

Contributions
of the
American Entomological Institute

Volume 14, Number 1, 1977



MEDICAL ENTOMOLOGY STUDIES.

- VII. THE SUBGENUS *STEGOMYIA* OF *AEDES*
IN SOUTHEAST ASIA.
II - THE *EDWARDSI* GROUP OF SPECIES.
III - THE *W-ALBUS* GROUP OF SPECIES.
(DIPTERA: CULICIDAE).
- VIII. NOTES ON THE TAXONOMIC STATUS OF
AEDES VITTATUS.
(DIPTERA: CULICIDAE).

by

Yiau-Min Huang

CONTENTS

ABSTRACT.	113
INTRODUCTION	113
<i>Aedes (Aedimorphus) vittatus</i> (Bigot)	114
ACKNOWLEDGEMENTS.	121
LITERATURE CITED	122
LIST OF FIGURES.	124
FIGURES.	125
INDEX	132

MEDICAL ENTOMOLOGY STUDIES - VIII.

NOTES ON THE TAXONOMIC STATUS OF *Aedes vittatus*
(DIPTERA: CULICIDAE)¹.

By

Yiau-Min Huang²

ABSTRACT

Aedes vittatus (Bigot) heretofore placed in the subgenus *Stegomyia* Theobald is transferred to the subgenus *Aedimorphus* Theobald. This conclusion was reached after a critical study and consideration of all known stages. Both sexes, larva and pupa of this species are redescribed, illustrated and its affinity is discussed.

INTRODUCTION

Edwards (1932) divided the subgenus *Stegomyia* Theobald of *Aedes* into 4 groups which he designated A, B, C and D, and placed *Aedes vittatus* (Bigot) in "Group D," a monotypic species group. Barraud (1934), Hopkins (1952), Mattingly (1965) and Service (1970) also placed it in the subgenus *Stegomyia* and considered it as an atypical or aberrant species of *Stegomyia*. After a critical study of both adults and the immature stages I believe that it is not a *Stegomyia* and should be removed from this subgenus. It shows a close resemblance to the subgenus *Aedimorphus* Theobald of *Aedes*, particularly with some rather basic genitalic characters in common with the *vexans* group of the subgenus *Aedimorphus*. Therefore, I am placing it in this subgenus.

The nomenclature for the chaetotaxy of the larva and pupa and the terminology of the structural parts of the adult as used in this paper largely follows Belkin (1962).

¹This work was supported by Research Contract No. DA-49-193-MD-2672 and DAMD-17-74C-4086 from the U. S. Army Medical Research and Development Command, Office of the Surgeon General, Washington, D. C.

²Medical Entomology Project, Department of Entomology, Smithsonian Institution, Washington, D. C. 20560.

Aedes (Aedimorphus) vittatus (Bigot)
(Figs. 1A; 2B, C; 3; 4; 5; 6)

Culex vittatus Bigot 1861: 227 (♀).

Stegomyia sugens Theobald (nec Wiedemann) 1901: 300; Edwards 1912: 9
(synonymized *Scutomyia sugens*, *Stegomyia brumpti* and *Reedomyia albopunctata*).

Scutomyia sugens Theobald 1905: 19.

Stegomyia brumpti Neveu-Lemaire 1905: 9 (♂, ♀*).

Reedomyia albopunctata Theobald 1907: 262 (♀).

Stegomyia vittata (Bigot), Edwards 1917: 210 (synonymized *Culex vittatus*,
Stegomyia sugens, *Stegomyia brumpti* and *Reedomyia albopunctata*);
Barraud 1923: 777 (♂*, ♀); Borel 1928: 77 (♂*, ♀, L*).

Aedes (Stegomyia) vittatus (Bigot), Edwards 1925: 265; Edwards 1932: 161; Barraud 1934: 245 (♂*, ♀*, L*); Edwards 1941: 155 (♂*, ♀*), 391 (P*); Hopkins 1952: 160 (L*); Mattingly 1952: 255, 291 (zoogeography); Senevet and Andarelli 1954: 320 (L*); Mattingly and Knight 1956: 93, 100 (L*; taxonomy); Senevet and Andarelli 1958: 273 (P*); Mattingly 1965: 53 (♂*, ♀*, P*, L*); Service 1970: 129 (♂*, ♀*, P*, L*; biology and taxonomy).

MALE (Fig. 1A). *Head*. Proboscis dark scaled, without pale scales on ventral side, as long as forefemur; palpus dark, distinctly longer than proboscis, with white basal band on each of segments 2-5; segments 4, 5 subequal, slender, upturned and with a few short setae; segment 4 with some distinct long bristles along ventral-lateral sides as well; antenna plumose, shorter than proboscis; clypeus bare; torus covered with white scales on inner and outer sides; decumbent scales of vertex largely broad and flat; erect forked scales dark, not restricted to occiput; vertex with a median stripe of broad white scales mixed with a few narrow white ones, with broad dark ones on each side interrupted by a lateral stripe of broad white scales followed by a patch of white broad scales ventrally; a few narrow white scales scattered on occiput area and a few broad white scales on eye margin. *Thorax*. Scutum with narrow dark scales and 3 pairs of prominent small white spots of narrow scales on anterior 0.67 of scutum (on fossal area, posterior fossal area and on about the level of wing root); the anterior 2 pairs of white spots usually larger than the posterior pair; some narrow white scales on anterior promontory and a few narrow white ones on scutal angle area; a patch of broad white scales on lateral margin just before level of wing root and some narrow white ones dorsally; a few narrow white scales on posterior portion of supra-alar area; prescutellar space surrounded by narrow white scales and a few narrow white scales on posterior dorsocentral area; acrostichal and dorsocentral setae present; scutellum with broad white scales on all lobes and with a few broad dark ones at the apex of midlobe; postnotum bare; anterior pronotum with broad white scales, sometimes with a few dark ones towards midline; posterior pronotum with broad white scales mixed with a few narrow white ones above and with some broad and narrow dark scales dorsally; spiracular setae absent; postspiracular setae present; paratergite without or with a few broad white scales; patches of broad white scales on propleuron, on the postcoxal membrane, hypostigial, subspiracular, postspiracular and prealar areas, on the upper and lower portions of sternopleuron and on the upper portion of mesepimeron; upper sternopleural scale patch does not reach to anterior corner of sternopleuron; lower mesepimeron with 2 (1-3) setae; metameron bare. *Wing*.

With dark scales on all veins except for a minute basal spot of white scales on costa; R_2 about equal to R_{2+3} . *Halter*. With pale scales. *Legs*. Coxae with patches of white scales; knee-spots present on all femora; all femora anteriorly dark with some white scales scattered, more so on mid- and hind- than on forefemur and each with a white band at about apical 0.25; all tibiae dark, each with a subbasal white spot and a white band at about basal 0.33 on fore- and mid- and at about 0.5 on hindtibia; fore- and midtarsi with basal white bands on tarsomeres 1-3; hindtarsus with basal white bands on tarsomeres 1-4; the ratio of length of white band to the total length of tarsomere is 0.40, 0.40, 0.50 and 0.75; tarsomere 5 all white or sometimes with a few dark scales on the apical ventral side; fore- and midlegs with tarsal claws unequal, all toothed; hindleg with tarsal claws equal, simple. *Abdomen*. Segment I with white scales on laterotergite; tergum I with a large median white spot; terga II-VII each with a basal white band and with lateral white curved markings which do not connect with the basal bands; sternum VIII largely covered with white scales. *Terminalia* (Fig. 3). Basimere elongate, about 3.5 times as long as wide, its scales restricted to lateral and ventral areas, with a patch of bristles on apicomeral area of ventral surface; claspette present, large, with spines along mesal edge, recurved setae on basal corner of expanded distal part, with some setae scattered on inner apical area and very fine setae on outer basal area; distimere irregular in shape, about 0.74 as long as basimere, greatly expanded apically, with numerous fine setae and some longer ones on dorsal side and with numerous spine-like setae on ventral side; a few setae near base of terminal appendage, which is a long, strongly curved spiniform process at the base of expanded distal part; aedeagus complex, rather small, widened subbasally, with several lateral teeth and about 4 apical curved ones on each side; paraprocts without teeth; cercal setae absent; tergum IX narrowed medially and with a distinct setose lobe on each side; tergum VIII rounded apically and with numerous long, stout bristles.

