

**SABETHES (PEYTONULUS) PARADOXUS, A NEW SPECIES OF SABETHINI
(DIPTERA: CULICIDAE) FROM PANAMA**

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Abstract.—The male, pupa and larva of *Sabethes (Peytonulus) paradoxus* Harbach, n. sp., are described and illustrated from Panama. The adult male lacks the brilliant metallic-colored scaling that is characteristic of all other *Sabethes*, and the paddle of the pupa is heterogeneous for the presence of a basal membranous area, a feature that has not been observed in other members of subgenus *Peytonulus*.

Key Words: Diptera, Culicidae, *Sabethes*, *Peytonulus*, new species, mosquito, Panama

When Hall et al. (1999) described *Sabethes luxodens*, subgenus *Peytonulus* Harbach included 11 formally named species and at least four unnamed species. The species described in this paper is one of the four previously unnamed species, the species which Harbach (1991) said “lacks metallic scutal scaling and bears certain other stasimorphic characters.”

Species of subgenus *Peytonulus* are readily identified by unique apomorphies that include the remarkably modified seta 1-VII of larvae and the absence of its ontogenetic homolog in pupae. Nevertheless, like all groups of organisms, members of the subgenus exhibit combinations of both ancestral and derived features, and the species described herein is a striking example of this. While the species bears the apomorphic characters diagnostic of the subgenus, it exhibits the plesiomorphic condition of the scutal scaling that is characteristic of genus *Wyeomyia* Theobald. The derived position of *Sabethes* Robineau-Desvoidy relative to *Wyeomyia* is supported by the cladistic analysis of Harbach and Kitching (1998).

MATERIALS AND METHODS

This study is based on specimens borrowed from the National Museum of Natural History (USNM), Smithsonian Institution, Washington, DC. Observations of the adults were made under simulated natural light. Larval and pupal chaetotaxy were studied using a combination of bright field and differential interference contrast microscopy. Measurements and counts were taken from all specimens of the type series where the structures in question were present. Numbers in parentheses represent modes of the reported ranges unless indicated otherwise. The form of presentation, descriptive terminology and abbreviations used in the description follow Harbach and Knight (1980, 1982) and recent papers published as part of an ongoing revision of genus *Sabethes* (Harbach and Peyton 1991; Harbach 1991, 1994, 1995a, 1995b; Harbach and Petersen 1992; Hall et al. 1999; Moses et al. 2000).

Sabethes (Peytonulus) paradoxus
Harbach, new species
(Figs. 1–3)

Sabethes (Sabethinus) sp 2 of Heinemann and Belkin 1978: 193.

This species is unique in lacking the brilliant metallic-colored scaling that is characteristic of *Sabethes* (Harbach and Peyton 1991). The female is unknown. For the most part, the male resembles species of *Wyeomyia* in overall ornamentation, particularly the relatively dull coloring of the scutal scaling.

Male.—Relatively small species with broad, flat, distinctly metallic-colored scaling only on head, antepronota and thoracic pleura; scales of vertex with different combinations of metallic blue, violet and green reflections depending on angle of light; scales of postgena, thoracic pleura and coxae silvery white; antepronotum ranging from brown to bright blue and violet depending on angle of view, lower margin with few silvery white scales; scutum and scutellum densely covered with moderately broad dark scales with dull bluish reflections; mesopostnotum without scales; proboscis and legs predominantly dark-scaled with subdued blue and violet reflections when viewed from certain angles; wing with veins entirely dark-scaled, anterior veins darker with bluish sheen depending on angle of light; abdominal terga mainly dark-scaled with weak bluish, greenish and golden reflections, lateral margins with rather large rounded pale patches; sterna with yellowish-brown scaling. **Head:** Eyes joined above and below. Occiput with transverse row of short semi-erect scales at back of head. Ocular setae moderately long, dark, close to margin of eye; 2 long, bronzy, approximated interocular setae present. Antenna dark; length about 1.8 mm, slightly shorter than proboscis; pedicel large, surface pubescent, with inconspicuous fine setae on dorsomesal area; flagellum rather strongly verticillate, proximal whorls with 14 setae, longest setae about 0.4 length of antenna. Clypeus and frons without setae and scales, clypeus with dense covering of silvery pubescence. Proboscis short, length about 2.0 mm, longer than antenna, about 0.8 length of forefemur; distal 0.2 of prementum flattened, expanded laterally to 4

