

Redescription of Four Oriental Species of *Culex* (*Culiciomyia*)
and the Description of a New Species from Thailand
(Diptera: Culicidae)¹

Sunthorn Sirivanakarn
Medical Entomology Project
Smithsonian Institution
Washington, D. C. 20560

ABSTRACT. All known stages of *Culex bahri* Edwards, *viridiventer* Giles, *shebbearei* Barraud and *javanensis* Bonne-Wepster are redescribed and their diagnostic features illustrated. A new species, *C. harrisoni*, from Thailand is recognized.

During the preliminary study of the *Culex* material from Southeast Asia and adjacent areas in 1968-1972, I have examined the types (holotypes, lectotypes) of *C. (Culiciomyia) bahri* Edwards, *viridiventer* Giles, *shebbearei* Barraud and *javanensis* Bonne-Wepster at the British Museum (Natural History). Because of inadequate descriptions, poor illustrations or absence of illustrations, the identity of these species has been difficult to determine. To alleviate this problem, I am now redescribing all known stages of these species so that they will be readily recognized by other workers studying the Oriental fauna. The descriptions of *bahri*, *viridiventer* and *shebbearei* are based on the type-material and other topotypic specimens subsequently collected and identified by Barraud (1934) and that of *javanensis* is based on the type and also on several additional reared specimens recently collected from various parts of Malaysia by Dr. Shivaji Ramalingam. Included in this paper is the description of *C. harrisoni* n. sp. from the material collected in Chiang Mai, Thailand in 1969 by the U.S. Army Medical Component - SEATO Laboratory, Bangkok. This new species is named in honor of Major Bruce A. Harrison, formerly of the Walter Reed Army Institute of Medical Research, Washington, D. C.

The format and terminology used in the description and illustration follow Bram (1967a) and Sirivanakarn (1973). The holotype ♂, allotype ♀, and paratypes of the new species will be deposited in the U.S. National Museum (USNM), Washington, D.C. Some paratypes will also be deposited in the British Museum (Natural History).

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

Culex (Culiciomyia) bahri Edwards

(Fig. 1)

Culex (Culiciomyia) bahri Edwards, 1914: 79(♂, ♀); Bar-
raud 1934: 386(♂, ♀); Carter 1950: 90(distribution);
Harrison et al. 1974: 156 (distribution).

FEMALE. Wing: 4.7 mm. Forefemur: 2.2 mm. Proboscis: 2.5 mm. Abdomen: 3.2 mm. Medium-large, blackish species; in general essentially conforms to the subgenus (see Bram 1967a:117). *Head*. Vertex with numerous whitish, narrow, linear decumbent scales along upper eye margin and in center, mixed with several broad, dark, decumbent scales on lateral and posterolateral areas; all erect scales entirely dark brown; lateral patch of broad scales whitish, very distinct. Palpus and proboscis entirely dark scaled. *Thorax*. Pleural integument without any definite dark stripe or spots; scales absent; 1 lower *mep* bristle present. *Legs*. Anterior surface of hindfemur with conspicuous longitudinal pale stripe extending from base to apex, rest of legs entirely dark or without distinctive pale marking on lateral and dorsal surfaces. *Wing*. Scales narrow, dark and dense on all veins; furcation of cell R_2 at same level as furcation of cell M_2 . *Abdomen*. Terga II-V entirely dark scaled; VI-VIII entirely dark or with very narrow basal pale bands; basolateral and lateral pale markings absent.

MALE. In general as described for female. *Head*. Palpus dark, long, slender, exceeding proboscis by length of segment 5; segment 3 with an inconspicuous ventral row of 5,6 short, narrow scales from middle to near apex, its apical 0.25 with a lateral tuft of 10-12 bristles; segments 4 and 5 long, with numerous strong bristles. Proboscis dark, uniformly thick, with distinct submedian false joint placed slightly beyond middle and a short ventral tuft of several dark setae proximad of false joint. Antennal flagellum strongly plumose.

MALE GENITALIA (Fig. 1). *Segment IX*. Tergal lobe broad, with a prominent row of about 15 strong setae. *Basimere*. More or less oval-shaped, about 0.27 mm in length; tergomesal margin straight, with 1,2 dense rows of about 15 submarginal setae extending from basal 0.5 to level of subapical lobe; lateral tergal surface with several strong bristles; lateral tergal margin broadly convex, with a strong tuft of 4,5 bristles on apical margin laterad of base of distimere. *Subapical lobe*. Short and small, with a lateral group of 2 long and 1 short, dark, stout rodlike setae and a mesal group of 1 long, flattened bladlike seta and 1,2 short, fine, hairlike setae, all closely packed; sterno-apical spiculose lobe minute or poorly developed, adjacent to the base of mesal bladlike seta. *Distimere*. Normal; subapical outer margin with a prominent crest of 5,6 strong, toothlike spicules distad of median curvature; 1 dorsal and 1 ventral tiny, subapical seta present; apical claw small, slender and short. *Phallosome*. Simple, vasselike, as in other members of the subgenus; apical tergal surface of lateral plate with a strong, basal, spinelike denticle followed distally by 1,2 close-set rows of about 5 strong and 4-6 weak denticles. *Proctiger*. Basal sternal process present, relatively short,

strongly curved sternad; 2 minute cercal setae.

PUPA and LARVA. Unknown.

TYPE-DATA. Holotype ♂ (marked as type by Edwards) with attached genitalia mount, *Badulla*, Ceylon (Sri Lanka), 1913, Dr. P.H. Bahr (BMNH).

DISTRIBUTION. Known only from Sri Lanka; records from other localities in Sri Lanka and Java by Barraud (1934) are doubtful. Material examined: 3♂ (including holotype) and 4♀, all apparently represent the type-series originally described by Edwards (1914:79).

TAXONOMIC DISCUSSION. *Culex bahri* has been known only from the adult males and females in the type-series. The recent record of this species from Sri Lanka by Harrison et al. (1974) is uncertain as this was based only on the female which may also belong to *C. fragilis* Ludlow. The latter is very common, widespread throughout Southeast Asia and has also been found in Sri Lanka.

Culex bahri can be readily separated from all other Oriental species of *Culiciomyia* in the male genitalia by the combination of 1) the specialized setae of the subapical lobe; 2) the prominent rows of strong setae on the upper tergomesal margin of the basimere; 3) the small or poorly developed sterno-apical spiculose lobe of the subapical lobe and 4) the relatively short basal sternal process of the proctiger. The male palpus is also diagnostic, particularly in the reduction in the length and size of the scales on the ventral surface of segment 3. The adults of both sexes can be generally recognized by the relatively large size, the entirely dark abdominal terga and the absence of distinct dark stripe or spot on the pleuron.

On the basis of the male genitalia, *bahri* apparently exhibits an affinity with *viridiventer* Giles with which it undoubtedly falls into a distinct group of *Culiciomyia*. For the separation of *bahri* from *viridiventer*, see the description of the latter.

BIONOMICS. Adult biology and larval breeding site are unknown.

Culex (Culiciomyia) viridiventer Giles

(Figs. 2,3)

Culex viridiventer Giles 1901:609 (adults).

Culex angulatus Theobald 1901:324(♀*); Edwards 1913:235(synonymy).

Culex longifurcatus Theobald 1910a:19(♂,♀); Edwards 1913:235 (synonymy).

