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REDESCRIPTION OF *ANOPHELES* (*ANOPHELES*) *SHANNONI* DAVIS; A MEMBER OF THE ARRIBALZAGIA SERIES FROM THE AMAZON BASIN (DIPTERA: CULICIDAE)

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Abstract.—*Anopheles* (*Anopheles*) *shannoni* Davis is redescribed and illustrated in the adult female, male genitalia, and larval and pupal stages. This species is distributed throughout the Amazon Basin of South America. The larvae are found in shaded forest pools, and the adults appear to be zoophilic and prefer to bite outdoors. This species is a member of the Neotropical Arribalzagia Series.

Key Words: Diptera, Culicidae, Arribalzagia, *Anopheles shannoni,* redescription, Amazon Basin

Anopheles (*Anopheles*) *shannoni* Davis is a member of the Arribalzagia Series (Reid and Knight 1961). Wilkerson and Peyton (1990) implied that the approximately 23 species in this Neotropical group are monophyletic based on shared wing spot characters. Except for *An. vestitipennis* Dyar and Knab (Belkin et al. 1970), *An. malefactor* Dyar and Knab, *An. punctimacula* Dyar and Knab (Wilkerson 1990) and *An. calderoni* Wilkerson (Wilkerson 1991), these species are not adequately described. This redescription is part of an incremental effort to characterize the species in the group. In the following redescription Harbach and Knight (1980, 1982) were used for morphological terminology and numbering of larval and pupal setae and, Wilkerson and Peyton (1990) for wing spot nomenclature. Generic and subgeneric abbreviations follow Reinert (1975). An asterisk in a taxonomic citation indicates illustration of a given developmental stage. The specific feature(s) illustrated follows in brackets.

Anopheles (*Anopheles*) *shannoni* Davis

Davis 1931: 345 (female* [wing, hindleg]). State of Pará, Brazil. Holotype female (National Museum of Natural History, Washington, DC).

Female (Fig. 1).—Integument pale brown to dark brown, grayish brown pollinose. *Head:* Interocular space with 6–9 (n = 10 for this and following measurements and counts except where indicated) long, white setae and row of small, narrow, appressed pale yellow scales; vertex, occiput and upper portion of postgena with numerous erect, truncate scales; a patch of grayish white to pale yellow scales on dorsal area of vertex, nearly concolorous with scales on median area of anterior promontory, a patch of dark scales laterally on head concolorous with scales on lateral area of anterior promontory and upper antepronotum; head with 15–23 long, black ocular setae; postgena with long black setae ventrally. Clypeus bare. Pedicel of antenna with 4–10 small, dorsolateral, narrow to broad, grayish white