times width of proximal part and bent downward; ventral surface white-scaled beginning 0.2–0.4 from base and extending to expanded distal part, white scales grading to pale yellow at base of expanded part, dark scaling of expanded part distinctly darker (black), especially ventrally, than other dark scaling of prementum; labella short, very broad and dark-scaled proximally. Maxillary palpus short, 0.12–0.15 length of proboscis; dark-scaled, ventral surface without scales. **Thorax:** Integument brown. Dorsum with dark setae on anterior promontory (9–12), antepronotum (10–14), supraalar area (22–24), scutellum (6,7) and mesopostnotum (9–14). Pleura with 2 or 3 prespiracular setae, 2–5 upper proepisternal setae, 6–8 long lower mesokatepisternal setae extending well above ventral margin of mesepimeron and 11–14 upper mesepimeral setae; prespiracular setae dark, others yellow or golden. Lower part of proepisternum without scales, scales on upper part contiguous with scales on anteprocoxal membrane; scales absent from postprocoxal membrane; mesopleuron with scales except on lower anterior margin of mesokatepisternum, upper posterior margin of mesepimeron and mesomeron; scales absent from metapleuron, metameron and postmetacoxal membrane. **Wing:** Length 3.5 mm; scales on veins moderately broad and slightly asymmetrical, smaller on cubitus and anal vein; alula with fine piliform scales on margin distally; calypters without setae. **Halter:** Scabellum without scales, integument pale; pedicel and capitellum dark-scaled. **Legs:** Without paddles; coxae and trochanters with silvery-white scales, trochanters with some dark scales dorsally at apices; femora dark above and golden below; tibiae mainly dark with golden scaling proximally on ventral surface; tarsi entirely dark-scaled except ventral surface of hindtarsomere 5 white-scaled. Forefemur about 1.3 length of proboscis, same length to slightly shorter than midfemur, about 1.3 length of hindfemur; hindtibia about as long as hindfemur, hindtarsomere 1 longer than