FEMALE. Essentially as in male, differing in the following respects: *Head* (Figs. 2A, B). Proboscis with pale yellowish scales occupying about middle 0.33-0.40; palpus 5-segmented, about 0.33 of proboscis, with white scales on less than apical half and with 2 or 3 white scales on the apex of 3rd segment, or sometimes with a few white scales on the base of 3rd segment as well, segment 5 small; antenna with some broad white scales on the inner side of first flagellomere; clypeus with a small patch of narrow white scales on each side; erect forked scales more numerous extending forward on to the vertex than in male; vertex with a median stripe of narrow white scales and with a few narrow white scales scattered on occiput area and on eye margin. *Thorax*. Anterior pronotum with broad white scales mixed with a few narrow white ones towards outside and with some broad and narrow dark scales towards midline; lower mesepimeron with 2-5 setae. *Wing*. With basal costal spot and a few pale scales scattered on costa and radius (R) veins; cell R_2 about 1.5 times as long as R_{2+3} . *Legs*. Fore- and midlegs with tarsal claws equal, all toothed. *Abdomen*. Segment VIII completely retracted. *Terminalia* (Figs. 4C, 6). Sternum VIII with deep notch at middle; insula longer than broad, with minute setae and with 6 (5-10) longer ones on apical 0.25-0.33; tergum IX with well developed lateral lobes and with 5-7 setae; post-genital plate rather narrow and small, sometimes with shallow notch; cerci long; 3 spermathecae, one slightly larger than the other 2.

PUPA (Figs. 4A, B). *Cephalothorax*. Trumpet short, about 3 times as long as wide in the middle; seta 1, 3-C usually single, longer than 2-C; 2-C usually single (1-2); 4-C single or 2-branched, longer than 5-C; 5-C with 2 or

3 branches; 6-C usually single (1-2), much shorter than 7-C; 7-C with 2 or 3 branches; 8-C at a short distance before the base of the trumpet; 10-C with 2-6 branches, mesad and caudad of 11-C; 11-C single, long, stout and barbed.

Abdomen. Seta 1-I well developed, with more than 10 branches, dendritic; 2-I single; 3-I single, long; 2, 3-I widely separated, distance between them twice the distance between 4, 5-I; 1-II well developed, usually with 8-14 branches; 1-III usually with 3 branches (3-4); 1-IV usually with 4 branches (3-5); 2-III-V mesad of 1, 3-III-V; 3-II, III single, or sometimes 3-II 2-branched, shorter than segment III; 5-IV-VI single, not reaching beyond the posterior margin of the following segment; 4-VII usually single, longer than 5-VII; 6-VI single, longer than 9-VI; 9-I-VI small, single; 9-VII, VIII strongly developed, branched; 9-VII usually with 3 branches (2-6) and barbed; 9-VIII usually with 6 branches (6-10) and barbed. *Paddle.* Oval, margins without hair-like fringe, with small, short spines on basal 0.8 of outer margin; inner margin very faint and without spines; seta 1-P single, strongly developed, thickened. Genital lobe with fine spicules laterally and apically.

LARVA (Fig. 5). *Head.* Antenna 0.5 length of head, with a few fine spicules; 1-A inserted on basal half of shaft, usually with 2-4 branches and barbed; inner mouth brushes pectinate at tip; seta 4-C very small, with 2-3 branches, closer to 6-C than 5-C, caudomesad of 6-C; 6-C single, stout; 4, 6-C at about level of antennal base; 5-C single, long and barbed, considerably caudad and slightly mesad of 6-C; 7-C with 4 or 5 branches and barbed; 8, 9 and 10-C single; 11-C with 3 branches; 12-C small, with 2 or 3 branches; 13, 14-C single; 15-C with 3 or 4 branches; mentum with 13-14 teeth on each side. *Thorax.* Seta 1-P single, long and barbed; 2-P single; 3-P double; 4-P single; 5, 6-P single, long and barbed; 7-P usually with 3 branches (2-3), long and barbed; 8-P with 2 or 3 branches, long and barbed; 9-P single; 11-P usually with 2 branches (1-2); 14-P double; 5, 7-M single, long and barbed; 6-M with 4-7 branches, long and barbed; 8-M usually with 6 branches, long and barbed; 9-M with 4-6 branches, long and barbed; 10 and 12-M single, long, stout and barbed; 11-M single, small; 7-T with 4-7 branches, long and barbed; 9-T usually with 3 branches (2-3), long and barbed; 10 and 11-T similar to those on mesothorax; 12-T single, much reduced. *Abdomen.* Seta 6-I-IV usually with 2 branches, long and barbed; 7-I, II usually with 2 branches (2-3), long and barbed; 6-V, VI single, long and barbed; 12-I not present; 5-II-V single, small; 13-III-V single; 1-VIII small, with 4-6 branches; 2-VIII distant from 1-VIII; 2, 4-VIII single; 3-VIII well developed, with 7-9 branches and barbed; 5-VIII much larger than 1-VIII, with 2-4 branches and barbed; comb of 6-10 (usually 8) scales in a single irregular row, each scale with fine denticles or fringes at base and with long apical spine. Saddle incomplete, without marginal spicules; 1-X single, short; 2-X with 5 branches; 3-X single, long; ventral brush (4-X) with 4 pairs of setae on grid, each with 3-7 branches; with 4 pre-cratal tufts, each with 5-9 branches; anal papillae long, about 4 times as long as saddle, slender and tapered. *Siphon.* Short, about 2 times as long as wide; acus present; 19-25 pecten teeth, the more proximal smaller, close-set, the distal one widely spaced, each tooth with 1-4 basal denticles; seta 1-S with 4-6 branches and barbed, inserted before last tooth and beyond middle of siphon.

TYPE-DATA. *Culex vittatus* Bigot, type-female, non-existent; type-locality: Corsica; *Stegomyia brumpti* Neveu-Lemaire, cotypes, male and female, non-existent; type-locality: Harrar, (Hararge), Ethiopia; *Reedomyia albopunctata* Theobald, type-female, in poor condition, in BMNH; type-locality: Sierra Leone (Major Smith).

DISTRIBUTION. 1,818 specimens examined: 612♂, 552♀, 60♂ terminalia,

38♀ terminalia, 56 L, 359 individual rearings (161 l, 339 p).

ADEN. (II-1895), 1♀; Hriotalon (Dr. Patton), 1♂, 3♀; Hinterland, 1♀; W. Aden Protectorate, Jebel Jihaf, 7, 100 ft (X-1937), 4♂, 4♀.

BOTSWANA. (BECHUANALAND PROTECTORATE), Kasane (1946, B. De M.), 1♂, 1♀.

CAMBODIA. *Kandal*: Oudong (VII-1968), 10♂, 5♀, 2♂ terminalia.

CAMEROON. (CAMEROONS), Yaoundé (J. Rageau) 1♂.

CHINA. *Hainan I.* - (1934), 6♂, 5♀.

ETHIOPIA. (ERITREA), Mt. Ramlu, 3, 000-4, 000 ft (II-1950, H. Merlin), 2♂.

FRANCE. *Corsica*: San Nicolao (VIII-1944), 5♂, 3♀; (X-1968, J. Mouchet), 2♂, 1♀; Ponte Leccia (X-1968, J. Mouchet), 6♂, 6♀, 2♂ terminalia, 4♀ terminalia; *Banyuls*, (IX-1952), 1♀.

GHANA. (GOLD COAST), Bole (1911, Dr. A. Ingram), 2♂, 1♀;

Sunyani, Ashanti (1915, Dr. A. Ingram), 1♀.

INDIA. (Christophers), 1♂, 2♀, 1♂ terminalia; (James), 3♂, 2♂ terminalia; (1910, Giles), 1♀; (1921), 1♂; 1♂, 1♀, 1♂ terminalia; *Bihar*: Darbhanga - Pusa (15-VII-13), 2♀; *Delhi*: (XII-1968, M. K. K. Pillai), 6♂, 1♀; *Kanara*: Karwar (Dr. H. Cogill), 3♂, 3♀; *Punjab*: Umballa (25-VIII-05, H. J. W. Borrow), 2♀; (VIII-1905), 1♀; Ambala (VIII-1923, P. J. Barraud), 2♂, 2♀; Pinjaur near Kalka (IX-1931, P. J. Barraud), 5♂, 1♀.

