all legs as in male.

PUPA: Cocoon (figs. 21I, J) slipper-shaped; anteroventral bridge distinct, rather salient. Cocoon dark brown; surface smooth, but with individual threads distinctly perceptible with moderate magnification. Rim of aperture distinctly reinforced. Length of cocoon dorsally, 3.5 mm.; maximum length along base, 5.0–5.5 mm.

Length of pupa, 4.0 mm.; length of respiratory organs, 2.0–2.2 mm.

Respiratory organs (fig. 21K, M) composed of six filaments arising from three main branches. Dorsal and median primary branches and their filaments lying closely together, ventral primary branch sharply ventrally bent, its ventral filament curved backward under cocoon, its dorsal filament generally curved forward but not closely associated with remaining filaments. All primary branches with division close to base of respiratory organ, all about equidistant from base. Surface structure of branches and filaments as usual for subgenus.

Head and thorax light brown. Frontoclypeus (fig. 21L) without platelets. 2+2 frontal trichomes, extremely varied in shape, often different in same specimen, from very short, divided, spine-shaped, to elongate bristle-like, generally divided. 1+1 facial trichomes, also extremely varied in shape, from spinelike (although not as short as some frontal trichomes) to elongate hairlike, with two branches, or simple. Facial trichomes situated in depression limited by distinct ridges. 1+1 ocular trichomes, hairlike, with two branches.

Thorax with platelets forming a band along area adjacent to aperture of cocoon (fig. 21K). Trichomes of thorax very similar to those of *barbatipes*, from lanceolate, simple or divided, to elongate hairlike (fig. 21N), but most frequently lanceolate. Number of thoracic trichomes from 120+120 to 180+180. Onchotaxy of abdomen as usual for subgenus.

LARVA: Length of mature larva, 6.5–7.0 mm.; width of head capsule, 0.6 mm. Color much as in *hectorvargasi*, although somewhat darker. General structure of antennae as in *hectorvargasi*; ratio of length of segments I–III, 1/1.7/0.9–1.1. Mouth brushes with 35–38 rays. Toothing of mandibles generally as shown in figure 21P, viz., with first marginal tooth much over twice as long as second, although in some