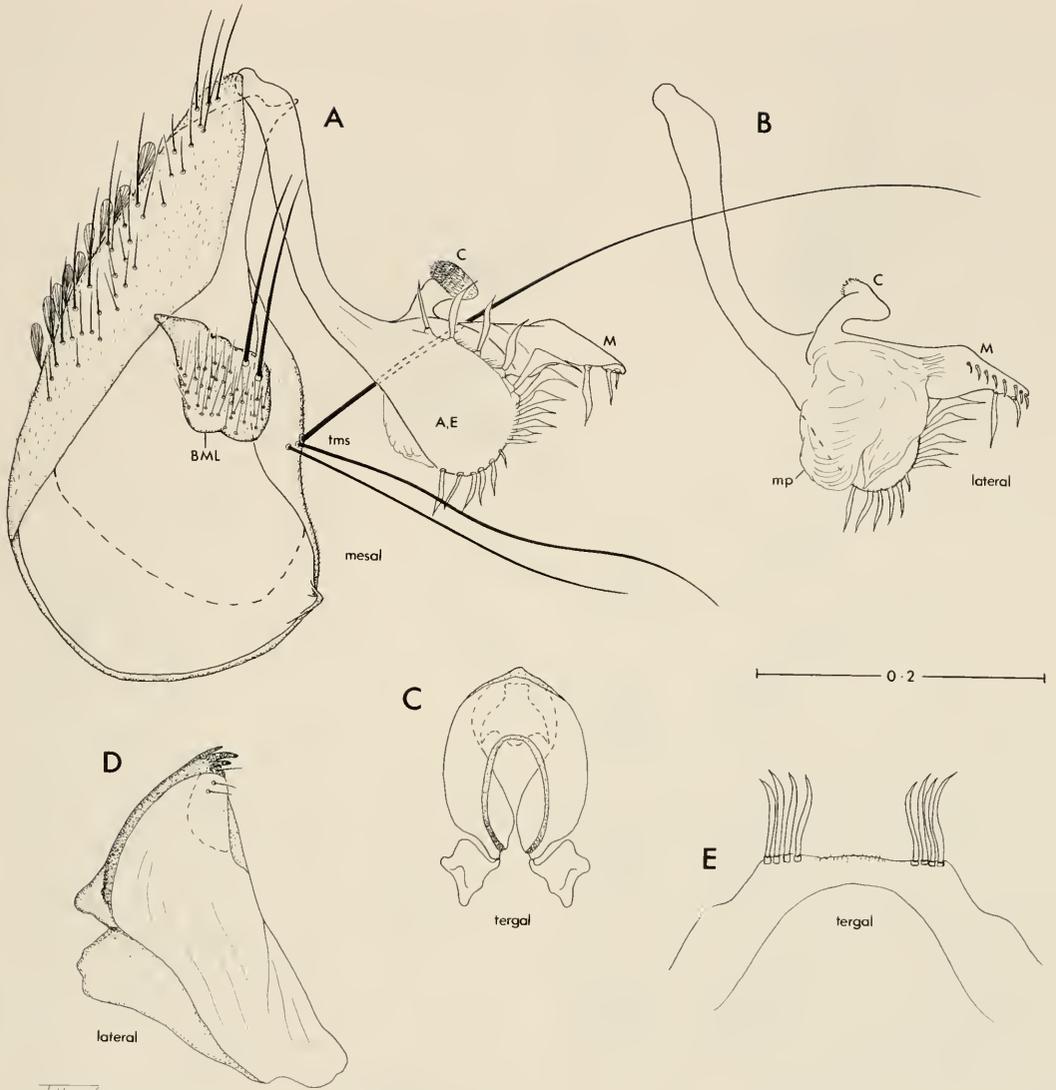


Fig. 1. Male genitalia of *Sabethes paradoxus*, aspects as indicated. A, Gonocoxopodite. B, Gonostylus. C, Aedeagus, with parameres attached. D, Proctiger. E, Tergum IX. Abbreviations: A, E, C and M = gonostylar lobes; BML = basal mesal lobe; mp = membranous process; tms = tergomesal setae. Scale in mm.

hindfemur. Ungues small, simple, black. *Abdomen*: Coloration as noted above; lateral pale areas of terga with silvery scales dorsally grading into yellow scales ventrally. *Genitalia* (Fig. 1): Tergum VIII (ventral in position; not figured) with posterolateral corners produced and broad V-shaped emargination at middle of posterior margin, border on either side of emargination with 4 or 5 irregular rows of long close-set setae

extending to posterolateral corners, setae become longer and more numerous toward corners; scattered scales before and among setae; anterior 0.3–0.4 of tergum bare. Tergum and sternum IX fused laterally, forming a complete ring of sclerotization; tergum IX widely separated by relatively narrow bridge, lobes slightly produced, each with 4–7(5) flattened setae with apices bent laterad. Gonocoxite elongate, tapered in

