

## RESTORATION OF *AYURAKITIA* TO GENERIC RANK IN TRIBE AEDINI AND A REVISED DEFINITION OF THE GENUS

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**ABSTRACT.** *Ayurakitia*, previously treated as a subgenus of genus *Aedes*, is restored as a genus in tribe Aedini of family Culicidae. Rationale for this action is discussed. The genus includes 2 species (*griffithi* and *peytoni*) and has been reported from Southeast Asia. The most distinctive features of the genus are listed. A revised and expanded definition of the genus and illustrations of the female and male genitalia, pupa, and 4th-stage larva of the type species are provided.

**KEY WORDS** *Ayurakitia*, Aedini, Culicidae, taxonomy

### INTRODUCTION

In 1954, Deed Thurman described genus *Ayurakitia* for a new species, *griffithi*, of which only the female and male were known. Other authors (Stone and Knight 1957, Stone et al. 1959, Belkin 1962, Stone and Delfinado 1973) listed *Ayurakitia* as a genus. Ernestine Thurman (1959) followed this arrangement in her treatment of Culicidae of northern Thailand. Mattingly (1971: 30), without explanation, reduced *Ayurakitia* to subgeneric rank and placed it in genus *Aedes* Meigen. Reinert (1972) retained the subgeneric placement of *Ayurakitia* and added a 2nd species, *peytoni*, which he described as new. All subsequent authors retained *Ayurakitia* as a subgenus of *Aedes* (Knight and Stone 1977, Rattananarithkul 1982, Gong 1985, Tsukamoto et al. 1987, Lu et al. 1988, Harrison et al. 1990, Qu et al. 1994, Rattananarithkul and Panthusiri 1994, Lu 1997, Harbach and Kitching 1998).

I have examined specimens of all subgenera of *Aedes* and genera of tribe Aedini, and after re-evaluation of all known life stages of the species assigned to *Ayurakitia* I am convinced that *Ayurakitia* should be elevated to generic rank in family Culicidae. This conviction is based on unique and unusual features for each of the life stages of *Ayurakitia*. These features are presented below, along with an expanded and revised definition of the genus, and a discussion of the rationale for this change in status. Illustrations of the female genitalia (Fig. 1), male genitalia (Fig. 2), pupa (Fig. 3), and 4th-stage larva (Fig. 4) of the type species of the genus are provided to show features mentioned in the description of *Ayurakitia*. The proposed generic abbreviation for *Ayurakitia* is *Ay.*

Within tribe Aedini the most distinctive features of genus *Ayurakitia* follow. In the adults the postspiracular area is bare; pleural areas of the

thorax have scales restricted to only small patches on the upper proepisternum, upper and lower mesokatepisternum, and upper mesepimeron. These scales are broad and silvery. The male posttarsus II has 2 unequal ungues that are both simple. In the female genitalia the insula is tongue-like and bears several moderately long, thin setae; the postgenital lobe is relatively narrow with a very deep median apical emargination; and tergum VIII is large and nearly covered (except narrow basal portion) with large broad scales. In the male genitalia the gonostylus is large, attached to apex of the gonocoxite, and is distinctly shaped (see description below); sternum IX is large and bears a few weakly developed setae posteromesally; and tergum IX has the posterior margin with a deep and wide median notch separating broadly rounded lobes, each bearing a few thin setae that are directed posterolaterally. In the pupae the paddle has the outer part laterad of midrib noticeably shorter than the apex and the inner part mesad of the midrib extending to the apex; seta 1-Pa is single, long, stout, hooklike, and attached to the midrib just distad to the shorter outer part of the paddle; and seta 7-CT is very long and approximately equal to the width of abdominal segment VIII. In the 4th-stage larvae setae 4-7-C are all fanlike, multiple branched, stout, aciculate, moderately long to long, even seta 4-C, which is the shortest of the group, and alveoli of setae 4-6-C form an equilateral triangle; seta 8-C is inserted noticeably mesad of the frontal ecdysial line whereas seta 9-C is located very near the frontal ecdysial line; seta 5-I-VI is multiple branched and inserted noticeably anterior to setae 3,4,6-I-VI; seta 3-VII is multiple branched and inserted noticeably anterior to setae 1,4,5-VII and about at level of seta 8-VII; and the ventral brush (seta 4-X) is composed of 2-4 short, single or occasionally 2-branched setae anteriorly and 4-6 very long, 2-4-branched setae posteriorly, and the grid is weakly developed.