Culex pseudolongifurcatus Theobald 1910a:366(nom. nov. for *longifurcatus* Theobald, non Becker, 1904); Edwards 1913:235 (synonymy).

Culex (Culiciomyia) viridiventer Giles, Barraud 1924:18(♂*); Borel 1930:350(♂*,♀,L*); Barraud 1934:378(♂*,♀,L).

FEMALE. Wing: 4.8 mm. Forefemur: 2.4 mm. Proboscis: 2.5 mm. In general as described for the subgenus (Bram 1967a:117). *Head*. Vertex with narrow, linear decumbent scales restricted to dorsal midline; lateral and posterolateral areas along upper eye margin with broad dusky decumbent scales; erect scales numerous and entirely dark brown; lateral patch of broad scales whitish. *Thorax*. Mesonotal scales predominantly brownish or yellowish, lighter on anterior promontory, prescutellar space and scutellum. Pleural integument usually without distinct dark stripe or spots on *ssp*, upper *stp* and upper *mep*, sometimes darkened on these areas, but not forming a striking pattern; scales absent; 1 lower *mep* bristle present. *Legs*. Without distinctive coloration. *Wing*. All scales narrow, linear or clavate. *Abdomen*. Terga II-VII with distinct basal white bands which are produced posteriorly in middle, narrow toward lateral margin; sterna pale yellowish.

MALE. In general as described for female. *Head*. Palpus exceeding proboscis by 0.5-1.0 of length of segment 5; segment 3 with a distinct ventral row of 5-6 long, translucent scales in apical 0.5, its apex bear 2,3 weak bristles; segments 4 and 5 reduced in length and weakly plumose, all bristles weak and short. Proboscis without distinct submedian false joint; median ventral tufts weak, composed of a few short setae which are rather inconspicuous. Antennal flagellum strongly plumose.

MALE GENITALIA (Fig. 2). *Segment IX*. Tergal lobe small, with a row of 7,8 setae. *Basimere*. Somewhat oval, with broadly convex tergomesal and lateral tergal margins; its length about 0.27 mm; tergomesal margin with prominent rows of numerous strong, flattened marginal and submarginal setae, extending from near base to proximal portion of subapical lobe; lateral tergal surface with several long bristles. *Subapical lobe*. Broad, with clearly separate proximal and distal divisions; proximal division with 1 stout rod mesad and 2 longer rods laterad; distal division with 1 stout blade and 2 strong flattened setae; sterno-apical spiculose lobe small, with several short setae forming tuft basad. *Distimere*. Normal; outer subapical margin with a strong crest of 7,8 toothlike spicules; 1 dorsal and 1 ventral tiny seta present distad of median curvature, apical claw short and slender. *Phallosome*. Apical portion of lateral plate with 1 strong spinelike basal denticle, followed distally by a row of 4,5 weaker denticles. *Proctiger*. Basal sternal process large and long, with broadly expanded apical portion, somewhat resembling a pouch; cercal setae 4, minute.

PUPA (Fig. 2). Abdomen: 3.2 mm. Paddle: 1.0 mm. Trumpet: 0.78 mm; index about 6. Cephalothorax yellowish white with indefinite brownish areas on wing and leg cases and along posterior mid-dorsal ridge; metanotum brownish in middle, pale towards lateral margin; abdomen largely yellowish white. *Trumpet*. Meatus uniformly thick or gradually broadened towards apex; pinna oblique, without slit extending to meatus. *Cephalothorax*. Seta 1-C double or triple; 2-C 3,4 branched; 3-C double; 4-C 4 branched; 5-C 5,6 branched; 8-C double; 9-C subequal to or slightly longer than 8-C, triple. *Metanotum*. Seta 10-C 6 branched; 11-C double; 12-C 4 branched. *Abdomen*. Setae 3-II,III single; I-II multiple, brushlike; I-III 5,6 branched; I-IV 3,4 branched; I-V-VII double; 5-IV,V long, double; 5-VI usually single (1-2), 2 times as long

as segment following; 6-III double; 6-IV-VI single; 9-VII 4,5 branched; 4-VIII double; 9-VIII 6 branched. *Paddle*. Very broad, pale whitish; midrib weak and pale; seta 1-P present; 2-P absent.

LARVA (Fig. 3). Head: 0.90 mm. Siphon: 1.8 mm; index 5. Saddle: 0.36 mm; siphon/saddle ratio 5. General features and chaetotaxy as figured; the following are diagnostic. *Head*. Integument yellowish white; seta 5-C double or triple; 6-C usually double (2-3). Antenna as long as head length; spicules minute and rather sparse; seta 1-A 12-15 branched, placed at about middle of the shaft; 2,3-A, subapical. *Thorax*. Spiculation not developed; setae 1,3-P subequal, weaker than 2-P; 1-P triple, 2-P single; 3-P double; 4-P double; 7-P triple; 8-p strong, usually double (1-2), subequal to 7-P. *Abdomen*. Spiculation not developed; setae 6,7-I double; 6-I sometimes triple; 6-II triple; 6-III-V double; 6-VI single, longer than 6-III-V; 1-III weak, short, double; 1-IV-VII single, strong, subequal, of the same length as 6-III-V. Comb scales small, subequal, about 40, aggregating into a broad oval patch, all with fringe of evenly fine spicules laterally and apically. *Anal segment*. Saddle complete, same color as siphon; caudal margin near bases of setae 2,3-X with a distinct patch of strong spinelike spicules; setae 1,2-X single; 4-X with 4 pairs of setae, 4,5 branched each, all inserted within grid; anal gills 4,5 times as long as saddle length. *Siphon*. Moderately long and thick, same color as head capsule; evenly broad in basal 0.5, gradually tapered in apical 0.5, sometimes slightly swollen in middle; pecten teeth 17-18; each tooth with 1,2 strong basal denticles and 2,3 finer distal denticles; siphonal tufts 4 pairs, in a regular row on subventral surface; first 2 proximal pairs 4 branched; next 2 distal pairs 3 branched; their length varying from 0.5-0.75 of siphonal width at point of insertion; 2-S short, spinelike; median caudal filament of spiracular apparatus minute or poorly developed.

TYPE-DATA. (1) *Culex viridiventer* Giles; Lectotype ♂ with attached genitalia mount; Naini Tal, U.P. (United Provinces), INDIA, 7000 feet, June 1900, Giles (BMNH; selection of Bram 1967b:328); (2) *Culex angulatus* Theobald; Lectotype ♂, Naini Tal, U.P. (United Provinces), INDIA, June 1900 Giles (BMNH; selection of Bram 1967b:328); (3) *Culex longifurcatus* Theobald, Type ♂ and ♀, Dahawangahary Hill, near Bengal frontier, NEPAL (BMNH).

DISTRIBUTION. India, Nepal and Bangladesh; also recorded from Vietnam and China. *Material examined*. 13 ♂, 15 ♀, 1 L, 5 lp.

INDIA. Western Himalayas: Kasauli; *United Provinces*: Naini Tal (type-locality); 13 ♂, 15 ♀, 5 lp.

CHINA. *Yunnan*; 1 L (APO 927, S. Billings, collector, 1944).

TAXONOMIC DISCUSSION. The above description of *viridiventer* is based on the adult specimens in the type-series and several others, including the reared adults with associated immature skins subsequently collected and identified by Barraud. The record of this species from Vietnam (Indochina) by Borel (1930) appears to be correct judging from the figure of the male genitalia by this author. The additional new record from Yunnan, China is based on a fourth in-

star larva collected by S. Billings in 1944.