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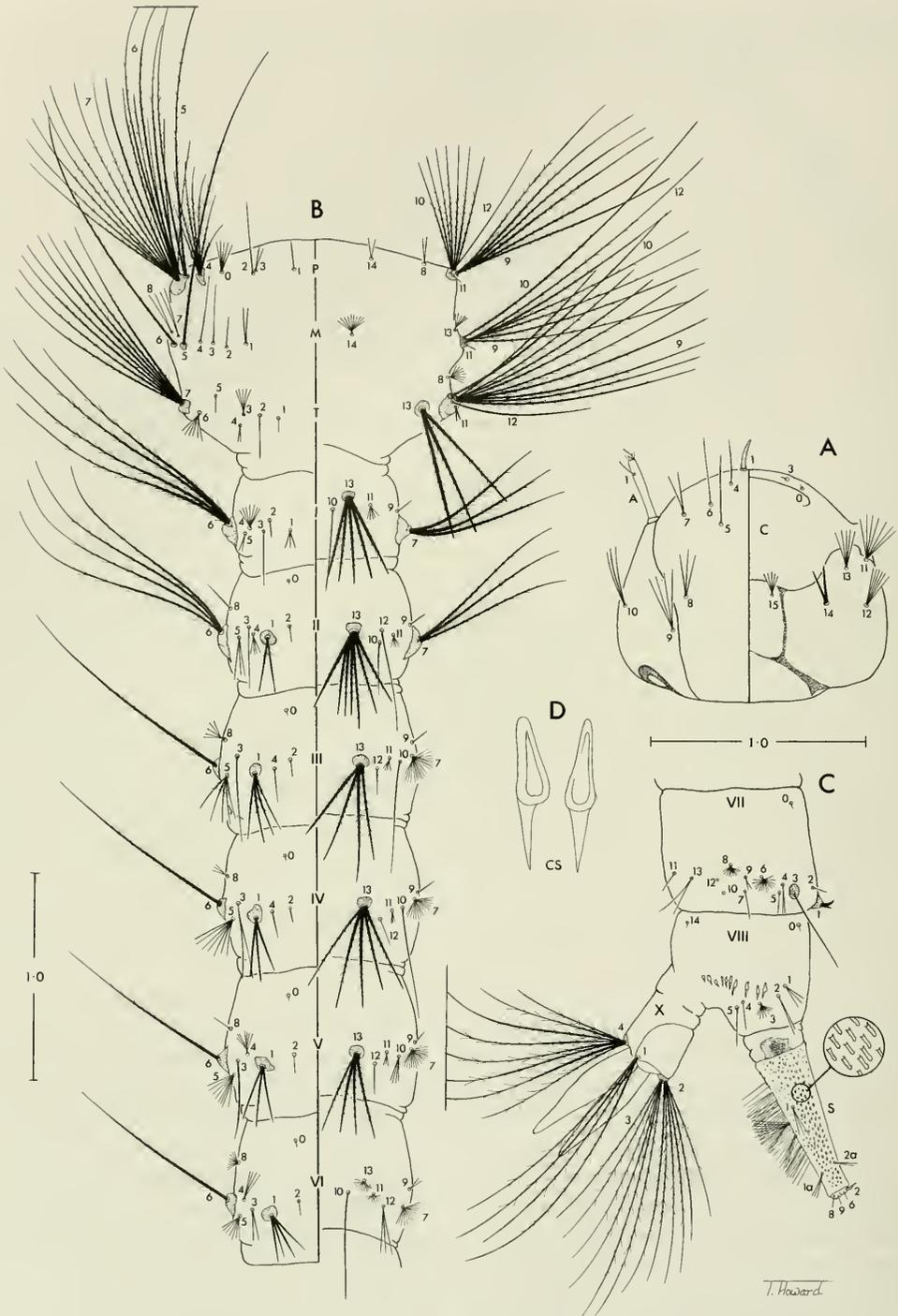


Fig. 2. Fourth-instar larva of *Sabethes paradoxus*. Reconstructed from exuviae of holotype; positions of setae may differ slightly from those shown. Setae missing from the right side of the exuviae (see Table 1) are drawn from those on the left side; an empty alveolus indicates that a seta was missing on both the right and left sides of the exuviae. A, Head, dorsal (left) and ventral (right) aspects of left side. B, Thorax and abdominal segments I-VI, dorsal (left) and ventral (right) aspects of left side. C, Abdominal segments VII-VIII and X, left

distal half, tergomesal surface membranous, distal part of sternal surface covered with scales and setae, bearing one very long and 2 unequal shorter tergomesal setae below level of basal mesal lobe; basal mesal lobe irregular in shape, produced caudomesally, covered with small slender setae and bearing 2 large setae at caudolateral angle. Gonostylus about 0.75 length of gonocoxite; stem narrow and curved in lateral view, slightly longer than head; head with 3 lobes developed as figured; lobe A,E large, laterally flattened and roughly ellipsoidal in lateral view, with fringe of setae from tergoapical angle to base of sternal side, setae on sternoapical edge noticeably flattened and expanded subapically; lobe M prominent, arising from sternolateral area of lobe A,E, tapered and bent apically, bearing 2 relatively large flattened setae on tergal margin and row of small stout setae on sternolateral surface; lobe C a relatively large stemmed process arising sternolaterally at base of head, bent mesad and bearing a globular head covered with rows of minute decumbent spicules; lateral side of head with a dangling bag-like membranous process (mp). Aedeagus longer than wide, broadly oval in tergal view; with submedian tergal arms joined at midline to form narrow median tergal bridge; apical tergal arms broadly fused and bearing a median tubercle; median sternal plate membranous, apex flared and hood-like. Proctiger (lateral view) with very broad basal sclerotization (tergum X) narrowly fused with base of paraproct; paraproct narrow, slightly enlarged apically, apex bearing 3 or 4 small teeth and 3 subapical cercal setae; cercal sclerite distinct.

