

**Podonominae from Ecuador, with Notes on the Sense Organs
and Pupal Respiratory Organs
(Diptera: Chironomidae)**

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Abstract: Two new species of *Podonomus* from Ecuador are described—*Podonomus caranqui*, adult and pupa, and *Podonomus quito*, adult, pupa, and larva. The association of the pupa of these species with blackfly puparia is discussed. The cast pupal skin of the species of *Parochlus* from the same collection is described. The distribution and types of sensilla of the adult wings, legs and antennae and the pupal tergites are given. The structure of the pupal respiratory organs, especially the plastron, is described and comparison is made with the plastron of representative Tanypodinae species.

The species here described were collected by Dr. Pedro Wygodzinsky, in the pupal stage, from the Rio Sumbahua in Cotopaxi Province, Ecuador. The notes, graciously furnished me by Dr. Wygodzinsky, show that the pupae of both *Podonomus* species are associated with the pupal cases of the simuliid genera *Simulium* and *Gigantodax*. The *Podonomus* pupae are highly mobile and are able to "walk" on the rocks with the help of the spinous appendages of the abdomen. They take shelter close to and in the blackfly pupal cases. The collection made by Dr. Wygodzinsky contained several blackfly pupal cases filled by 4–5 pupae and shed larval skins of *Podonomus quito*,² figs. 49, 50. This shows that the larvae crawl into the blackfly pupal cases while still inhabited by the blackfly pupae or while the cocoon is empty and use them as a shelter in which to pupate. The larvae, as Brundin (1967) notes, with their strongly developed proleg claws are capable of withstanding the full strength of the torrential currents in which they live. The pupae are, however, obviously not so well endowed and must seek shelter to avoid being swept away before the adult is ready to emerge.

The adult male of *Podonomus caranqui*² and the adult females of both species of *Podonomus* had been reared by Dr. Wygodzinsky. The presence of mature pupae with well developed genitalia permitted the association of the

¹ In addition to my great debt to Dr. Wygodzinsky, I am also indebted to Dr. Eleanor Slifer who gave extensively of her time and knowledge to help interpret the sensory structures and to Mr. Stanley Luszcz of the Franklin Institute Research Laboratories for the excellent scanning electron microscope photographs reproduced in figures 53–76.

² These names are based on two of the pre-Inca tribes of Ecuador.



FIGS. 1-8. *Podonomus caranqui*. Fig. 1—lateral view of mesonotum. Fig. 2—claw, empodium-pulvillus, ventral. Fig. 3—pad of fourth tarsal segment, lateral. Fig. 4—genitalia. Fig. 6—struts of male genitalia. Fig. 7—filaments of female eighth sternite. *Podonomus quito*. Fig. 5—male genitalia. Fig. 8—spurs of tibia III, female, comb omitted.

pupal and adult stages of both species. *Parochlus* nr. *maorii* Brundin was represented by only a single cast pupal skin.

Symbols and Ratios Used in Text and Figures

AR—Antennal ratio, considering pedicel as seg. 1: ♂ segments 14 & 15/2–13 ♀ segment 10/2–9	S _c —Subcosta
ARC—Arculus to r-m/arculus to wing tip	T ₁₋₅ —Tarsal segments
BR—Length of basistyle/length of dististyle	Ti—Tibia
Cx—Coxa	Tr—Trochanter
F—Femur	8S—Eighth sternite
fR—Fork of radius	9T—Ninth tergite
LR—T ₁ /Ti of each leg	I–III—Pro-meso-and metathoracic legs.
RR—Height of cell R ₁ /height of cell R ₄₊₅ : taken from apex of R ₁	(AMNH)—American Museum of Natural History
R ₁ , R ₄₊₅ —Radial veins	(ANSP)—Academy of Natural Sciences of Philadelphia

Podonomus caranqui new species

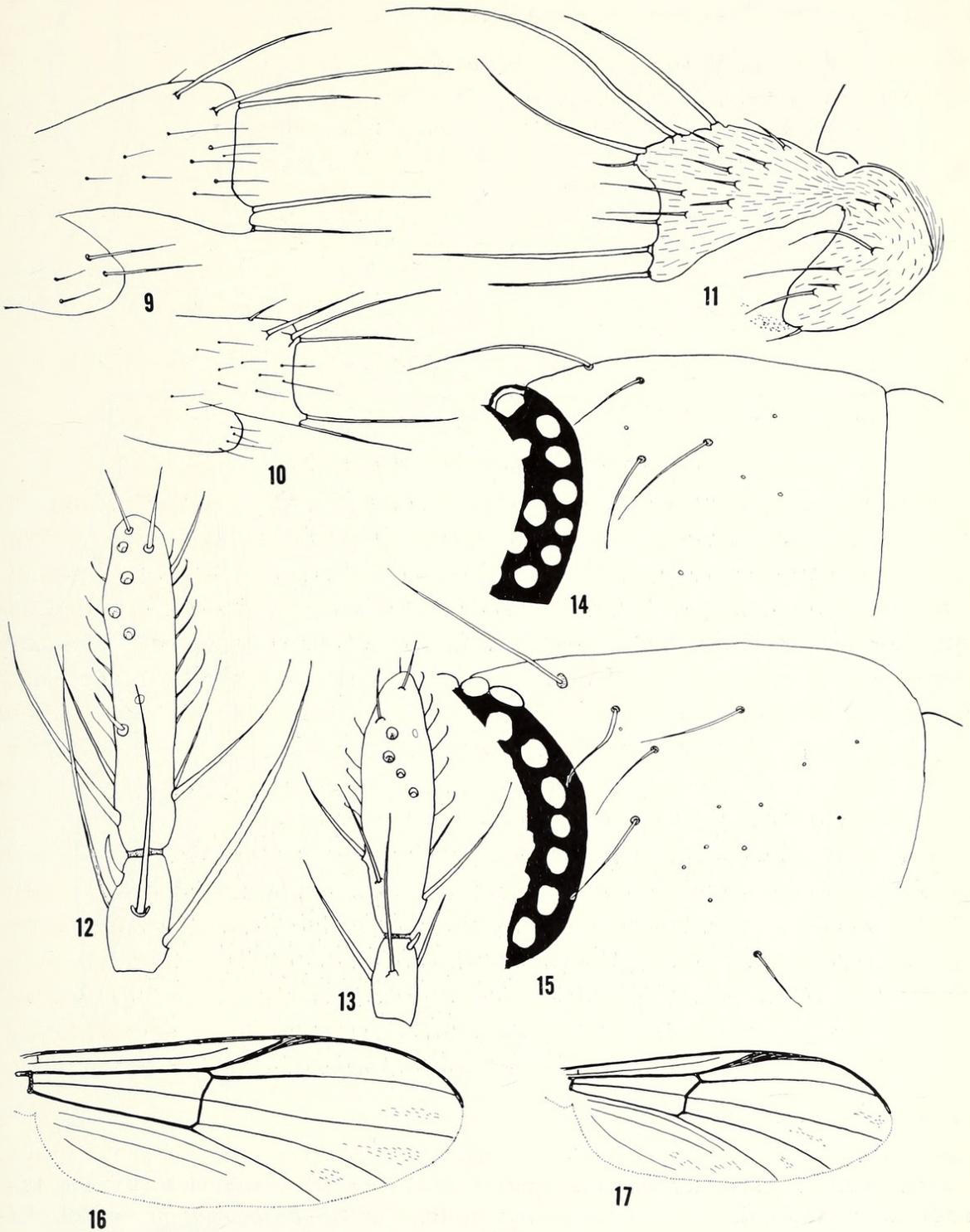
This species appears to be a member, though slightly aberrant, of the *albinervis* group of Brundin (1967). The male dististyle, in some aspects, combines characters of some members of the *decarthus* and *albinervis* groups. The subapical lobe, fig. 4, though smaller than most of those illustrated for the *decarthus* group, is larger than any in the *albinervis* group and lacks any microtrichia at its apex. In general form the dististyle is somewhat intermediate between that shown for *P. albinervis* (Brundin 1967, fig. 206) and *P. illesi* [S. Am.] or *P. derwentensis* [Tasm.] (loc. cit. figs. 190, 193). The subapical lobe of this species bears 3 “t” setae as does *P. derwentensis* and the “P” seta is longer than that of most members of the *albinervis* group.

The pupa, which keys to *Podonomus* sp. “La Paz” in Brundin 1967, is very typical of the *albinervis* group. If there were any doubts as to the placement of this species it would be resolved by the pupa. The form of the lateral abdominal spines, fig. 27 a–c, the pupal respiratory organ, figs. 21, 53, and the presence of a large ventral flap on abdominal segment 2, fig. 32, fit the characters of the *albinervis* group. In addition the female cerci, figs. 9, 11, are also typical of the *albinervis* group and are, in fact, very close to those of *P. albinervis*.

