

TEWARIUS REINERT, A NEW GENUS OF AEDINI (DIPTERA: CULICIDAE)

JOHN F. REINERT

Center for Medical, Agricultural and Veterinary Entomology (CMAVE), United States Department of Agriculture, Agricultural Research Service, 1600/1700 SW 23rd Drive, Gainesville, FL 32608-1067, U.S.A., and collaborator Walter Reed Biosystematics Unit (WRBU), National Museum of Natural History, Smithsonian Institution, Washington, DC (e-mail: jreinert@gainesville.usda.ufl.edu)

Abstract.—A new genus, *Tewarius Reinert*, is described in tribe Aedini and the primary diagnostic characters of females, female genitalia, males, male genitalia, pupae, and fourth-instar larvae are provided. Four species are included in the genus: *Tewarius agastyai* (Tewari and Hiriyan) (type species), *Te. nummatus* (Edwards), *Te. pseudonummatus* (Reinert), and *Te. reubenae* (Tewari and Hiriyan). Two species groups are designated, the Agastyai and Nummatus Groups.

Key Words: mosquito, Diptera, Culicidae, Aedini, *Tewarius*, new genus

Edwards (1923) described *Aedes nummatus* as a new species and placed it in subgenus *Aedimorphus* Theobald, but indicated it was an extremely distinct species and strikingly different from all other species of the subgenus. His description was based on only adult habitus characters. Edwards (1932) later included *Ae. nummatus* in the monotypic group B (*nummatus*-group) of *Aedimorphus*. Barraud (1928, 1934) also included *Ae. nummatus* in subgenus *Aedimorphus* and stressed it was an aberrant species in markings and structure, and differed in many features from all others of the subgenus. He also provided partial illustrations and brief descriptions of the male genitalia and the damaged larval exuviae. Reinert (1973) redescribed and illustrated all known stages of *Ae. nummatus*, and those of a new species, *Ae. pseudonummatus*, and transferred them to subgenus *Diceromyia* Theobald, but in a separate species group. He provided a comparison of morphological

features of the known stages and their structures with subgenera *Aedimorphus* and *Stegomyia* Theobald. Tewari and Hiriyan (1992) described and illustrated two new species, *Ae. (Dic.) agastyai* and *Ae. (Dic.) reubenae*, of this group. In this important paper they described and illustrated the pupal and fourth-instar larval stages in detail, as well as the adults and genitalia, revealing numerous important morphological characters of the pupa and fourth-instar larva for the first time.

After evaluation of all known life stages of the four species mentioned above, and a comparison with other genera of tribe Aedini, it is obvious that they do not belong in any known aedine genus (see Reinert et al. 2004). They are, therefore, transferred to a new genus, *Tewarius*, which is described below. *Tewarius* is masculine and named in honor of Satish C. Tewari, Centre for Research in Medical Entomology, Tamil Nadu, India. The proposed two-letter

abbreviation for *Tewarius* is *Te*. The morphological terminology used follows Harbach and Knight (1980, 1982), except for terms proposed by Reinert (1990, 1999, 2000). The classification of Aedini proposed by Reinert et al. (2004) is used.

***Tewarius* Reinert, new genus**

Type species: *Aedes agastyai* Tewari and Hiriyani, 1992

Previous usage.—*Aedes* (*Aedimorphus*) of Edwards (1923), in part of Barraud (1928, 1934), Stone et al. (1959); *Aedes* (*Aedimorphus*) Group B (*nummatus*-group) of Edwards (1932); *Aedes* (*Diceromyia*) in part of Reinert (1973), Knight and Stone (1977), Kaur (2003); and *Aedes* (*Diceromyia*) *nummatus* group of Tewari and Hiriyani (1992).