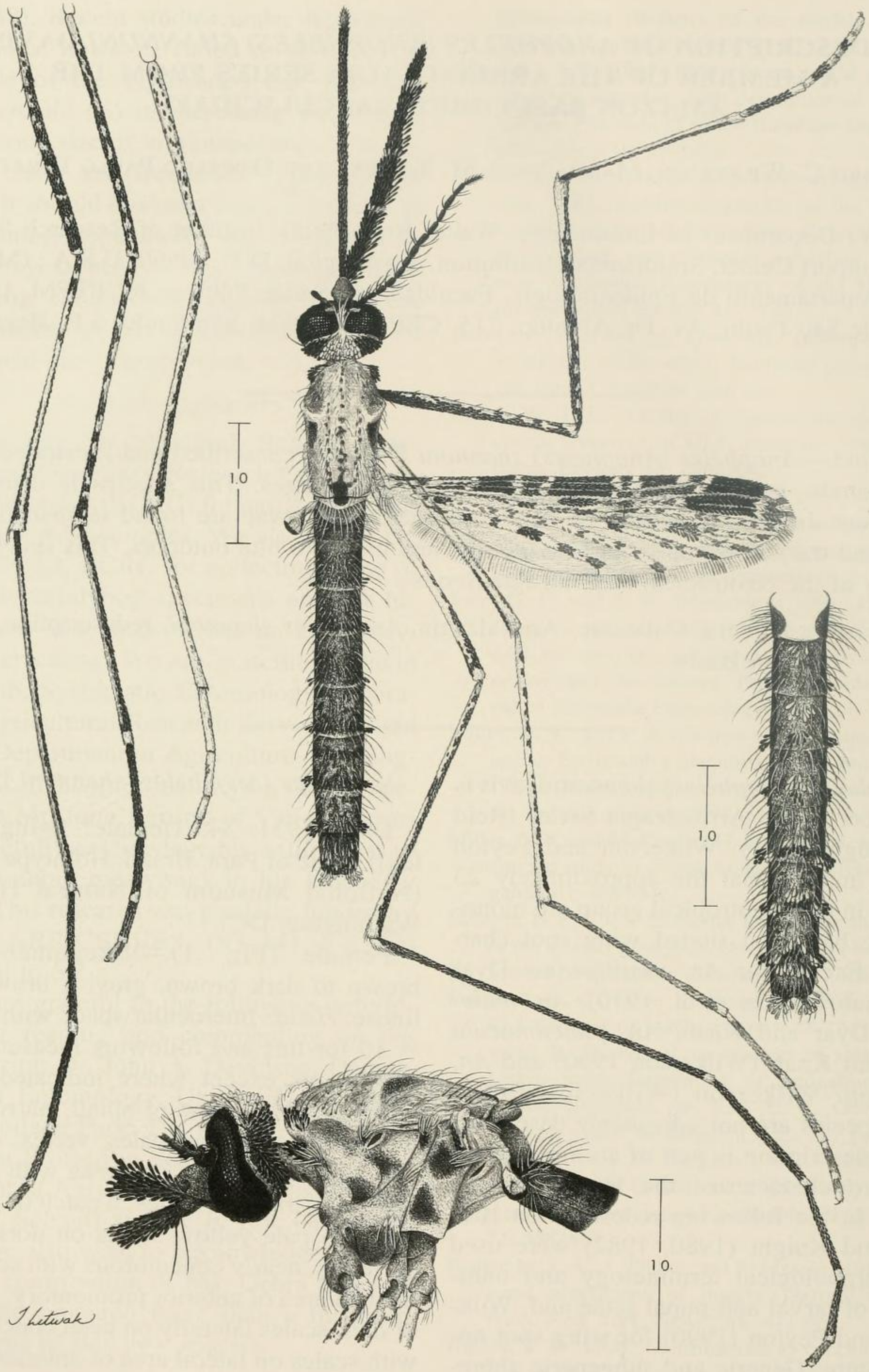

Fig. 1. *Anopheles shannoni.* Adult female habitus.

spatulate scales; flagellomere 1 with numerous narrow to broad, dark spatulate scales. Scales of maxillary palpus slender and spatulate, mostly dark brown with intermixed dark brown setae; scales on palpomeres 2–4 erect; pale yellow scales present on the bases of palpomeres 3, 4 and 5; length of maxillary palpus 1.99–2.61 mm (mean 2.27 mm); ratio of length of palpomeres 2–5 to total length of palpus, 2 = 0.26–0.35 (mean 0.31), 3 = 0.32–0.37 (mean 0.35), 4 = 0.17–0.22 (mean 0.20), 5 = 0.12–0.17 (mean 0.15); ratio of palpomere 4 to 5, 1.10–1.65 (mean 1.35); palpus 1.01–1.25 (mean 1.12) forefemur length. Proboscis with dark brown setae and decumbent dark brown scales, base with longer erect scales and setae; proboscis length 2.21–2.81 mm (mean 2.50 mm), proboscis 1.03–1.16 (mean 1.10) palpus length. *Thorax:* Integument brown to dark brown, silvery pollinose. Scutum with 3 prominent dark brown spots, 2 at the ends of and slightly posterior to prescutal sutures and another in prescutellar area continuing onto scutellum, sometimes 2 smaller spots at the ends of lateral portions of prescutellar area. Scutal setae numerous, pale yellow with golden reflections; scutum mottled with small dark brown spots mostly corresponding to setal insertions in acrostichal and dorsocentral areas; median anterior promontory with patch of long, narrow falcate white to pale yellow scales; scutal fossa without scales except anterior scutal fossa with patch of broad, spatulate dark brown erect scales, sometimes with a few intermixed pale scales; supraalar area with spatulate, elongate, narrow falcate, pale yellow scales. Scutellum with 11–23 shorter and 14–20 long, pale yellow setae. Antepronotum with 20–43 yellowish to dark brown setae and 10–20 upper, dark spatulate scales. Pleural vestiture as follows, with all scales white or pale yellowish white and spatulate: upper proepisternum with 3–6 setae, rarely with 1 narrow scale; prespiracular area with 6–13 setae, a single scale sometimes present; prealar area with 10–24 setae; upper mesokatepisternum with 3–6 setae, rarely with 1 narrow scale; lower mesokatepisternum with 2–5 setae, 7–9 scales; upper mesepimeron with 6–14 setae, 0–4 scales. Legs as figured, scales dark brown and white or pale yellow, scales and setae at apices of fore- and hindtibiae yellow. Distribution of scales on coxae and trochanters as figured. Extent and number of pale spots on femora and tibiae variable. Bases and apices of femora pale; mid- and hindfemora with ventral pale stripes, stripe on hindfemur distinct and with well demarcated borders; fore- and midtibiae with ventral longitudinal stripe of yellow scales, anterior, posterior and dorsal surfaces with yellow spots, hindtibia with an anterior longitudinal stripe of yellow scales and an indistinct stripe of pale yellow scales on posterior surface, basal portion with spots of yellow scales; foretarsomere 1 with a ventral stripe of pale scales, apex of foretarsomeres 1–5 with pale spots, more evident on anterior surface, 5 sometimes totally pale, midtarsomere 1 with indistinct pale stripe on ventral surface, apex of tarsomeres 1–5 with pale spots, these more evident anteriorly, anterior surface of hindtarsomere 1 with an indistinct longitudinal stripe of pale scales and with a few spots of pale scales at base, hindtarsomere 2 with intermixed pale scales, hindtarsomeres 1–5 with pale rings at apices. Forefemur length 1.76–2.28 mm (mean 2.03 mm), ratio of forefemur length to proboscis length 1.16–1.29 (mean 1.23). Wing (Table 1). Length (measured from humeral crossvein) 3.47–4.52 mm (mean 3.93 mm). Dark scales brown to black, pale scales nearly white. Basal pale spot usually present; prehumeral pale spot absent; subcosta basad of humeral crossvein with patch of dark scales ventrally, sometimes also with a few white scales; humeral crossvein dark-scaled dorsally and ventrally; accessory sector dark spot present; often 2 pre- and 2 postsubcostal pale spots and 1 pre- and 1 postsubcostal dark spot, less often a presubcostal and/or a postsubcostal pale spot and/or a postsubcostal dark spot ab-