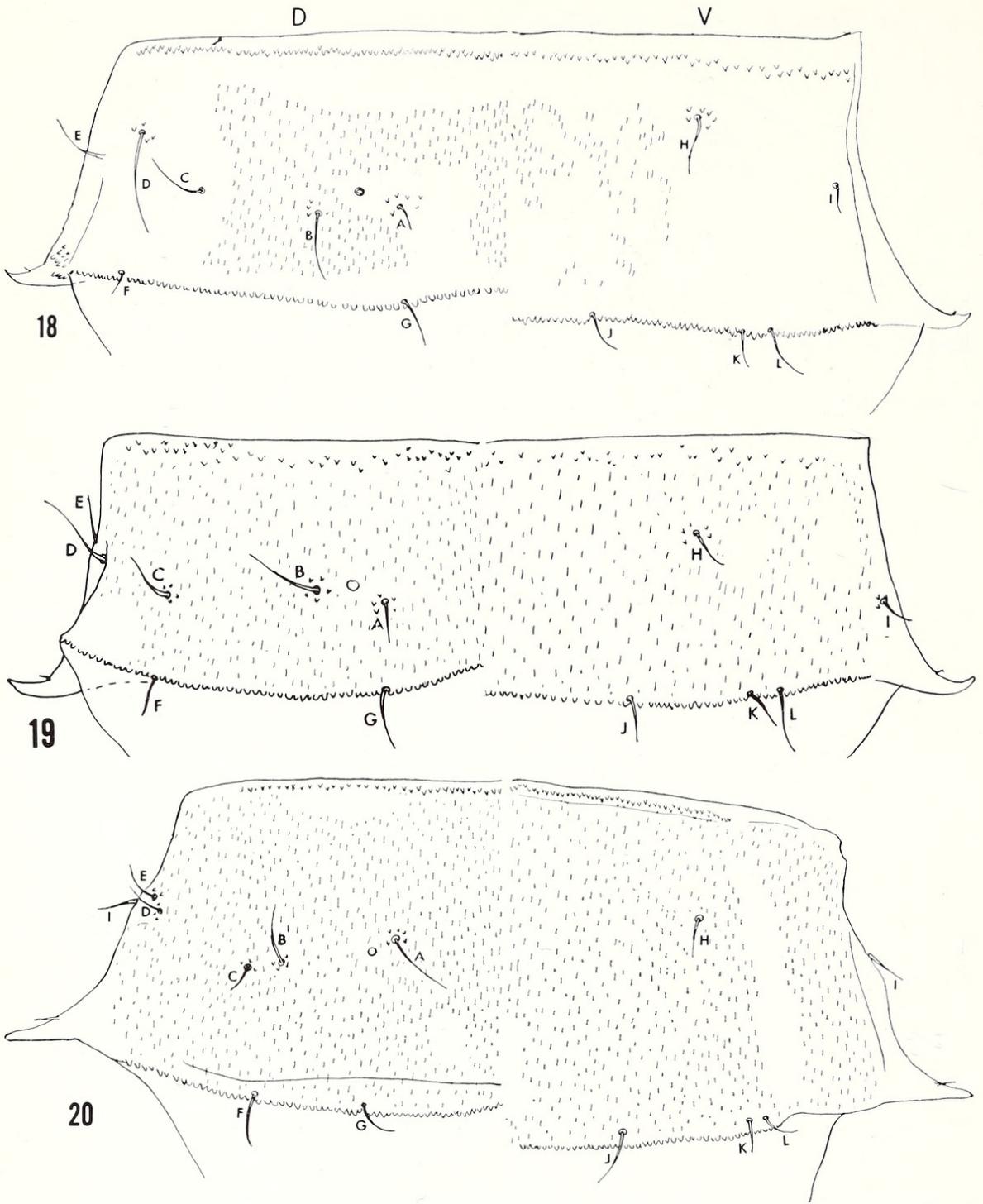
MALE: 1.9 mm. long, wing 2.0–2.1 mm.

HEAD. Brown; eyes bare; postoculars uniserial, extend onto vertex as in fig. 15; antenna 15 segmented (pedicel = segment 1); segments 2–13 with 2 verticels of long hairs each; scape and pedicel with 1–2 hairs each; last four segments in ratio 16-16-56-20; AR .47–.52; maxillary palpus appears four segmented; basal segment appears partially divided into small basal section with 1 ventral seta and distal section with a whorl of 3 setae; ratio 40 (10 + 30)—85-50-75; clypeus with 2–4 setae.

THORAX. Pronotum dark brown; reduced above; lateroventrals—4; mesonotum black-brown, vittae not too distinct; acrostichals, fig. 1; biserial with anterior hairs 58 μ , caudal hairs 110 μ ; dorsocentrals also biserial with hairs 60 and 190 μ long; humerals 4–6; supra-alars 11–12; postalars 1; scutellar bristles—4 strong.

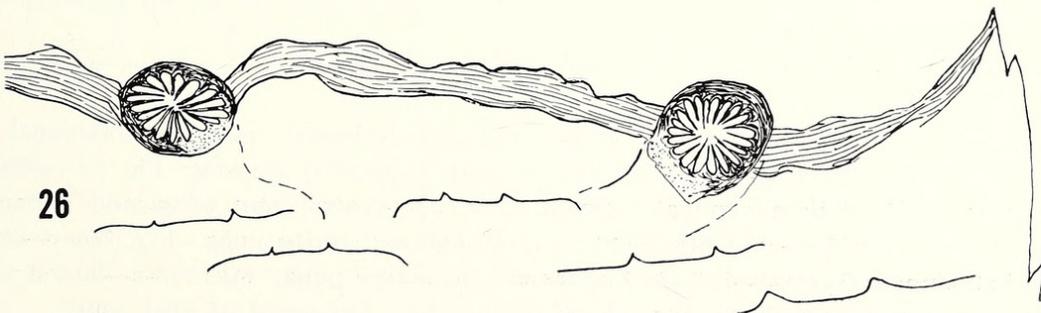
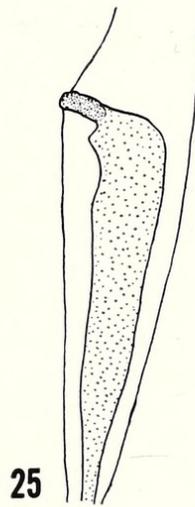
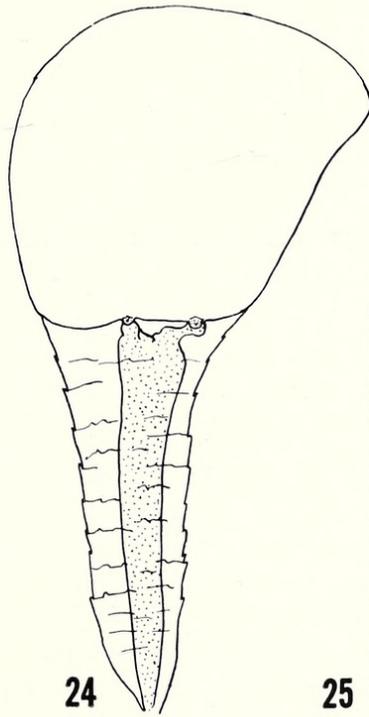
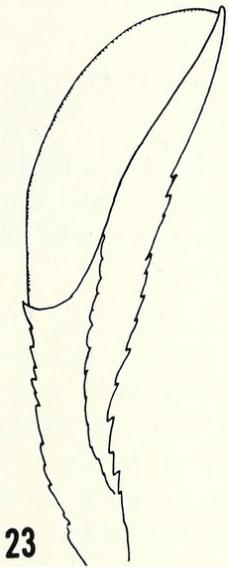
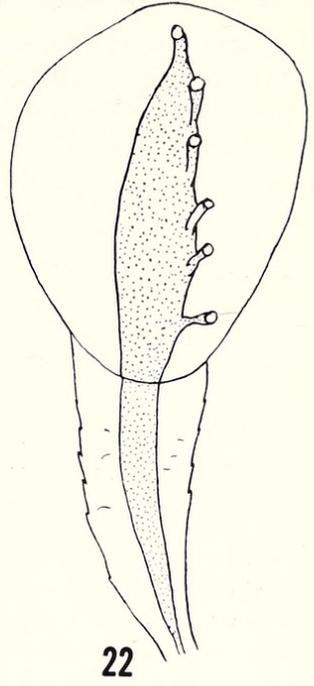
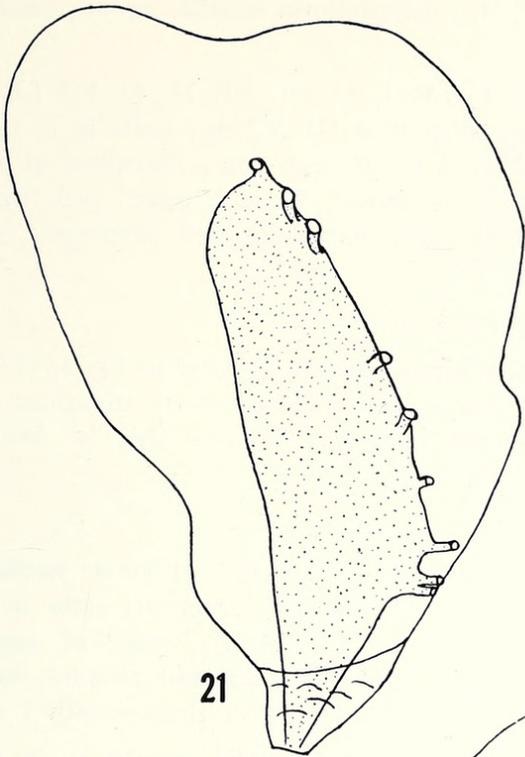


FIGS. 9-17. *Podonomus caranqui*. Fig. 9—Female cercus, lateral. Fig. 11—Same ventro-lateral. Fig. 12—apex of female antenna. Fig. 15—right half of female vertex. Fig. 16—female wing. *Podonomus quito*. Fig. 10—female cercus, lateral. Fig. 13—apex of female antenna. Fig. 14—right half of female vertex. Fig. 17—female wing.



FIGS. 18-20. Pupal sixth abdominal segment, dorsal view (D), ventral view (V). Fig. 18—*Podonomus caranqui*. Fig. 19—*Podonomus quito*. Fig. 20—*Podonomus* nr. *maorii*. Explanation of small A-L in text.

FIGS. 21-26. *Podonomus caranqui*. Fig. 21—Pupal respiratory organ, dorsal. *Podonomus quito*. Fig. 22—pupal respiratory organ, dorsal. Fig. 23—same, lateral. *Podonomus m. maorii*. Fig. 24—pupal respiratory organ, dorsal. Fig. 25—base of same, lateral. Fig. 26—Aeropyle openings at base of plastron, detail.



WING. Only microtrichia on disc; RR .78; ARC .43; campaniform sensilla, fig. 36; venation as in fig. 16; costal extension past R_{4+5} 109μ ;

LEGS. Black-brown; proportions given in table 1; LR I .53-.60; LR II .51-.53; LR III .50-.54; spur tibia I 51μ ; spurs tibia II 41, 32μ ; spurs tibia III 79, 38μ ; spurs as in fig. 8, with numerous fine spines along shaft; apical $17 \pm 1\mu$ of each spur, regardless of total length, clear of fine spines; comb tibia III with 13 spines; T_4 with apical pad, fig. 3; claw spatulate, fig. 2, with one large filament at base; empodium well developed; small pulvilli present.

ABDOMEN. Black-brown; 9T with $32 \pm$ bristles arranged 3-26-3;

GENITALIA. Basistyle, fig. 4, $160-167\mu$; $24 \pm$ heavy bristles mesally; dististyle, fig. 4, $77-80\mu$; BR about 2.0; "t" seta of apical lobe $15-18\mu$ long; subapical lobe broadly triangular with apex clear of microtrichia; 3 "t" setae, 11μ , present ventrally; "P" seta 58μ ; "x" and "y" setae present, 11μ each; genitalic struts as in fig. 6.

FEMALE: 1.8-2.0 mm. long; wing 2.2 mm.

HEAD. Colored as male; vertex, fig. 15; small pits (10) on each side of vertex appear to be dermal gland canal openings, 0.60μ in diameter; antenna 10 segmented; ratio of segments starting with pedicel 45-30-28-22-22-23-22-22-24-75; average width of segment in same ratio 15; segments 2-9 with 1 verticel of long hairs and 1 basiconic receptor, $14-16\mu$ long on each, fig. 12; AR .37; palpal segments in ratio 38-75-60-79; clypeus with 2 setae.