Of all stages, the male genitalia of *viridiventer* is most diagnostic, particularly in the peculiar development of the basal sternal process of the proctiger, the densely packed bristles on the tergal surface of the basimere and in the detail of the subapical lobe. The female and pupa are difficult to distinguish but the larva is quite distinct and can readily be separated by the combination of the chaetotaxy, the shape and other features of the siphon. Among the Oriental species, the *viridiventer* larva strongly resembles that of *spiculothorax* Bram (1967a:155) from Thailand except for the absence of spicules on the thorax. It is quite possible that both forms are conspecific, however, as *spiculothorax* is known only from the larva, the point can not be settled. There is also much similarity in the larva of *viridiventer* and *shebbearei* Barraud, indicating that they are probably related.

BIONOMICS. According to Barraud (1934:380), the larvae of *viridiventer* were found breeding in tree holes, garden water tanks and butts and that it was reported to occur at a high elevation (5,000 to over 8,000 feet). Nothing is known about adult feeding behavior and its medical importance.

Culex (Culiciomyia) shebbearei Barraud

(Fig. 4)

Culex (Culiciomyia) shebbearei Barraud 1924:19(♂*,♀);
Barraud 1934:380(♂*,♀).

FEMALE. Wing: 4.2 mm. Forefemur: 1.9 mm. Proboscis: 2.25 mm. As described by Barraud (1924:19; 1934:380); in general very similar to *viridiventer*, differing in smaller size, darker coloration and in the following features. *Head*. Narrower linear decumbent scales of vertex apparently fewer. Palpus and proboscis more slender and thinner. *Thorax*. Mesonotal scales finer and darker. *Abdomen*. Terga II-VII with narrow, evenly broad basal pale bands.

MALE. As in female, differing from *viridiventer* particularly in the following features. *Head*. Palpal segment 3 with longer and broader translucent scales on ventral surface; segments 4 and 5 with stronger bristles. Proboscis with distinct false joint at middle and a strong, distinct ventral tuft of 4,5 hairlike setae proximad of false joint.

MALE GENITALIA (Fig. 4). *Segment IX*. Tergal lobe with 6,7 setae. *Basimere*. Slender, more or less rectangular, about 0.23 mm in length; tergomesal margin concave, lateral tergal margin slightly convex; tergomesal margin with 1,2 rows of very short, weak setae and 4-6 strong submarginal setae from basal 0.5 to level of subapical lobe. *Subapical lobe*. Short, broad, proximal and distal divisions largely overlapped but clearly divided; proximal division bears 3 rodlike setae and a dense patch of about 10 strong, lanceolate setae laterad; distal division with a stout bladellike seta, 1 fine spinelike seta

and a broad, apically pointed sterno-apical spiculose lobe, latter with 6-8 fine setae forming patch basad. *Distimere*. Normal, subapical crest well developed, consisting of 4-5 strong toothlike spicules; 1,2 dorsal and 1 ventral tiny seta present distad of median curvature. *Phallosome*. Essentially similar to *viridiventer* and *bahri*. *Proctiger*. Basal sternal process slender, relatively short, dark pigmented; 4 cercal setae.

PUPA. Abdomen: 2.5 mm. Paddle: 0.74 mm. Trumpet: 0.65 mm; index 5. Exceedingly similar to *viridiventer*, detailed chaetotaxy as figured for the latter, differing in smaller size and in the following features. *Cephalothorax*. Seta 2-C double; 5-C double or triple; 9-C double. *Metanotum*. Seta 11-C double, sometimes single. *Abdomen*. Seta 6-III single; 5-IV-VI shorter; 9-VII double or triple; 4-VIII single or double.

LARVA (Fig. 4). Exceedingly similar to *viridiventer* in general and detailed chaetotaxy, differing in the following combination of characters. *Head*. Seta 5-C 4 branched; 6-C triple. *Thorax*. Seta 7-P double or triple. *Siphon*. Siphonal tufts stronger, first proximal pair double; second proximal pair triple; 2 distal pairs double, 1.5-2.0 times as long as siphonal width at point of attachment.

TYPE-DATA. Lectotype ♂ with slide of genitalia, Kurseong, Darjeeling District, *East Himalaya*, INDIA, 4500 ft., Bred, Sept. 1922, P.J. Barraud (BMNH; selection of Bram 1967b:328).

DISTRIBUTION. India (East and West Himalayas), Sri Lanka, Borneo (Barraud 1934:380-381) and Hong Kong. Records from Sri Lanka and Borneo are doubtful. Material examined. 7♂, 10♀, 2 lp. INDIA *East Himalaya*: Kurseong; *West Himalaya*: Simla, 6♂, 10♀, 2 lp. HONG KONG, 1♂ (R.B. Jackson, collector, 1934).

TAXONOMIC DISCUSSION. The above description of *shebbearei* is based on the type males and females from the eastern Himalayas and a few other reared adults with associated immature skins from the western Himalayas originally and subsequently described by Barraud (1924; 1934). In addition to the previous records, this species is now known also from Hong Kong. This new record is based on a male collected by R.B. Jackson in 1934.

Culex shebbearei closely resembles *viridiventer* in the general adult characters and in the immature stages but can be readily separated from it by several features of the male genitalia as described and illustrated. The male genitalia of *shebbearei* are rather similar to that of *javanensis* and *bailyi* in the basimere and the development of the setae of the subapical lobe but is distinct from these 2 species in the presence of a strong spiny crest on the outer subapical margin of the distimere, the shorter basal sternal process of the proctiger and the details of the setae of the subapical lobe.

BIONOMICS. As noted for *viridiventer*, *shebbearei* also appears to be restricted to high elevation in mountainous areas. In the western Himalayas, the larvae were collected in tree holes and those in Borneo in a large pitcher

plant (Barraud 1934:380). The latter record and the type of breeding site are doubtful. Nothing is known about adult biology.

Culex (Culiciomyia) javanensis Bonne-Wepster

(Fig. 5)

Culex (Culiciomyia) javanensis Bonne-Wepster 1934:274(♂*,♀*).

Culex (Culiciomyia) spiculothorax Bram, Ramalingam and Pillai 1972:272(misidentification).

FEMALE. Wing: 4.2 mm. Forefemur: 2.25 mm. Proboscis: 2.5 mm. As described by Bonne-Wepster (1934:274); in general relatively large in size; abdominal terga entirely dark. *Head*. Narrow, linear decumbent scales yellowish brown, restricted to small, central area of vertex and occiput; scales on anterior margin and lateral area broad, numerous and entirely dark brown; erect scales slender and dark brown; lateral patch of broad scales pale whitish. Palpus and proboscis entirely dark scaled. *Thorax*. Mesonotal scales predominantly dark brown and apparently not as dense as most *Culiciomyia* species. Pleural integument without striking pattern of dark bands or spots; scales entirely absent; 1 lower *mep* bristle present. *Legs*. No distinctive coloration. *Wing*. All scales dark; scales on veins R₂, R₃ and R₄₊₅ narrow, linear and dense; furcation of cell M₂ apparently proximad of furcation of cell R₂. *Abdomen*. Terga II-VII dark scaled, basal pale bands absent; sterna pale yellowish.