ITALY. *Sardinia*: Riopicocca (VII-VIII-47), 3♀; Sarrabus Ponte Picocca (VIII-1947), 1♀.

KENYA. Nairobi (VI-1935), 3♂, 5♀, 8 individual rearings (8 l, 8 p).

MALAWI. (NYASALAND), (XI-29), 1♂.

MALAYSIA. *Peninsular Malaysia*: *Langkawi Is.* - (IV-1928), 1♂; *Penang Is.* - Telok Kumbor (I-1969, James, Chia & Sulaiman), 1♂, 2♀, 1♂ terminalia, 1♀ terminalia, 3 individual rearings (2 l, 2 p).

NIGERIA. Oshogbo (IV-1911, Dr. T. F. G. Mayor), 1♂, 1♀; Baro (X-1910), 1♀; Lokoja, 1♂; Anara, Arora, Ioria, Jos, Kaduna River (VI-1960-VIII-1961, M. W. Service), 6♂, 4♀.

SAUDI ARABIA. Wadiyain (VIII-1936), H. St. J. B. Philby), 2♀.

SIERRA LEONE. (Major Smith), 1♀; Freetown (IX-99, E. E. Austen), 2♂, 2♀, 1♂ terminalia; Daru (VI-1911, Dr. J. C. Murphy), 1♀; (VI-1912), 1♀; (II-1925, Major Fraser), 1♀.

SOMALIA. (BR. SOMALILAND), Buran, 3, 000 ft (IX-1930), 3♂, 2♀.

SOUTH AFRICA. *Messina*, Groot Belai (III-1934), 1♀; *Johannesburg*, N. Bryanston (A30/46), 1♂, 1♀; *Transvaal*: Brits (1913), 1♂, 1♀; Tzaneen (VI-1934), 1♂; Potgietersrus (1953), 1♀; Sabie Bungalow Hotel (SAIMR, CSIR-54, Coll. No. E. T. 562, J. Muspratt), 1♂, 1♀; *Natal*, Keate's Drift (1952), 1♂.

SOUTHWEST AFRICA. Okimbahe (1950, B. De M.), 1♂, 1♀.

SPAIN. *Cáceres Province* - Cuartos (? = Cuacos), (1935, J. Gil Collado), 1♂, 1♀; (1935), 1♀.

SRI LANKA. (CEYLON), (1921, P. J. Barraud), 4♀; *Central Province*: Suduganga (IX-1919), 3♂; *Kandy Dist.* - Peradeniya (I-1971, Piyadasa & Somapala), 1♂; *North Central Province*: *Anuradhapura Dist.* - Hunuwilagama, Wilpattu, 200 ft (III-1970, D. R. Davis & W. H. Rowe), 3♂, 1♂ terminalia; *Northern Province*: *Vavuniya Dist.* - Paraiyanalankulam, 100 ft (III-1970, D. R. Davis & W. H. Rowe), 1♂; *Sabaragamuwa*: *Ratnapura Dist.* - Uggalkaltota, 350 ft (I-II-1970, D. R. Davis & W. H. Rowe), 1♂, 1♀; Panamure, 500 ft (X-1970, O. S. Flint, Jr.), 1♀.

SUDAN. Hills E. of Erkowit (II-1908), 1♀; (IV-34), 1♂.

TANZANIA. (TANGANYIKA), *Ukara I.* (1915, A. Smith), 6♀; (1952), 2♀; Lindi (1923, Dr. W. E. Haworth), 1♂, 1♀.

THAILAND. *Chiang Mai*: Huey Keo (III-1952-II-1953, D. C. & E. B. Thurman), 119♂, 71♀, 6♂ terminalia; Doi Suthep, Maerim, Muang (1962-1964, SEATO), 15♂, 22♀, 4♂ terminalia; Rong Rian Choeng Doi (IV-1970, Kol & Sanit), 9♂, 16♀, 4♂ terminalia, 7♀ terminalia, 21 L, 25 individual rearings (21 l, 22 p); Ban Om Kut, Ban Pang Kwang (VI-X-1970, Kol & team), 10♂, 11♀, 3♀ terminalia, 21 individual rearings (10 l, 13 p); *Chon Buri*: Bang La Mung, Had Hin Klom, Ko Si Chung (1963-1964, SEATO), 19♂, 27♀, 11♂ terminalia; Bangphra (1967, SEATO), 3♂, 1♀, 4 individual rearings (1 l, 4 p); *Kanchanaburi*: Huai Bong Ti, Huai Lan Sang, Huai Mae Nam Noi, Khao Na Chang, Sapan Mae Nam Kwde, Tamakam (1964-1965, SEATO), 39♂, 43♀; *Khon Kaen*: Ban Maung Kao, Ban Nong Khu, Phu Wiang (VII-1966, Somboon, Chaliou, Kol), 21♂, 22♀, 3♂ terminalia, 1 individual rearing (1 p); *Lampang*: Ngao (VII-1952, SEATO), 1♂, 1♀; (V-1968, Harrison), 5♂, 5♂ terminalia, 3 L, 5 individual rearings (5 p); *Mae Hong Son*: Mae Sariang (V-1969, Chaliou & Samarn), 43♂, 36♀, 3♂ terminalia, 9♀ terminalia, 56 individual rearings (22 l, 56 p); *Nakhon Nayok*: Huey Tak Kong, Khao E. To (1964, SEATO), 7♂, 3♀; *Nakhon Ratchasima*: Koraj Pak Chong, Lamu Huey Tha Krong (1964-1965, SEATO), 2♂, 5♀, 1♂ terminalia; Ban Phak Kong Thang, Ban Wang Mut (V-1967, SEATO), 1♂, 6♀, 7 individual rearings (6 p); *Nakhon Sawan*: Ban Talat Tai (XI-1968, Kol & team), 2♂, 2♀, 2♂ terminalia, 4 individual rearings (1 l, 4 p); *Prachin Buri*: Ban Bu Phram (VII-1971, Kol & team), 7♀, 4♀ terminalia, 7 individual rearings (3 l, 7 p); *Prachuap Khiri Khan*: Huai Yang Phrach Khwa (IV-1968, Chaliou, Somboon, Kol), 33♂, 21♀, 3♀ terminalia, 5 L, 48 individual rearings (29 l, 48 p); *Surat Thani*: Khao Phlu, Khao Yai (1966, SEATO), 8♂, 33♀, 6♂ terminalia, 2♀ terminalia; *Ko Samui I.* - Ban Lamai, Laem Chong Klum, Laem Thong Lak, Laem Yai (IX-X-1967, SEATO), 109♂, 61♀, 119 individual rearings (52 l, 116 p); (1968, SEATO), 22♂, 27♀, 4♀ terminalia, 27 L, 41 individual rearings (3 l, 37 p); Ao Thong Yang (XI-1971, Kol & team), 4♂, 6♀, 10 individual rearings (9 l, 10 p); *Tak*: Huai Lan Sang (1965, SEATO), 6♂, 3♀.

UGANDA. (VIII-1910), 1♂; Metu (III-1953), 3♂, 6♀; Entebbe (V-1911), 1♀.

UPPER VOLTA. Bobo-Dioulasso (1949, M. Holstein), 3♂.

VIETNAM. *Bien Hoa*: (1964), 3♂, 6♀; *Binh Dinh*: An Khe (V-1966), 1♀; *Darlac*: Ban Me Thuot, 500 m (V-1960, L. W. Quate), 1♀; *Khanh Hoa*: Cam Ranh Bay (VI-VIII-1966), 2♂, 1♀; Duc My (IX-X-1966), 6♂, 6♀, 4♂ terminalia, 1♀ terminalia; *Pleiku*: 300 m (V-1960, L. W. Quate), 8♂; *Quang Nam*: Kim Lien Miller (IX-1968), 5♂, 1♀; *Quang Tri*: (VI-1961), 1♀.

YEMEN. *Socotra I.*: Kallansiya (4-I-43), 1♀.

ZAIRE. Stanleyville (XI-1927, Dr. J. Schwetz), 1♂; (1930, Dr. Richard), 2♂, 1♀; Matadi (V-1948, P. H. Vercammen), 1♂.

ZAMBIA. (N. RHODESIA), Livingstone (1946), 1♀.

ZANZIBAR. (1919), 1♀.