THORAX. Pronotum as male; humerals 11-12; supra-alars 16; other bristles as in male.

WING. Venation as in fig. 16; RR .81; ARC .40; some macrotrichia in cells R_{4+5} , M and Cu_1 , campaniform sensilla as in fig. 36 except that sensilla in R_1 is closer to fR; costal extension 73μ .

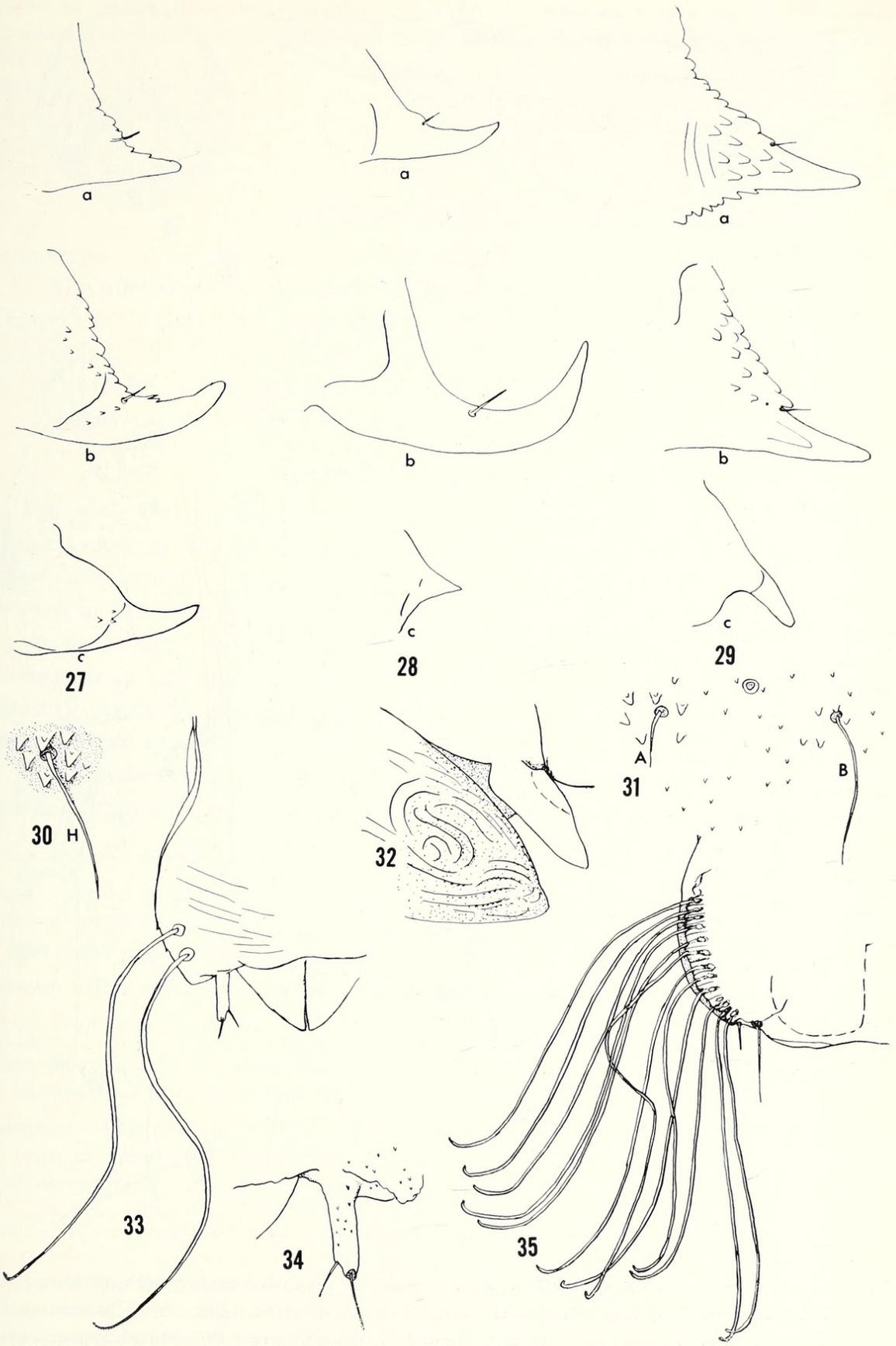
LEGS. Black-brown; proportions and ratios in table 1; spur I 43μ ; spurs II 41, 31μ ; spurs III, fig. 8, $85, 42\mu$; comb III as male, claws sharp with 2 basal hairs.

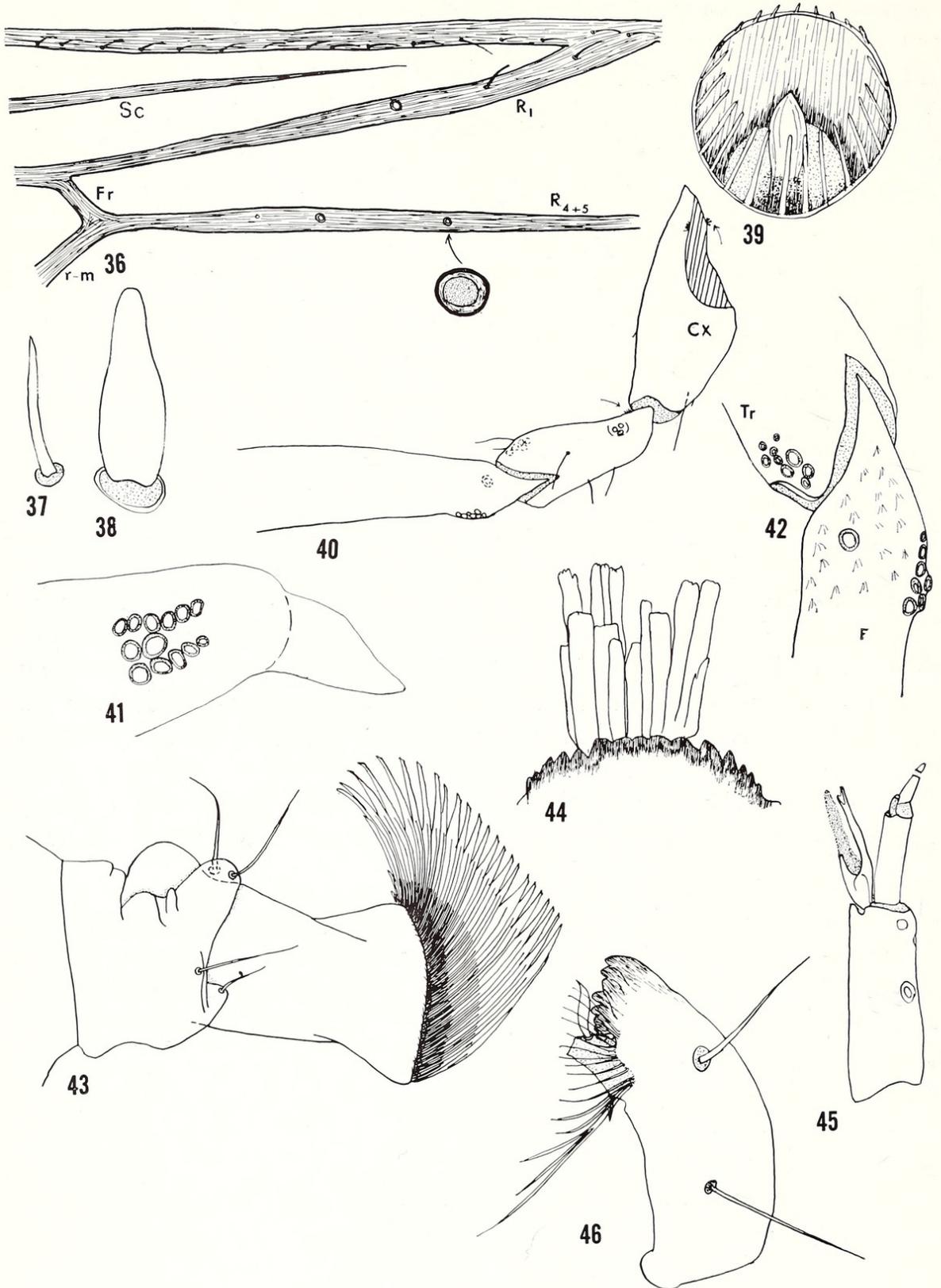
ABDOMEN. Black-brown; 8S covered by mesally expanded hairs, fig. 7, $44-67\mu$ long; these more concentrated around genital opening; cerci as in figs. 9, 11; longest 5 hairs from top to bottom 69, 107, 67, 73, 49μ ; spermathecae about 47μ diameter; canal to genital opening elongate, transversely striate.

PUPA. 2.5-3.1 mm. long, figs. 47, 48; respiratory organ, figs. 26, 53, 370μ long by 222μ greatest width; in life, bright red-orange; stalk only 74μ long; plastron extends over both dorsal and ventral surfaces; dorsal plastron slightly wavy with a slight fold along line of aeropyles, fig. 53; ventral plastron shallowly v-shaped with a mesal longitudinal ridge; details of plastron structure, figs. 54-58; respiratory atrium as in figs. 21, 59; opens to plastron through about 9 aeropyles, fig. 21; there is some variation in number and detailed distribution; internally atrium with a fine structural meshwork, fig. 60; ventral flap of abdominal segment 2, fig. 32, 177μ long along midline; flap is .83 length of segment 3; microsculpture of abdominal segments as in fig. 18; lateral spines present

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FIGS. 27-35. *Podonomus caranqui* pupa. Fig. 27a-c—lateral spines of abdominal segments 4, 7, 8. Fig. 30—detail of ventral hair H, sixth abdominal segment. Fig. 31—detail of dorsal hairs A, B, sixth abdominal segment. Fig. 32—ventral flap of second abdominal segment, lateral. Fig. 35—anal fins, right half. *Podonomus quito* pupa. Fig. 28a-c—lateral spines of abdominal segments 4, 7, 8. *Podonomus m. maorii* pupa. Fig. 29a-c—lateral spines of abdominal segments 4, 7, 8. Fig. 33—anal fins. Fig. 34—detail of anal spurs.