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## REDESCRIPTION OF GENUS *AYURAKITIA* D. THURMAN, 1954

Type species: *Ayurakitia griffithi*  
D. Thurman, 1954

**Females.** *Head:* Maxillary palpus approximately 0.18 length of proboscis; proboscis with equal thickness throughout length, with large portion pale-scaled but dark-scaled apically; eyes contiguous dorsally; ocular line covered with broad overlapping silvery scales except for small median patch of broad dark scales, several dark setae posterior to silvery scales; vertex with broad decumbent scales and with several erect forked scales intermixed; occiput with narrow curved decumbent scales and numerous erect forked scales. *Thorax:* Scutum covered with narrow curved dark scales except prescutellar area bare; well-developed dark setae on following areas—2 anterior promontory, few scutal fossal, numerous acrostichal (anterior and posterior), several dorsocentral (anterior and posterior), several prescutellar, 2,3 antealar, numerous supraalar, and 1 parascutellar; scutellum with narrow curved scales on each lobe, median lobe also with few small broad scales, few setae on each lobe; mesopostnotum bare; anteprenota widely separated, not enlarged; pleural areas with all scales broad, overlapping, silvery, and restricted to small patches on upper proepisternum, upper and lower mesokatepisternum, and upper mesepimeron; setae on following areas—7–10 anteprenotal, 2,3 postprenotal, 4–7 upper proepisternal, 2 upper, 1 median posterior, and 3–6 lower posterior mesokatepisternal, 3–5 prealar, 5–8 upper and 2 lower anterior mesepimeral. *Legs:* Femora I–III dark-scaled with pale-scaled areas, II, III with apical and subapical patches of silvery scales on anterior surface; tibiae I–III dark-scaled and each with pale-scaled stripe on posterior surface; tarsi I–III dark-scaled and with pale-scaled basal bands on at least tarsomeres 1 and 2; posttarsi I–III each with 2 ungues, equal in size, I, II toothed, III simple. *Wing:* Dark-scaled; alula with row of narrow dark scales on posterior margin; upper calypter with numerous setae on margin. *Abdomen:* Dark-scaled and with pale-scaled areas, most terga with pale-scaled basal bands and lateral patches near midlength.

**Female genitalia.** *Tergum VIII:* Large; apex broad and straight or slightly convex; with numerous large broad scales covering most of area except for narrow basal portion; several long stout setae along apical margin; VIII-Te index 0.81–0.93. *Ster-*

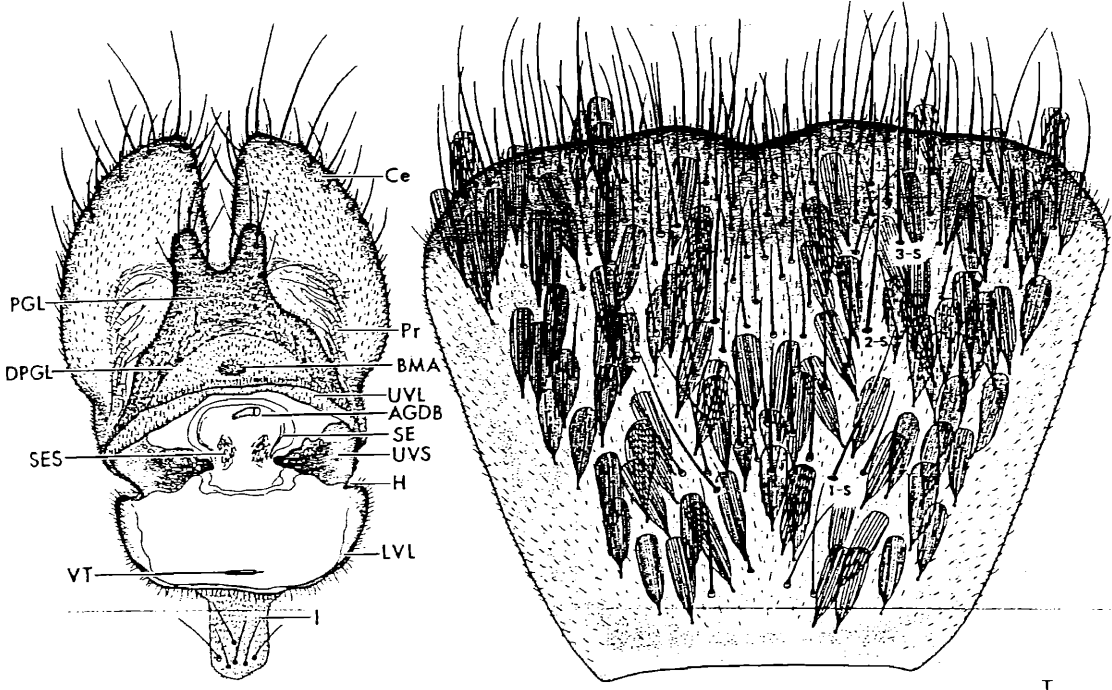
*num VIII:* Large; wide; apex with very small median indentation; numerous large broad scales; numerous short and few moderately long setae; numerous short to moderately long setae on apical margin; VIII-S index 0.78–0.91. *Tergum IX:* Apex with moderately deep median indentation, few moderately long setae on each side of midline; IX-Te index 0.65–0.76. *Insula:* Tonguelike; 4–8 moderately long thin setae on apical area (these setae are apparently loosely attached to the insula and are frequently lost during slide-mounting so that only alveoli remain). *Lower vaginal lip:* Lightly pigmented; narrow; sclerite absent. *Upper vaginal lip:* Lightly to moderately pigmented; narrow; sclerite moderately large to large, lightly to moderately pigmented, lightly fenestrated. *Spermathecal eminence:* Membranous; ill-defined. *Postgenital lobe:* Moderately long and narrow; apex with very deep median emargination; 7–10 total setae. *Cercus:* Short and broad; inner margin nearly straight or slightly convex; outer margin gently curved from base to apex; dorsal surface with number of large broad scales; 6,7 stout setae along apical portion of outer margin, distal 2 setae long and remainder moderately long; several short and moderately long setae on remainder of dorsal surface; cercus index 1.92–2.21. *Spermathecal capsules:* One large- and 2 slightly smaller-sized ones; moderately pigmented; spherical; very few small spermathecal capsule pores near orifice.