Egg.—Unknown.

Larva, fourth instar (Fig. 2).—Reconstructed from single exuviae (holotype),

character of setae as figured (positions may differ slightly from those shown), numbers of branches in Table 1. Exhibiting the subgeneric characters noted by Harbach (1991). *Head*: Slightly wider than long, widest in posterior half; length approximately 1.0 mm; width approximately 1.1 mm; moderately tanned. Occipital foramen widely V-shaped with arms extending dorsolaterally to point laterad of level of seta 9-C, margins heavily tanned, ventrocaudal margin with collar-like edge. Anterior margin of labiogula minutely denticulate; hypostomal suture complete, gently curved. Dorsomentum short, roughly triangular, with 8 teeth on either side of median tooth, median tooth and most lateral tooth of either side larger than the others. Mandible without distinctive features. Maxilla relatively short, with 4 large lateral teeth of nearly equal size, about 0.25 length of apical tooth; apical tooth large, about half length of maxillary body, curved mesad. Setae 4–6-C single, simple; 7-C double; 11,13-C relatively short, about length of 12-C; 14-C much thicker and stiffer than other cranial setae, double; 15-C inserted cephalad of 14-C near anterior margin of labiogula. *Antenna*: Short, cylindrical, length 0.3 mm; moderately tanned, progressively lighter toward apex, surface smooth. Seta 1-A single, simple, borne dorsally about 0.8 from base, length about twice width of antenna at point of insertion. *Thorax*: Integument hyaline, smooth. Setae 1-PT, 4,5-T and 8,14-P weakly developed; 8-M much shorter than usual, slightly shorter than 7-M; 13-T shorter than thorax, with 3 thick aciculate branches. *Abdomen*: Integument hyaline, smooth. Setae 1-I weakly developed, 1-II-VI relatively well developed, with stiff thickened branches, borne on basal plates; 2-I-VII weakly developed, small

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side. D, Comb scales. Abbreviations: A = antenna; C = cranium; CS = comb scale; P = prothorax; M = mesothorax; S = siphon; T = metathorax; I–VIII, X = abdominal segments I–VIII, X; 0–15 = setal numbers for specified areas, e.g., seta 5-C. Scales in mm.

and single, 2-I well laterad of 1-I, 2-II-VI well mesad and slightly anterior to seta 1; 6,7-I,II similarly developed but seta 6 significantly longer than seta 7, both strongly aciculate; 6-III-VI long, single, strongly aciculate; 7-III small, resembling 7-IV-VI, small with numerous branches; 9-I-VII all of normal size and development; 13-I-V well developed, stellate, with stiff aciculate branches, borne on basal plates; 4-III,IV distinctly mesad of seta 1, more or less midway between setae 1 and 2; 12-VI shorter than usual, double or triple; 11-VII ventral to seta 13-VII; 13-VII not strongly developed, double; punctures absent from segments III-V. *Segment VIII*: Comb an irregular single row of 10,11 small thorn-like scales without lateral fringes of minute spicules. *Siphon*: Short, tapered, slightly flared at apex; moderately tanned, with dark plates laterally at base; lateral surfaces covered with offset rows of blunt stud-like projections that decrease in length posteriorly; length 0.90 mm, width at base 0.35 mm, index 2.57. Pecten of approximately 70 filaments staggered irregularly along posterior margin, filaments arise individually (about 25) and in clusters, 2 large clusters at midlength arise from basal rings of paler integument that resemble alveoli, proximal of these clusters with 12 filaments, distal one with 6 filaments. Seta 1-S inserted about 0.4 from base. *Segment X*: Saddle lightly tanned, with imperceptible rows of minute spicules mainly on sides; length 0.22 mm; siphon/saddle index 4.1. Setae 1-4-X equally well developed, shorter than usual, multiple with aciculate branches.

