

The Fourth Instar Larval Mandible and Maxilla  
of Selected Aedes (Aedimorphus) Species  
(Diptera, Culicidae)<sup>1</sup>

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Mosquito larval mouthparts have been largely neglected in taxonomic studies even though they possess a wealth of structural detail. This neglect has been due in part to the need for troublesome special handling if the mouthparts are to be included in species descriptions, and in part to the lack of a full terminology for all of the included structural parts.

Since mosquito larval mouthparts have seldom been included in species descriptions, it is still not known to what extent they possess differences at the species level. However, it is abundantly clear from such works as Howard, Dyar and Knab (1912) and LaCasse and Yamaguti (1950) that higher categories can be recognized on the basis of differences in larval mouthparts and it accordingly seems quite possible that they may sometimes be of use in defining specific or supraspecific categories; and they will certainly be of use in phylogenetic studies.

Because of the deficiencies just described a study was undertaken (1) to contribute to the development of a terminology for all of the structures of mosquito larval mouthparts, and (2) to determine if constant differences occur among the members of a group of closely related species.

The mouthparts of the fourth stage larva of Aedes (Aedimorphus) vexans (Meigen) were used for the first part. The results of that portion of the study are contained in an article by Pao and Knight (1970). For the second part, comparative mandibular and maxillary descriptions and a preliminary key were prepared for 20 species of the subgenus Aedimorphus. The results of this portion of the study are given here. Although this study was confined to the mandible and maxilla because time did not permit an equally exhaustive examination of the remaining mouthparts, there is no reason to think that taxa-definitive characters will not be found on the other mouthparts.

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The techniques used in the preparation of specimens and the structural terminology developed are presented in Pao and Knight (1970). Aedes vexans was described from specimens from Iowa. This description is given in Pao and Knight (1970) and is not repeated here. All of the other Aedimorphus species included in this study and described in the following pages are African. Special thanks are due to Dr. E. C. C. van Someren of the Division of Insect-Borne Disease, Nairobi, Kenya and to Dr. B. M. McIntosh of the Arbovirus Research Unit, Johannesburg, South Africa for providing the specimens of these species.

There are presently 106 species and subspecies assigned to the subgenus Aedimorphus. Except for the cosmopolitan species Aedes vexans (Meigen), the subgenus Aedimorphus is present everywhere except in the New World. It is particularly well represented in the Ethiopian Region.

With such a proliferation of species, one should expect to find some natural groupings among the species. To help form some phylogenetic concepts of the members of the subgenus and also to expedite their identification, several efforts have been made to elucidate the natural groupings which occur.

The earliest comprehensive attempt of this type was made by Edwards (1932). Based mostly upon differences in male palpi, in male and female terminalia, and in ornamentation, he classified all of the then-known species into eight groups which were designated by the letters A through H and by the name of one of the more conspicuous species of each group.

Later, in his monumental work on the culicine mosquitoes of the Ethiopian Region, Edwards (1941) classified the Aedimorphus species of this Region into nine groups. These groups were based principally upon differences in leg markings and scutellar scaling. The letter designations were dropped but species names were used for the groups. Unfortunately, species occurring only outside of the Ethiopian Region were not considered.

Knight and Hurlbut (1949) in describing a new Aedimorphus species from Ponape Island in the Eastern Carolines, discussed some aspects of the group classification of Edwards (1932).

Additional aspects of the system have been touched upon by Knight and Hull (1951, 1953) and Hamon et al. (1961).

Based upon the information provided by all of these authors, the presently-known species of Aedimorphus have been segregated into 12 groups. One insufficiently described species has not been placed. The groups have been named after the earliest described included species.

Since no comprehensive comparison has been made of the morphological and biological features of this very large group of species, it is obvious that the groupings which follow should inevitably include many errors in association and for the time being must be considered highly preliminary in nature.

Species represented in this study are marked below with an asterisk.