Females.—*Head*: Vertex with broad, decumbent scales; occiput with several erect, forked scales; ocular line narrow, with broad, pale scales; interocular space with 2 long setae; eyes contiguous above antennal pedicels; clypeus bare; antennal pedicel with several broad scales and short, fine setae on mesal surface; maxillary palpus 0.19–0.22 length of proboscis, dark-scaled; proboscis 0.78–1.10 length of forefemur, dark-scaled. *Thorax*: Scutum with dark integument, covered with narrow, curved, decumbent scales except bare prescutellar area, scales dark except for large white-scaled patch covering most of anterior approximately 0.50, similar white scales on lateral margins of prescutellar area mesal to setae in *Te. agastyai* and *Te. reubena*; dorsocentral setae present (few anterior and few posterior); acrostichal setae absent; setae few on antalar area, numerous on supraalar area and several on prescutellar area; scutellum trilobed, broad scales on midlobe, lateral lobes with either broad or narrow, curved scales; anteppronota widely separated, with scales and several setae; postpronotum with narrow, curved scales dorsally

and few broad scales ventrally, few posterior setae; upper proepisternum with broad, white scales, 4–10 setae; lower proepisternum bare; postspiracular area with broad, white scales, 2–5 setae; subspiracular area normally with few, broad, white scales (none seen in *Te. nummatus*); mesokatepisternum with large patch of broad, white scales extending from upper area over posterior area (small break at about middle of patch in *Te. reubena*), few upper and numerous posterior setae; paratergite narrow, with broad, white scales (*Te. agastyai* and *Te. reubena*) or bare (*Te. nummatus* and *Te. pseudonummatus*); prealar area with broad, white scales on lower area (*Te. agastyai* and *Te. reubena*) or without scales (*Te. nummatus* and *Te. pseudonummatus*), upper area with 5–16 setae; mesepimeron with patch of broad, white scales on upper area, several setae on posterodorsal area, lower setae absent; metameron bare. *Legs*: Fore-, mid-, and hindcoxae with patch of broad, pale scales, several setae; fore- and midfemora with anterior surface dark-scaled with basal pale-scaled area, posterior surface mainly white-scaled with dark-scaled areas; hindfemur mainly white-scaled but with distal part of dorsal margins of anterior and posterior surfaces dark-scaled; tibiae dark-scaled or with pale-scaled areas on posterior surfaces; tarsi dark-scaled or with pale-scaled areas on posterior surfaces of some tarsomeres; posttarsi each with 2 equal ungues, fore- and midungues each with one tooth, hindungues simple. *Wing*: Veins dark-scaled (*Te. pseudonummatus* with small white-scaled patch at base of costa); upper calypter with numerous setae on posterior margin; alula with narrow scales on margin. *Abdomen*: Terga I–VII each dark-scaled with white-scaled patch basolaterally. *Genitalia*: Tergum VIII with base and apex slightly concave, numerous broad scales on much of surface, several long,

stout setae on apical margin, setae on distal 0.35–0.42; sternum VIII with base slightly concave, apex with small, median emargination separating small lobe on each side of midline, numerous scales and setae covering most of surface; tergum IX relatively short, apex with small, median emargination, 3–11 setae distally on each side of midline, index 0.56–0.72; insula tongue-like, long, with 1 or 2 small tuberculi on distal 0.20; upper vaginal lip narrow, sclerite large; lower vaginal lip narrow, without sclerite; postgenital lobe moderately long, moderately broad, apex rounded, several setae distally; cercus short, moderately wide, apex rounded with few long, stout setae on margin, dorsal surface with several broad scales; 3 spermathecal capsules, one slightly larger than others.