FIGS. 36-46. *Podonomus caranqui*. Fig. 36—detail of radial sector with campaniform sensilla. Fig. 37—chemoreceptor, apical segment male antenna. Fig. 38—Chemoreceptor, flagellar segments 2, 3, male antenna. Fig. 41—detail coeloconic receptor, apical segment male antenna. Fig. 41—detail venter of base of femur. *Podonomus quito*. Fig. 40—coxa,

on segments 3-8; those on 3-7 similar to figs. 27 a, b; spine on 8 as in fig. 27c; abdominal chaetotaxy of intermediate segments, fig. 18; lengths of setae given in table 2; a small "O" seta (4.7μ) seems to be present; tergites 2-7 with a campaniform sensilla (4.5μ diameter) between setae A & B, fig. 31; 2 such sensilla on each side of tergite 1; major dorsal and ventral setae each surrounded by a ring of blunt heavier spines, figs. 30, 31; segment 8 with 8 lateral wavy hairs; anal segment with 12, fig. 35; wavy hairs about 330μ long; anal spurs reduced, fig. 35; a pair of hairs 20 and 70μ long at this spot on each side.

MATERIAL EXAMINED

HOLOTYPE. ♂ on slide; Ecuador, Prov. Cotopaxi, 3,500 m. Road Pujili-Quevedo, Rio Sumbahua, July 29-Aug. 15, 1969 Coll. P. & B. Wygodzinsky (AMNH)

ALLOTYPE. ♀ on slide, same data as holotype (AMNH)

PARATYPES. ♂, 2 ♀♀ in alcohol, (AMNH), ♂ on slide (ANSP), ♂ on slide (AMNH) ♂, ex pupa on slide (AMNH), same data as holotype
Numerous pupae and pupal skins

Podonomus quito new species

The male dististyle of this species, fig. 5, (dissected from mature pupa) appears close to that of *P. inermis* Brundin, *P. paynensis* Brundin and *P. nordenskjoldi* Brundin. The male, as far as could be discerned, differs from *P. inermis* in lacking a narrowed tip of the last antennal segment; from *P. paynensis* in its smaller size and lack of stout setae on the basistyle; from *P. nordenskjoldi* in having a normal, not reduced, antennal plume. The pupal respiratory organ differs, figs. 22, 61, from any figured by Brundin (1967) for the *albinervis* group.

The female cercus resembles that of *P. inermis* but differs in the straight dorsal margin and lacks the setal tuft on the lower lobe of the *P. inermis* cercus.

MALE: dissected from mature pupa.

HEAD. Chaetotaxy as in female; antennal plume normal; apical segment not narrowed; apical antennal segments (teneral) in ratio 24-20-85-52; sensilla as in *P. caranqui*; clypeus with 6 setae; pedicel and scape, 1 seta each.

THORAX. Does not appear to differ from *P. caranqui* in color or chaetotaxy.

WING. Not fully developed.

LEGS. Spur tibia I 37μ ; spurs II 27, 23μ ; spurs III 63, 32μ ; claws, pad of T_4 , distribution of leg sensilla as in *P. caranqui*.

GENITALIA. Basistyle, fig. 5, with only fine setae; length about 95μ ; dististyle about 58μ ; "t" seta of apical lobe 14μ ; subapical lobe not clearly present; entire dististyle covered with microtrichia.

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trochanter and base of femur, leg I, anterior view, tonic receptor hair patches indicated by arrows. Fig. 42—detail of base of femur, apex of trochanter, posterior view. Fig. 43—larval posterior proleg, dorso-lateral. Fig. 44—larval labial plate and hypopharyngeal blades. Fig. 45—antenna. Fig. 46—mandible.

TABLE 1. Proportions of leg segments and leg ratios.

Leg	F	Ti	T ₁	T ₂	T ₃	T ₄	T ₅	LR
<i>Podonomus caranqui</i>								
					MALE			
I	170	175	100	45	30	17	17	.57
II	180	161	85	45	26	15	17	.53
III	210	220	110	65	32	14	17	.50
					FEMALE			
I	150	157	95	55	28	16	17	.61
II	150+	152	75	43	25	14	16	.49
III	—	185	100	65	32	15	17	.54
<i>Podonomus quito</i>								
					FEMALE			
I	115	111	65	36	20	11	13	.59
II	134	114	53	31	18	12	14	.46
III	195	152	75	48	23	12	14	.49

FEMALE: 1.6 mm; wing 1.7 mm.

HEAD. Black-brown; eyes bare; postoculars uniserial, extend on to vertex as in fig. 14; 5-6 gland openings on each side of vertex; antennal segments in ratio 28-27-19-19-18-19-19-19-55; pedicel in same ratio-35; antennal ratio .32; last two antennal segments, fig. 13; palpal segments in ratio 32 (10 + 22)—55-45-60; basal segment appears partially divided into a short basal part with 1 latero-ventral bristle and a longer apical section with a whorl of 4 bristles;

THORAX. Pronotum black-brown; 3 latero-ventrals; acrostichals as in male of *Podonomus caranqui*; humerals 14; supra-alars 10; postalars 1; scutellars 4; vittae not distinct.

WING. Venation as in fig. 17; RR—.62; ARC—.34 macrotrichia only in cells, R₄₊₅, M, Cu₁, and behind Cu₂; costal extension 76 μ .

LEGS. Brown; proportions and ratios given in table 1; spur I 29 μ ; spurs II 32, 23 μ ; Spurs III 62, 26 μ ; comb tibia III, 13 setae; leg sensilla, figs. 40, 42, same as for *Podonomus caranqui*; claws apically sharp with 2 basal spines.

ABDOMEN. Black-brown with usual scattered bristles; spermathecae (2) ovoid, 38 \times 56 μ ; brownish with apical 13 μ clear; 8S with bristles on disc and around genital opening as in *Podonomus caranqui*, fig. 7; cercus as in fig. 10; five longest hairs top to bottom 42, 66, 53, 57, 37 μ .

PUPA. 1.9-2.3 mm. long, figs. 49-52, respiratory organ, figs. 22, 23, 61, 276 μ long by 148 μ greatest width; in life, bright red-orange; plastron 162 μ long; stalk 114 μ ; plastron, figs. 61-64, only on dorsal surface, moderately convex and smooth; details of the plastron structure shown in figs. 62-64; respiratory atrium, fig. 22, opens to plastron through 6 aeropyles; there is some variation from specimen to specimen; venter of respiratory organ with flat spines as on dorsal side of stalk, fig. 64; ventral flap of abdominal segment 2 166 μ ; .90 length of segment 3; microsculpture of mesal abdominal segments as in fig. 19; lateral spines on abdominal segments 3-8; those on 3-7 as figs. 28 ab, spine on segment 8 very small and triangular in shape, fig. 28 c; abdominal chaetotaxy of intermediate segments as in fig. 19; lengths of setae given in table 2; small "O" setae and campaniform sensilla present on tergites as in *Podonomus caranqui*; spines around abdominal setae not as well developed as in *Podonomus caranqui*; abdominal segment 8 with 12 wavy hairs; anal segment with 14, wavy hairs about 325 μ ; anal spurs reduced similar to fig. 35; setae 23 and 86 μ on each side.

TABLE 2. Lengths in μ of setae of sixth pupal abdominal segment. As did Brundin (1967), I found it impossible to, with certainty, homologize the dorsal and ventral setae of the podonomine pupal abdomen with those of the Tanypodinae (Fittkau 1962). I have designated these setae in figs. 18–20 with the letters A–L and have above suggested possible homologies with those of Fittkau. No "O" setae could be discerned on *Parochlus* nr. *maorii*.

Possible Homology ¹	seta	<i>P. caranqui</i>	<i>P. quito</i>	<i>P. nr. maorii</i>
D ₅	A	26	20	37
D ₃	B	51	39	29
D ₁	C	44	31	14
D ₂	D	66	39	22
L ₁	E	44	29	22
	F	13	17	32
	G	36	32	19
V ₁	H	44	19	22
L ₂	I	19	19	22
	J	20	25	29
	K	15	25	14
	L	22	38	14
O		4	4	—

¹ Fittkau (1962), p. 97, fig. 10.

LARVA: Head black-brown; anteriorly narrowed, triangular in shape in dorsal view; 320 μ long by 170 μ at widest point (about .16 from caudal margin); antenna, fig. 45, four segmented; ratio 40-19-7-2; membranous blade extends from unequally bifurcate sclerotized base; shorter fork 17 μ , blade extends from 16 μ beyond this; longer sclerotized fork (nebenborste?) 32 μ ; slightly curved rod, 6 μ at apex of segment 2, with a membranous apex; sense pit 11 μ in diameter .5 from base of segment 1; 2 light areas of unknown function near apex, each 4 μ in diameter; mandible, fig. 46, 91 μ long; mandibular comb of 15–16, filaments, 19–58 μ in length; accessory tooth 15 μ long; maxillary palpus 15 μ wide, tapers from 14–7.3 μ in length; labial plate fig. 44, with 15 teeth; hypopharyngeal lamellae (13–14) 48–73 μ long, some apically incised; body with brownish pigment; abdominal segments with 2 transverse circles of long setae each about .25 from nearest end of segment; 2 trifurcate short hairs on each side and a few additional setae, anteriorly; anal papillae (brush pedestal) black, slightly curved, 122 μ long by 33 μ wide; with one dark anteromesal hair, 185 μ long and one light apicocaudal hair 55 μ long; apical bristles (7) black, 204 μ ; posterior prolegs, fig. 43; claws in four ranks—131, 102, 36 and 17 μ long; a few longer claws, 138 μ present; anal gills (4) ovoid, 11 \times 52 μ .

MATERIAL EXAMINED

HOLOTYPE. ♂ ex pupa on slide, Ecuador, Prov. Cotopaxi, 3500 m. Road Pujili-Quevedo, Rio Sumbahua, July 29–Aug. 15, 1969 Coll. P. & B. Wygodzinsky (AMNH)

ALLOTYPE. ♀ on slide, same data as holotype (AMNH)

PARATYPES. ♂ ♀, ex-pupa, on slide (ANSP)—♀ in alcohol (AMNH), ♀ in alcohol, genitalia on slide (AMNH)—same data as holotype
Approximately 26 pupae and numerous larval skins.