**Males.** Generally similar to females in habitus. *Head:* Antenna plumose with setae directed mainly dorsally and ventrally; maxillary palpus 0.87–0.95 length of proboscis, thin, palpomere 1 tiny, palpomeres 2,3 long, palpomere 4 approximately 0.33 length of palpomere 3 and bearing few moderately long setae dorsoapically, palpomere 5 short, downturned, and bearing few moderately long and several short setae apically. *Legs:* Posttarsi I–III each with 2 ungues, I with ungues unequal and larger one with tooth, II with ungues unequal and simple; III with ungues equal and simple. *Abdomen:* Terga with pale-scaled areas much enlarged.

**Male genitalia.** Described in prerotation sense. *Tergum IX:* Posterior margin deeply and broadly notched mesally and separating broadly rounded lobes, each bearing few, short, thin, posterolaterally directed setae; anterior margin with moderately deep broad notch mesally. *Gonocoxite:* Moderately long and relatively narrow; long setae on dorsal, lateral, and ventral surfaces; ventral surface with mesal margin bearing row of several long, stout,

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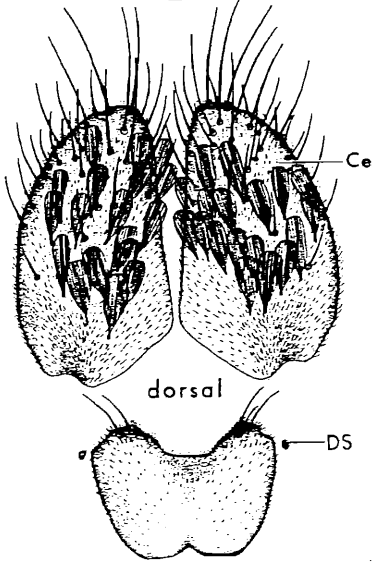
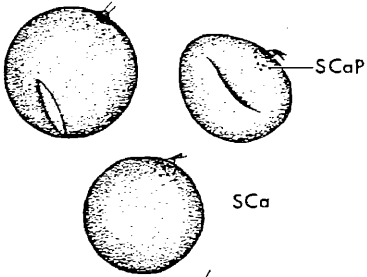
Fig. 1. Female genitalia of *Ayurakitia griffithi* showing structures. Abbreviations used: AGDB, accessory gland duct base; BLS, basal lateral seta; BMA, basal mesal apodeme; Ce, cercus; DPGL, line of attachment of Pr to dorsal surface of PGL; DS, dorsal sphere; H, hinge; I, insula; IX-Te, tergum IX; LVL, lower vaginal lip; PGL, postgenital lobe; Pr, proctiger; SCa, spermathecal capsule; SCaP, spermathecal capsule pore; SE, spermathecal eminence; SES, spermathecal eminence spicule; UVL, upper vaginal lip; UVS, upper vaginal sclerite; VIII-S, sternum VIII; VIII-Te, tergum VIII; VT, ventral tuft; 1–3-S, setae 1–3-S of VIII-S. Scale in mm.