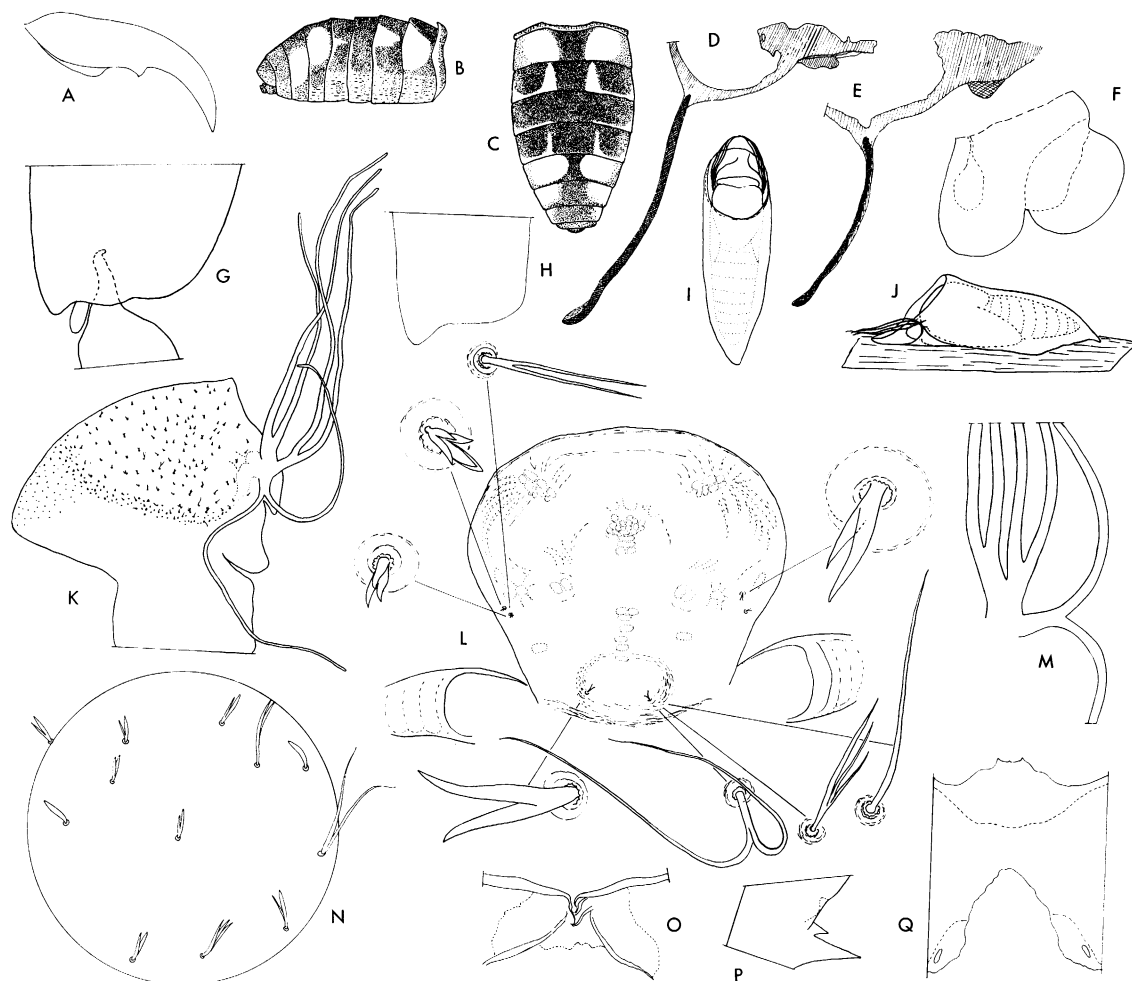


FIG. 21. *Simulium quechuanum*. A-D. Female. A. Claw. B. Pattern of abdomen, lateral. C. Pattern of abdomen, dorsal. D. Portion of genital fork. E. Intersex, portion of genital fork. F. Female, cercus and paraproct. G. Male, apex of hind basitarsus, with base of second tarsal segment. H. Female, apex of hind basitarsus. I-N. Pupa. I. Cocoon with pupa, dorsal. J. Cocoon with pupa, lateral. K. Portion of thorax with respiratory organ. L. Frontoclypeus, with trichomes as seen under high magnification. M. Base of different respiratory organ; ventral primary branch to right. N. Trichomes of thorax, high magnification. O, P. Larva. O. Anal sclerite, pigmentation not shown. P. Marginal teeth of mandible. Q. Undersurface of head.

individuals only twice as long as second. Maxillary palp and structure and pigmentation of hypostomium much as in *hectorvargasi*; hypostomial setae arranged in two or three irregular series, with 11-16 setae in each group. Gular cleft (fig. 21Q) 2-2.5 times as deep as postgenal bridge.

Anal sclerite as shown in figure 21O; spicules or scales not perceptible. Crochet ring with 80-85 rows composed of about 14 hooks each. Anal gills with three simple lobes.

MATERIAL EXAMINED: *Chile:* Tarapacá: 1 km. west of Putre, 3100 m.; October 13-14, 1967 (S. Coscarón and H. Vargas; AMNH), one female, holotype, one male, allotype, two females and four males, paratypes, all reared, two intersexes, reared, pupae and larvae; 12 km. east of Putre, 3600 m., October 13-14, 1967 (S. Coscarón and H. Vargas; AMNH), pupae and larvae; Quebrada de Tarapacá, 3500 m., April 19, 1969 (L. Peña; MNHN, AMNH), one female, one male, reared, pupae and larvae.

Argentina: Jujuy: near Rosario de Coyaguaima, 4300 m., November 4, 1968 (S. Coscarón; AMNH, INM), pupae.

ETYMOLOGY: The specific name *quechuanum* is taken from quechua, the designation of a language and ethnic group of the highlands of several Andean countries.

DISCUSSION: *Simulium* (*Pternaspatha*) *quechuanum* resembles *S. barbatipes* in the kind and arrangement of the thoracic trichomes of the thorax, but in *barbatipes* all branches of the respiratory organ lie closely together. The diverging filaments of the ventral primary branch as observed in *quechuanum* are also found in *herrerii* and *yacuchuspi*, but the thoracic trichomes are very different in these species.

The adults of *quechuanum* are extremely similar to those of *hectorvargasi*; the two species are sympatric. The females can be distinguished by the presence in *quechuanum* of 1+1 white spots on abdominal tergum V, and the absence of these spots in *hectorvargasi*, and the slightly less-developed calcipala in *quechuanum*; this latter character is the only one to separate males of the two species. Only well-preserved adults will permit identification, but the very different pupae distinguished easily by the number of filaments of their respiratory organs and by the thoracic trichomes, are sufficient to recognize each species. There seem to be no clearcut characters to distinguish the larvae of both species; a more careful analysis than that we have carried out will show if the meristic characters we mention are reliable.

BIOLOGY: The intersexes mentioned in the above description are the first ever reported from the subgenus *Pternaspatha*. They were bred from pupae collected west of Putre; mermithids were here found to parasitize several larvae; this may explain the presence of intersexes.

West of Putre, *S. quechuanum* was collected together with *S. (P.) hectorvargasi* and *Gigantodax bolivianum*; east of Putre, the species was found with an undescribed simuliid possibly representing a new genus near *Gigantodax*, and the specimens from Rosario de Coyaguaima were collected with *S. (P.) prodeargenteum*.