Pupa (Fig. 3).—Character and positions of setae as illustrated, numbers of branches in Table 2. *Cephalothorax*: Lightly to moderately tanned, some darker mottling on scutum. Seta 1-CT strongly developed, double or triple, branches not noticeably sigmoidally curved, with hooked tips; 5-CT also well developed, single or double. *Trumpet* (Fig. 3A,C): Moderately and evenly tanned, short, rather abruptly expanded at base; length 0.38–0.47 (\bar{x} = 0.43 mm),

width at midlength 0.14–0.16 mm (\bar{x} = 0.15), index 2.38–3.21 (\bar{x} = 2.95); pinna short, length 0.06–0.11 mm (\bar{x} = 0.09). *Abdomen*: Lightly to moderately tanned, sterna II–VII darker anteriorly; length 4.09–5.20 mm (\bar{x} = 4.45 mm). Seta 5-I laterad of seta 4-I; 7-I shorter than seta 6-I, with 2–4 branches; 2-II anterolateral to 1-II; 3-II on level anterior to level of 2-II; 5-II,III much smaller than 5-IV–VI, 5-IV–VI longer than length of following tergum; 7-II dorsal to 9-II; 8-II present or absent, alveolus present when seta absent, 8-VI dorsal; 10-II present; punctures absent from segments III–V. *Genital lobe*: Lightly tanned, length (male only) about 0.6 mm. *Paddle*: Lightly tanned, broadest at base, narrowed apically, outer part wider than inner part, minutely spiculate along margins, demarcated basal membranous area present (Fig. 3D) or absent (Fig. 3B) on dorsal surface; length 0.59–0.70 mm (\bar{x} = 0.66 mm), width at widest point 0.39–0.46 mm (\bar{x} = 0.43 mm), index 1.46–1.65 (\bar{x} = 1.52).

Systematics.—The female of *Sabethes paradoxus* is unknown, but the male is easily distinguished from that of all other species of the genus by the absence of brilliant metallic-colored scutal scaling, the greatly expanded apical portion of the proboscis, and features of the gonostylus. Assuming that the female of this species resembles the male in general habitus, it is possible, if not likely, that it will be confused for species of *Wyeomyia*. It will be necessary to note the absence of prelar setae to correctly identify the female as a species of *Sabethes*.

The larva of *Sa. paradoxus* most closely resembles that of *Sa. soperi* Lane and Cerqueira, but is easily distinguished from this and all other *Sabethes* by the short, uniquely ornamented siphon. Within subgenus *Peytonulus*, the robust development of seta 14-C is shared with *Sa. soperi* as well as *Sa. hadrognathus* Harbach and *Sa. undosus* (Coquillett). As far as known, the reduced seta 8-M of *Sa. paradoxus* is a unique feature of this species.