Table 1. *Anopheles shannoni*: descriptive statistics for ratios of costal wing spot lengths to length of wing measured from the humeral crossvein (n = 10 wings from 10 individual females).

Wing Spot	Range	Mean	SD
Basal pale	0.00–0.01	0.01	0.00
Prehumeral dark	0.08–0.11	0.10	0.01
Humeral pale	0.01–0.02	0.02	0.00
Humeral dark	0.04–0.07	0.06	0.01
Presector pale	0.01–0.02	0.02	0.00
Presector dark	0.07–0.12	0.10	0.01
Sector pale	0.07–0.13	0.09	0.02
Accessory sector dark	0.13–0.37	0.24	0.02
Sector dark	0.13–0.17	0.15	0.02
Subcostal area	0.18–0.27	0.22	0.03
Presubcostal dark	0.00–0.06	0.03	0.02
Presubcostal pale (prox.)	0.01–0.04	0.02	0.01
Presubcostal pale (distal)	0.00–0.02	0.01	0.01
Postsubcostal dark	0.00–0.04	0.02	0.02
Postsubcostal pale (prox.)	0.04–0.05	0.02	0.02
Postsubcostal pale (distal)	0.00–0.03	0.01	0.01
Subcostal dark	0.08–0.12	0.10	0.01
Preapical dark	0.14–0.18	0.15	0.01
Preapical pale	0.01–0.05	0.03	0.01
Apical dark	0.00–0.10	0.02	0.04

sent; apical dark spot usually absent, occasionally represented by a few scales at the end of vein R_1 and sometimes dark scales on fringe. Spots on posterior veins variable; R_{4+5} sometimes mostly dark-scaled with intermixed pale scales, always with a small pale spot and distinct black spot at proximal end of vein, M_2 sometimes dark-scaled with intermixed pale scales, sometimes with a pale spot on proximal portion, sometimes with 2 black spots, one on proximal and another on distal end of vein, mcu at CuA variable from white-scaled to dark-scaled. Pale fringe spots indistinct, not well demarcated. Halter. Scabellum and ventral surface of pedicel with pale integument, dorsal surface of pedicel and capitellum with brown integument; pedicel and capitellum white-scaled dorsally, capitellum dark-scaled ventrally, concave center without scales. *Abdomen:* Integument brown to dark brown with some grayish pollinosity. Terga with numerous long yellowish setae; terga II–VII with erect, posterolateral, dark scale patches; tergum VIII with narrow, nearly white to yellow spatulate scales and also with patches of posterolateral, dark spatulate scales. Cercus distinctly constricted apically, pale yellow scaled. Sterna with scattered brown to yellow setae; sternum I without scales; sterna II–VII with scattered broad, white, spatulate scales and posteromesal patches of brown, dark, spatulate scales; sternum VIII with scattered, narrow, pale yellow and dark scales.

Male (Fig. 2).—As in female except for the following sexual differences. Maxillary palpus about 0.90 length of proboscis; apex of palpomere 3 and all palpomeres 4 and 5 enlarged, palpomere 4 about 4 times broader than base of palpomere 3. Maxillary palpus with dark brown and white to pale yellow scales; basal 0.5 of palpomere 2 with erect scales, apex with dorsolateral patch of white scales; palpomere 3 dark-scaled with an incomplete ring of white scales at base, a dorsolateral patch of white scales on basal 0.3 and a few scattered pale yellow scales; palpomere 4 mostly dark-scaled with scattered, pale yellow scales on dorsal and lateral surfaces and a patch of white scales at apex; palpomere 5 mostly dark-scaled with a dorsal patch of pale yellow scales at apex; palpomeres 4 and 5 mostly bare mesally, with long yellowish setae dorso- and ventromesally, 5 with scattered pale yellow scales. Proboscis length 2.87 mm, with small, decumbent, dark brown scales, and a ventrobasal patch of erect, dark scales, labella brown. Foreungues with curved submedian tooth and short, blunt, external basal tooth. *Genitalia:* Ninth tergal lobes short, somewhat triangular in outline, widely separated. Dorsal surface of gonocoxite with a few scattered, moderately long setae, lateral surface with slender fusiform and spatulate scales, ventral surface as dorsal surface but with lateral scales, most mesal parabasal spine stout with slender, recurved tip, borne on a slightly raised base; the other parabasal longer and more slender, both about 0.23 from base of gonocoxite; internal seta slender, about as long as most mesal parabasal, base about 0.75 distance from