MALE. *Head*. Palpus exceeding proboscis by full length of segment 5; segment 3 with distinct row of 7-8 translucent scales on ventral surface, its apex bears 1,2 dark bristles; segments 4 and 5 weakly to strongly plumose. *Abdomen*. Terga entirely dark; terga V-VII sometimes with narrow basal pale bands.

MALE GENITALIA (Fig. 5). *Segment IX*. Tergal lobe with a row of 8-10 subequal setae, sometimes 4-7. *Basimere*. Slender, more or less rectangular, about 0.24 mm in length; tergomesal margin slightly concave with about 10 submarginal setae in 2 irregular rows from basal 0.25 to level of subapical lobe; lateral tergal margin convex with 4-6 strong bristles restricted to basal 0.5 on outer surface. *Subapical lobe*. Broadly round and short with all specialized setae similarly developed as in *shebbearei*; setae laterad of rodlike setae on proximal division very strong, flattened, lanceolate, about 8, densely packed; sterno-apical spiculose lobe broad and rounded, without patch of setae other than minute fine setae basad. *Distimere*. Simple, normal; subapical crest poorly developed, with a row of 2-5 small toothlike spicules, sometimes more reduced or absent; subapical claw very short, slender and pale. *Phallosome*. As described for *shebbearei*. *Proctiger*. Basal sternal process slender, moderately long and dark pigmented; 3,4 cercal setae.

PUPA. As figured for *viridiventer*. Abdomen: 3.4 mm. Paddle: 1.0 mm. Trumpet: 0.82 mm; index about 6. Cephalothorax and abdomen pale yellowish, brownish on wing case, metanotum and abdominal segments I-IV. *Trumpet*. More or less cylindrical, meatus dark in basal 0.3 and apical 0.25, pale in middle; pinna

oblique; apical margin truncate. Detailed chaetotaxy very similar to *viridiventer* and *shebbearei*, differing in the following combination. *Cephalothorax*. Seta 2-C double or triple; 5-C 4 branched; 8-C usually double (2-3); 9-C double, subequal to 8-C. *Abdomen*. Setae 3-II, III double; 5-IV usually double, sometimes triple; 5-VI usually double (1-2); 6-III-VI usually double, sometimes single or triple. *Paddle*. Midrib stronger, more pigmented and distinct.

LARVA (Fig. 5). Head: 0.90 mm. Siphon: 1.9 mm; index about 7. Saddle: 0.46 mm; siphon/saddle ratio about 4. Very similar to *viridiventer* and *shebbearei*, differing particularly in the following characters. *Head*. Antennal shaft with stronger spicules; setae 2,3-A located at a longer distance from apex. *Thorax*. Spiculation variable, from poorly to moderately developed or completely absent; seta 1-M very strong, double, as long as or longer than 3-M. *Abdomen*. Setae 6-III-V double; setae 1-III-VII double. *Anal segment*. Saddle yellowish or brownish, caudal margin with more numerous spicules; seta 1-X very strong, 1,2 times as long as saddle; setae of ventral brush with 6-8 branches. *Siphon*. Relatively longer and darker, uniformly pale yellowish to brownish throughout the whole length; pecten teeth 17-20, each with 5 graded denticles; siphonal tufts strong, usually 4 pairs, sometimes 3 or 3.5, each tuft usually double or triple; most distal pair sometimes 4 branched; median caudal filament well developed.

TYPE-DATA. Holotype ♀ (81-36), marked as type by Bonne-Wepster, Tjisarua (near Buitenzorg), Java, INDONESIA, larvae in a temporary ground pool on a mountain road (1,200 m), April, 1931, Bonne-Wepster (BMNH).

DISTRIBUTION. Indonesia (Java) and Malaysia. *Material examined*. 61♂, 96♀, 9 L; 4 1 with associated immature skins (9 p, 32 lp).

INDONESIA. Java: Tjisarua (type-locality); 8♂, 1♀ (holotype). MALAYSIA. *Peninsular Malaysia - Pahang*: Cameron Highlands; 42♂, 55♀, 9 L, 11 lp. *Sabah*: Mt. Kinabalu; 11♂, 40♀, 9 p, 21 lp.

TAXONOMIC DISCUSSION. The assignment of the Malaysian material previously attributed to *Culex spiculothorax* Bram (1967a:155) by Ramalingam and Pillai (1972:272) to *javanensis* is based on the comparison of the male genitalia with the specimens in the type-series from Java. It is possible that some of this material, particularly from Sabah, also includes specimens of *bailyi* to which it is very similar. The distribution of both species appears to largely overlap throughout Malaysia. *Culex javanensis* is evidently closely related to *shebbearei* and *bailyi*. The 3 species also exhibit a strong similarity to *kyotoyensis* Yamaguti and LaCasse (1952) and *sasai* Kano, Nitahara and Awaya (1954) from Japan in the male genitalia, indicating that they are closely related and form a species complex or group. Further studies based on the topotypic reared material of each of these forms and their distribution patterns are needed for determining their specific status. It is probable that some of these nominal forms are only subspecifically distinct.

Culex javanensis can be readily separated from all other related species mentioned above in the adults by the completely dark abdominal terga; in the

male genitalia by the details of the subapical lobe and the development of the spiny crest of the distimere. The pupa is difficult to distinguish from *shebbearei* and *bailyi* except for the slight difference in the branching of certain setae specified above. The larva is very variable in the development of the spiculation of the thorax and exhibits a strong resemblance in general character and detailed chaetotaxy to that of *bailyi* as described and figured by Bram (1967a:123,128). It can however be distinguished from *bailyi* by abdominal setae I-III-VII usually double (single in *bailyi*), the shorter siphon and the stronger siphonal tufts which are usually 4 pairs (3 in *bailyi*).

BIONOMICS. *Culex javanensis* has been reported to occur in mountainous regions at elevations ranging from 4,000 to 7,000 ft. It has been found breeding frequently in general ground pools and rock pools and occasionally in tree holes, stump holes and discarded tin cans. These breeding sites are under partial or heavy shade of primary or secondary rain forests. At Cameron Highlands, Pahang and Mt. Kinabalu, Sabah, Malaysia, *javanensis* appears to be rather common and has been collected on several occasions. Nothing is known about adult biology.

Culex (Culiciomyia) harrisoni n.sp.

(Fig. 6)

FEMALE. Wing: 4.0-5.0 mm. Forefemur: 1.9-2.7 mm. Proboscis: 2.0-2.9 mm. Medium to large sized, with the following diagnostic features. *Head*. Decumbent scales of vertex numerous, entirely narrow, linear, pale beige or yellowish, occupying an extensive triangular area in center and along upper eye margin; broad scales largely restricted to lateral patch at side of eye; erect scales numerous and entirely black. Palpus and proboscis dark scaled. *Thorax*. Mesonotal scales very dense and predominantly pale golden or yellowish. Pleuron with more or less distinct darkened areas or spots on *ppl*, *ssp*, *psp*, anterior lower *stp*, base of *pra* and sometimes also on upper *mep*; scales absent; lower *mep* bristles 1-3. *Legs*. Hindfemur with distinct whitish stripe from base to near apex, rest of legs dark scaled on dorsal and lateral surfaces. *Wing*. Scales on veins R_2 , R_3 , R_{4+5} narrow, linear and dense; furcation of cell M_2 clearly proximad of furcation of cell R_2 . *Abdomen*. Terga II-VII with broad, clearly marked basal pale bands; sterna entirely yellowish white.