The pupae of *Peytonulus* are generally

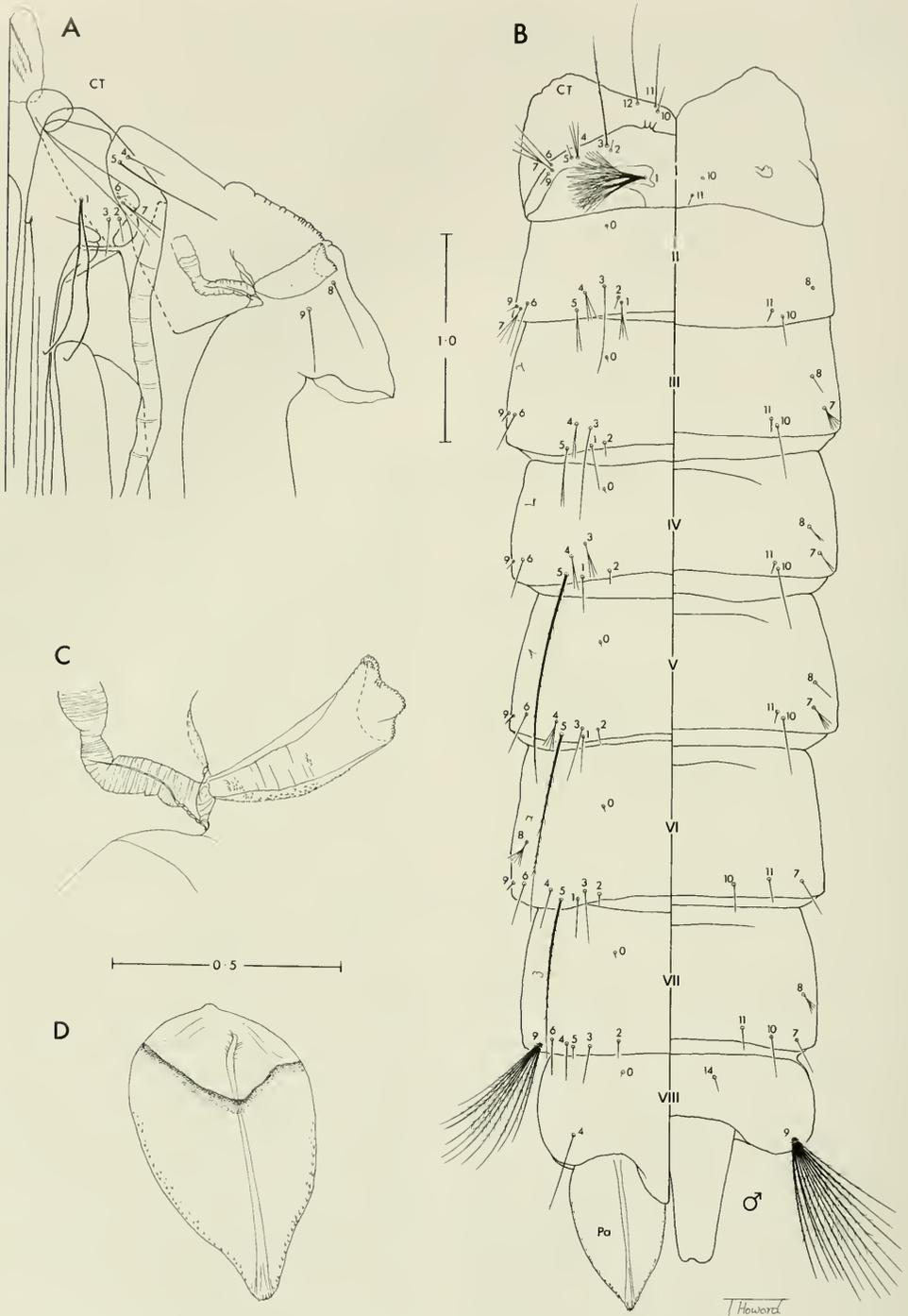


Fig. 3. Pupa of *Sabethes paradoxus*. A, Left side of cephalothorax, dorsal to right. B, Dorsal (left) and ventral (right) aspects of metathorax and abdomen. C, Trumpet. D, Paddle of paratype GG105-121 showing basal segments 1-VIII; 0-14 = setal numbers for specified areas, e.g. seta 3-1. Scales in mm.

Table 2. Numbers of branches for setae of pupae of *Sabethes paradoxus*. Range (mode, when evident) of the type series (holotype and three paratypes).

Seta	Cephalo- thorax CT	Abdominal Segments									Paddle Pa
		I	II	III	IV	V	VI	VII	VIII	IX	
0	—	—	1	1	1	1	1,2(1)	1	1	—	—
1	2,3(2)	38–45	1–4	1,2(1)	1,2(1)	1	1,2(1)	—	—	—	—
2	1,2(1)	1	1,2(1)	1	1	1	1	1	—	—	—
3	1,2	1	1	1	2–5(3)	1	1	1	—	—	—
4	1	1–3(3)	2–4(3)	1–3(2)	1–3(2)	2–7(4)	1	1	1	—	—
5	1,2	1–3(1)	1–4(2)	2–4(3)	1	1	1	0 ^a /1(0 ^a)	—	—	—
6	1,2(2)	1	1	1	1,2(1)	1	1	1,2(1)	—	—	—
7	1–3(2)	2–4(2)	2–5(3)	3–7(5)	1,2(1)	2–5(4)	1,2(1)	1	—	—	—
8	1	—	0 ^a ,1(0 ^a)	1,2	1–3(1)	1–4(1)	4–8(5)	3–7(4)	—	—	—
9	1	1,2(1)	1	1	1	1	1	9–14	11–15	—	—
10	1,2(1)	0 ^a	1	1	1,2(1)	1	1	1	—	—	—
11	1	1	0 ^a /1(1)	1	1	1	1	1	—	—	—
12	1	—	—	—	—	—	—	—	—	—	—
13	—	—	—	—	—	—	—	—	—	—	—
14	—	—	—	—	—	—	—	—	1	—	—

^a Alveolus present.

very similar and more difficult to differentiate than the larvae. The pupa of *Sa. paradoxus* resembles that of *Sa. hadrognathus* and differs from other species of the subgenus in the dorsal placement of seta 8-VI. This seta is usually but not always dorsal in the latter species, and whether this is a fixed feature of *Sa. paradoxus* will remain uncertain until additional material becomes available for study.