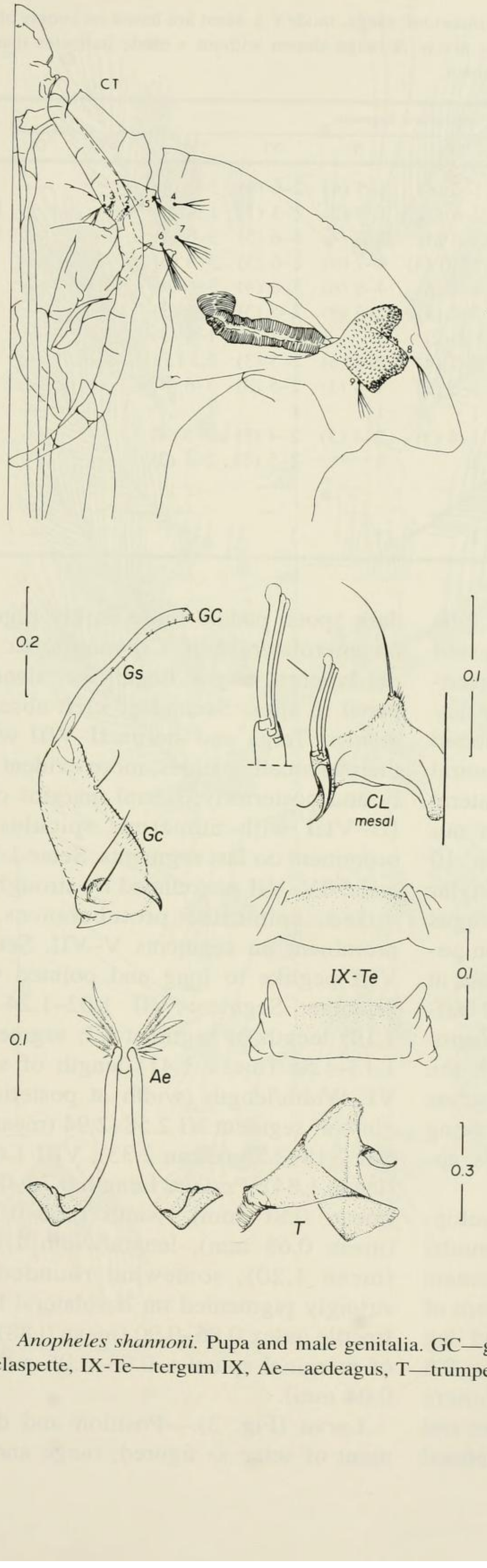

Fig. 2. *Anopheles shannoni.* Pupa and male genitalia. GC—gonostylar claw, Gs—gonostylus, Gc—goncoxite, Cl—claspette, IX-Te—tergum IX, Ae—aedeagus, T—trumpet.

Table 2. Pupal setal branching for *Anopheles shannoni*: range, mode ( ). Most are based on counts of twenty setae. In the case of equal modes, the highest is given. A range shown without a mode indicates that it was indefinite. Seta 8–II was found in only one specimen.