Simulium quechuanum is a species restricted to the puna. It is found in streams having cold, crystal clear water, on leaves of trailing grasses, on aquatic plants such as *Potamogeton*, and occasionally on the surface of rocks.

***Simulium* (*Pternaspatha*) *stelliferum*,**
new species
Figures 22–25

Simulium (*Pternaspatha*) *schoenemanni*: WYGODZINSKY AND COSCARÓN, 1967, p. 89 (misidentification).

DIAGNOSIS: The diagnostic characters can be taken from the key to the species of the subgenus. The most striking feature of this species is the structure of the thoracic trichomes of the pupa.

FEMALE: Length of wings, 2.9–3.1 mm. (mode, 3.1 mm.).

Color of head and its appendages, thorax, wings, and halteres as in *pulchrum*; legs similar to those of *pulchrum* in color, but somewhat darker (fig. 22I–K). General color of abdomen gray; pattern as shown in figure 22O. P. Terga II–V velvet black at center. Tergum II with 1+1 large sublateral silver-white spots. Terga III–V narrowly silver-white along hind margin except on median black area. Terga VI and VII each with 1+1 large silver-white spots, those of VII separated by a larger dark median area than those of VI. Terga VIII and IX silver-gray.

Frons as shown in figure 22E; frontal angle 115 degrees. Fronto-ocular triangle as shown in figure 22A, very slightly deeper than wide. Shape and proportions of antennal segments as shown in figure 22G. Maxillary palp as illustrated (fig. 22B). Sensory vesicle half as wide as third article of palp, its structure as shown in figure 22F. Maxillae (fig. 22C) with 26–28, mandibles (fig. 22D) with 42–45 teeth.

Wings as usual for the subgenus. Sc with 12–14 hairs occupying most of length of vein. Basal section of R glabrous. Setae and spines on R₁ (fig. 22R) and setae on R_s arranged in one or two irregular rows. Shape and proportions of leg segments as shown in figure 22I–K. Calcipala (fig. 22L) well developed, not quite so long as wide. Claws with tooth well developed (fig. 22H).

Eighth sternum (fig. 22Q) with central and lateral areas well pigmented. Gonapophyses as usual for the subgenus, their inner margins distinctly pigmented. Cerci and paraprocts as shown in figure 22N. Genital fork as illustrated (fig. 22M). Spermatheca as usual for subgenus, spicules on inner surface arranged in small groups.

MALE: Length of wings, 2.7–2.9 mm. (mode, 2.8 mm.).