ventral

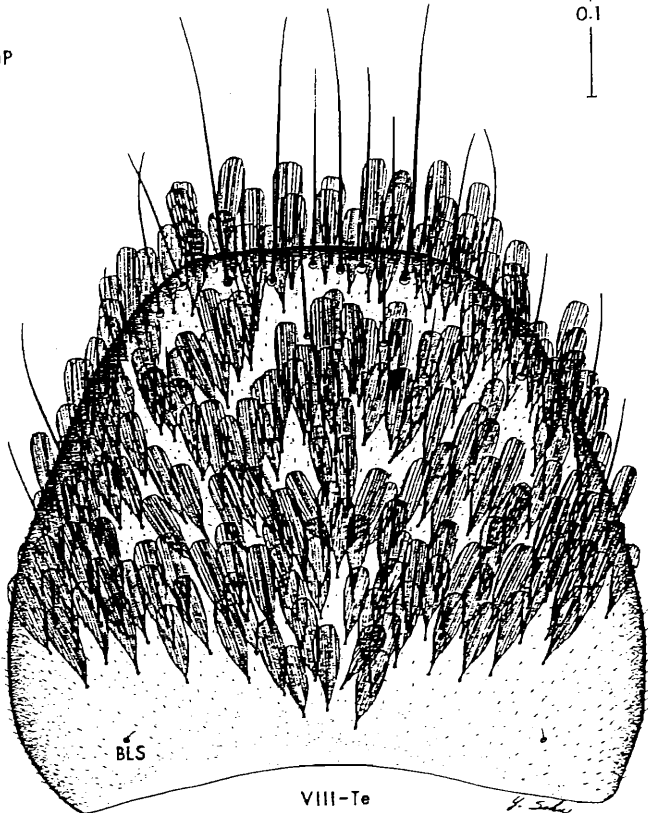
VIII-S

0.1



dorsal

IX-Te



VIII-Te

Y. Suda

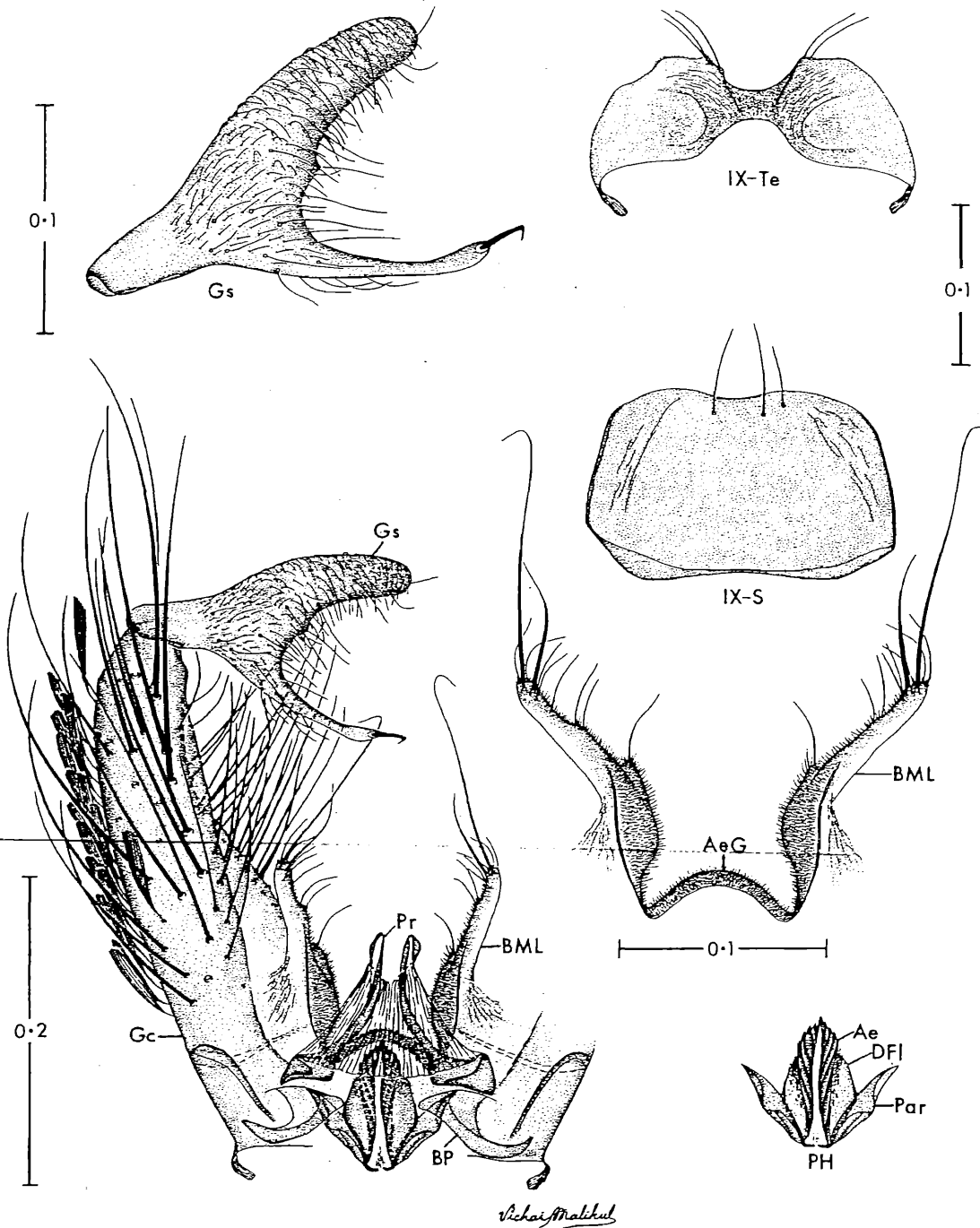


Fig. 2. Male genitalia of *Ayurakitia griffithi* showing structures. Abbreviations used: Ae, aedeagus; AeG, aedeagus guide; BML, basal mesal lobe; BP, basal piece; DFI, dorsal flap; Gc, gonocoxite; Gs, gonostylus; IX-S, sternum IX-Te, tergum IX; Par, paramere; PH, phallosome; Pr, proctiger. Scale in mm.