MALE. In general as described for female. *Head*. Palpus long, slender, exceeding proboscis by full length of segment 5; segment 3 with a distinct ventral row of 5,6 long, translucent scales, its apex with 2,3 weak, short bristles; segments 4 and 5 moderately plumose. Proboscis with a distinct false joint, more or less median in position and a distinct ventral tuft of 6-8 long, bristlelike setae. Antennal flagellum densely long plumose.

MALE GENITALIA (Fig. 6). Extremely similar to *shebbearei* and *javanensis*, differing particularly in the following details. *Segment IX*. Tergal lobe small, with about 10 strong and relatively long, bristlelike setae which are

densely packed. *Basimere*. Very stout, almost 0.3 mm in length; lateral tergal surface with stronger and more numerous bristles; inner tergal surface with 3, 4 prominent rows of stronger submarginal setae from middle to level of subapical lobe, these setae are densely packed with several other broad, bladelike setae laterad of proximal division of subapical lobe. *Subapical lobe*. Rodlike setae stronger and dark pigmented; sterno-apical spiculose lobe more prominent, elongate and apically pointed, bearing at its base a dense tuft of several long, fine setae sternad. *Distimere*. Subapical spiny crest strong, distinct, composed of 4-6 heavy, toothlike spicules. *Phallosome*. Lateral plate with stronger distal denticles. *Proctiger*. As in *shebbearei* and *javanensis*, basal sternal process slender, short and dark pigmented; 5 cercal setae.

PUPA. As figured for *viridiventer*. Abdomen: 3.6 mm. Paddle: 0.9 mm. Trumpet: 0.75 mm; index 7. Cephalothorax and abdomen pale whitish with indefinite darkened areas. Essentially similar to *viridiventer* and *shebbearei* in most features of chaetotaxy, differing slightly in the following. *Cephalothorax*. Seta 2,3-C usually triple (2-4); 8-C usually single or double (1-3). *Metanotum*. Seta 11-C usually single, sometimes double. *Abdomen*. Seta 3-II double; 3-III usually single (1-2); 6-III-IV usually double (1-3); 6-V-VI single. *Paddle*. Seta 2-P present, minute or poorly developed.

LARVA (Fig. 6). Head: 0.90 mm. Siphon: 1.3 mm; index 4. Saddle: 0.4 mm; siphon/saddle ratio 4. As figured; head capsule, antenna, siphon and saddle pale whitish; the following features are diagnostic. *Head*. Setae 5,6-C placed cephalad; 5-C 3-5 branched; 6-C 3-4 branched. Antenna rather short, about 0.5 of head length. *Thorax*. Spiculation absent; seta 7-P usually 4,5 branched (3-5); 8-P minute or strongly reduced to about the same magnitude as 0-P, 4-7 branched; 1-M minute, 2-3 branched; 5-M usually double (1-2). *Abdomen*. Most setae very weak and short; setae 6-I,II usually 4 branched (3-5); 7-I usually triple (2-3); 6-III-V 3,4 branched; 6-VI double or single; 1-III-VI weak, usually double (1-2); 1-VII short, single or forked into 2 branches. Comb scales 40-45; apical fringes normal. *Anal segment*. Saddle short; seta 4-X weak, with 4 pairs of setae, each 3,4 branched; anal gills 4,5 times as long as saddle. *Siphon*. Thick and short, resembling *viridiventer* in shape and size; 16,17 pecten teeth; distal teeth barbed with 4,5 graded denticles; siphonal tufts strong, usually 5 pairs, sometimes 4.0-4.5; first 2 proximal pairs inserted within or slightly distad of pecten; 4,5 branched, next 2 pairs 3-5 branched; subequal to first 2 proximal pairs; most distal pair weakest and shortest, triple; median caudal filament not developed.

TYPE-DATA. *Holotype* ♂ (05670-6) with associated pupal and larval skins and genitalia slide, rock pool, inside a cave; Chiang Dao, *Chiang Mai*, THAILAND, 11 December 1969, B.A. Harrison and K. Mongkolpanya, deposited in United States National Museum (USNM). *Allotype* ♀ (05670-3) with associated pupal and larval skins, same data and depository as holotype; *paratypes*: 4 lp ♂ (05670-4, 5,16,17); 5 p ♂ (05670-104,105,106,107,108); 11 lp ♀ (05670-1,2,7,8,9,10,11,12, 13,14,15); 4 p ♀ (05670-100,101,102,103); 38 whole larvae (L); same data as holotype; to be deposited in USNM and BMNH.

DISTRIBUTION. Known only from Chiang Mai, Thailand. *Material examined*.

16 ♂, 21 ♀, 45 L; 37 individual rearings (17 larval, 20 pupal).

THAILAND. *Chiang Mai*: Chiang Dao: 10♂, 19♀, 38L; 9 , 17 lp, all in collection No. 05670 as indicated in the type-data; 2♂ (05676); 5♀, 5 p (05679), 19 December 1969, other data as in collection 05670.

TAXONOMIC DISCUSSION. *Culex harrisoni* is evidently closely related to *shebbearei*, *javanensis* and *bailyi* and with the latter 3 species, *kyotoyensis* and *sasai*, fall into a distinct species group or complex. Of all stages, the larva is most distinctive. It can be readily differentiated from the above species by the minute seta 8-P, minute seta 1-M, seta 5-M usually double; 6-III-V 3,4 branched; weak and short setae 1-III-VII, the short and thick siphon and the siphonal tufts usually 5 pairs. The adults closely resemble *shebbearei* and *bailyi* but differ conspicuously in having more numerous narrow decumbent scales on the dorsum of vertex and the presence of more distinct pattern of dark spots on the pleuron. The male genitalia are rather similar to *shebbearei* and *javanensis* from which they can be readily distinguished by the setae of tergal lobe of segment IX and the detail of the subapical lobe of the basimere.

BIONOMICS. The specimens of *harrisoni* were collected from a cave in a mountainous area at an elevation of about 600 m. Larvae were found breeding in 2 dark shaded rock pools which were approximately 300 to 400 m inside the cave. These pools were about 38-45 cm in diameter and 8.5-10.0 cm in depth. The water was fresh and contained no vegetation. Most of the adults came from rearing the larvae or pupae and only a few were collected while resting on wall of cave near the breeding site. Adult biology is unknown.

ACKNOWLEDGMENTS

I thank Ronald A. Ward and John F. Reinert for reading and editing the manuscript, Young T. Sohn for preparing the illustrations and Linda Benton for typing the manuscript. I also thank Peter F. Mattingly for the loan of specimens of *bahri*, *viridiventer* and *shebbearei* from the British Museum (Natural History), Shivaji Ramalingam for providing numerous specimens of *javanensis* and Bruce A. Harrison for placing at my disposal the numerous reared specimens of *harrisoni*.

REFERENCES

- Barraud, P. J. 1924. A revision of the culicine mosquitoes of India. Part XIV. The Indian species of the subgenus *Culiciomyia* (Theo.) Edw., including one new species. *Indian J. Med. Res.* 12: 15-22, 1 pl.
- _____. 1934. The fauna of British India, including Ceylon and Burma. Diptera. Vol. V. Family Culicidae. Tribes Megarhinini and Culicini. Taylor and Francis, London. 463 p., 7 pl.