TAXONOMIC DISCUSSION. *Aedes vittatus*, formerly placed in the subgenus *Stegomyia*, differs greatly from all other members of *Stegomyia* and should be excluded from that subgenus. It is more similar in both adult and immature stages to members of the subgenus *Aedimorphus* than to *Stegomyia*, particularly in having some rather basic genitalic characters in common with the *veaxans* group of *Aedimorphus*. I believe that it should be placed in the subgenus *Aedimorphus* rather than in the subgenus *Stegomyia*.

Adults of both sexes of this species can easily be distinguished from those of *Stegomyia* by the numerous erect forked scales on the head, not restricted to occiput and presence of acrostichal setae. The male terminalia of this species can easily be distinguished from those of *Stegomyia* by the irregularly

shaped distimere which is greatly expanded apically, with a long, strongly curved spiniform process subapically. The female terminalia of this species can easily be distinguished from those of *Stegomyia* by sternum VIII which has a deep medial V-shaped notch and by the long cerci. On the other hand, these characters which are markedly different from *Stegomyia*, are characteristics of *Aedimorphus*.

Superficially, the male palpus of *vittatus* resembles that of *Stegomyia* (except the *albolineatus* group which has the palpus dark) in having a white basal band on each of segments 2-5, segments 4, 5 subequal, slender, up-turned and with a few short setae. However, it differs in having the white basal band on segments 4, 5 complete dorsally. The female palpus of *vittatus* is very similar to that of *Stegomyia* (except the *albolineatus* group which has palpus dark) in having white scales on the apex. However, it differs from that of *Stegomyia* in the presence of a few white scales on segment 3 and with segment 5 well developed. These characters recall *Aedimorphus*. The male palpus of this species is by no means a typical *Aedimorphus* type but a rather reduced one. It is most nearly matched by some members of the Ethiopian *Aedimorphus* (*Aedes aerarius* McIntosh and *Aedes gibbinsi* Edwards).

The most important adult characters for determining the subgeneric position in the genus *Aedes* Meigen are those of the male terminalia. The male terminalia of this species appear to have some rather basic characters in common with 4 subgenera in genus *Aedes*, namely, *Aedimorphus*, *Diceromyia* Theobald, *Stegomyia* and *Ayurakitia* Thurman, suggesting affinities with these 4 subgenera. However, they have more characters reminiscent of *Aedimorphus* than of *Stegomyia*. In addition, with respect to the pupal and larval characters, *vittatus* does not conform to the subgenus *Stegomyia* at all.

The pupa of *vittatus* with seta 8-C slightly cephalad of the trumpet base, 1-II well developed, branched, 2-III-V distinctly mesad of 1-III-V, 9-VII, VIII strongly developed, branched, and barbed, paddle margins without hair-like fringe, with small, short spines on basal 0.8 of outer margin, inner margin very faint and without spines, 1-P single; can easily be distinguished from that of *Stegomyia*. On the other hand, these characters are shared with *Aedimorphus*.

The larva of *vittatus* is strikingly different from that of *Stegomyia* in having seta 4-C very small, mesad and caudad of 6-C; 4, 6-C at about level of antennal base and anal segment with 4 well developed precratal tufts. On the other hand, these characters are also those of *Aedimorphus*.

Reinert (1973) divided the male terminalia of Oriental species of *Aedimorphus* into 2 types. The male terminalia of *vittatus* are characteristic of Type II (*vexans* group). The larva of *vittatus* has seta 4-C very small, closer to 6-C than 5-C and mesad of 5, 6-C; 4, 6-C at about level of antennal base and 5-C considerably caudad and slightly mesad of 6-C which are also as in the *vexans* group. Differences from the *vexans* group include the broad, decumbent scales on the vertex and all lobes of the scutellum which recall some members of the *alboscuteallatus* group of *Aedimorphus*. However, the closest affinities of *Aedes vittatus* are with the *vexans* group. It thus seems that *Aedimorphus* is the most suitable subgenus for *vittatus* among the currently accepted subgenera of genus *Aedes*, and I am here making the subgeneric transfer.

Aedes vittatus is a very interesting species. Present evidence shows that it is somewhat a combination of several species groups of *Aedimorphus*. It exhibits similarity to the members of the subgenus *Aedimorphus* from both Oriental and Ethiopian regions as described above. On this basis, I am tentatively placing *vittatus* in a separate group. At present, it is felt that the taxo-

nomic position of *vittatus* and its relationship to other members of *Aedimorphus* can not be further discussed until a careful study of all stages of Ethiopian *Aedimorphus* has been completed.

Aedes vittatus is mainly confined to the Ethiopian region and the Oriental area (of Belkin 1962), with extensions into the southern part of the Palearctic and the northwestern part of the Indomalayan area.

Sharma and Chaudhry (1974) reported that they found a special strain which differed from the typical *Aedes vittatus* in the pattern of hindtarsus banding. In my opinion, their special strain has the same pattern of hindtarsus banding as the typical *Aedes vittatus* whose hindtarsus has basal white bands on tarsomeres 1-4, tarsomere 5 all white. In fact, Barraud (1934) did not describe the hindtarsus banding and the picture on Plate VII (Fig. 4) has the hindlegs incomplete. It only shows 4 tarsomeres; tarsomere 5 either was broken off or has all the white scales faded out. Therefore, the last tarsomere did not show clearly on the plate.

Since I have examined more than 1,000 adult specimens of *Aedes vittatus* through the entire range including topotypic material, museum type-material and Barraud's specimens, I have no doubt that the typical *vittatus* has the hindtarsus with basal white bands on tarsomeres 1-4, tarsomere 5 all white. Thus, the pattern which they thought to be "abnormal form" (Fig. 1, B) is, in fact, the typical form (normal form). In response to my request in August 1974, Dr. George B. Craig, Jr. of the University of Notre Dame, Indiana, has examined specimens from his 2 laboratory colonies of *vittatus*. The banding on the hindtarsi agrees with my interpretation of typical *Aedes vittatus*.

BIONOMICS. The immature stages of *vittatus* have been found mainly in rock pools and rock holes in Thailand, Malaysia, Vietnam, India and Africa. They have also been found in log holes in Thailand and Vietnam, in bamboo cups and tree trunks in Thailand. Presence of larvae in coconut palm crowns at Lindi, Tanzania, was an artifact resulting from deliberate introduction by the native collector (see Lester 1927, Wiseman et al. 1939). Immature stages have been found in association with *Aedes (Stegomyia) albopictus* (Skuse), *Aedes (Stegomyia) malayensis* Colless, and *Culex* sp. in Thailand, and with *Aedes malayensis* in Malaya.

Mattingly (1952: 271) stated that *vittatus* preferred rock pools, occasional utensils, hoofprints, boats, wells, tree holes and bamboo pots. Boorman (1961: 721) found that deep rock holes usually contained larvae of *vittatus*, particularly those where the water was clear and there was a layer of mud and a few dead leaves. Service (1970: 104) stated that larvae of this species are found predominantly in pools in rock outcrops or river beds, or even in pools formed in coral and on several occasions at the peak of the breeding season in open floodwater concrete drains.

In Thailand, this species was found mainly in partially shaded temporary small rock pools with fresh, colored water without algae in secondary deciduous forests or secondary rain forests, in a mountain area about 550-660 m or in small temporary rock pools surrounded by coconut palms and unshaded or partly shaded, situated in villages or beaches, along the sea coast, in that country at about sea level or 5-20 m. These contained brackish, clear or colored water, without algae.

Boorman (1961: 724) found that eggs survived desiccation for 10 weeks but not for 18 weeks. Service (1970: 141) found that eggs, fourth instar larvae and pupae were killed after 2 days exposure to 8-11°C and below, but little mortality resulted from exposure down to 15°C.

Boorman (1961: 720) took *vittatus* biting man in northern Nigeria in fair

numbers. Over most of its range it appears to bite man freely and will at least occasionally enter villages to bite. Mattingly (1965: 56) states that it is usually recorded as biting man freely, but not in South Africa. Service in northern Nigeria (1970: 141) found that no adults were caught in a Magoon trap baited with goats, sheep, monkeys and a pig; porcupine was the most important host in the area. He also stated that *vittatus* has a relatively short crepuscular biting period, with maximum activity between 1800 and 2100 hours.

MEDICAL IMPORTANCE. *Aedes vittatus* is a potential vector species. It can transmit yellow fever virus from monkey to monkey in the laboratory (Philip 1929) and has been suspected as a vector in the Nuba Mountain epidemic in Sudan (Lewis 1943).