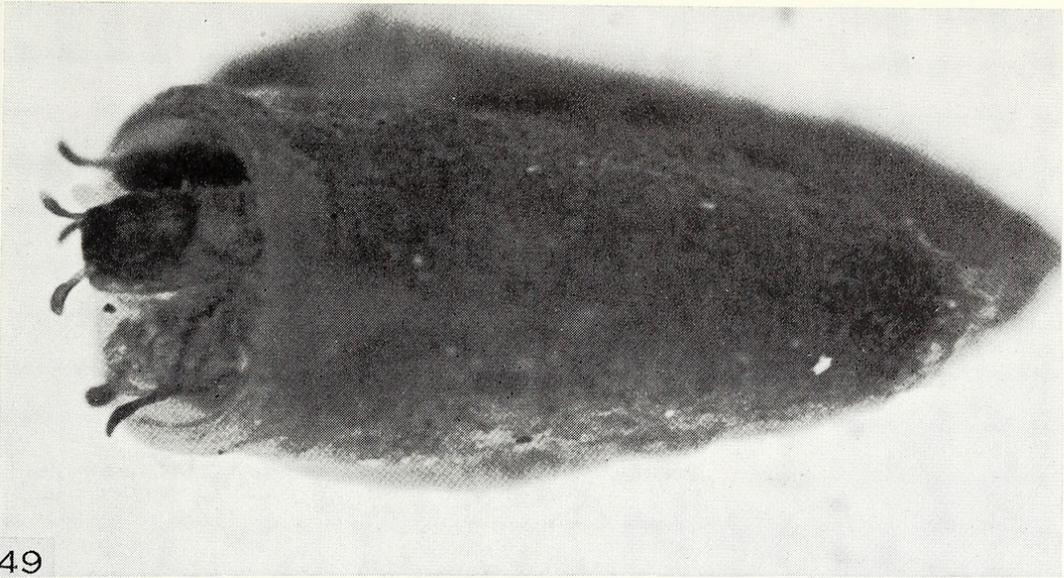


FIGS. 47-48. *Podonomus caranqui* pupa. Fig. 47—dorsal. Fig. 48—lateral.

Parochlus nr. *maorii* Brundin 1967

Only a single cast skin of this species was found in the collection. In Brundin's 1967 key to the pupae of this genus it keys to the New Zealand species *Parochlus maorii* Brundin in the *araucanus* subgroup. It differs from *P. maorii* only in the more angulate shape of the plastron and the five wavy setae on the eighth abdominal segment. According to Brundin, *P. maorii* pupae are so variable that even these differences may not be meaningful. In South America, this

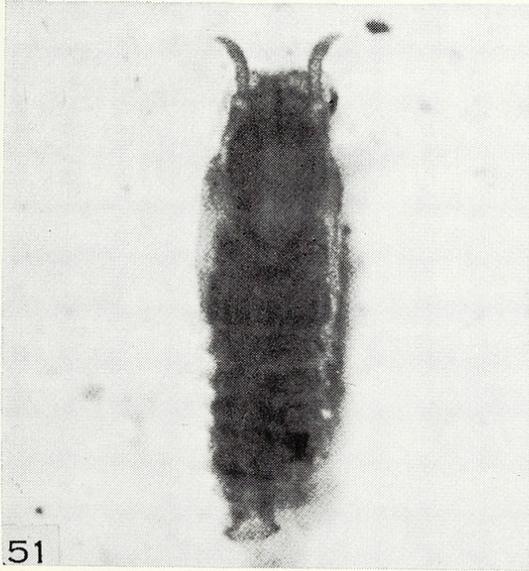
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 FIGS. 49-52. *Podonomus quiteo*. Fig. 49—Simuliid puparium with enclosed *Podonomus quiteo* pupae, dorsal. Fig. 50—same, ventral. Fig. 51—pupa, dorsal. Fig. 52—pupa, lateral.



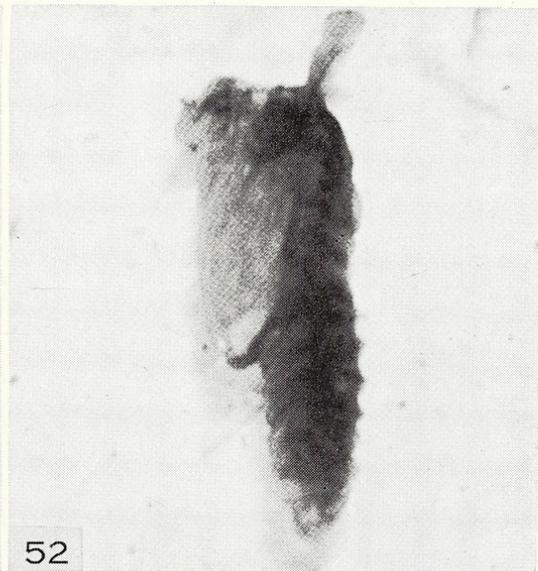
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50



51



52

species is the most northerly of the *Parochlus* species. Except for *P. incaicus* Brundin, from Peru and Bolivia most South American *Parochlus* are South Andean, Chilean or Patagonian in distribution. It is much closer to *P. maorii* and *P. araucanus* than to the Holarctic *P. kiefferi*.

PUPA. Respiratory organ, figs. 24, 25, 344 μ long; plastron 159 μ on dorsal surface only; stalk 185 μ with plate-like spines; greatest width of plastron 148 μ ; horn sac not discernible; spiracular atrium extends to base of plastron, opens into plastron by means of two aeropyles, fig. 26, set in basal ridge of plastron; ventral flap of abdominal segment 2, 56 μ long at midline; about .25 length of segment 3; microsculpture of abdominal tergites as in fig. 20, moderate; not as well developed on intersegmental membranes; lateral spines on segments 3–8; those on segments 3–7 as in figs. 29 a, b; laterally directed spine of segment 8, 29 μ ; caudolaterally directed, fig. 29c; abdominal chaetotaxy of intermediate segments as in fig. 20; lengths of setae given in table 2; segment 8 with 5 wavy hairs, anal segment with 2, fig. 33; hairs 280–330 μ ; anal spur figs. 33, 34, slightly rugose, caudally directed, 38 μ long; apical seta 20 μ on one spur, 23 μ on other; lateral seta 20 and 17 μ long.

MATERIAL EXAMINED. 1 pupal cast skin—Ecuador, Prov. Cotopaxi, 3500 m. Road Pujili-Quevedo, Rio Sumbahua, July 29–Aug. 15, 1969, Coll. P. & B. Wygodzinsky (AMNH)

SENSILLA

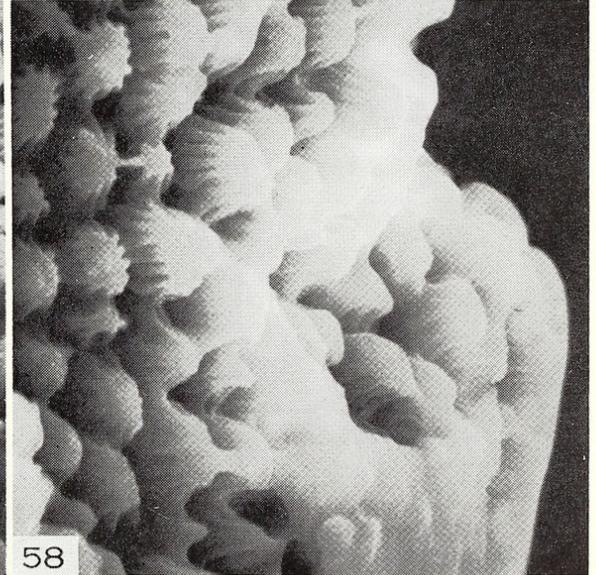
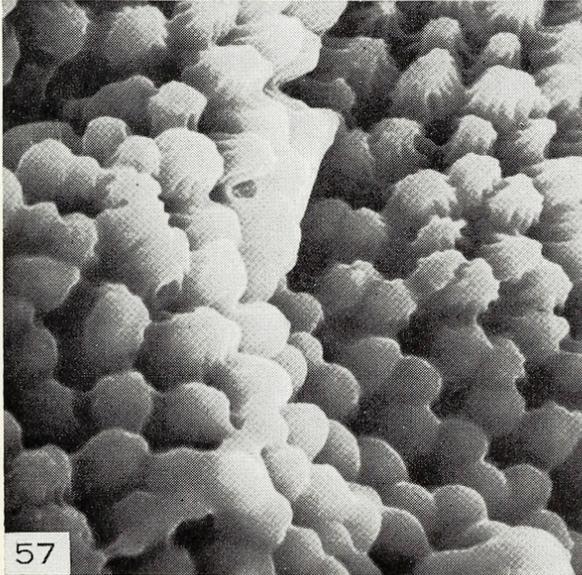
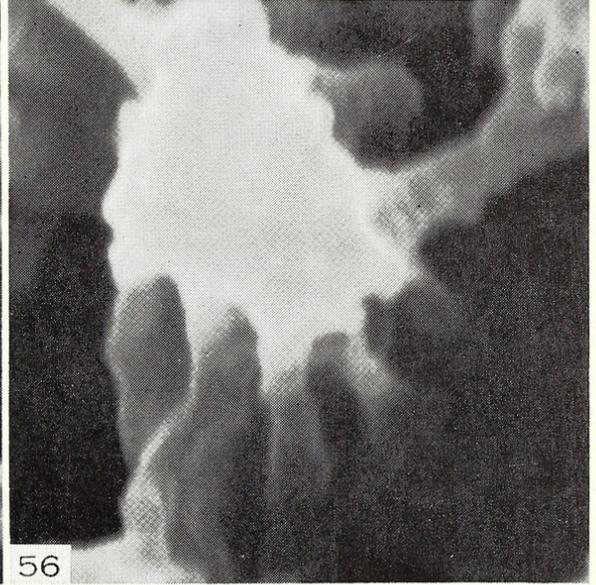
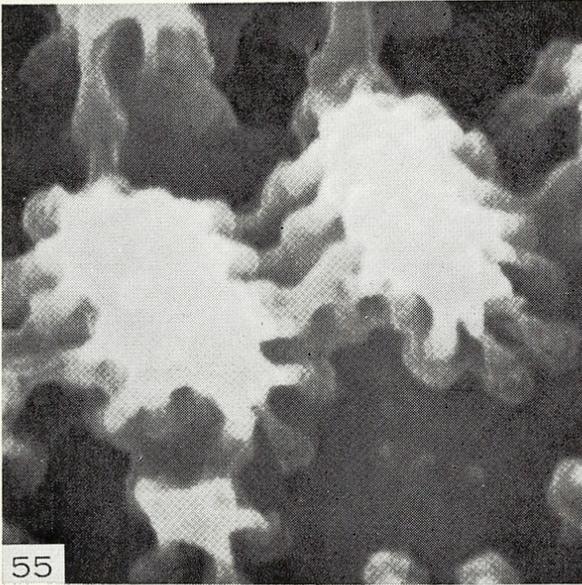
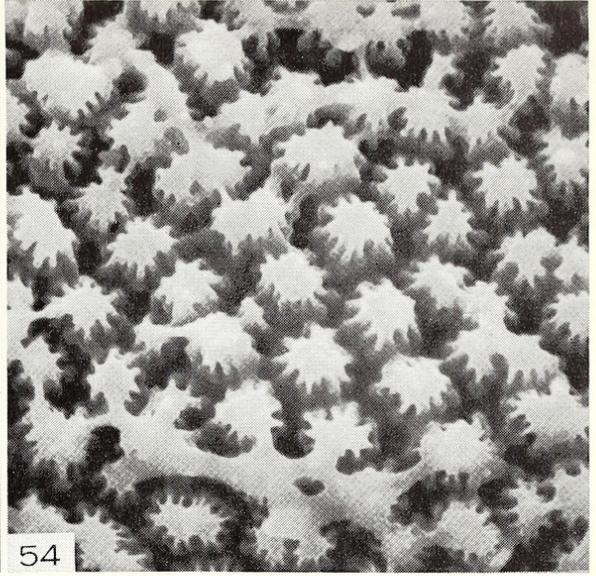
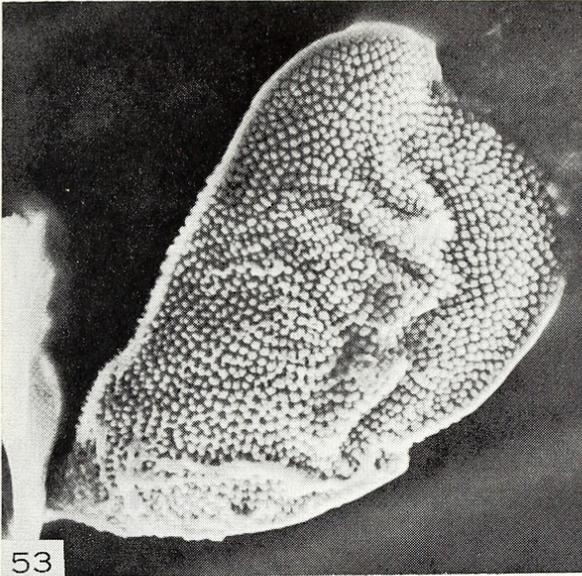
CHEMORECEPTORS