Males.—*Head:* Antenna with whorls containing numerous long setae directed dorsally and ventrally, apical 2 flagellomeres disproportionately long compared to others; maxillary palpus 5-segmented, approximately 0.42–0.50 length of proboscis, slender throughout, palpomere 5 short, very few relatively short setae on distal palpomeres, palpomere 5 also with 2 or 3 longer setae; proboscis long, slender. *Legs:* Fore- and midtarsi with ungues unequal, each with one tooth; hindtarsus with ungues equal, simple. *Genitalia:* Tergum IX with broad lobe on each side of midline of posterior margin, each lobe bearing 4–11 moderately long, slender setae; gonocoxite short, moderately wide, broad scales on lateral and ventral surfaces and outer part of dorsal surface, dorsal surface without apical and basal lobes, with several long, stout setae on outer margin for most of length and numerous moderately long, slender setae especially on proximal part of mesal area, ventral surface with short, slender setae; gonostylus attached to apex of gonocoxite, proximal part broad, forked near midlength into 2 narrow, slightly curved arms, lateral arm with

one minute, slender, seta at apex, mesal arm with one short, dark, stout, bluntly pointed gonostylar claw at apex; claspette comprised of narrow, basal setose plaque bearing 1 or 2 short, dark, stout setae apically and few, short, slender setae subapically, basal plaque connected with its mate by narrow, spiculate aedeagal guide; proctiger moderately long, paraproct moderately to heavily pigmented, with 3 bluntly pointed teeth apically, without cercal setae; phallosome with aedeagus comprised of 2 lateral sclerites each bearing numerous elongate, curved, pointed, caudally directed teeth, paramere moderately long and narrow; sternum IX moderately long, with 2–4 setae on caudomesal area.

Pupae.—*Cephalothorax:* Seta 3-CT single to 2-branched, very long, noticeably longer than 1-CT; 2-CT branched, short; 5-CT noticeably longer than 4-CT; 6-CT short; 7-CT single to 5-branched, long; 10,12-CT branched; 11-CT single. *Trumpet:* Moderately long; pinna moderately wide; tracheoid area weakly developed. *Abdomen:* Seta 3-I single, very long, noticeably longer than 6,7-I; 1-II–IV branched, slender; 2-II single, relatively long, inserted lateral to 1-II and slightly mesal to 3-II; 3-II,III single, noticeably longer than following terga; 5-II inserted lateral to 4-II; 6-II single, very long but shorter than 3-II; 5-IV–VI very long, single, each longer than combined length of following 2 terga; 6-V longer than 6-III,IV,VI; 2-VI noticeably mesal to 1,3-VI; 6-VII branched, shorter than and inserted posterior to 9-VII; 9-VII branched, aciculate, normally 1 or 2 branches noticeably longer than others, inserted on posterolateral corner of segment. *Paddle:* Ovoid, apex sharply rounded, midrib extends to near apex; hairlike, marginal spicules absent; seta 1-Pa single (rarely forked at tip), very long, about length of paddle.

Fourth-instar larvae.—*Head:* Seta 1-C single, long, slender, attenuate; 4-6-C

inserted close together, points of insertion forming a small triangle; 4-C short, branched, inserted mesal and slightly posterior to 6-C; 5-C long, with 2-5 aciculate branches, inserted posterolateral to 4-C, posteromesal to 6,7-C; 6-C single (rarely 2-branched), very long (noticeably longer than dorsal apotome), inserted lateral to 4,5-C and slightly posteromesal to 7-C; 7-C branched, aciculate, moderately long; 13-C branched, inserted lateral to 12-C; 14-C single. *Antenna*: Long; with few small spicules, primarily on proximal 0.50; seta 1-A with 2 or 3 attenuate branches; 2,4-A both long, approximately equal in length. *Mouthparts*: Dorsomentum long and relatively narrow, with several teeth. *Thorax*: Seta 1,3-P branched, shorter than 2-P; 2-P single; 4,5,7,8-P branched; 6-P single; 1,4-M, 1,2,6-T branched; 13-T branched, long. *Abdomen*: Setae 1-I-III branched, slender; 3-I,II branched; 6-I-III branched, long, 6-I,II aciculate, 6-II shorter than 6-III; 7-I branched, long; 7,8-II branched, short; 13-III-V branched; 1-VII single, long; 3,7,10,12-VII and 2,4-VIII branched; comb with 20-32 scales; saddle incomplete ventrally; 1-X branched, short, inserted on saddle; 2,3-X long, single (2-X occasionally 2-branched in *Te. nummatus*); ventral brush (4-X) with several long, multiple-branched setae with short stems attached to grid with transverse bars, 2 or 3 short, branched, precatal setae. *Siphon*: Pecten comprised of numerous, long, slender, slightly curved, evenly spaced spines with tiny spicules on ventral margin from base to near apex; seta 1-S multiple-branched, inserted distal to pecten; 6,8-S short.