Color of head and its appendages, thorax,

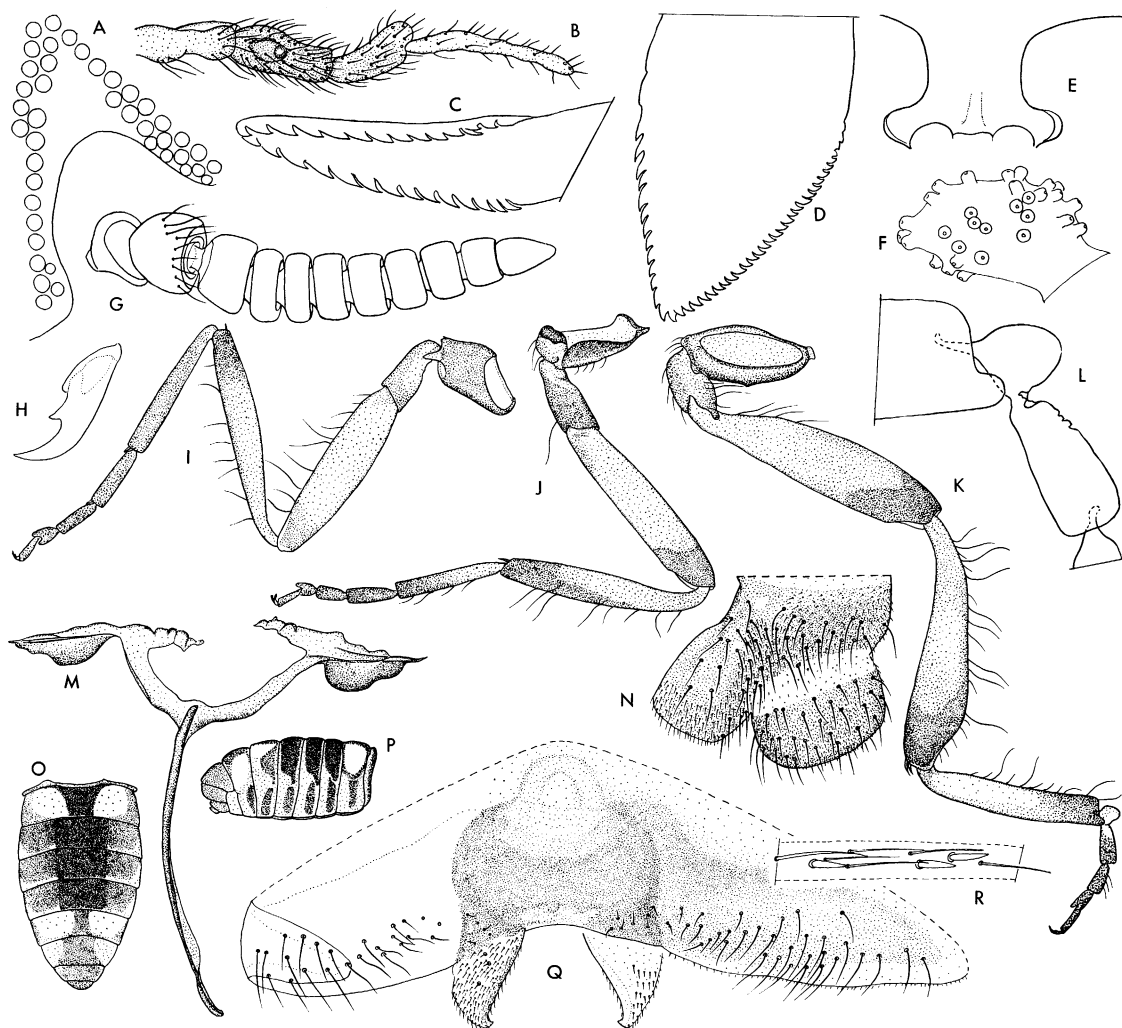


FIG. 22. *Simulium stelliferum*, female. A. Fronto-ocular triangle. B. Maxillary palp. C. Apex of maxilla. D. Apex of mandible. E. Frons. F. Sensory vesicle of maxillary palp. G. Antenna. H. Claw. I. Foreleg. J. Midleg. K. Hind leg. L. Apex of hind basitarsus, with second tarsal segment. M. Genital fork. N. Cercus and paraproct. O. Pattern of abdomen, dorsal. P. Pattern of abdomen, lateral. Q. Eighth sternum with gonapophyses. R. Portion of R_1 .

wings, halteres, and legs much as in *simile*, but legs slightly darker; details of leg pattern shown in figure 23C, F, G. Abdomen (fig. 23J, K) grayish, velvet black dorsally except on segments VIII and IX which are dark gray. Terga II, V, and VI with 1+1 large sublateral silver-white spots; terga III–VII narrowly lighter along hind margin.

Shape and proportions of antennal segments as shown in figure 23A; scapus and pedicellus with conspicuous long hairs. Maxillary palp as illustrated (fig. 23B); basal segments with

long hairs. Diameter of sensory vesicle approximately equal to half the width of third segment; its detailed structure as shown in fig. 23D.

Chaetotaxy of wing veins as in female, but Sc only with 8–10 hairs. Shape and proportions of segments of legs as shown in figure 23C, F, G. Hind basitarsus narrow, 4.3–5.5 times as long as wide. Calcipala well developed, not quite so long as wide (figure 23E).

Genitalia as illustrated (fig. 23H, I, L, M); distimere smooth distally (fig. 23M).