Both basiconic and coeloconic receptors are found on the antennae of the adults of the *Podonomus* species examined. One receptor, apparently basiconic, fig. 37, was found on the apical antennal segment of both sexes. It is 7.8 μ long. A larger but similar receptor, fig. 38, 12 μ long, was found on the lateral apex of flagellar segments 2, 3 of the male antenna and on flagellar segments 1–8 of the female antenna with a size range of 11–15 μ , figs. 12, 13. Both the aforementioned figures also show the slightly hooked, thin walled hairs, 14.6 μ long, present on the apical antennal segments. Their nature is not clear, without stained sections one cannot say whether they are chemoreceptors or tactile setae.

The coeloconic receptors are present on the apical segments of the male and female antennae, figs. 12, 13, 4–5 on each. One was also present at the apex of the preapical segment of the male antenna. Those sensilla consist of a short peg at the bottom of a parallel sided or slightly tapering depression, fig. 39. The surface opening is about 5 μ in diameter and is fringed with upright filaments, 2.4 μ long. The depression is not as sheltered as those illustrated for the Orthoptera and Sarcophagidae but undoubtedly the filaments serve the

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FIGS. 53–58. *Podonomus caranqui*. Pupal respiratory organ, electron photomicrographs. Fig. 53—entire organ, 275 \times . Fig. 54—plastron 2000 \times . Fig. 55—detail of plastron tubercles, 9,000 \times . Fig. 56—plastron tubercle 20,000 \times . Fig. 57 plastron at dorsal fold, 2,000 \times . Fig. 58—plastron at right side notch, 2,500 \times .



same function as the covering or the spines in those groups (Slifer et al. 1959, Slifer and Sekhon 1964).

MECHANORECEPTORS

Campaniform sensilla, in addition to those on the halteres, are found on the wings and legs of the *Podonomus* adults and the pupal abdominal tergites. On the wings of both species here described there is one sensilla on R_1 and 2 or 3 on R_{4+5} , fig. 36. These are about 7μ in diameter. On the female, the sensilla on R_1 is closer to fR than in the male, fig. 36. One female specimen had a campaniform sensilla in the membrane below Sc, 145 distad of the arculus. The basal vein of both sexes of both species had 8–9 campaniform sensillae. Saether (1969) mentions that the Podonominae have in total 3–4 sensory organs on the wing—these located near r-m, fR or proximally on R_{4+5} . On the legs 4–5 of these sensilla are found scattered in the basal .25 of the tibiae; a distinct patch of 13, figs. 40, 41, on the base of F and a single sensilla caudally above this patch; in distinct groups of 9 at the apex (caudally) and 3 at the base (anteriorly) of the trochanter, figs. 40, 42. There are none on the tarsal segments. Pringle (1938a) reports them for the Orthoptera.

Tonic receptors, consisting of beds of 4–7 hairs about 6μ long are present on the trochanter at the dorsal edge of its base and on both sides of the base of the coxa (see arrows on fig. 40). In both cases they would function as proprioceptors, being stimulated by contact with the adjoining apex of coxa and cuticle of the pleuron respectively, Pringle (1938b).

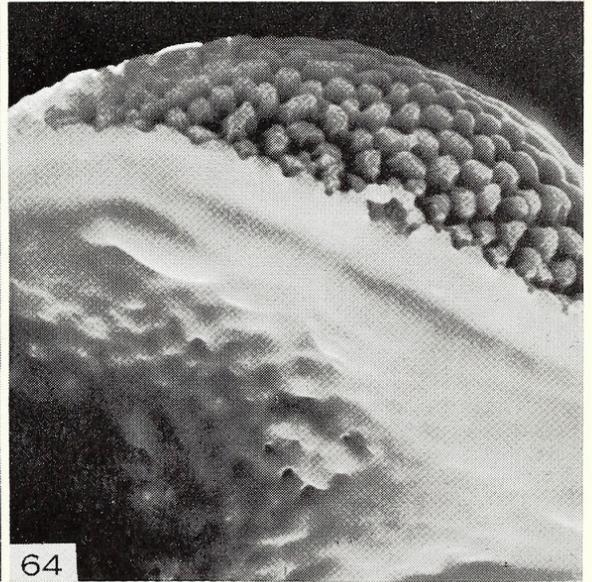
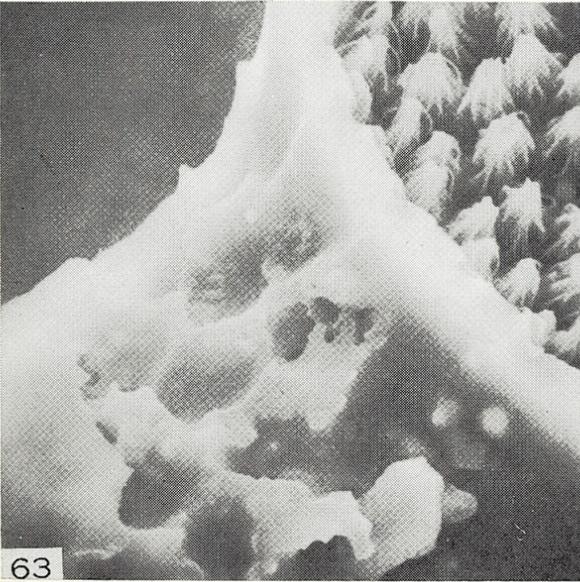
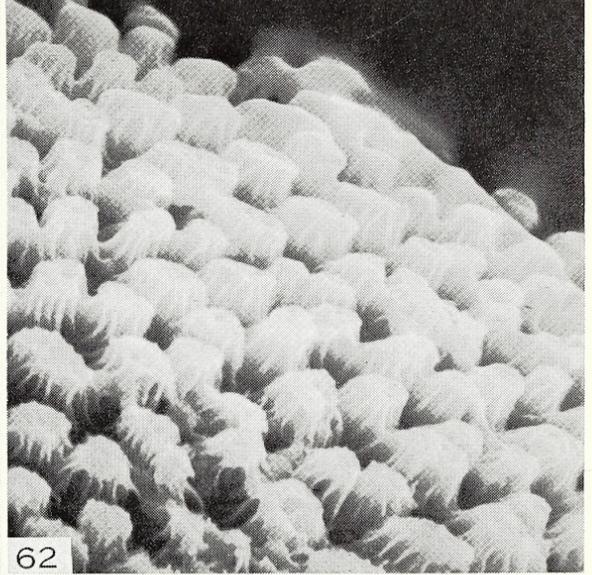
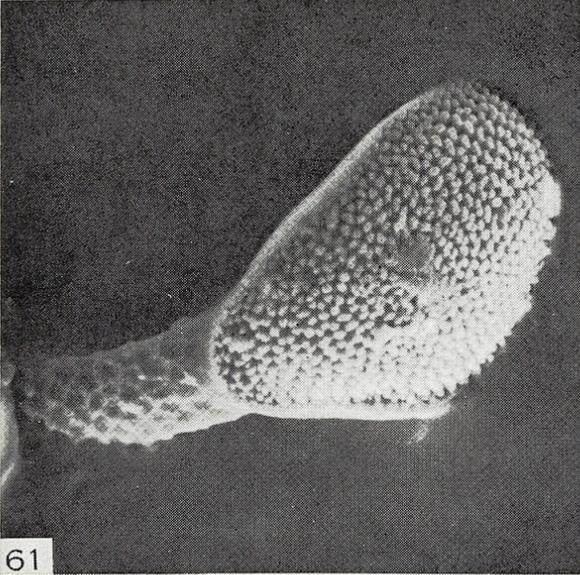
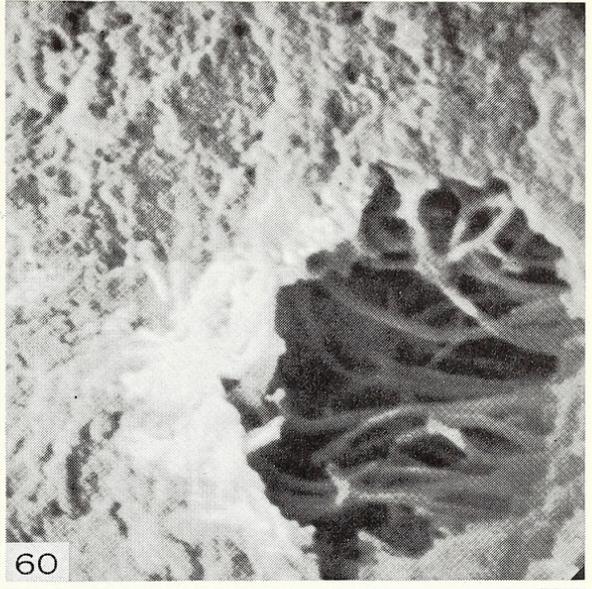
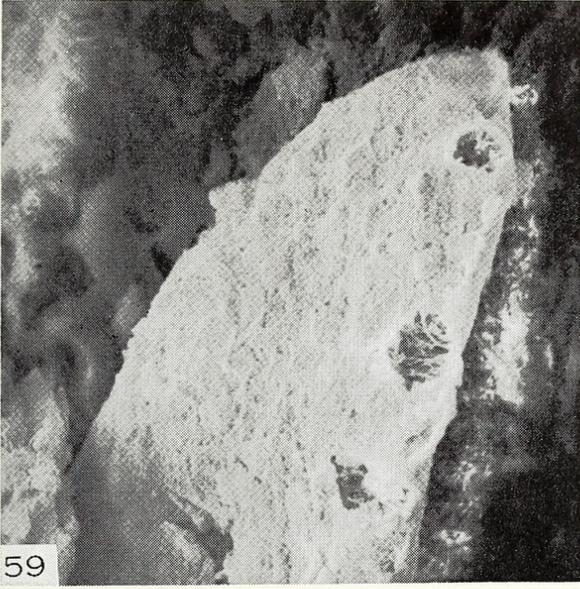
In addition to those on the adult, small campaniform sensilla appear to be present between hairs A & B on each side of abdominal tergites 2–7 of the pupa, figs. 18–20, 31. These are $4\text{--}5\mu$ wide. On the first tergite there are two on each side. These campaniform sensilla may be associated with the "walking" habit of these podonomine pupae. The ability to sense the flexing of the tergites would be of value to a pupa trying to hold on to or move on a rock in a torrent or to locate itself in a simuliid pupal case. To the best of my knowledge the pupae of the Tanypodinae, Orthocladiinae, and Chironominae which swim or flip about in the water, lack these campaniform sensilla.