ACKNOWLEDGEMENTS

I wish to express my sincere appreciation to Dr. Ronald A. Ward, Dr. Peter F. Mattingly, Dr. Alan Stone, Dr. John N. Belkin, Dr. Elizabeth N. Marks, Dr. Botha de Meillon and Mr. E. L. Peyton for a critical review of the manuscript and for their valuable comments.

I am grateful to Dr. J. Mouchet, O. R. S. T. O. M., Bondy, France, for topotypic material of *vittatus*; to Dr. P. F. Mattingly, Department of Entomology, British Museum (Natural History), London, for the loan of type-specimen of *Reedomyia albopunctata* and other material in the British Museum; to Dr. M. W. Service, The Nature Conservancy, Monks Wood Experimental Station, Huntingdon, England, for his personal specimens. The Thailand material from Dr. D. J. Gould and his staff of the SEATO Medical Research Laboratory, Bangkok; The Malayan material from Dr. S. Ramalingam and his staff, Department of Parasitology, the University of Malaya, Kuala Lumpur and the Sri Lanka material from Dr. K. V. Krombein and his collection teams, Department of Entomology, U. S. National Museum (Natural History), Washington, D. C., are acknowledged with sincere appreciation. I wish to thank also the following institutions for the loan of material: Bernice P. Bishop Museum, British Museum (Natural History), South African Institute for Medical Research and United States National Museum. Thanks are extended to Mr. Vichai Malikul, for preparing the drawings, and to Mrs. Janet D. Rupp who typed the manuscript for offset reproduction.

LITERATURE CITED

- BARRAUD, P. J.
1923. A revision of the culicine mosquitoes of India. Part I. Indian J. Med. Res., 10: 772-88, pl. XLIII-LIX.
1934. The fauna of British India, including Ceylon and Burma. Diptera V, Family Culicidae. Tribes Megarhinini and Culicini. Taylor and Francis, London, 463 p., 8 pl., 1 map.
- BELKIN, J. N.
1962. The mosquitoes of the South Pacific. (Diptera, Culicidae). Univ. Calif. Press, Berkeley and Los Angeles, 2 vols., 608 and 412 p.
- BIGOT, M. J.
1861. Trois Diptères nouveaux de la Corse. Ann. Soc. Entomol. Fr. (4)1: 227-9.
- BOORMAN, J. P. T.
1961. Observations on the habits of mosquitos of Plateau Province, Northern Nigeria, with particular reference to *Aedes (Stegomyia) vittatus* (Bigot). Bull. Entomol. Res. 52: 709-25.
- BOREL, E.
1928. Les moustiques de la Cochinchine et du Sud-Annam. II. Arch. Inst. Pasteur Indo-Chine, 7: 75-106.
- EDWARDS, F. W.
1912. A synopsis of the species of African Culicidae, other than *Anopheles*. Bull. Entomol. Res. 3: 1-53.
1917. Notes on Culicidae, with descriptions of new species. Bull. Entomol. Res. 7: 201-29.
1925. Mosquito notes. - V. Bull. Entomol. Res., 15: 257-70.
1932. Diptera, Fam. Culicidae. In P. Wytman, Genera Insectorum, Desmet-Verteneuil, Brussels. Fasc. 194, 258 p., 5 pl.
1941. Mosquitoes of the Ethiopian region III. - Culicine adults and pupae. Br. Mus. (Nat. Hist.), London, 499 p., 4 pl.
- HOPKINS, G. H. E.
1952. Mosquitoes of the Ethiopian region. I. - Larval bionomics of mosquitoes and taxonomy of culicine larvae. 2nd edition with notes and addenda by P. F. Mattingly. Br. Mus. (Nat. Hist.), London, 355 p.
- LESTER, A. R.
1927. The coconut palm. Its potentialities for providing breeding places for mosquitoes. J. Trop. Med. Hyg. 30: 136-45.
- LEWIS, D. J.
1943. Mosquitoes in relation to yellow fever in the Nuba Mountains, Anglo-Egyptian Sudan. Ann. Trop. Med. Parasitol., 37: 65-76.

McINTOSH, B. M.

1975. A taxonomic revision of certain *Aedes* species (Diptera: Culicidae) of the subgenus *Aedimorphus* in southern Africa. J. Entomol. Soc. South. Afr. 38: 251-87.

MATTINGLY, P. F.

1952. The subgenus *Stegomyia* (Diptera, Culicidae) in the Ethiopian region I. A preliminary study of the distribution of species occurring in the West African sub-region with notes on taxonomy and bionomics. Bull. Br. Mus. (Nat. Hist.), Entomol. 2: 233-304.
1965. The culicine mosquitoes of the Indomalayan area Part VI: Genus *Aedes* Meigen, subgenus *Stegomyia* Theobald (Groups A, B and D). Br. Mus. (Nat. Hist.), London, 67 p.

MATTINGLY, P. F. and K. L. KNIGHT.

1956. The mosquitoes of Arabia. I. Bull. Br. Mus. (Nat. Hist.), Ent. 4: 89-141.

NEVEU-LEMAIRE, M.

1905. Mission du Bourg de Bozas. Description d'une nouvelle espèce de *Stegomyia* recueillie par le Docteur Brumpt à Harar. Bull. Soc. Zool. Fr. 30: 8-11.

PHILIP, C. B.

1929. Preliminary report of further tests with yellow fever transmission by mosquitoes other than *Aedes aegypti*. Am. J. Trop. Med. 9: 267-9.

REINERT, J. F.

1973. Contributions to the mosquito fauna of Southeast Asia. -XVI. Genus *Aedes* Meigen, subgenus *Aedimorphus* Theobald in Southeast Asia. Contr. Am. Entomol. Inst. 9(5): 1-218.

SENEVET G. and L. ANDARELLI.

1954. Le genre *Aedes* en Afrique du nord I. -Les larves. Arch. Inst. Pasteur Algér. 32: 310-51.
1958. Le genre *Aedes* en Afrique du nord II. -Les nymphes. Arch. Inst. Pasteur Algér., 36: 266-86.

SERVICE, M. W.

1970. Studies on the biology and taxonomy of *Aedes (Stegomyia) vittatus* (Bigot) (Diptera: Culicidae) in Northern Nigeria. Trans. R. Entomol. Soc. Lond. 122: 101-43.

SHARMA, G. P. and S. CHAUDHRY.

1974. A strain of *Aedes (Stegomyia) vittatus* Bigot with an unusual pattern on the tarsi (Diptera: Culicidae). Mosq. Syst. 6: 163-5.

THEOBALD, F. V.