PUPA: Cocoon wall pocket-shaped, but with

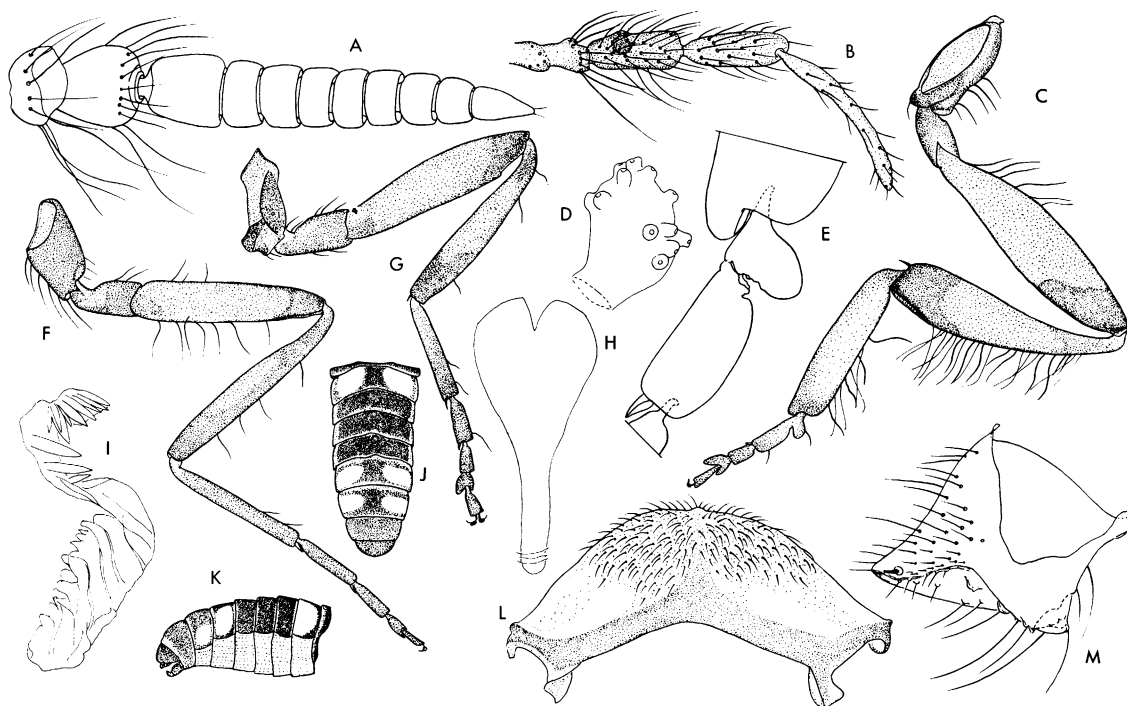


FIG. 23. *Simulium stelliferum*, male. A. Antenna. B. Maxillary palp. C. Hind leg. D. Sensory vesicle of maxillary palp. E. Apex of hind basitarsus, with second tarsal segment. F. Foreleg. G. Midleg. H. Median sclerite. I. Endoparamere. J. Color pattern of abdomen, dorsal. K. Color pattern of abdomen, lateral. L. Ventral plate. M. Distimere.

very short anteroventral bridge (fig. 24C, G). Cocoon brown, its surface smooth, closely woven, individual threads not perceptible. Rim of aperture slightly reinforced. Length of cocoon dorsally, 3.7–3.8 mm.; maximum length along base, 4.5–4.7 mm.

Length of pupa, 3.5–3.7 mm. Length of respiratory organs, 2.5–2.8 mm.; viz., not quite so long as pupa proper, or cocoon.

Respiratory organs (fig. 24D, F) with six filaments arising from three main branches. Ventral and dorsal primary branches divided very close to their bases; median primary branch slightly longer. Dorsal and median branches and filaments closely parallel to each other; ventral branch diverging somewhat from remaining branches, its filaments much narrower than remaining, ventrally but not backwardly directed. Surface structure of filaments as usual for subgenus.

Head and thorax of pupa brown, darkest on frontal region and exposed portion of thorax. Frontoclypeus with very numerous smooth

platelets, and with 2+2 frontal, 1+1 facial and 1+1 ocular trichomes. Shape of these trichomes extremely variable, even on opposite sides in one individual. Frontal trichomes generally rather short, with two or three branches, but occasionally longer; facial trichomes generally hairlike, bifid; ocular trichomes short, inconspicuous. Facial trichomes inserted in distinct depression limited by irregular carinae. Exposed portion of thorax covered with very numerous platelets similar to those of head, and several hundred trichomes. Most thoracic trichomes roughly stellate, as shown in figures 1, 24B, E; 25B, with three to six branches, the latter short, flattened, pointed apically, slightly curved. Some trichomes (fig. 25A) long, hairlike, branched; such trichomes more numerous in lower portion of exposed area. Onchotaxy of abdomen as usual for subgenus.

LARVA: Length of mature larva, 8.5–8.8 mm.; width of head capsule, 0.7–0.75 mm. General body shape of larva as illustrated (fig. 25D).