THE PLASTRON OF *Podonomus* AND THE TANYPODINAE

The plastron in *Podonomus caranqui* covers most of the dorsal, fig. 53, and ventral surface of the pupal respiratory organ. As can be seen in figs. 55–56 the individual components of this plastron consist of dorsally rugose, laterally

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FIGS. 59–64. *Podonomus caranqui*. Electron photomicrographs. Fig. 59—dorsal view of spiracular atrium-holes are removed aeropyle tubes, 1500 \times . Fig. 60—detail of aeropyle tube exit hole, 10,000 \times . *Podonomus quito*. Fig. 61—pupal respiratory organ, 325 \times . Fig. 62—plastron, 2,000 \times . Fig. 63—detail of lower edge of plastron and top of stalk 2,000 \times . Fig. 64—apex showing plastron and ventral surface of respiratory organ.



eroded islands. As far as could be seen, there do not appear to be any open spaces under the islands of the plastron. These may be connected at their bases, figs. 55, 56 or dorsally to form a mesh. This interconnection as well as a more lateral view of the plastron components is shown in figs. 57, 58. Figure 57 was taken along the fold containing the aeropyles and fig. 58 at the notch in the right hand margin. In fig. 59 the dorsal plastron has been removed, exposing the respiratory atrium. In removing the plastron the aeropyle tubes were torn away revealing the interior of the atrium. The network of cuticular struts, which strengthen the atrium against collapse can be seen in fig. 59 and in more detail in fig. 60.

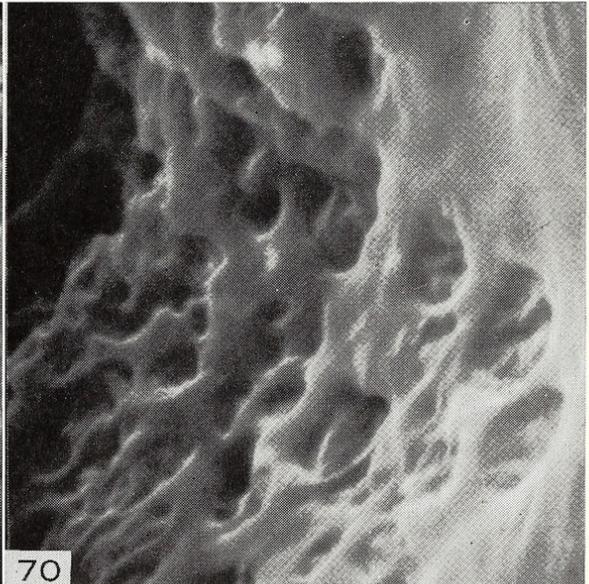
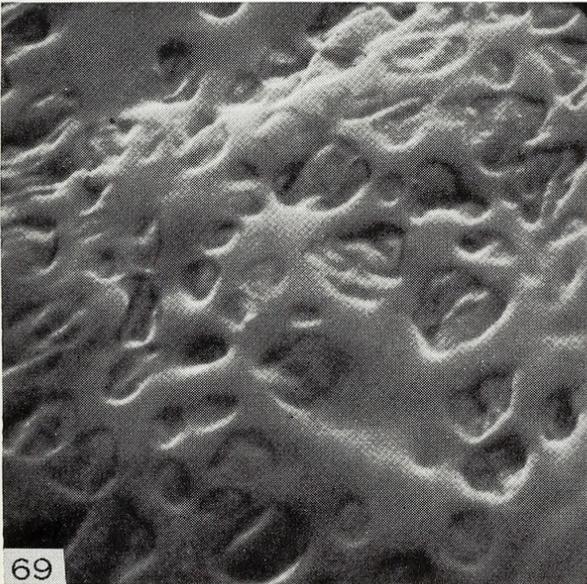
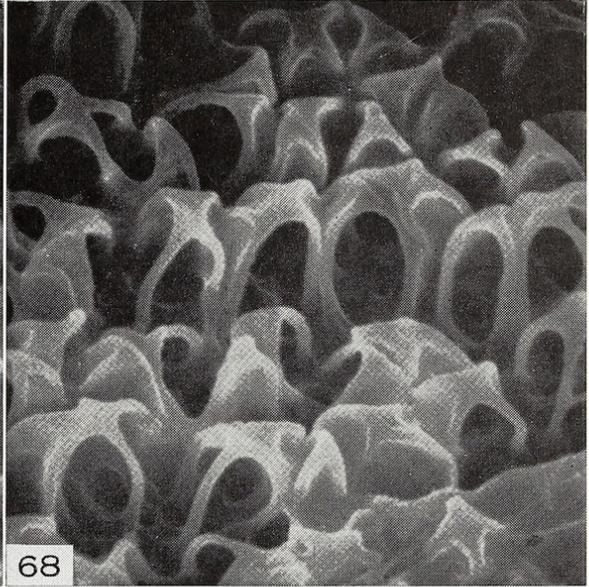
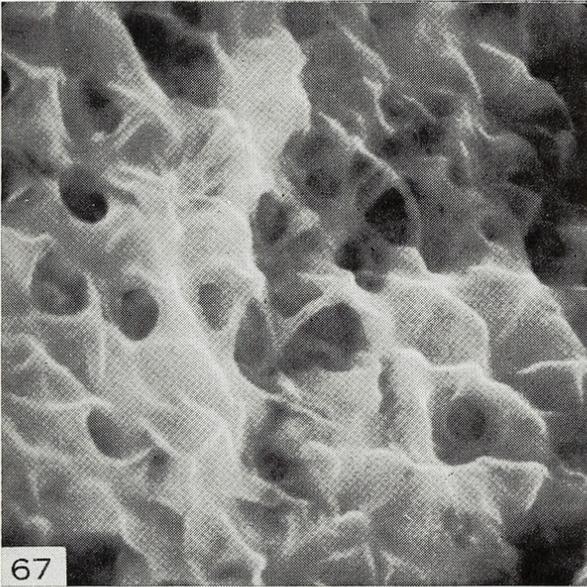
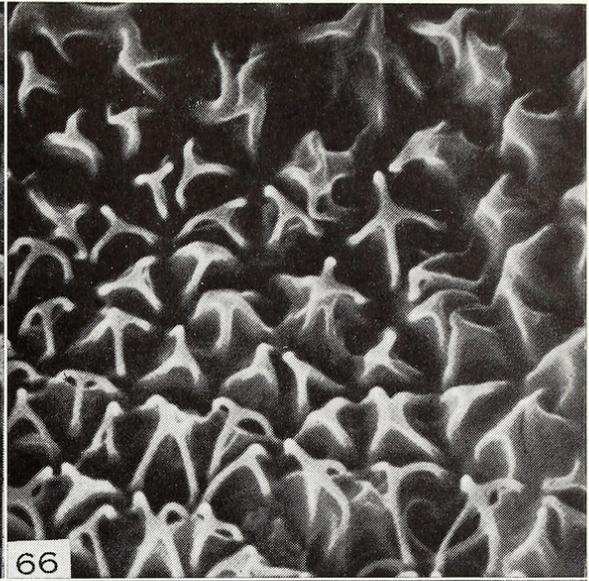
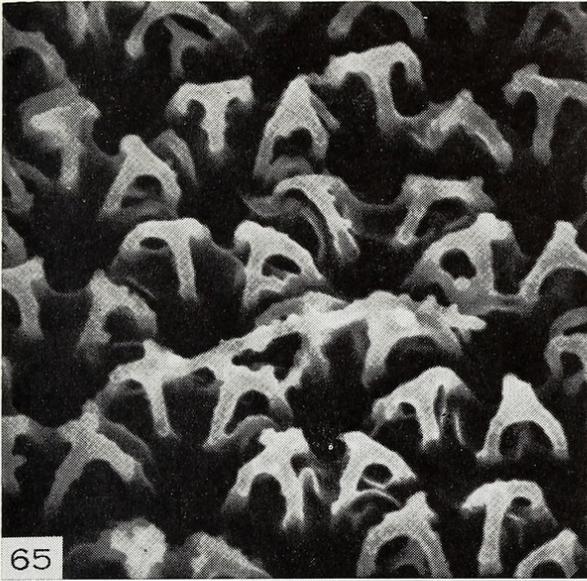
As can be seen in figures 61, 63, 64 the plastron of *Podonomus quito* is restricted to a dorsal ovoid, convex area. The individual island are similiar to those of *Podonomus caranqui* but are slightly convex apically and more finely eroded laterally. There appear to be some open arches extending from these islands, fig. 63. The surface of the stalk of the respiratory organ is scale-like, fig. 63, or smooth toward the ventral apex, fig. 64.