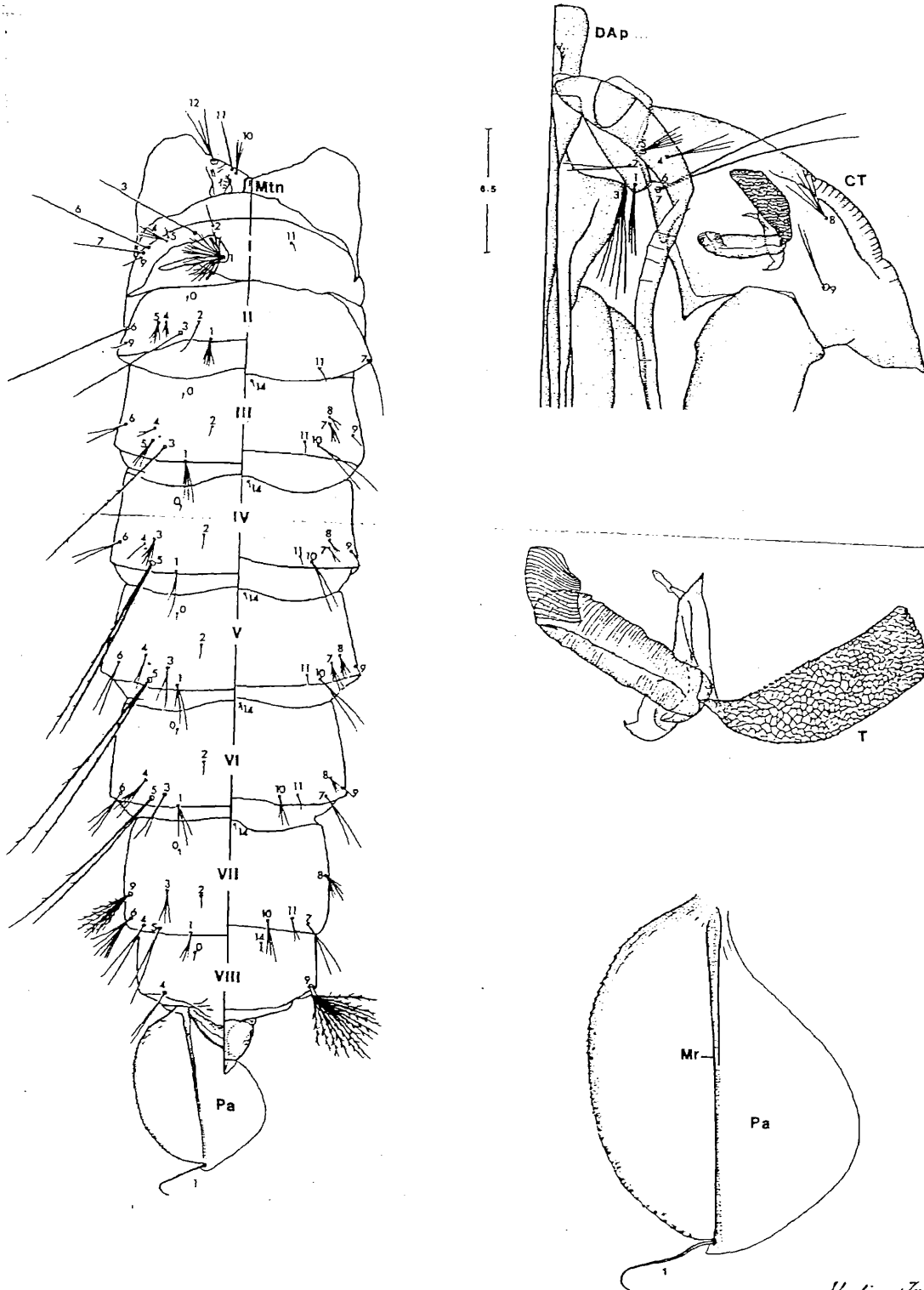


Fig. 3. Pupa of *Ayurakitia griffithi* showing positions and development of setae and structures. Abbreviations used: CT, cephalothorax; DAp, dorsal apotome; I-VIII, abdominal segments I-VIII; Mr, midrib; Mtn, metanotum; Pa, paddle; T, respiratory trumpet. Scale in mm.