Color of larva light greenish brown. Head

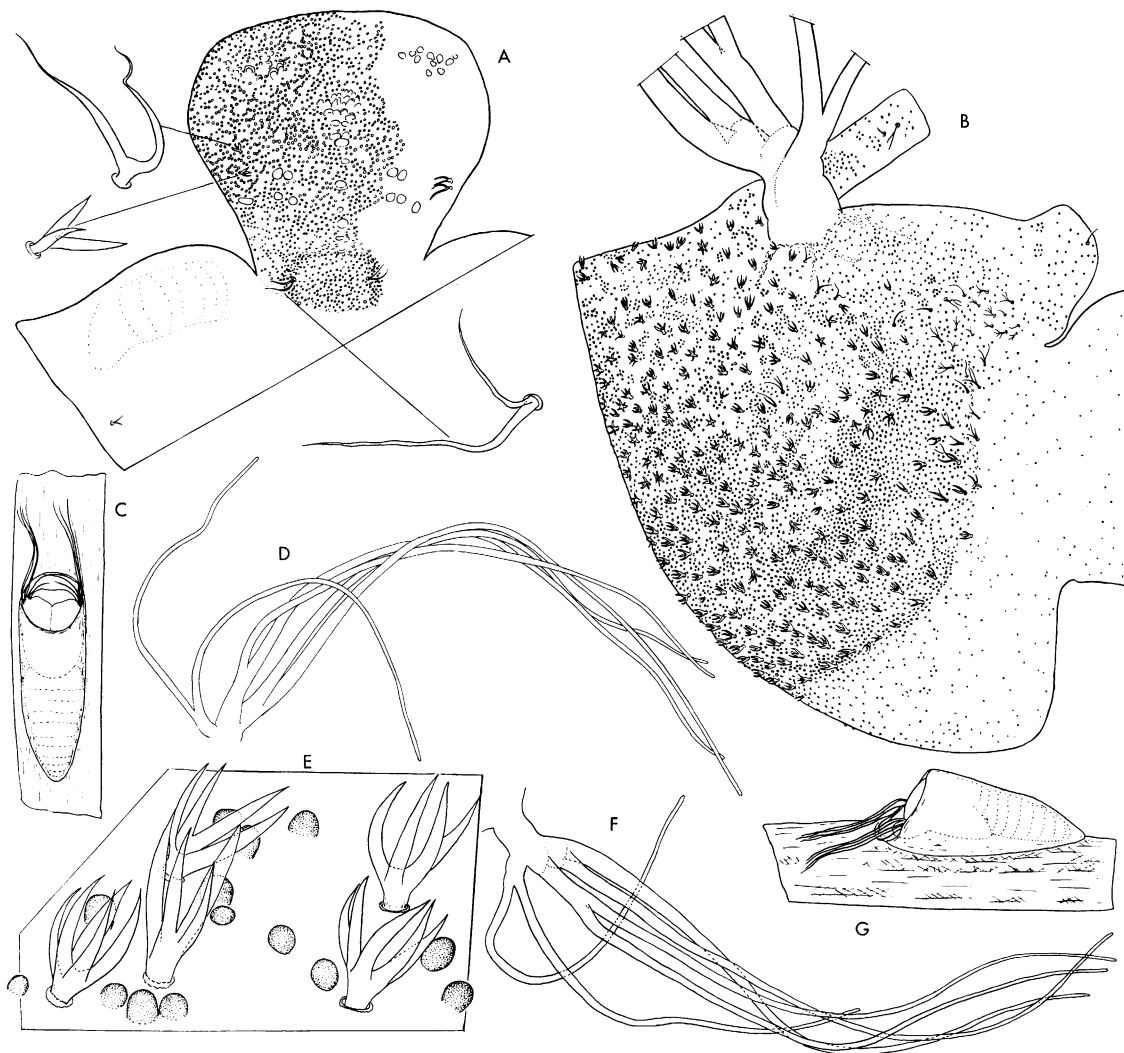


FIG. 24. *Simulium stelliferum*, pupa. A. Portion of head, with some trichomes magnified. B. Portion of thorax. C. Cocoon with pupa, dorsal view. D. Respiratory organ; ventral primary branch to left. E. Trichomes and platelets of thorax, high magnification. F. Respiratory organ; ventral branch on lower left. G. Cocoon with pupa, sublateral aspect.

brown; anterior half or two-thirds of cephalic apotome (fig. 25F) conspicuously lighter than rest of head, which is dark brown; in some specimens, pigment on cephalic apotome reduced to narrow dark band along basal margin (fig. 25G). Antennae (fig. 25H) light brown, third segment the darkest; first segment slightly rugose longitudinally. Ratio of length of segments I–III, 1/1.2/0.8. Mouth brushes with 37–39 rays. Toothing of mandible as shown in figure 25L. Shape of maxillary palp as shown in figure 25C. Anterior border of hypostomium

strongly pigmented (fig. 25J). Median tooth of hypostomium (fig. 25E) almost as prominent as lateral teeth; marginal serration distinct but not very pronounced. Hypostomial setae arranged in one or two irregular rows, with 12–15 setae in each group. Disc of hypostomium with a few scattered setae. Gular cleft as illustrated (fig. 25J), pointed or narrowly rounded apically.

Anal sclerite as shown in figure 25M, O, characterized by very extensive sclerotized areas between anterior and posterior arms. Base of anal sclerite lacking scalelike cuticular