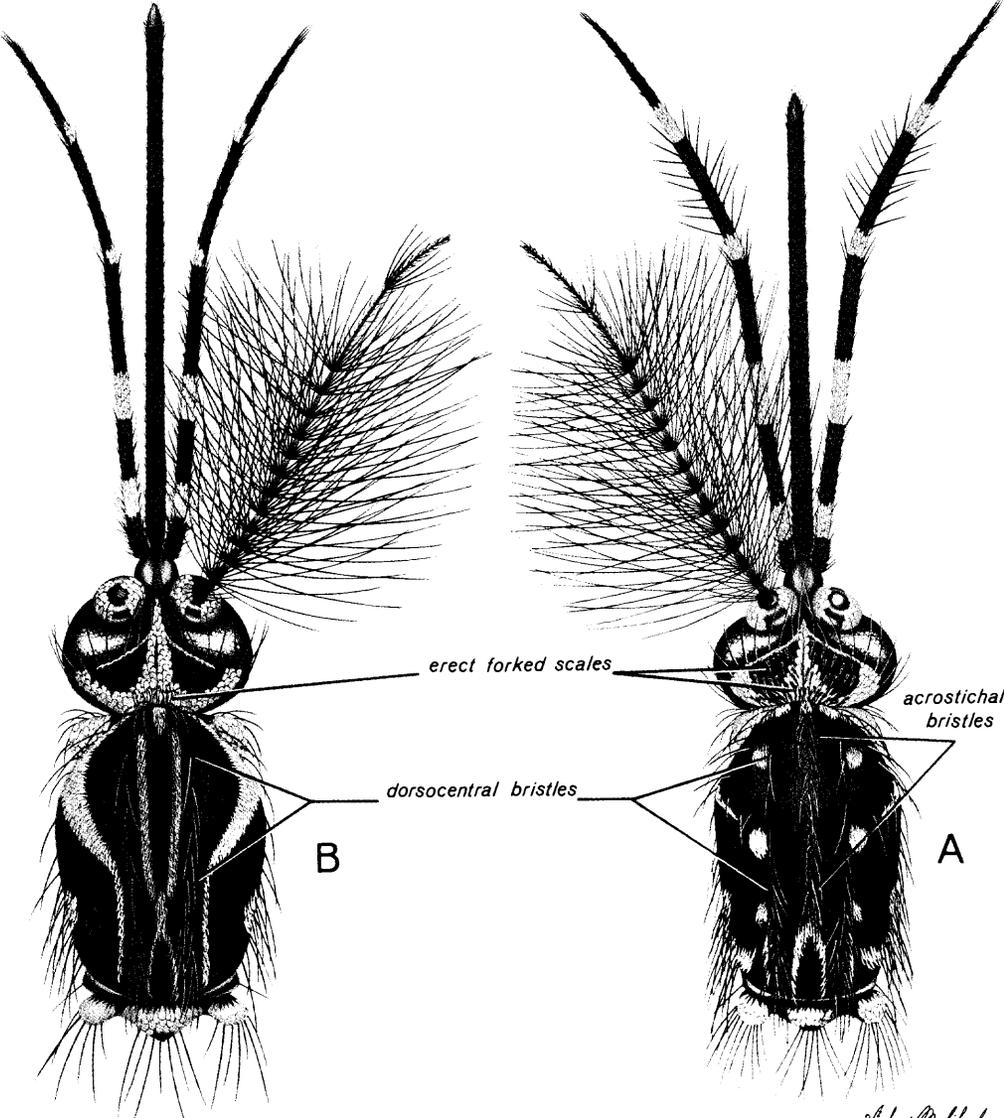
1901. A monograph of the Culicidae or mosquitoes. Vol. I, Br. Mus. (Nat. Hist.), London, 424 p.
1905. Genera Insectorum. Diptera, Fam. Culicidae. Fasc. 26, Belgium, 50 p., 2 pl.

1907. A monograph of the Culicidae or mosquitoes. Vol. IV, Br. Mus. (Nat. Hist.), London, 639 p., 16 pl.
- WISEMAN, R. H., C. B. SYMES, J. C. McMAHON and C. TEESDALE.
1939. Report on a malaria survey of Mombasa. Government Printer, Nairobi, 60 p.

LIST OF FIGURES

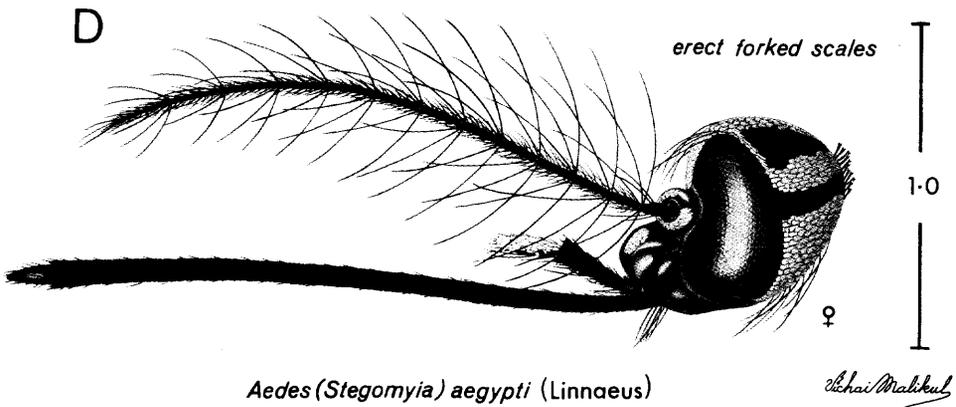
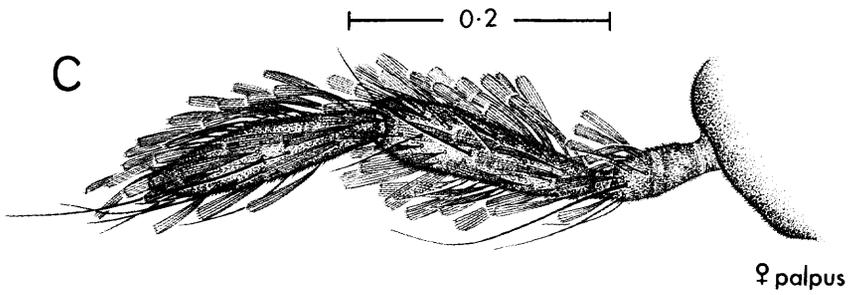
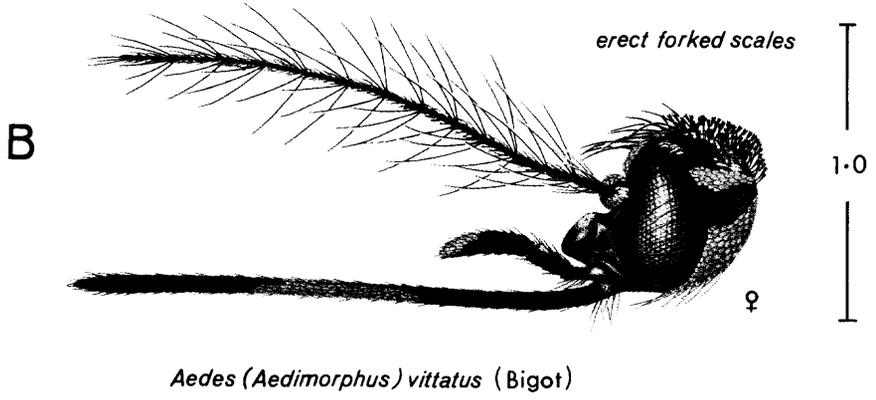
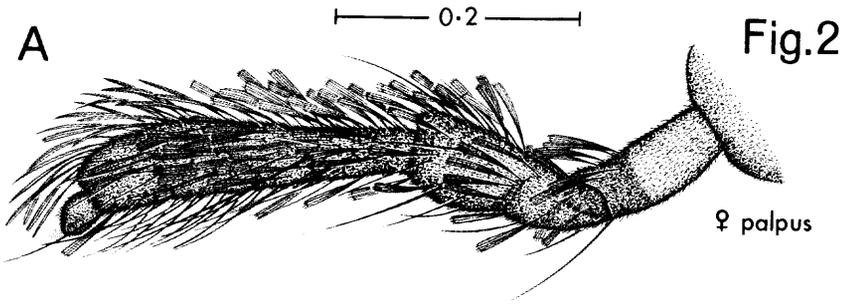
1. *Aedes (Aedimorphus) vittatus* (Bigot) - A, male adult;
Aedes (Stegomyia) aegypti (Linnaeus) - B, male adult.
2. *Aedes (Aedimorphus) vittatus* (Bigot) - A, female palpus; B, female head;
Aedes (Stegomyia) aegypti (Linnaeus) - C, female palpus; D, female head.
3. *Aedes (Aedimorphus) vittatus* (Bigot) - A, B, C, D, E, F, male terminalia.
4. *Aedes (Aedimorphus) vittatus* (Bigot) - A, B, pupa; C, female terminalia.
5. *Aedes (Aedimorphus) vittatus* (Bigot) - A, B, C, larva.
6. *Aedes (Aedimorphus) vittatus* (Bigot) - A, B, C, D, female terminalia.
7. Distribution of *Aedes (Aedimorphus) vittatus* (Bigot).