*Shuling Jiang*

simple setae; mesal surface membranous; lateral and ventral surfaces with numerous broad scales. *Gonostylus*: Attached to apex of gonocoxite; large; mitten-shaped and consisting of long narrow, mesal, thumblike process bearing short, stout, sharply recurved gonostylar claw apically, and a 2nd outer, broad, apically rounded process bearing numerous thin setae and long hairlike spicules. *Basal mesal lobe*: Distal portion narrow, free of mesal membrane of gonocoxite, bearing 1 long and 1 moderately long, relatively thin, simple setae and several short fine setae; proximal portion attached to mesal membrane of gonocoxite, connected with its mate by narrow, spiculate aedeagal guide. *Proctiger*: Paraproct heavily pigmented, bluntly rounded apically, cercal setae absent. *Phallosome*: Aedeagus divided into 2 moderately long, lateral plates bearing several long teeth along nearly entire length and with dorsal flap covering lateral and basal areas; paramere shorter than aedeagus length; basal piece relatively short, narrow and curved. *Sternum IX*: Large, with few short, thin setae posteromesally.

**Pupae.** *Cephalothorax*: Seta 4-CT longer than 5-CT length; 7-CT very long, stout, 2-branched; 6-CT short, thin; 9,12-CT each borne on tubercle; 11-CT situated very close to 10-CT, widely separated from 12-CT; seta 12-CT longer than 10,11-CT length. *Abdomen*: Seta 1-II-VII with very fine branches; 2-I-VII stout, single, 2-II long; 2-II laterad of 1-II and mesad of 3-II, 2-III-VII mesad of 1-III-VII; 3,6-I long, 6-I noticeably longer than 7-I; 3-II,III very long, stout; 3-VII displaced anteriorly; 5-IV-VI very long, stout, each equal to or exceeding combined length of following 2 abdominal terga; 6-I,II, 7-I single; 8-VII inserted far anteriorly, borne near midlength of segment VII; 9-VII noticeably anterior to 6-VII; 9-VII,VIII branched, stout, aciculate. *Paddle*: More or less elliptical in shape; midrib extending to apex; outer part lateral to midrib noticeably shorter than inner part; outer part terminating at level of seta 1-Pa whereas inner part extends beyond level of seta 1-Pa; without fringe of long hairlike spicules on both outer and inner parts; seta 1-Pa single, long, stout, hooklike, attached to midrib just distad to shorter, outer part of paddle.

**Fourth-stage larvae.** *Head*: Seta 1-C long, moderately stout, single; 4-7-C fanlike, multiple branched, stout, aciculate, 5-7-C moderately long to long, 4-C moderately long but slightly shorter than 5-7-C; 4-C inserted mesad and posterior to 6-C and mesad and anterior to 5-C, 4-C approximately equal distance from 5-C and 6-C, 5-C in line posterior to 6-C, 6-C with all branches approximately equal in length, alveoli of 4-6-C form an

equilateral triangle with 4-C at apex; 7-C laterad of 4-6-C and nearly at same level as 4-C; 8-C inserted noticeably mesad of frontal ecdysial line whereas 9-C located very near frontal ecdysial line and is multiple branched; 13-C multiple branched, located anterolateral to 12-C; 15-C short, thin, with 2,3 branches; labiogula very short; hypostomal suture connected with collar; posterior tentorial pit borne posteriorly at level of collar; collar very narrow. *Antenna*: Long, narrow, curved mesad, lightly pigmented, with numerous small stout spicules on most of length; seta 1-A multiple branched, aciculate. *Thorax*: Seta 0-P multiple branched, well developed, posterolaterad of 4-P; 2-P single, longer than 1,3-P, which are multiple branched; 5,6-P very long; 3-M long, aciculate, single; 6-T single. *Abdomen*: Seta 2-I-VII multiple branched, inserted far anteriorly; 2-VIII single, noticeably longer than 1-VIII; 3-I-VI moderately long to long, single, noticeably longer than 4-I-VI; 3-VII multiple branched, inserted noticeably anterior to 1,4,5-VII and about at level of 8-VII; 5-I-VI multiple branched, inserted noticeably anterior to 3,4,6-I-VI; 6-I-VI long, stout, aciculate, branched; 12-I absent; comb consisting of 19-36 scales arranged in 2 curved rows, posterior row shorter and with few scales; saddle incompletely rings segment X, acus absent, covered with small spicules, numerous long stout spicules along posterior margin both dorsal and ventral to seta 1-X; 1-X very long, greater than 2.8 times dorsal length of saddle, aciculate; 4-X consisting of 2-4 short, single or occasionally 2-branched setae anteriorly and 4-6 very long, 2-4 branched setae posteriorly; grid weakly developed. *Siphon*: Distal half strongly tapered and very heavily pigmented; acus absent; pecten with several (5-12) evenly spaced spines; seta 1-S inserted near midlength distad of pecten, with very long stout aciculate branches (greater than 0.8 length of siphon); 2-S short, stout, with pointed distal portion curved cephalad; 6-S short; 8-S moderately long; 9-S short, hooklike.