Eggs.—Unknown for all species.

Included species (known stages in parentheses).—*Tewarius agastyai* (female, male, pupa and larva), *Te. nummatus* (female, male, and larva), *Te. pseudonummatus* (female) and *Te. reubenae* (female, male, pupa, and larva).

Distribution.—Known species have been reported from the Oriental Region, i.e., *Te. agastyai* and *Te. reubenae* from Western Ghats, India, *Te. nummatus* from Assam, India, and *Te. pseudonummatus* from Chiangmai, Thailand.

Bionomics.—Immature stages have been collected from treeholes, bamboo stumps, cut bamboo, and once from a broken bottle in the jungle. *Tewarius agastyai* immatures were collected in natural forest in high rainfall areas at elevations ranging from 350 to 750 m whereas *Te. reubenae* immatures were collected in wet evergreen forests at elevations ranging from 850 to 1,600 m (Tewari and Hiriyan, 1992).

Diagnosis and discussion.—See Tewari and Hiriyan (1992) for descriptions and illustrations of the female, female genitalia, male, male genitalia, pupa, and fourth-instar larva of the type species, *Te. agastyai*. Pupal setae in their fig. 4 are corrected as listed: 1-CT = 5-CT; 2-CT = 1-CT; and 5-CT = 2-CT. These authors also provide a key to the four species I include in *Tewarius*.

The most distinctive characters of each life stage of genus *Tewarius* follow. *Females*: Head with vertex covered with broad, decumbent scales, erect forked scales restricted to occiput; eyes contiguous; maxillary palpus and proboscis dark-scaled; scutum with large, white-scaled patch covering most of anterior approximately 0.50; supraalar area dark-scaled; acrostichal setae absent; dorso-central setae present; scutellum with broad scales on midlobe; mesokatepisternum with one large patch of broad, white scales extending from upper area over posterior area (rarely with small break in patch at about midlength); mesepimeron without lower setae; fore- and midungues equal, each with one tooth, hindungues equal, simple; tergum VIII and sternum VIII each with numerous broad scales; insula tongue-like with 1 or 2 small tuberculi on distal 0.20;

upper vaginal sclerite large; cercus short, apex rounded, with several broad scales on dorsal surface; and 3 spermathecal capsules. *Males*: Maxillary palpus 5-segmented, approximately 0.42–0.50 length of proboscis, slender throughout, with few setae; fore- and midtarsi with unguis unequal, each with one tooth, hindtarsus with unguis equal, simple; posterior margin of tergum IX with broad lobe on each side of midline bearing several, moderately long, slender setae; gonocoxite short, without apical and basal lobes on mesal margin of dorsal surface; gonostylus forked near midlength into 2 narrow arms, lateral arm with minute seta apically, mesal arm with short, stout, bluntly pointed gonostylar claw apically; claspette comprised of basal setose plaque bearing 1 or 2 short, stout setae apically and several short, slender setae subapically; cercal setae absent; and aedeagus comprised of 2 lateral sclerites bearing numerous elongate teeth. *Pupae*: Seta 3-CT single or 2-branched, very long, noticeably longer than 1-CT; 3-I single, very long, noticeably longer than 6-I; 3-II,III single, noticeably longer than following terga; 6-II single, very long but shorter than 3-II; 5-IV–VI single, very long, each longer than combined length of following 2 terga; and paddle ovoid, apex sharply rounded, hairlike spicules on margin absent, seta 1-Pa single (rarely forked at tip), very long, about length of paddle. *Fourth-instar larvae*: Seta 1-C single, long, slender, attenuate; 4-C short, branched, inserted mesal and slightly posterior to 6-C; 5-C long, with 2–5 aciculate branches, inserted posterolateral to 4-C and posteromesal to 6,7-C; 6-C single (rarely 2-branched), very long (noticeably longer than dorsal apotome), inserted lateral to 4,5-C and slightly posteromesal to 7-C; 13-C branched; antennal shaft with few small spicules; setae 2,4-A both long; 1,3-P branched, shorter than 2-P; 4-M, 6-T branched; 13-