Seta No.	Cephalothorax CT	Abdominal Segments I	II	III	IV	V	VI	VII	VIII	IX	Paddle P
0	—	—	1–4 (3)	1–7 (3)	1–6 (4)	1–5 (4)	2–6 (4)	2–6 (4)	1	—	—
1	2–4 (3)	13–23 (22)	5–10 (6)	3–7 (4)	2–5 (3)	1–3 (2)	1–3 (1)	1,2 (1)	1	1	1,2 (1)
2	2,3 (3)	2–10 (5)	6–8 (7)	5–8 (6)	3–5 (4)	3–5 (4)	4–6 (5)	3–6 (4)	—	—	1–3 (2)
3	2–4 (3)	1,2 (1)	2–5 (4)	3–7 (4)	4–10 (8)	3–7 (6)	2–6 (3)	3–8 (6)	—	—	—
4	2–5 (4)	2–8 (4)	2–6 (3)	3–6 (4)	2–6 (5)	4–8 (6)	3–6 (4)	3–6 (4)	3–5 (4)	—	—
5	3–6 (4)	3–5 (4)	4–7 (5)	4–9 (6)	2–5 (3)	2–5 (3)	2–5 (3)	2–4 (3)	—	—	—
6	3–7 (4)	2–4 (3)	2–5 (3)	2–6 (3)	1,2 (2)	2	1–4 (2)	1–4 (3)	—	—	—
7	4–8 (5)	3–6 (4)	3–8 (5)	2–6 (4)	2–7 (4)	2–6 (3)	2–5 (3)	2,3 (3)	—	—	—
8	2–6 (3)	—	2	1–5 (3)	1–5 (3)	1–4 (3)	2–5 (3)	3–6 (4)	—	—	—
9	2–5 (4)	1,2 (1)	1	2–6 (4)	1	1	1	1	1	—	—
10	2–5 (3)	—	—	1–4 (1)	1–4 (3)	2–4 (3)	2–4 (3)	2–5 (4)	—	—	—
11	4–7 (4)	—	—	—	1	1	2–5 (4)	2–5 (3)	—	—	—
12	—	—	—	—	—	—	—	—	—	—	—
13	—	—	—	—	—	—	—	—	—	—	—
14	—	—	—	1	1	1	1	1	1	—	—

base of gonocoxite. Claspette. Dorsal lobe of claspette with 3 strong, closely appressed setae, nearly equal in length, 2 setae inserted nearly at the same level, rounded in lateral view and 1 narrower seta inserted slightly basal to the other 2 setae; ventral lobe with 1 long, apical, slender seta; lateral and mesal surfaces of claspette with numerous small setae. Gonostylus with 10 minute setae on dorsal surface; gonostylar claw short, spiniform and blunt. Aedeagus with 5–8 pairs of leaflets, depending on position these appear as laminar, truncate at apex or bluntly pointed; the most mesal leaflet about 0.45 of aedeagus length, uniformly sclerotized, the other leaflets with the outer edge less sclerotized; largest leaflets with a few denticles toward apex and along one or both edges, no basal denticles apparent.

Pupa (Fig. 2).—Position and development of setae as figured; range and modal number of branches in Table 2. Integument weakly pigmented with a mottled pattern of dark pigmentation on wing case and leg cases, antennal case darker on outer 0.5 with dark pigmentation at flagellomere joints; integument near base of trumpet and metathoracic wings with poorly defined dark spots; paddle more darkly pigmented on anterolateral half. *Cephalothorax:* Trumpet laticorn, tragus finger-like, slender, tapered to apex. Secondary cleft absent. *Abdomen:* Terga and sterna II–VIII with numerous small spicules, more evident mesally and posteriorly; lateral margins of terga III–VIII with numerous spicules, most prominent on last segments. Setae 1-III–VII and 5-IV–VII surrounded by strongly sclerotized, spine-like protuberances, more prominent on segments V–VII. Seta 9-II–VIII peglike to long and pointed without aciculae. Segment VII 1.02–1.24 (mean 1.10) length of segment VI; segment VIII 1.13–1.55 (mean 1.41) length of segment VI. Width/length (width at posterior margins) of segment VI 2.58–2.94 (mean 2.75), VII 2.18–2.56 (mean 2.33), VIII 1.69–2.20 (mean 1.84). *Paddle:* Length 0.76–0.90 mm (mean 0.81 mm), width 0.62–0.74 mm (mean 0.68 mm), length/width 1.14–1.24 (mean 1.20); somewhat rounded, more strongly pigmented on basolateral half; refractile index 0.86–0.90 (mean 0.88); length of marginal spicules 0.03–0.05 mm (mean 0.04 mm).