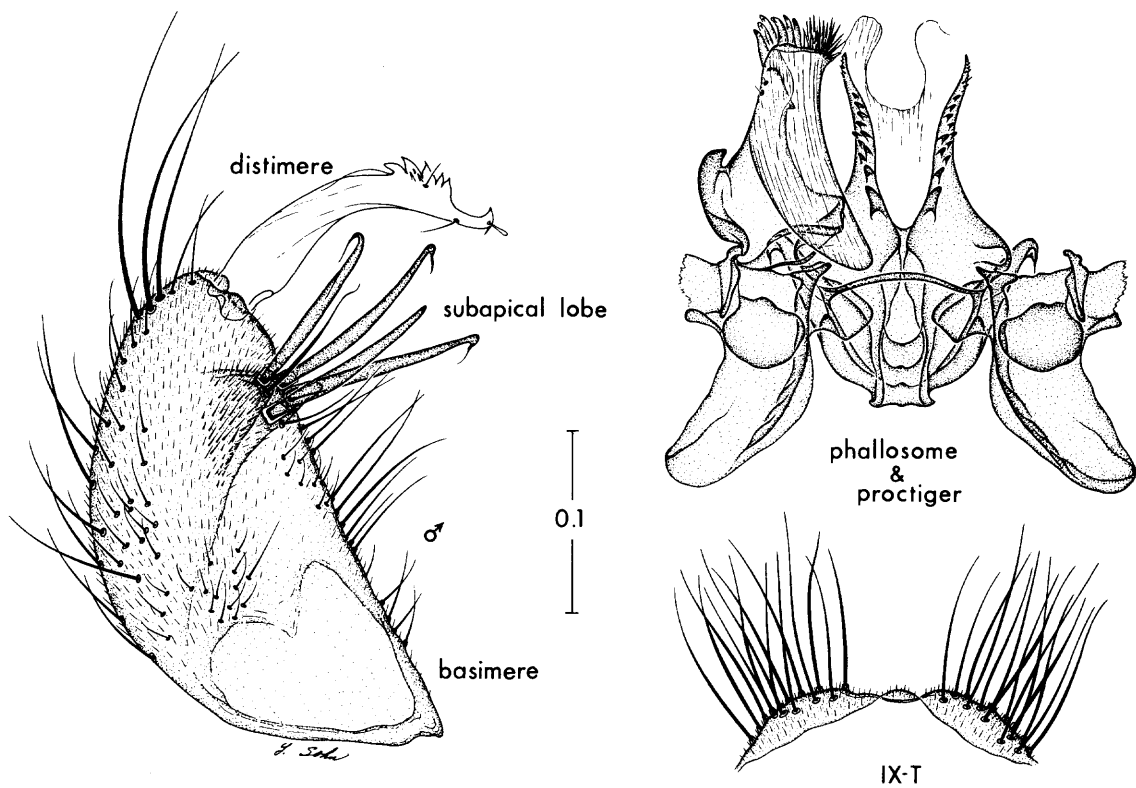
- Bonne-Wepster, J. 1934. New mosquitos (Dipt.) from the Netherlands Indies. *Stylops* (Roy. Entomol. Soc., Lond.) 3: 272-6.
- Borel, E. 1930. Les moustiques de la Cochinchine et du Sud-Annam. *Soc. Pathol. Exot. Monogr.* 3: 1-423.
- Bram, R. A. 1967a. Contribution to the mosquito fauna of Southeast Asia - II. The genus *Culex* in Thailand (Diptera: Culicidae). *Contrib. Am. Entomol. Inst.* (Ann Arbor) 2(1): 1-296.
- _____. 1967b. Lectotype assignments for several species of the genus *Culex* in Southeast Asia (Diptera: Culicidae). *Proc. Entomol. Soc. Wash.* 69: 327-8.
- Carter, H. F. 1950. Ceylon mosquitoes: Lists of species and names of mosquitoes recorded from Ceylon. *Ceylon J. Sci.* (B)24: 85-115.
- Edwards, F. W. 1913. New synonymy in Oriental Culicidae. *Bull. Entomol. Res.* 4: 221-42.
- _____. 1914. New species of Culicidae in the British Museum, with notes on the genitalia of some African *Culex*. *Bull. Entomol. Res.* 5: 63-81.
- Giles, G. M. 1901. A plea for collective investigation of Indian Culicidae, with suggestions as to moot points for enquiry, and a prodromus of species known to the author. *J. Bombay Nat. Hist. Soc.* 13: 592-610.
- Harrison, B. A., J. F. Reinert, S. Sirivanakarn, Y.-M. Huang, E. L. Peyton, and B. De Meillon. 1974. Distributional and biological notes on mosquitoes from Sri Lanka (Ceylon) (Diptera: Culicidae). *Mosq. Syst.* 6: 142-62.
- Kano, R., M. Nitahara and J. Awaya. 1954. Description of a new mosquito, *Culex* (*Culiciomyia*) *sasai* n.sp., collected in the southwestern part of Japan (Culicidae, Diptera). *Jap. J. Sanit. Zool.* 5: 14-20.
- Ramalingam, S. and A. G. Pillai. 1972. Ten new records of mosquitoes occurring in West Malaysia. *Southeast Asian J. Trop. Med. Public Health.* 4: 271-2.
- Sirivanakarn, S. 1973. Three new species of *Culex* subgenus *Culiciomyia* Theobald from Southeast Asia and a redescription of the type of *C. tricuspis* Edwards from Alor, Lesser Sunda Islands, Indonesia (Diptera: Culicidae). *Proc. Entomol. Soc. Wash.* 75: 112-24.
- Theobald, F. V. 1901. A monograph of the Culicidae or mosquitoes. Vol. II, *Br. Mus. (Nat. Hist.)*, London. 391 p.

Theobald, F. V. 1910a. I. Second report on the collection of Culicidae in the Indian Museum, Calcutta, with descriptions of new genera and species. Rec. Indian Mus. 4: 1-33.