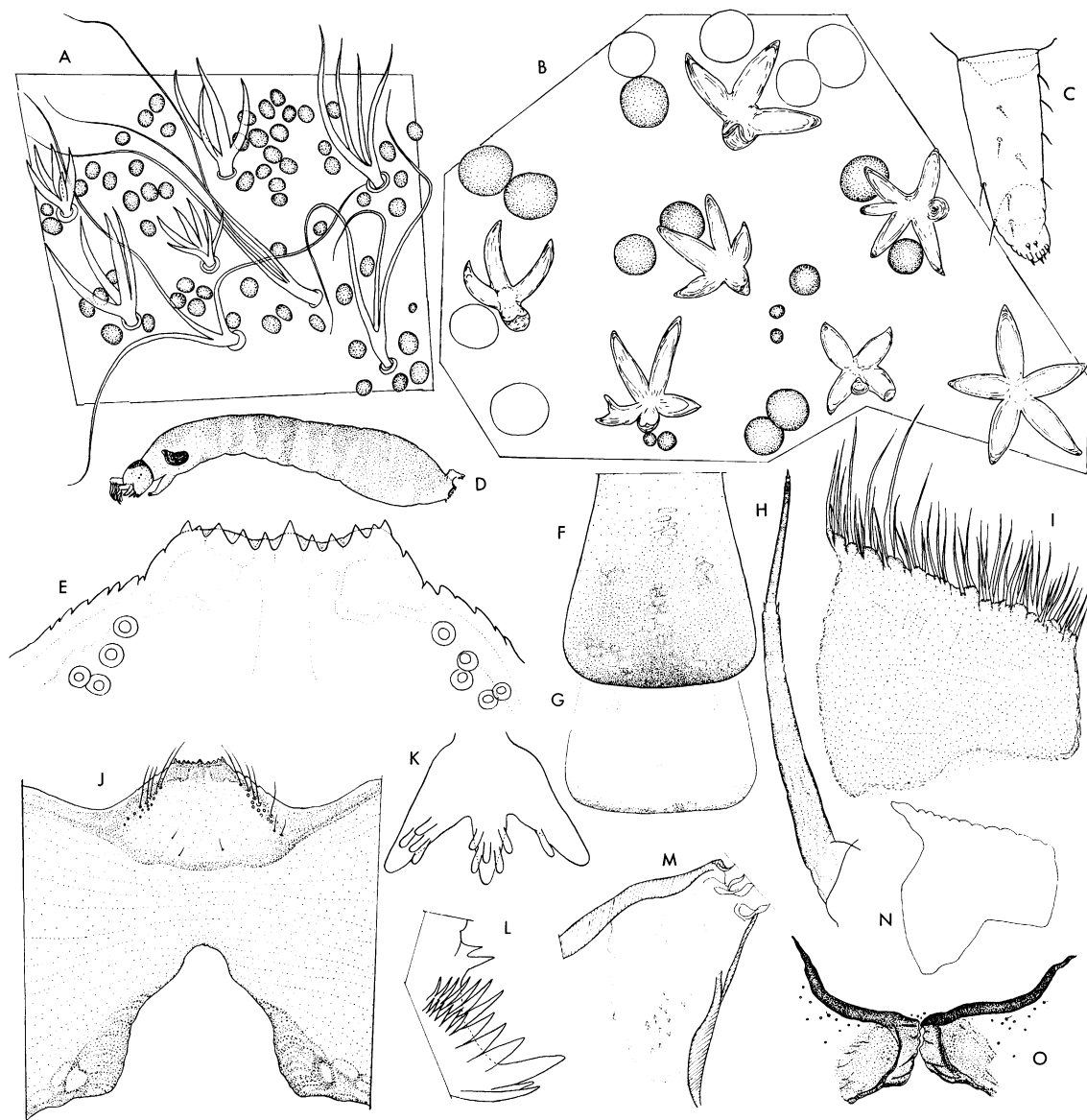


FIG. 25. *Simulium stelliferum*. A, B. Platelets and trichomes of thorax of pupa, high magnification. C–O. Larva. C. Maxillary palp, pigment not shown. D. Larva, lateral view. E. Anterior portion of hypostomium. F, G. Cephalic apotomes of different specimens. H. Antenna. I. Lateral sclerite of pseudopod. J. Portion of undersurface of head, as seen on slide mount. K. Anal gills. L. Apex of mandible. M. Portion of anal sclerite, schematic. N. Outline of lateral sclerite of pseudopod. O. Anal sclerite.

structures, at most with a small number of spicules (fig. 25M). Crochet ring with 81–83 rows composed of 14–15 hooks each. Anal gills (fig. 25K) with three primary lobes, either simple or each with not more than five lobules.

MATERIAL EXAMINED: Chile: O'Higgins: Río Claro, 5 km. north of Rengo, February 27,

1967 (S. Coscarón; AMNH), two males, reared, paratypes, pupae; La Leonera, October 23, 1967 (S. Coscarón; AMNH), one pupa, Valparaíso: Río Limache, October 19, 1967 (S. Coscarón; AMNH), three males and three females, reared, paratypes, pupae and larvae; Los Perales, Río Marga-Marga, 395 m.,