Fig.1



Aedes (Stegomyia) aegypti (Linnaeus)

Aedes (Aedimorphus) vittatus (Bigot)



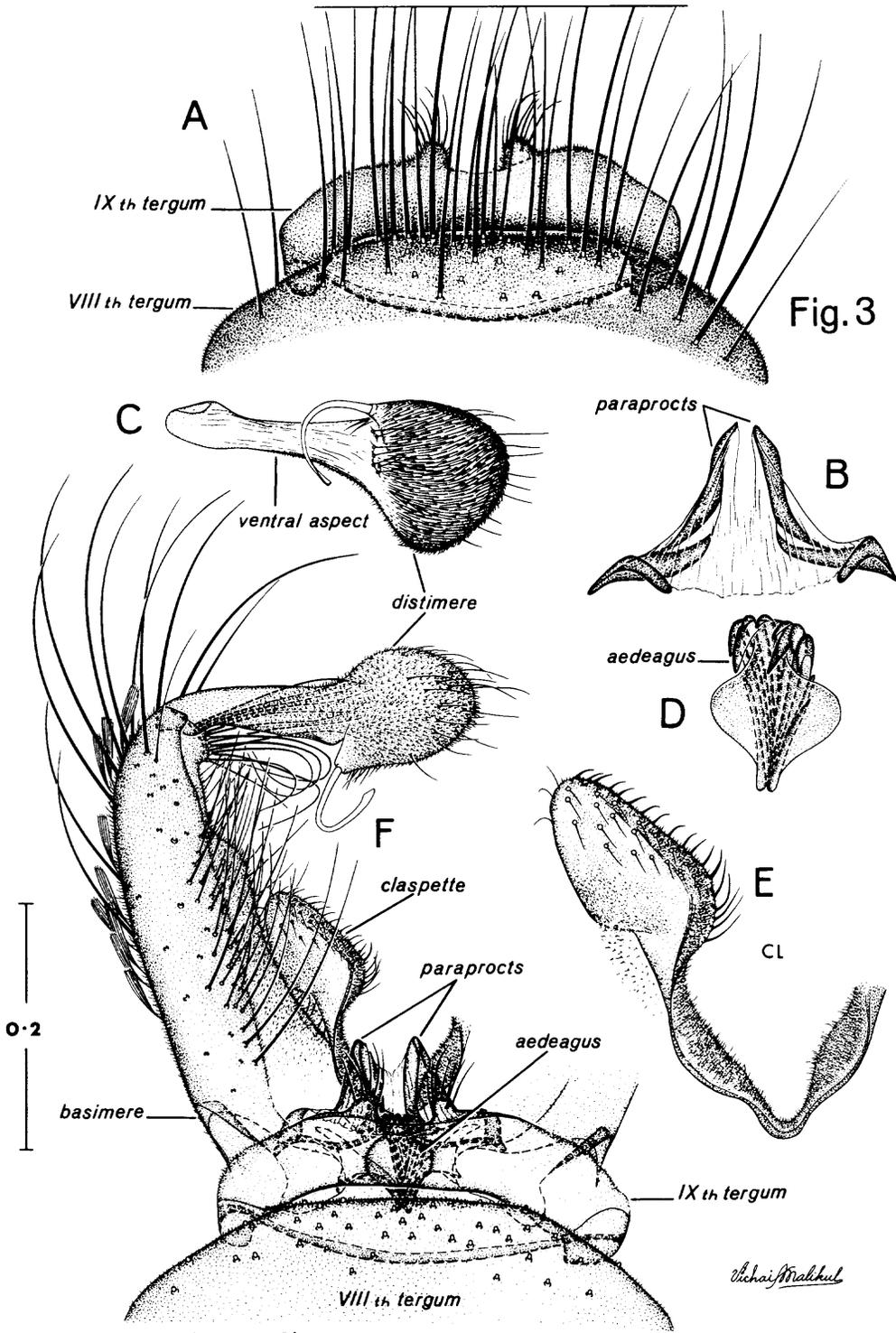


Fig. 3

Aedes (Aedimorphus) vittatus (Bigot)

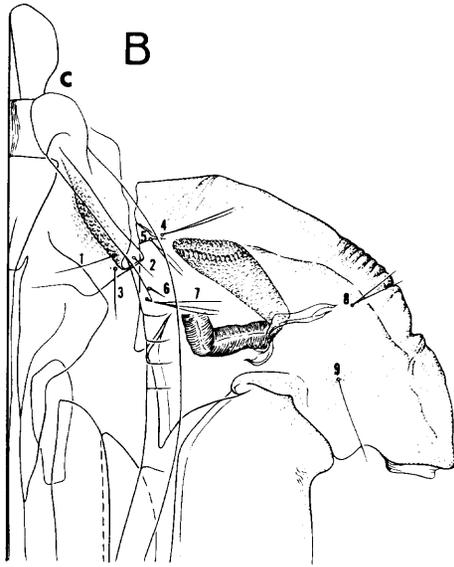
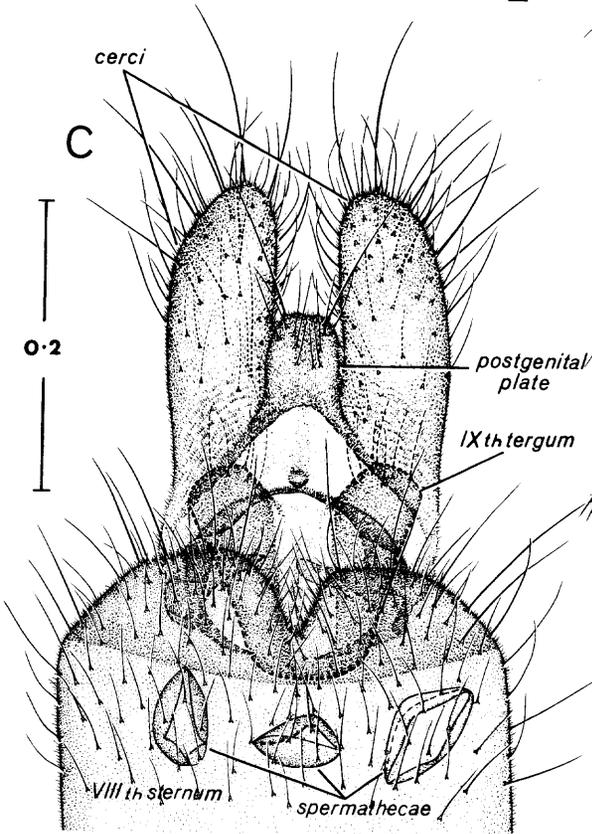
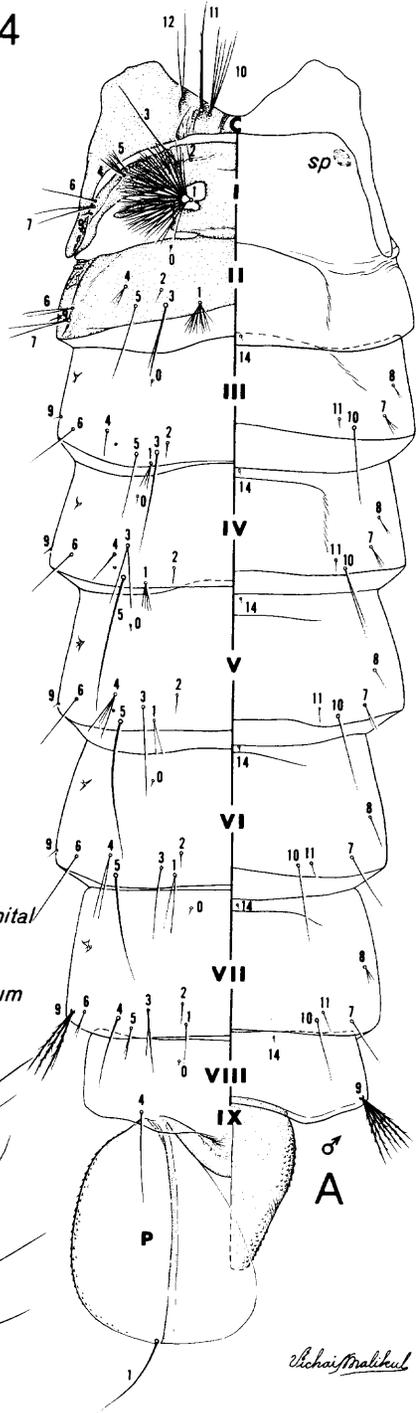
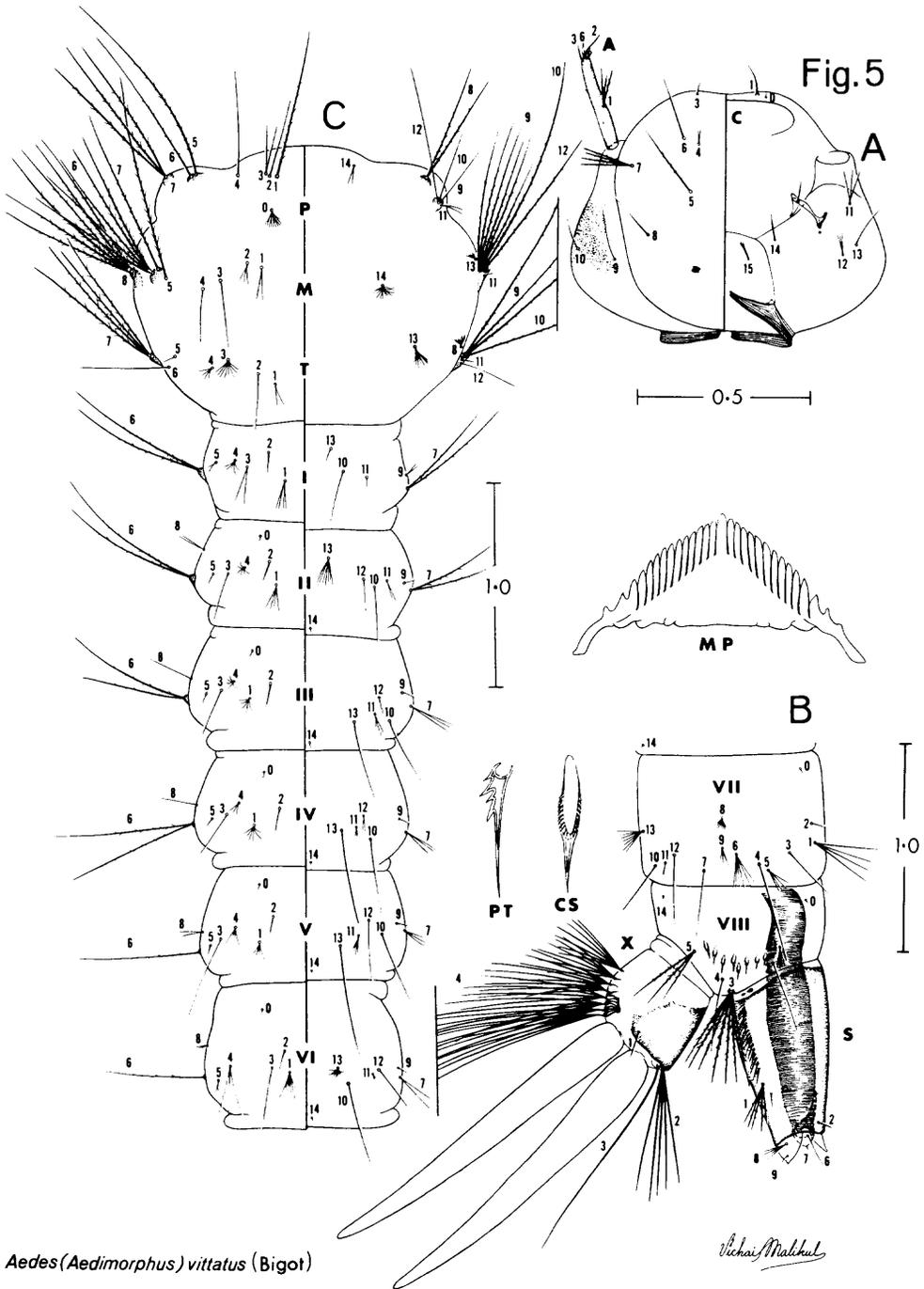