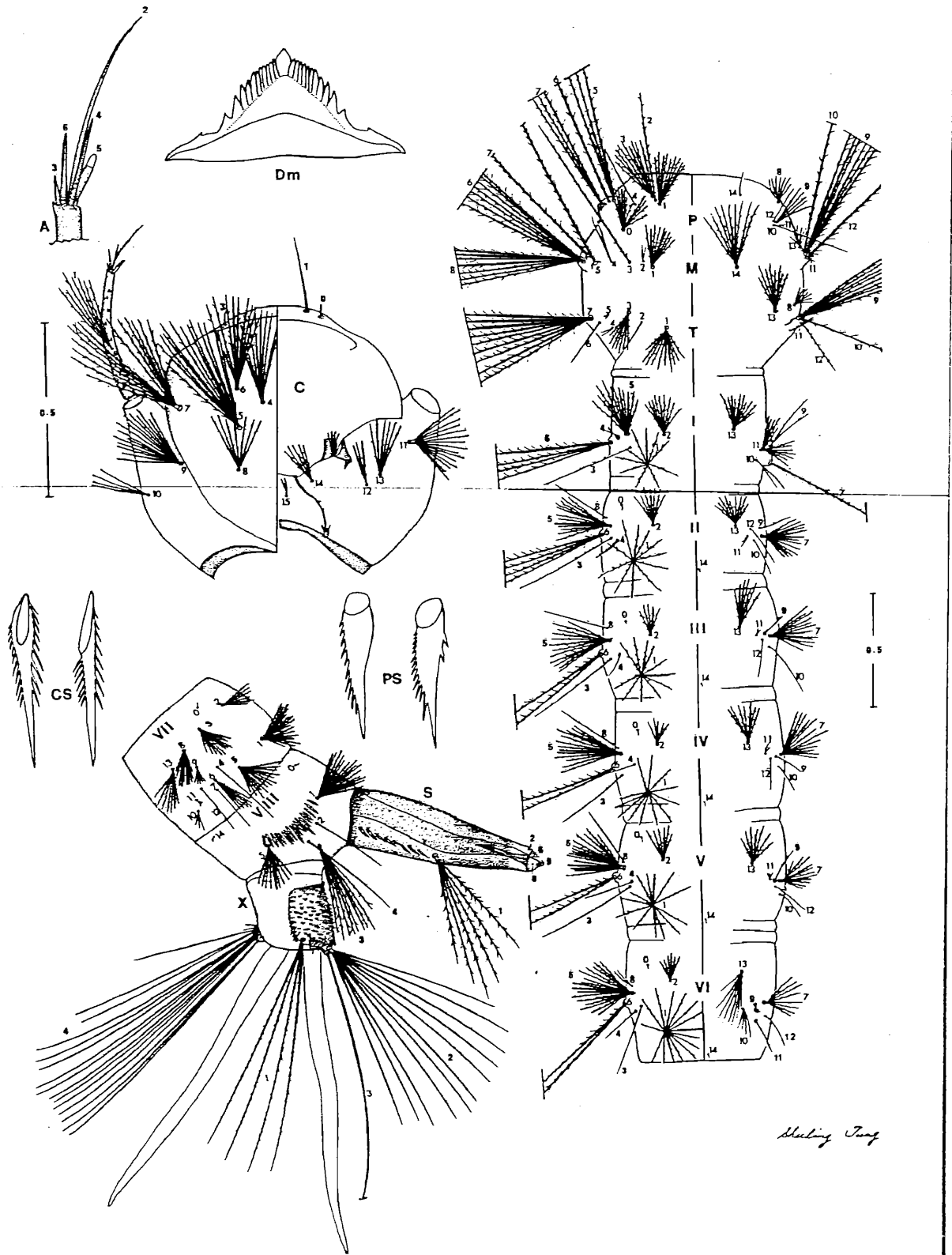
**Eggs.** Unknown.

**Distribution.** Reported from Chiang Mai Province, Kanchanaburi Province, Nakon Si Thammarat Province, Phangnga Province, and Ranong Province, Thailand (Thurman 1954, Thurman 1959, Reinert 1972) and Yunnan Province, China (Gong 1985, Lu et al. 1988, Lu 1997). Lu (1997) also lists Malaysia and Myanmar, but does not provide collection localities.

**Bionomics.** Immature stages have been collected from freshwater in the axils of bananas and *Pandanus*, and bamboo stumps and internodes (Reinert 1972, Rattanarithikul 1982, Gong 1985, Lu 1997).

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Fig. 4. Fourth-stage larva of *Ayurakitia griffithi* showing positions and development of setae and structures. Abbreviations used: A, antenna; C, cranium; CS, comb scale; Dm, dorsomentum; I-VIII, X, abdominal segments I-VIII; X, M, mesothorax; P, prothorax; PS, pecten spine; S, siphon; T, metathorax. Scale in mm.