_____. 1910b. A monograph of Culicidae or mosquitoes. Vol. V, Br. Mus. (Nat. Hist.), London. 646 p., 6 pl.

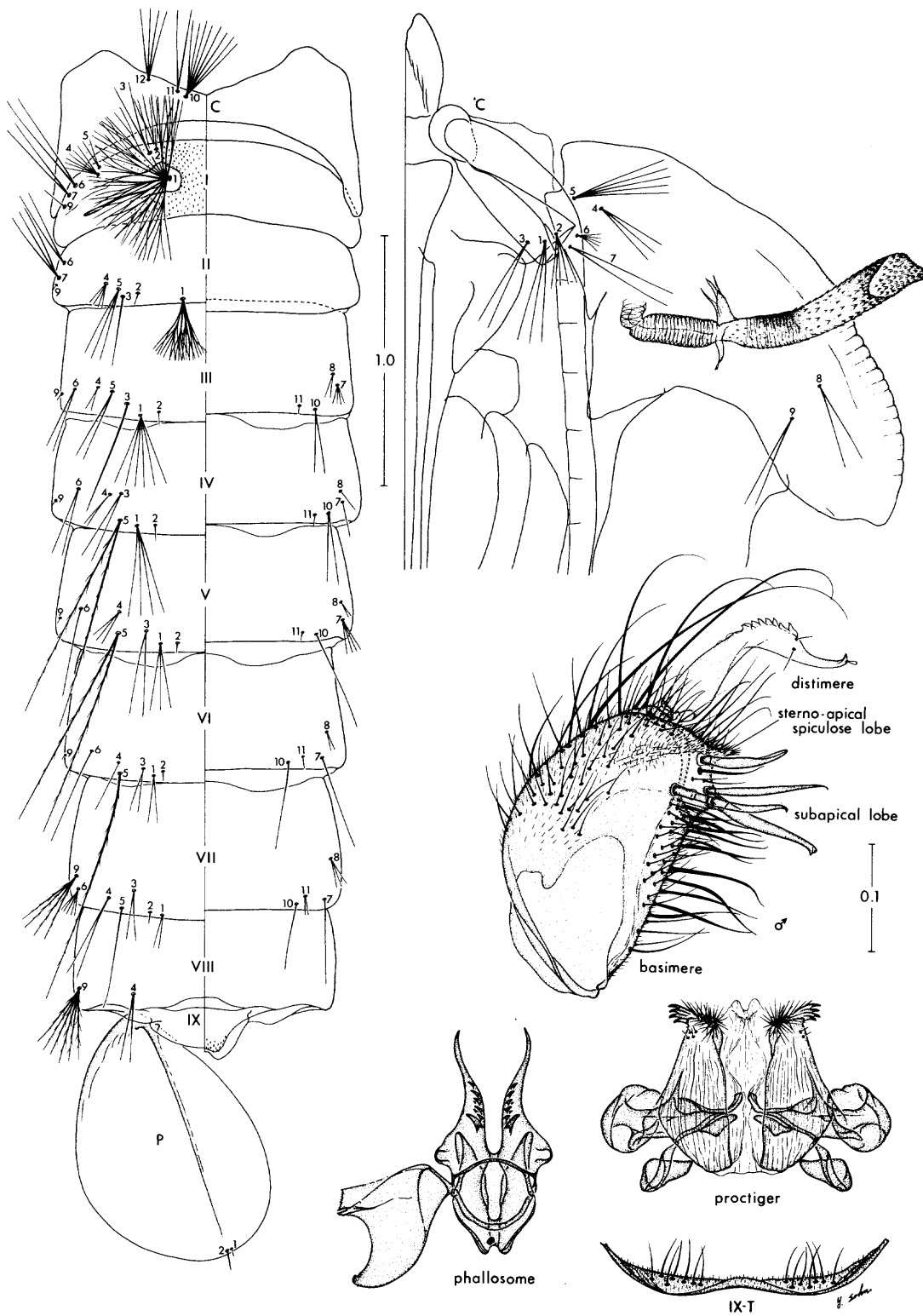
Yamaguti, S. and W. J. LaCasse. 1952. *Culex (Culiciomyia) kyotoyensis* n.sp. (Culicidae, Diptera) from Japan. Published by authors, Kyoto, Japan. 5 p., 2 pl.