Larva (Fig. 3).—Position and development of setae as figured; range and modal

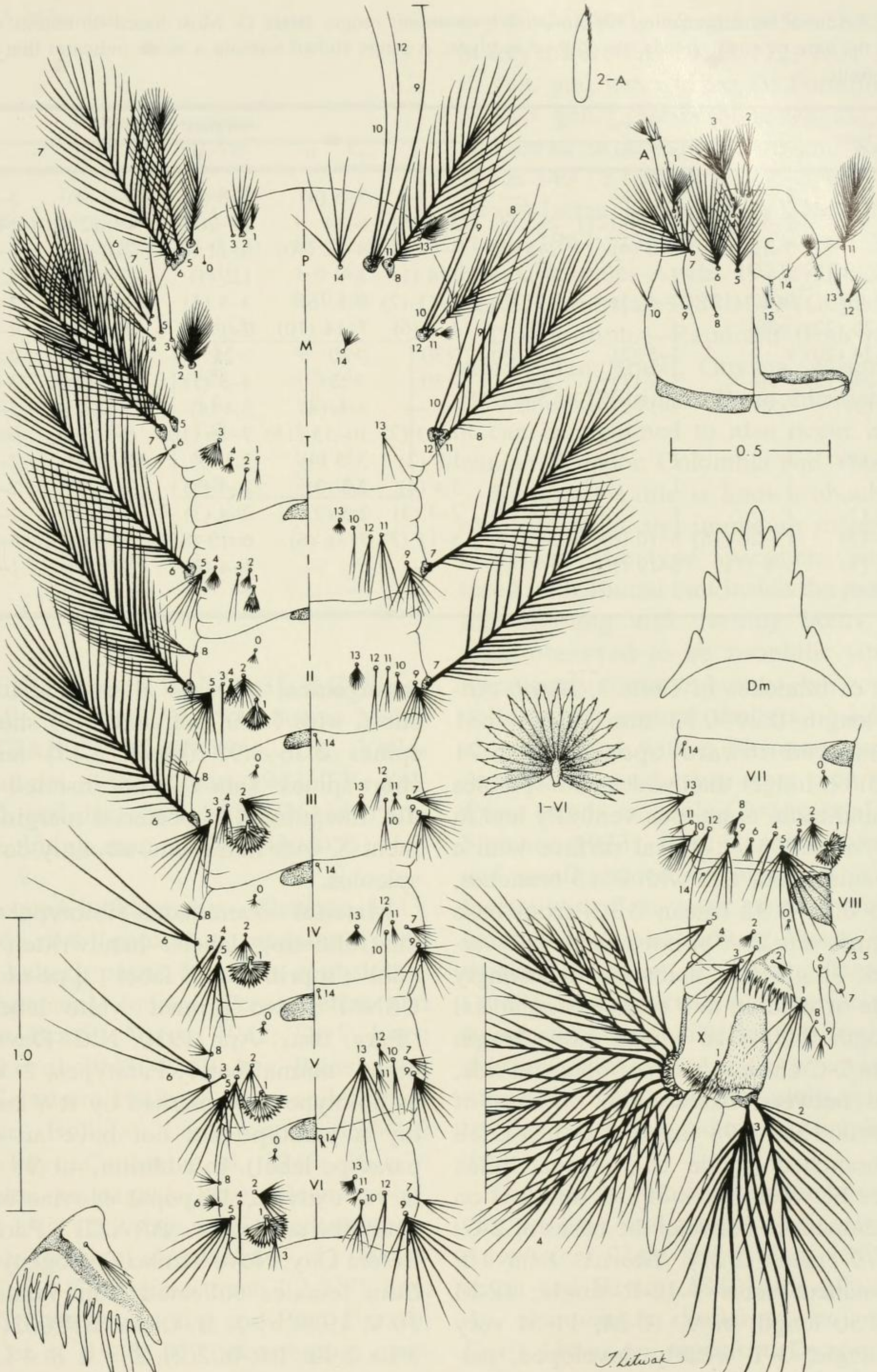

Fig. 3. *Anopheles shannoni*. Larva.

Table 3. Larval setal branching for *Anopheles shannoni*: range, mode (). Most based on counts of twenty setae. In the case of equal modes, the highest is given. A range shown without a mode indicates that the mode was indefinite.

Seta No.	Head C	Thorax P	Thorax M	Thorax T	Abdominal Segments I	II	III	IV	V
0	—	1	—	—	—	3–5 (4)	3–8 (4)	4–6 (4)	3–5 (5)
1	1	2–5 (4)	21–30 (21)	2–5 (4)	3–9 (6)	6–14	15–20 (19)	18–22 (20)	14–20 (20)
2	1–9	7–12 (8)	2–6 (4)	2–5 (2)	4–9 (6)	8–12 (10)	6–11 (8)	2–8 (4)	2–5 (4)
3	14–24 (18)	1	1	7–14 (12)	1–4 (1)	1	1,2 (1)	2–4 (4)	2,3 (3)
4	4–7 (5)	9–17 (12)	2–4 (3)	4–7 (5)	7–11 (7)	6–8 (6)	3–5 (4)	3–5 (4)	3–5 (4)
5	17–26 (22)	>30	1	>30	4–7 (6)	7–14 (10)	7–11	4–6 (5)	4–8 (5)
6	16–24 (20)	1	2–5 (3)	3–5 (4)	>30	>30	>25	2,3 (2)	2,3 (2)
7	17–24 (19)	>30	3–7 (7)	>30	>30	>25	4–8 (5)	3–7 (4)	3–5 (5)
8	2,3 (2)	>30	9–19 (10)	>30	—	3–6 (4)	3,4 (4)	3,4 (4)	3–5 (5)
9	2	1	1	1	7–13 (7)	10–15 (15)	7–16 (10)	6–11 (7)	6–10 (10)
10	1–3 (2)	1	1	1	1,2 (2)	3–5 (4)	2,3 (3)	1–3 (2)	2–4 (3)
11	>20	1	1	1	3,4 (4)	2,3 (3)	2–4 (3)	3–5 (4)	2–4 (3)
12	2–4 (3)	1	1	2–4 (3)	2–4 (3)	2,3 (2)	2–4 (3)	3–5 (3)	2–5 (4)
13	2–4 (3)	13–26 (15)	5–10 (6)	3–5 (4)	5–11 (7)	7–16 (8)	6–13 (8)	5–13	5–7 (5)
14	1–4 (3)	5–9 (7)	5–19 (12)	—	—	—	1–4 (2)	1–3 (2)	1–3 (2)
15	1–7 (3)	—	—	—	—	—	—	—	—