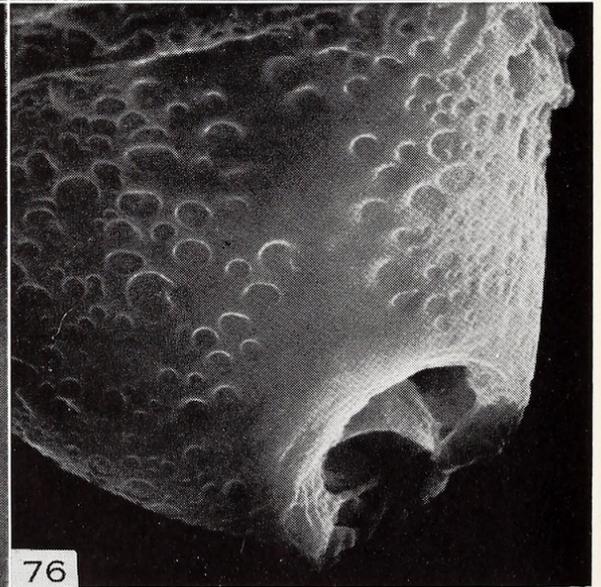
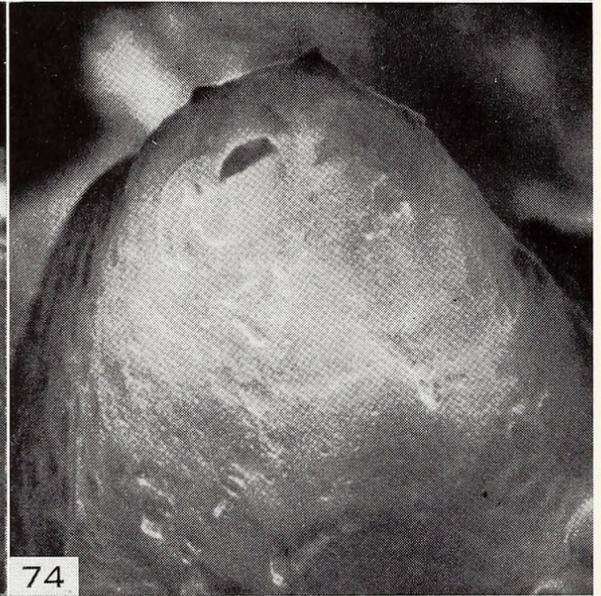
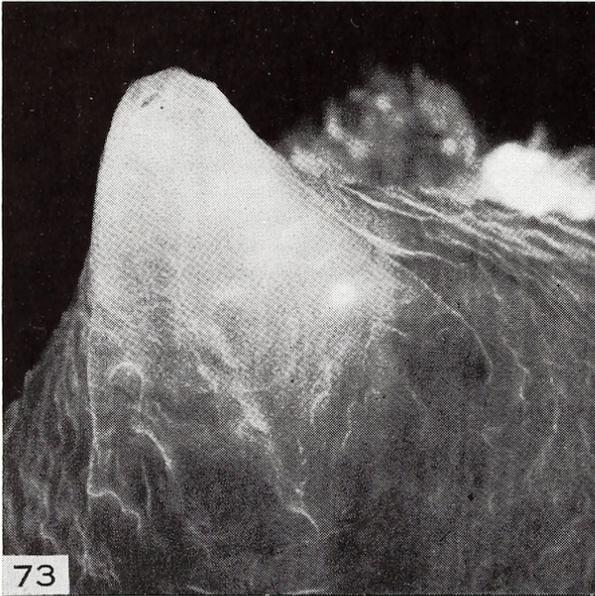
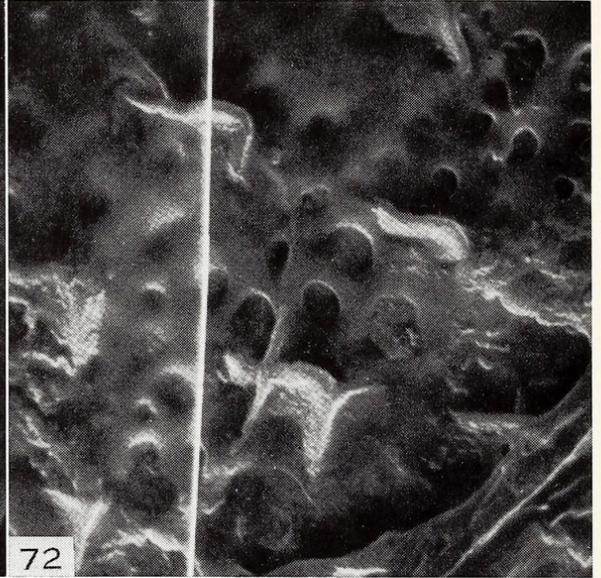
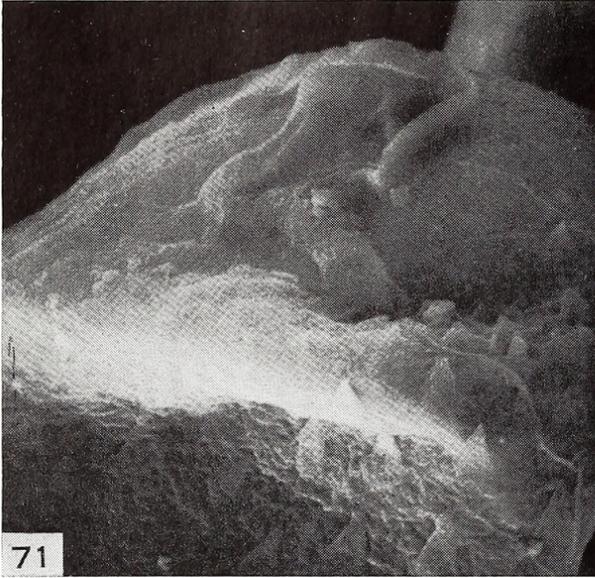
Superficially the plastron of *Paulianina pamela* Stuck. [Blepharoceridae] as illustrated by Hinton (1968) appears similar. Hinton has pointed out that similar plastron components appear to have arisen several times, independently, in the aquatic insects and this resemblance does not necessarily imply any relationship.

Brundin (1967) considered the Tanypodinae to be the "sister group" to the Podonominae and the availability of the scanning electron microscope provided me with the opportunity to examine the plastron of representative tanypodine genera. The respiratory organ of representatives of the Coelatanypodini (*Clinotanypus pinguis* Loew), Tanypodini (*Tanypus carinatus* Subl.), Macropelopiini (*Psectrotanypus dyari* Coq. and *Procladius* sp.) and *Pentaneurini* (*Conchapelopia* sp., *Ablabesmyia mallochi* Walley) were mounted and photographed, figs. 65–76. *Anatopynia nebulosa* Meig. whose plastron Hinton (1968) illustrates, falls in the Macropelopiini. Figures 65–68 show that the plastron of *Coelotanypus*, *Psectrotanypus*, *Procladius* and *Conchapelopia* are very similar, and could, without stretching ones' imagination too far, be derived from the type found in *Podonomus*. Considering the affinity between the Tanypodinae and Podonominae shown by other lines of evidence this could be a logical conclusion. The fact that similar patterns of plastron have shown up in groups clearly unrelated to each other and to *Podonomus*—such as

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FIGS. 65–70. Details of plastron, electron photomicrographs. Fig. 65—*Clinotanypus pinguis* (Loew) 6,000×. Fig. 66—*Anatopynia dyari* (Coq.) 6,000×. Fig. 67—*Procladius* sp. 6,000×. Fig. 68—*Conchapelopia* sp. 6,000×. Fig. 69—*Ablabesmyia mallochi* (Walley) 6,000×. Fig. 70—*Ablabesmyia mallochi* 10,000×.





Geranomyia in the Tipulidae and the egg plastron of *Culex pipiens molestus* (Hinton, 1969)—only indicates that, taken alone, the plastron cannot be used to show relationship but in conjunction with other indications of relationship it provides supporting data. There are, after all, not an infinite number of solutions to the problem of providing an air-water interface for the respiration of aquatic pupae and some basic patterns will repeat themselves.

In *Tanypus* fig. 72–76 and *Ablabesmyia* figs. 69–71 we can see that some genera of the Tanypodinae have evolved different solutions to the above problem. The ovoid respiratory organs of both are covered with a mesh quite different from the other Tanypodinae and most similar to that illustrated by Hinton (1968) for *Pauliana umbra* [Blepharoceridae]. The respiratory organ of *Ablabesmyia* is far less rigid than that of *Tanypus* and fig. 71 shows the collapsed apex with the outline of the aeropyle tube visible. In figs. 73–75 increased magnification of the apex of the *Tanypus* shows what appears to be the aeropyle. Both these genera have only a single aeropyle in each respiratory organ. The white line in figure 72 is an artifact caused by a malfunction of the scanning electron microscope.

Literature Cited

- BRUNDIN, L. 1967. Transantarctic relationships and their significance as evidenced by chironomid midges. With a monograph of the subfamilies Podonominae and Aphroteniinae and the Austral Heptagytiae. Kungl. Svensk. Vetenskapakad. Handl. Ser. 4, 11 (1): 1–474.
- FITTKAU, E. J. 1962. Die Tanypodinae (Diptera: Chironomidae) Die Tribus Anatopyniini, Macropelopiini und Pentaneurini. Abhandl. Larvalsyst. Insekten 6: 1–453.
- HINTON, H. E. 1968. Spiracular gills. Advances in Insect Physiology 5, Academic Press: 65–162.
- . 1969. Respiratory systems of insect egg shells. Ann. Rev. of Entomol. 14: 343–368.
- PRINGLE, J. W. S. 1938a. Proprioception in insects II. The action of the campaniform sensilla on the legs. J. Exp. Biol. 15: 114–131.
- . 1938b. Proprioception in insects III. The function of the hair sensilla at the joints. J. Exp. Biol. 15: 467–473.
- SAETHER, OLE A. 1969. Some Nearctic Podonominae, Diamesinae and Orthoclaadiinae (Diptera: Chironomidae). Fish. Res. Bd. Canada Bull. 170: 1–154.
- SLIFER, E. H., J. J. PRESTAGE AND W. H. BEAMS. 1959. The chemoreceptors and other sense organs on the antennal flagellum of the grasshopper (Orthoptera: Acrididae). J. Morph. 105: 145–191.
- SLIFER, E. H. AND S. S. SEKHON. 1964. The fine structure of the sense organs on the antennal flagellum of a flesh-fly *Sarcophaga argyrostoma* R. D. J. Morph. 114: 185–207.

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FIGS. 71–76. Electron photomicrographs. *Ablabesmyia mallochii* (Walley) Fig. 71—apex of respiratory organ with outline of aeropyle tube, 1,000×. *Tanypus carinatus* Sublette. Fig. 72—plastron 2,500×. Fig. 73—apex of respiratory organ with aeropyle (?) 1,200×. Fig. 74—same, 4,000×. Fig. 75—same 10,000×. Fig. 76—base of respiratory organ, 1,500×.



Roback, Selwyn S. 1970. "Podonominae from Ecuador, with Notes on the Sense Organs and Pupal Respiratory Organs (Diptera: Chironomidae)." *Journal of the New York Entomological Society* 78, 148–169.

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