October 14, 1966 (E. I. Schlinger; CIS), one female. Santiago: Maipú, Quebrada de La Plata, April 21, 1966 (M. E. Irwin; CIS), one female. Aconcagua: Cuesta de Chacabuco, October 5, 1967 (S. Coscarón; AMNH), pupae, larvae. Coquimbo: 7 km. north of Los Vilos, August 16, 1966 (M. E. Irwin; CIS), one female; Río Pupio, 10 km. east of Los Vilos, November 16, 1963 (G. F. Edmunds; CNC), pupae and larvae; Río Choapa, from Illapel to Los Vilos, November 16, 1963 (G. F. Edmunds; CNC), one pupa, larvae; Illapel, Hacienda Illapel, November 21–24, 1959 (L. Peña; CNC), two males, one female; Illapel, Hacienda Illapel, Río Santa Virginia, October 21, 1967 (S. Coscarón; AMNH), one male, holotype, one female, allotype, 20 males and 16 females, paratypes, all reared, pupae and larvae; Río Illapel, Hacienda Illapel, 600–900 m., October 19, 1966 (E. I. Schlinger, M. E. Irwin; CIS), two females; Huintil, Río Illapel, Hacienda Illapel, 500 m., November 12, 1963 (G. F. Edmunds; CNC), one pupa, larvae; El Calabozo, Hacienda Illapel, November 23, 1959 (L. Peña; CNC), 43 females; Río Carén, Carén, Hacienda Illapel, 800 m., November 13, 1963 (G. F. Edmunds; CNC), one female; 25 km. north of Combarbalá, November 20, 1959 (L. Peña; CNC), 31 females; near Punitaqui, 800 m., September 24, 1966 (E. I. Schlinger; CIS), one female; 50 km. south of La Serena, December 1, 1950 (E. Ross and A. E. Michelbacher; CAS), one female; valley of Río Elqui, 400–500 m., October 25, 1967 (S. Coscarón; AMNH), seven males and five females, paratypes, reared, pupae, larvae; Fray Jorge, November 4–5, 1957 (L. Peña; CNC), one female; 10 miles west of Vicuña, December 3, 1950 (E. Ross and A. E. Michelbacher; CAS), 14 females; Rivadavia, October 29, 1957 (L. Peña; CNC), two females; on International highway, small creek 2 km. west of Guanta, 1900 m., October 25, 1967 (S. Coscarón; AMNH), four males and six females, paratypes, reared, pupae and larvae; Guanta, October 24, 1967 (S. Coscarón; AMNH), one male, reared; on International highway southeast of Guanta, 2500 m., October 24, 1967 (S. Coscarón; AMNH), one male and five females, paratypes, reared; 5 km. north of Laguna dam, 8000 ft., December 6, 1950 (E. Ross and A. E. Michelbacher; CAS), one female; Los Molles, 1800–2000 m. October 2,

1967 (L. Peña, coll. Peña), 15 females. Atacama: 20 km. south of Vallenar, August 16, 1966 (M. E. Irwin; CIS), two females; Río Jorquera, 1350–1500 m., October 27, 1967, specimens entering car (S. Coscarón; AMNH), 18 females; near La Junta, Río Jorquera, 1200–1500 m., October 27, 1967 (S. Coscarón; AMNH), 21 males and nine females, paratypes, reared, pupae, larvae; Quebrada and Río del Medio, 1300 m., October 27, 1967 (S. Coscarón; AMNH), five males and two females, paratypes, reared, pupae, larvae; Bahía de Copiapó, coastal dunes, October 5, 1966 (E. I. Schlinger and M. E. Irwin; CIS), one male, 14 females. Tarapacá: Valle de Lluta, October 12, 1967, in irrigation ditches (S. Coscarón; AMNH), larvae.

ETYMOLOGY: *stelliferum*, from the Latin, *stelliferus*, bearing stars; an allusion to the star-shaped trichomes of the thorax of the pupa of this species.

DISCUSSION: The adults of *stelliferum* are most similar to *S. (P.) caprii* from which they can be distinguished as indicated in the key. The pupa differs from all other species of the subgenus by the unique structure of the trichomes of the thorax. The larva of *stelliferum* lacks peculiarities, and varies in some key characters; in consequence, it had to be placed in the key more than once.

BIOLOGY: *Simulium stelliferum* has a comparatively wide ecological spectrum. It is found mainly in fast-flowing streams but also occasionally in irrigation ditches, at altitudes from 200 to 2500 m., and at water temperatures from 6–17° C. The larvae and pupae were found attached to vegetation, such as grass or small branches of other plants trailing in the current, but also, in some cases, to the surface of rocks. The streams in which specimens were collected were mostly clear, but sometimes *stelliferum* was obtained in slightly turbid waters containing abundant diatoms and other organic matter; in the latter case, the current was invariably exceedingly fast.

Species *Incertae Sedis*

Simulium (Pternaspatha) schoenemanni (Enderlein)

Coscarón and Wygodzinsky (1967) tentatively identified certain Chilean specimens of *Pternaspatha* as *schoenemanni*. We have now seen additional material of the species then identified

as Enderlein's species. Upon careful re-examination we have come to the conclusion that the females fail to agree with the characters given by Enderlein (1934) for the female type and only specimen known of *schoenemanni*, especially as to the color pattern of the abdomen. The type of *schoenemanni* could not be found at the Zoological Museum at Berlin, where it was deposit-

ed, according to Enderlein (1934), nor at the Staatliches Museum fuer Tierkunde, Dresden, where the type might have been deposited by error. The species formerly identified by us as *schoenemanni* is described above as *stelliferum*, new species, but *schoenemanni* itself continues to be an enigma.

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