number of branches in Table 3. *Head:* Antennal length 0.29–0.33 mm (mean 0.31 mm), tapered toward apex, 5.05–6.71 (mean 5.69) longer than wide; with spicules longer and more numerous ventrally and in vicinity of seta 1-A; dorsal surface with a few spicules; seta 1-A with 7–13 branches, inserted 0.26–0.32 (mean 0.30) from base of antenna; seta 2-A pointed. Seta 2-C varies from single and aciculate to strongly aciculate or with up to 9 branches on apical 0.3, length 0.90–1.16 (mean 1.04) length 3-C, seta 2-C close to mate of opposite side, distance between bases/width of base of single seta 1.06–1.98 (mean 1.64); 3-C 18 to 24 branched (mode 18), clypeal index (distance between bases of 2-C and 3-C on one side/distance between the bases of 2-C) 1.67-2.79 (mean 2.21). *Thorax:* Seta 1-P 2-5 branched; setae 9-12-P single; 12-M about 0.30 length of 9, 10-M; 11-M very short, single; 3-T weakly developed, palmate; 11, 12-T very short. *Abdomen:* Seta 1-I–VII palmate, seta 1-I,II weakly developed, leaflets broad, with jagged margins, apex weakly pigmented; 9-I with 7–13 branches; 8–II with 3–6 branches; 6-IV,V with 2,3 branches. Pecten with 15–20 teeth; arrangement of teeth alternating long and short, with 7–10 long and 7–11 short; long spines 2.26–3.93 (mean 3.17) length of short spines. Seta 1-X not inserted on saddle. Integument of posterior margin of segment X with numerous, strongly developed spicules.

Material examined.—Holotype ♀ with the following labels: handwritten "shannoni"; a printed red label "type no. 44166 USNM"; two printed white labels, one "Para, Braz. Apr. 1930, N.C. Davis", another "animal bait". Paratypes, 2 ♀; same as holotype (one marked by RW as probably a paratype did not have an original paratype label). In addition, 49 ♀, 4 ♂, 13 larval exuviae, 15 pupal exuviae and 4 ♂ genitalia as follow. BRAZIL, Pará State, Belém City, Nova Timbo, 3 progeny broods from females collected from human bait, 10.V. 1989 by J. B. Lima: BR 002(1), 1 ♀ 2 Le 2 Pe; BR 002(2), 2 ♀ 2 ♂ 4 Le 4 Pe; BR 002(3), 7 ♀ 1 ♂ 1 ♂ gen. 8 Le 9 Pe; BR 002(×), 2 ♀; biting cow, 14.IV.194?, Komp coll. and det., 1 ♀; Amazonas State, Lábrea, Rio Ituxí, Floresta, 18.1.1984, J. Bento coll. and det., 1 ♂ 1 ♂ genitalia; Manaus, VI.1931, R.C. Shannon col. and det.,

Table 3. Extended.

Abdominal Segments			
VI	VII	VIII	X
2–5 (4)	1–5 (4)	1–4 (2)	—
15–22 (19)	13–22 (17)	2,3 (2)	1
6–10 (7)	7–12 (8)	5–8 (6)	18–25 (20)
1–4 (2)	3–7 (5)	6–10	4–6 (6)
1	1–3 (2)	1	9,10 (9)
6–9 (8)	7–11 (9)	4,5 (5)	—
4–8	4–8 (6)	1-S	4–7 (6)
3–7 (3)	4–7 (4)	2-S	4–8 (4)
4,5 (5)	6–8 (7)	6-S	1,2 (1)
6–10 (10)	4–8 (5)	7-S	1
4–6 (5)	7–15 (11)	8-S	1–4 (3)
3–5 (3)	3	9-S	2–5 (4)
1–3 (2)	2–4 (3)	—	—
6–11 (9)	4–7 (5)	—	—
2,3 (2)	1–3 (1)	1	—
—	—	—	—

3 ♀. PERU, Iquitos, III,IV.1931, R.C. Shannon coll., 15 ♀. GUYANA, Sector Malar. Lab. TS&B.C., 19.VII.1944, T.K. Yolles coll. and det. 1 ♀; on man, 1942, T.K. Yolles coll. and det., 16 ♀. SURINAM, Paramaribo, biting man, 3.IX.1943, D.G. Hall coll., 1 ♀.