Fig. 1



bahri

Fig. 2



viridiventer

Fig. 3

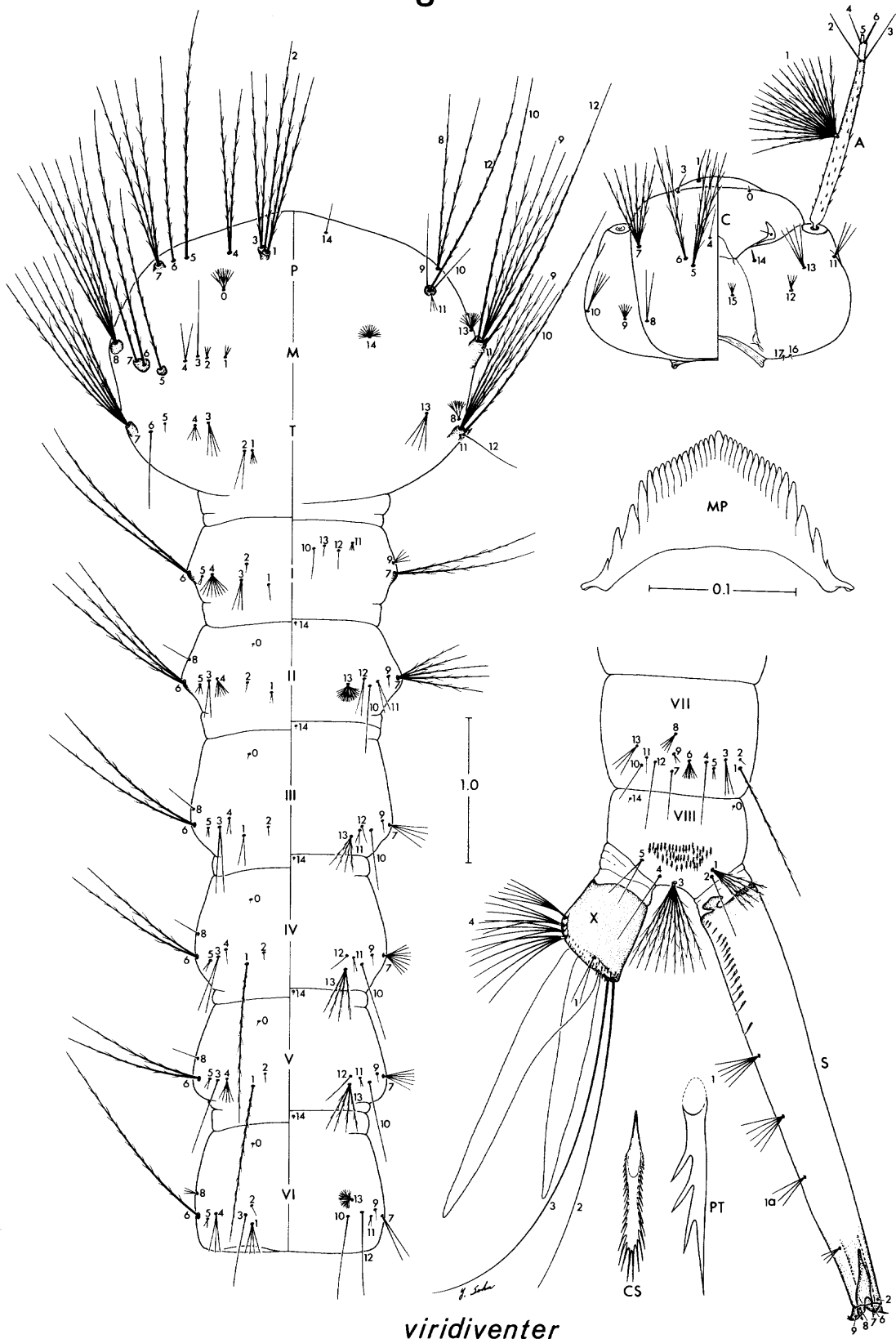


Fig. 4

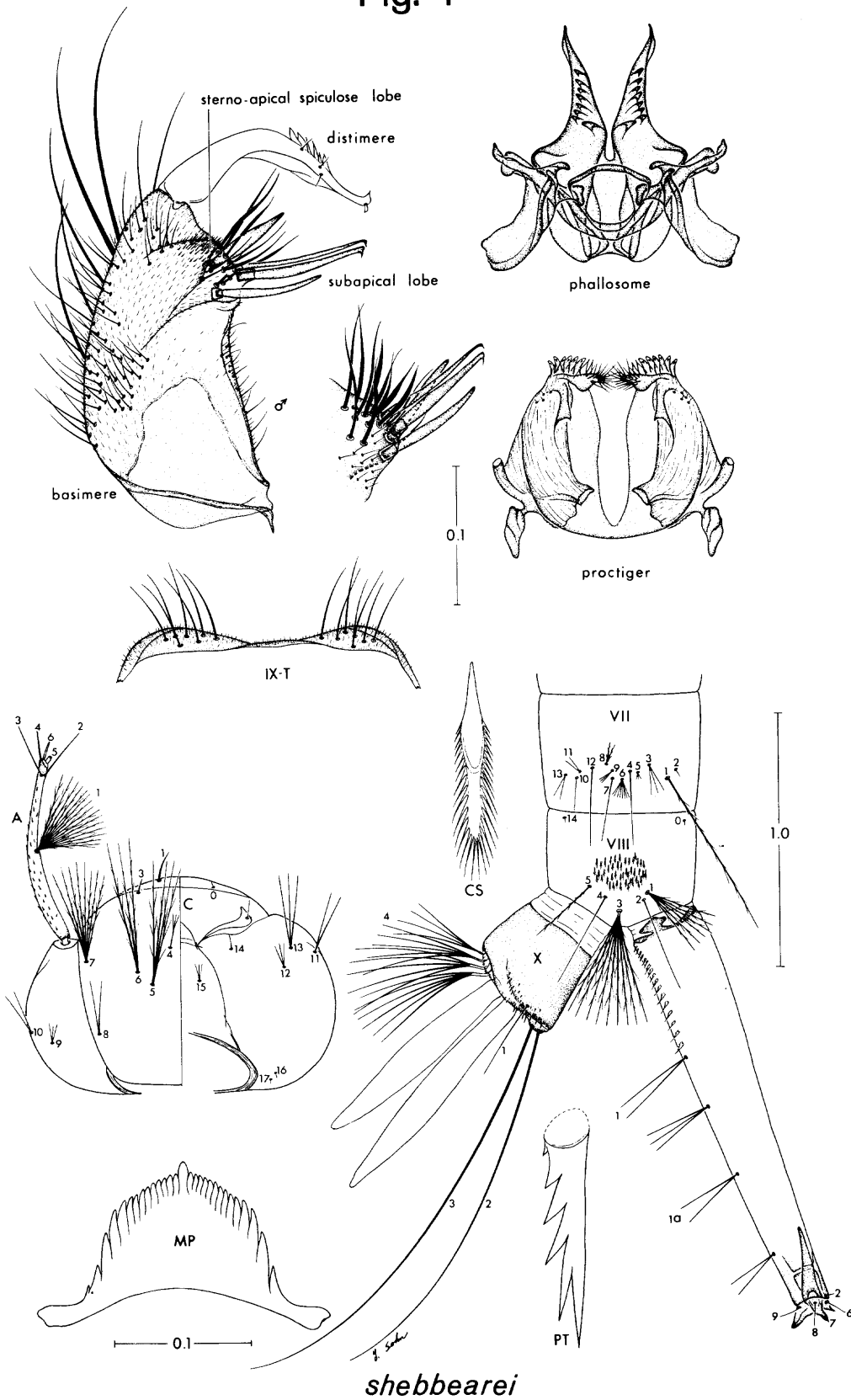


Fig. 5

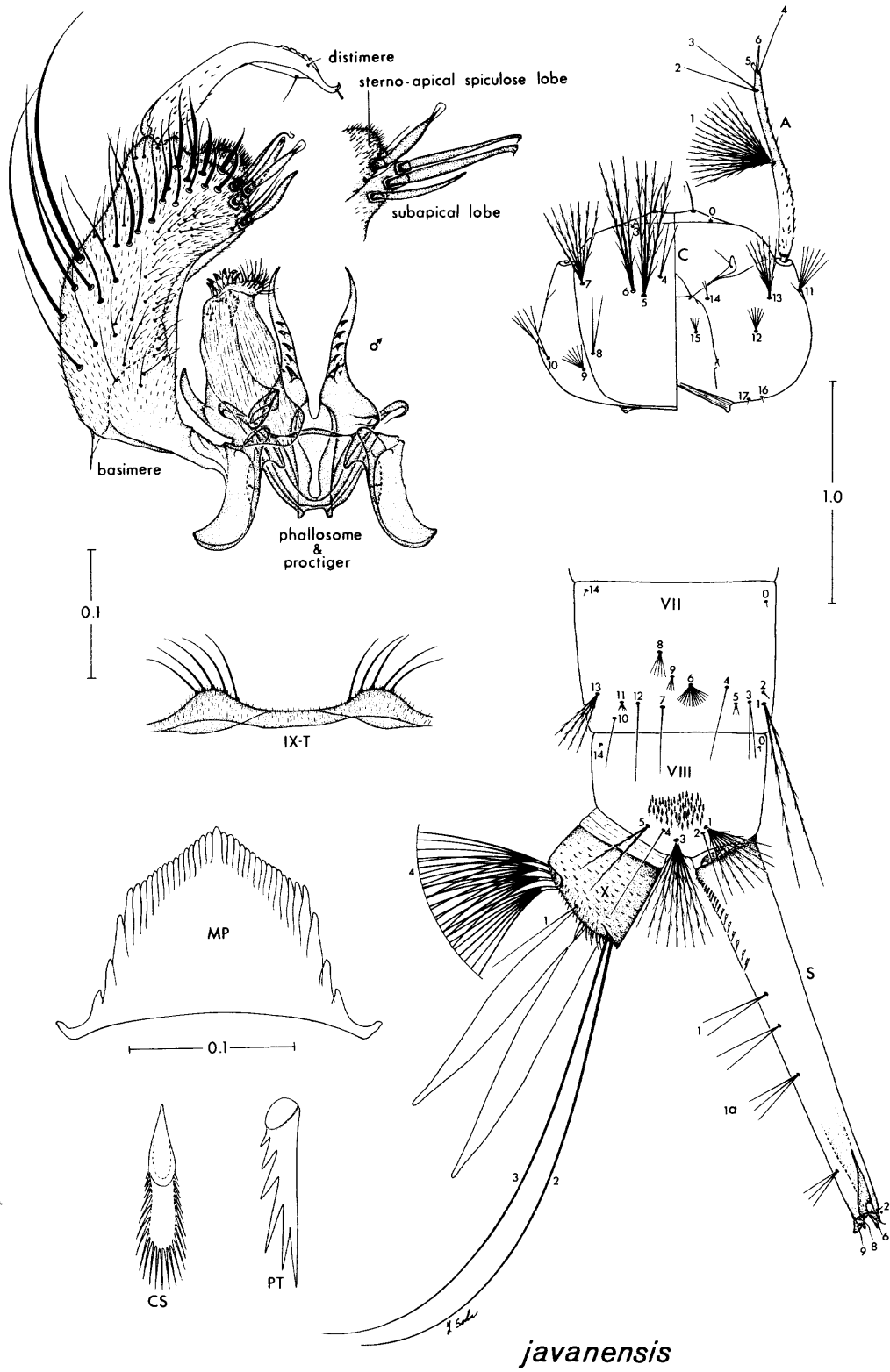


Fig. 6