Adults have been taken resting on trunks of trees and vegetation in jungle valleys located in mountainous areas.

**Discussion.** Adults of *Ayurakitia* lack postspiracular setae, which readily distinguish them from adults of genus *Aedes*, except *Ae. (Kompia) purpleipes* Aitken in which I consider the absence of setae to be a reversal. Posttarsus II with 2 unequal, simple ungues of *Ayurakitia* males occurs elsewhere in Aedini in *Ae. (Belkinius) aurotaeniatus* Edwards and *Ae. (Leptosomatomyia) aurimargo* Edwards; however, the latter 2 species also have posttarsi I and III simple.

In male genitalia of *Ayurakitia*, the gonostylus is uniquely shaped, but this structure bears a superficial resemblance to some species of *Aedes* in subgenus *Aedimorphus* Theobald (e.g., *Ae. nigrostriatus* (Barraud), *Ae. pallidostris* (Theobald), *Ae. pipersalatus* (Giles), *Ae. taeniorhynchoides* (Christophers)). However, upon closer examination the 2 groups are very different, that is, species of *Aedimorphus* have the mesal process broad, truncate, and with a differently shaped gonostylar claw, and the outer process is narrow and bears a very short, fine, seta apically. The development of tergum IX (see above) seems to be unique for the tribe.

Female genitalia of *Ayurakitia* have tergum VIII large and nearly covered with large, broad scales, a feature that is unique among Aedini. A tongue-like insula bearing a few well-developed setae is also unusual for Aedini; however, a somewhat similarly developed insula bearing seta is found in genus *Haemagogus* Williston and genus *Psorophora* Robineau-Desvoiy. The postgenital lobe with a very deep median apical emargination is another unusual feature for the tribe; however, a somewhat similarly developed postgenital lobe occurs in *Ae. (Blk.) aurotaeniatus* and some species of subgenus *Aedimorphus*.

Pupae of *Ayurakitia* are unique in the development of the paddle (i.e., outer part is noticeably shorter than the inner part, and seta 1-Pa is single, stout, hooklike, and attached to the midrib at the apex of the shorter outer part of the paddle). The paddle is without long hairlike spicules along both the outer and inner margins, which distinguishes *Ayurakitia* from genera *Armigeres* Theobald, *Eretmapodites* Theobald, *Heizmannia* Ludlow, *Udaya* Thurman, *Zeugomyia* Leicester, and *Aedes* subgenera *Abraedes* Zavortink, *Belkinius* Reinert, some *Diceromyia* Theobald, *Lorrainea* Belkin, some *Stegomyia* Theobald, and *Ae. meronephada* (Dyar and Shannon). Setae 7-CT is 2-branched and very long (approximately equal to the width of abdominal segment VIII), which is unusual in Aedini; however, seta 7-CT is very long, but single, in *Ae. (Christophersomyia) annulirostris* (Theobald), *Ae. (Chr.) gombakensis* Mattingly, and *Ae. (Chr.) ibis* Barraud, and with 3-6 (rarely with 2) branches in *Ae. (Chr.) thomsoni* (Theobald).

Fourth-stage larvae of *Ayurakitia* are unique

within Aedini in the development and placement of setae 4-7-C, which are fanlike, multiple branched, stout, aciculate, moderately long to long, and with the alveoli of setae 4-6-C forming an equilateral triangle. Some species of genera *Haemagogus* and *Heizmannia*, and *Aedes* subgenera *Finlaya* Theobald, *Howardinia* Theobald, *Ochleroiatus* Lynch Arribalzaga, and *Protomacleaya* Theobald, have some of setae 4-7-C developed as above, but not all of them, and they are not in the above positions. Seta 4-C being fanlike and with multiple, long, stout, aciculate branches is unusual in the tribe. Seta 5-I-VI in *Ayurakitia* being multiple branched and inserted noticeably anterior to setae 3,4,6-I-VI is also unusual for Aedini, occurring elsewhere only in the Kochi Group of *Finlaya* and *Ae. meronephada*. For *Ayurakitia*, setae 3-5-I-VII have been reevaluated and are interpreted differently here than previously. The unusual occurrence of seta 8-C inserted noticeably mesad of the frontal ecdysial line was noted elsewhere within Aedini in *Psorophora* (*Psorophora*) *ciliata* (Fabricius) and *Ps. (Pso.) howardii* Coquillett. The development of the ventral brush (seta 4-X) is very unusual, if not unique, in genus *Ayurakitia*. All available specimens of larvae had some abdominal segments partially damaged.

Numerous other features mentioned in the description of genus *Ayurakitia* can be used in combination to separate the life stages from those of other genera of the tribe and subgenera of genus *Aedes*.

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