Fig.4



Aedes (Aedimorphus) vittatus (Bigot)

Uchais Maliboul



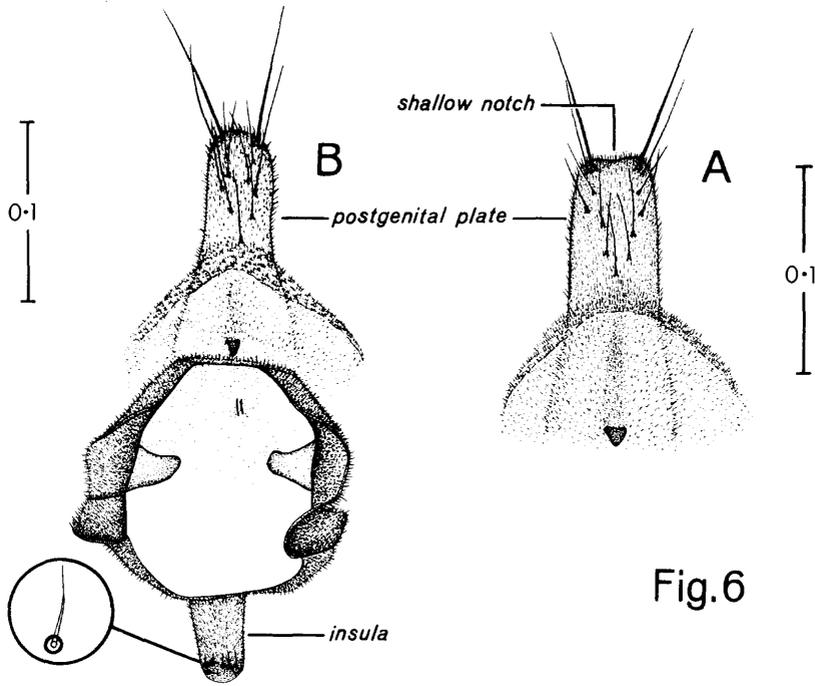
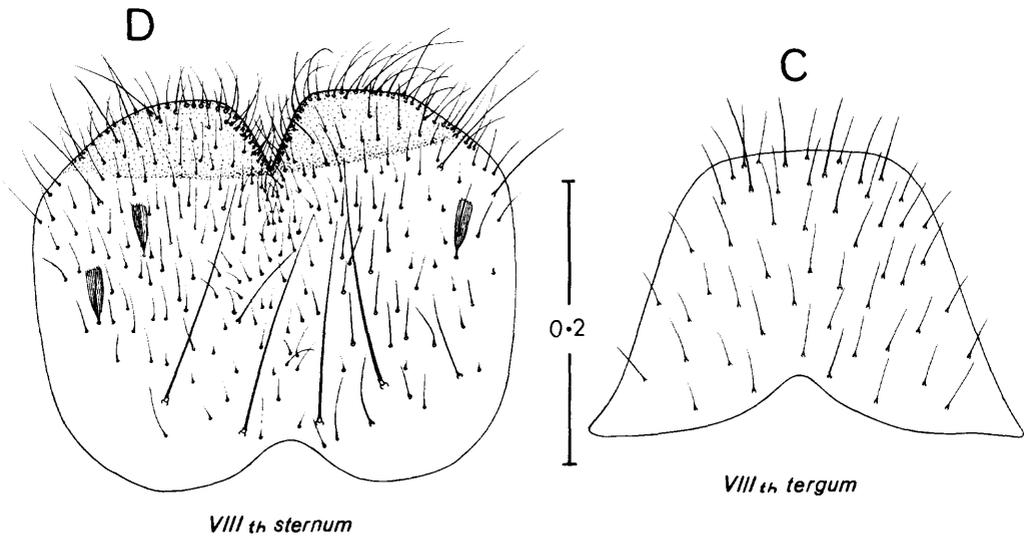


Fig.6



Uchai Malikul

Aedes (Aedimorphus) vittatus (Bigot)

INDEX

Names of valid taxa are in roman type; synonyms are in italic type. Italic numerals refer to the principal text references. Roman numerals refer to secondary text references. Roman numerals in parentheses without a suffix refer to the figures and with the suffix "m" to a map.

- | | |
|-----------------------------------|---------------------------------------|
| Aedes Meigen 1, 7 | Diceromyia Theobald 7 |
| Aedimorphus Theobald 1, 6, 7, 8 | |
| aegypti (Linnaeus) (13, 14) | gibbinsi Edwards 7 |
| aerarius McIntosh 7 | |
| albolineatus group 7 | malayensis Colless 8 |
| albopictus (Skuse) 8 | |
| <i>albopunctata</i> Theobald 2, 9 | Stegomyia Theobald 1, 6, 7 |
| alboscuteclatus group 7 | <i>sugens</i> Theobald 2 |
| Ayurakitia Thurman 7 | |
| | vexans group 1, 6, 7 |
| <i>brumpti</i> Neveu-Lemaire 2 | vittatus (Bigot) 1, 2, 4, 6, 7, 8, 9, |
| | (13, 14, 15, 16, 17, 18, 19m) |
| Culex sp. 8 | |