Annotated bibliography.—Shannon 1933: 136 (♂; ♀* [genitalia, marginal wing scales, halter]; pupa* [trumpet, cephalothorax, abdomen]. Iquitos, Peru; Belém and Manaus, Brazil); Vargas 1942: 72 (♀, key); Russell et al. 1943: 49 (♀, key. British Guiana); Cerqueira 1943: 18 (Beni and Terr. de Colonias, Bolivia); Causey et al. 1944: 3 (egg*, key); Causey et al. 1946: 26 (♂* [claspette, aedeagus], key); Deane et al. 1946a: 13, (♀* [wing, cerci, hindtarsomere 1], key); Deane et al. 1946b: 37, 41 (larva* [setae 2,3,4-C, antenna, setae 1,2,3-P], key. Mato Grosso, Amazonas and Pará, Brazil); Deane et al. 1948: 917 (distribution map, northern Brazil); Correa 1950: 81 (♀ and larva in keys); van der Kuyp 1950: 63 (♀, ♂ and larva, in keys. Moenga, Surinam); Lane 1953: 204 (♀* [wing], key; ♂; pupa* [trumpet, abdomen]; larva* [illus. from Deane et al. 1946b]; egg* [illus. from Causey et al. 1944]); Vargas 1959: 385 (♂ gen. in key); Forattini 1961: 172, 181, 186 (♀, ♂ gen. and larva in keys); Forattini 1962: 342 (♂ gen.* [claspette, aedeagus], key; ♀ and larva in keys); García and Ronderos 1962: 149 (♀* [wing], key; ♂ gen. in key; larva* [setae 2,3-C, 6-IV,V], key); Gorham et al. 1967: 25, 40, 61; (♀ and larva in keys); Morales-Ayala 1971: 138 (Loreto, Peru); Rambajan 1987: 149 (Guyana).

Distribution.—Reported from northern Amazonian Brazil, Guyana, eastern Peru, Bolivia and Surinam. From this distribution it can be assumed to also occur in Amazonian Ecuador, Colombia and Venezuela.

Biology.—Little is known about the biology of adult and immature stages of *An. shannoni*. The type specimens were captured with animal bait inside the jungle during morning and evening hours. Adults were observed to be zoophilic since they were rarely found in houses, but commonly collected in animal shelters. Adults were also collected with a Shannon trap in the Amazon forest. Larvae were reported from forest ponds or pools (Deane et al. 1946b, Shannon 1933), from stagnant river waters and small shaded streams, and in flooded forests with clear water generally full of decomposing leaves, among shrubs and tree trunks (Deane et al. 1948). Deane et al. (1948) also reported that the larvae were found associated with *An.* (*Nyssorhynchus*) *darlingi* Root and *An.* (*Ano.*) *mediopunctatus* (Theobald) and that adults seldom entered houses and fed mostly on horses at dusk.

Discussion.—In comparison to other species in the Arribalzagia Series (subgenus *Anopheles*) (Reid and Knight 1961, Wilkerson and Peyton 1990), the adult female *An. shannoni* is similar to *An. minor* Da Costa Lima, *An. peryassui* Dyar and Knab and *An. mattogrossensis* Lutz and Neiva in having mostly dark-scaled tarsi with narrow rings of pale scales at the tarsomere articulations. However, the former two species have posterolateral abdominal scale tufts and speckled tibiae and femora, while *An.*

peryassui and *An. mattogrossensis* have neither. In many other respects *An. shannoni* is quite similar to *An. minor* but *An. shannoni* has wide wing scales, the apical half of the cercus is strongly constricted and there is no speckling on hindtarsomere 1. *Anopheles minor* has narrow wing scales, a rounded cercus and speckling on hindtarsomere 1.

The male genitalia of *An. shannoni* has the ninth tergal lobes short and triangular while they are short to long but rounded in the other three species. *Anopheles shannoni* has 5–8 large subequal aedeagal leaflets with one edge usually thinner and nearly transparent, and with small apical denticles. *Anopheles minor* and *An. mattogrossensis* both have one pair of leaflets (*An. minor* also has several very small pairs) and *An. peryassui* has 4–5 pairs of uniformly sclerotized leaflets without denticles. Of the four species only *An. shannoni* has a single primary seta on the ventral lobe of the claspette.

In the larval stage *An. shannoni* can be distinguished from other *An.* (*Anopheles*) by the following combination of characters: seta 2-A lanceolate with a fine apical fringe on one margin; seta 3-C with 18–24 branches; seta 1-P short with 2–5 branches; setae 9-12-P single; seta 6-IV,V 2–3 branched and; the pecten plate with alternating short and long teeth.

In the pupal stage, *An. shannoni* can be easily recognized by setae 1-III–VII and 5-IV–VII which have bases surrounded by spinelike projections. Also, the trumpet has a slender, fingerlike tragus, the secondary cleft is absent and the paddle is strongly pigmented on the basolateral half.

The egg is unusual in having numerous frills (Causey et al. 1944, Lounibos et al. in press), similar to *An. peryassui* Dyar and Knab (Causey et al. 1944, Linley and Lounibos 1994).

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