The three paratypes of *Sa. paradoxus* (see below) were reared from pupae collected from bamboo. The pupal exuviae of one of these specimens (GG105-121) bears a differentiated membranous area at the base of the paddle. This is paradoxical for two reasons: the holotype and other paratypes have a normal paddle, and the feature is not known to occur in any other species of *Peytonulus*. A membranous area at the base of the paddle is characteristic of subgenus *Sabethoides* and occurs in some species of subgenus *Sabethes* (Harbach 1991). The exuviae does not appear to be incorrectly associated with the adult male because seta 8-VI is dorsal in position and the specimen otherwise agrees with the holotype and other paratypes in all other fea-

tures. Seta 8-VI is ventral in species of subgenus *Sabethoides* and those species of subgenus *Sabethes* that have a membranous area at the base of the paddle. The genetics that control the expression of the character are unknown, but it seems plausible that this involves latent genes that may be influenced by environmental conditions. The function of the membranous area is likewise unknown, but it could be a region of weakness to facilitate abscission of the paddle should it be grasped by a predator or entangled in debris.

Etymology.—The specific name of *paradoxus* is a Latin adjective (masculine) meaning strange or contrary to expectation. The name refers to the uncharacteristic coloration of the adult male and the enigmatic presence of a delineated membranous area in one pupa of the type series.

Bionomics.—The holotype was collected as a larva found in a terrestrial bromeliad; the paratypes were collected as pupae found in bamboo. In addition to the holotype, the bromeliad also contained larvae of the *Culex* (*Microculex*) *imitator* group, *Johnbelkintia ulopus* (Dyar and Knab), *Limatus durhamii* Theobald, a species of *Toxorhynchi-*

tes (*Lynchiella*), a species of *Wyeomyia* (*Hystatomyia*), and two species of the *Wy.* (*Wyeomyia*) *pertinans* group. Species found in bamboo with the paratypes include the following (superscript 1 indicates collection GG105; 2 indicates collection GG109): *Culex* (*Carrollia*) *antunesi* Lane and Whitman^{1,2}, an unidentified species of *Cx.* (*Culex*)¹, *Limatus durhamii*¹, *Onirion sirivankarni* (Duret)^{1,2}, *Sa.* (*Peytonulus*) *identicus* Dyar and Knab^{1,2}, *Sa.* (*Pey.*) *hadrognathus*^{1,2}, a species of *Shannoniana*^{1,2} (same species in both collections), *Trichoprosopon pallidiventer* (Lutz)², *Tr.* sp. near *pallidiventer*^{1,2}, *Tr. castroi* Lane and Cerqueira², a species of *Tx.* (*Lynchiella*)¹ (?same species found in bromeliad), and two species of *Wyeomyia* (*Wyeomyia*)^{1,2} (same two species in both collections). Nothing is known about the biology of the adults.

Distribution.—Known only from the type locality in the Darien of Panama. The species probably occurs in neighboring countries in Central America and northern South America.

Material examined.—Thirteen specimens (4 ♂, 4 ♂ genitalia, 1 larval exuviae, 4 pupal exuviae) from 1 larval and 3 pupal rearings. Holotype: ♂ (GG108-101, with associated larval and pupal exuviae and dissected genitalia on separate microscope slides), PANAMA: *Darien*, specific locality not known, 7 Jul 58, terrestrial bromeliad (Gorgas Memorial Lab. personnel). Paratypes, same data as holotype except as follows: 1 ♂ (GG105-121, with associated pupal exuviae and dissected genitalia on separate microscope slides), Pucro, 'Paya Camp', 50 m, 6 Jul 58, bamboo; 2 ♂ (GG109-112 and -122, both with associated pupal exuviae and dissected genitalia on separate microscope slides), Pucro, 50 m, 8 Jul 58, bamboo. The holotype and paratypes are deposited in the USNM.

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