T branched, long; 6-II shorter than 6-III; 1-VII single, long; 2,4-VIII branched; comb with 20–32 scales; saddle incomplete ventrally; ventral brush comprised of several, multiple-branched, long setae with short stems attached to grid with well developed transverse bars and 2 or 3 short precratal setae; setae 2,3-X both single (2-X occasionally 2-branched), long; pecten comprised of numerous, long, slender, slightly curved, evenly spaced spines with tiny spicules on ventral margin from base to near apex; and seta 1-S multiple-branched, inserted distal to pecten.

The large patch of white scales on the anterior half of the scutum is somewhat similar to species of the *Gubernatoris* Group of *Finlaya s.l.* Theobald from the Oriental Region. Another *Finlaya s.l.* species, *gilli* (Barraud), also has the anterior half of the scutum pale-scaled. These species differ in numerous features of the adult habitus, female and male genitalia, and immature stages from *Tewarius*. Especially different are characters of the male genitalia, e.g., development of the gonostylus (long, narrow, curved), claspette (columnar stem with long claspette filament at apex), aedeagus (tubelike without teeth) and proctiger (with cercal setae), and female genitalia, e.g., insula (liplike with setae laterally). Pupae of *Finlaya gilli* also have seta 1-Pa very long and single but are easily separated from pupae of *Tewarius* by having seta 6-VII inserted anteromesal to seta 9-VII and seta 9-VIII inserted far anterior to the posterolateral corner of segment VII. The larvae differ having a short seta 1-C with blunt apex, setae 5,6-C both single and very long, and seta 2-X multiple-branched and noticeably shorter than seta 3-X.

The forked gonostylus of *Tewarius* is somewhat similar to some Afrotropical species of *Diceromyia*, however, these species have the inner branch of the gonostylus much shorter than the outer branch and the gonocoxite of most of

these species also has a patch of long, broad, fusiform scales distally on the mesal margin of the ventral surface.

The moderately long and thin male maxillary palpus somewhat resembles those of some *Scutomyia* Theobald, e.g., *Sc. albolineatas* (Theobald) and *Sc. platylepida* (Knight and Hull). However, males of *Tewarius* differ in a number of important adult habitus, genital, pupal, and larval characters from *Scutomyia*.

Species of *Tewarius* can be separated into two groups, Agastyai Group containing *Te. agastyai* and *Te. reubenae* and the Nummatus Group containing *Te. nummatus* and *Te. pseudonummatus*. Only adult female characters are used for distinguishing the two groups since the male and immature stages are not known for *Te. pseudonummatus* and only two damaged larval exuviae are known for *Te. nummatus*. Also, the pupa is unknown for the latter species. Females of the Agastyai Group have the prescutellar area with narrow, curved, white scales on lateral margins mesal to setae, paratergite with broad, white scales, upper proepisternum with 4 or 5 setae, and lower prealar area with broad, white scales. Females of the Nummatus Group have the prescutellar area with narrow, curved, dark scales on lateral margins mesal to setae, paratergite bare, upper proepisternum with 9 or 10 setae, and lower prealar area bare.

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