Alboscutellatus Group

<u>alboscuteUellatus</u> (Theobald) 1905*	Australasian and Oriental Regions, Japan
<u>argenteoscutellatus</u> Carter and Wijesundara 1948	Ceylon
<u>culicinus</u> Edwards 1922	India
<u>jamesi</u> (Edwards) 1914	Ceylon, India
<u>lowisii</u> (Theobald) 1910	Andamans, Moluccas
<u>mindoroensis</u> Knight and Hull 1951	Philippines
<u>niveoscutellum</u> (Theobald) 1905	India, Indochina, Java
<u>oakleyi</u> Stone 1939	Marianas
<u>orbitae</u> Edwards 1922	Malaya
<u>pampangensis</u> (Ludlow) 1905	Philippines
<u>punctifemoris</u> (Ludlow) 1921	Philippines
<u>senyavinensis</u> Knight and Hurlbut 1949	Carolines
<u>trukensis</u> Bohart 1956	Carolines

Argenteopunctatus Group

<u>argenteopunctatus</u> (Theobald) 1901*	Tropical Africa
<u>bedfordi</u> Edwards 1936	Natal
<u>hopkinsi</u> Edwards 1936	Uganda
<u>insolens</u> Edwards 1936	Uganda, Upper Volta, Sierra Leone
<u>microstictus</u> Edwards 1936	Transvaal
<u>mixtus</u> Edwards 1936	Central and South Africa
<u>mutilus</u> Edwards 1936	Uganda, Belgian Congo
<u>punctothoracis</u> (Theobald) 1910	Central West Africa

Domesticus Group

<u>domesticus</u> (Theobald) 1901	Africa
<u>leptolabis</u> Edwards 1936	Africa
<u>longiseta</u> Edwards 1936	Belgian Congo
<u>ovazzai</u> Hamon and Adam 1959	French W. Africa

Irritans Group

<u>abnormalis abnormalis</u> (Theobald) 1910	Central W. Africa
a. <u>kabwachensis</u> Edwards 1941	Kenya, Uganda
<u>alboventralis</u> (Theobald) 1910	Africa
<u>congolensis</u> Edwards 1927	Belgian Congo, Gold Coast, Uganda
<u>culicinus</u> Edwards 1922	India
<u>dalzieli</u> (Theobald) 1910	Africa
<u>ebogoensis</u> Rickenbach and Ferrara 1966	Cameroons
<u>eritreae eritreae</u> Lewis 1942	Eritrea, Transvaal
e. <u>karooensis</u> Muspratt 1961	South Africa
<u>hamoni</u> Mattingly 1963	Nigeria
<u>irritans</u> (Theobald) 1901	Africa
<u>leesoni leesoni</u> Edwards 1932	Africa
l. <u>verna</u> Lewis 1944	Africa
<u>mattinglyi</u> Hamon and Rickenbach 1954	Haute Volta
<u>nigricephalus</u> (Theobald) 1901	Africa
<u>tauffliebi</u> Rickenbach and Ferrara 1966	Cameroons
<u>semlikiensis</u> Someren 1950	Uganda
<u>tricholabis tricholabis</u> Edwards 1941	Kenya
t. <u>bwamba</u> Someren 1950*	Uganda, Kenya, Dahomey
<u>wigglesworthi</u> Edwards 1941	Nigeria, Uganda

Lamborni Group

<u>boneti boneti</u> Gil Collado 1936	Fernando Po Island
<u>b. kumbae Chwatt</u> 1948	Nigeria
<u>lamborni</u> Edwards 1923*	Africa

Marshallii Group

<u>apicoannulatus</u> (Edwards) 1912	Sierra Leone, Nigeria
<u>capensis</u> Edwards 1924*	Africa
<u>gilliesi</u> Someren 1962	Tanganyika
<u>grjebinei</u> Hamon, Taufflieb, Maillot 1957	Gabon, Middle Congo
<u>haworthi</u> Edwards 1923*	Africa
<u>kapretwae</u> Edwards 1941	Kenya
<u>kennethi</u> Muspratt 1956*	Natal
<u>marshallii</u> (Theobald) 1901*	Africa
<u>ngong</u> Someren 1950	Kenya
<u>simulans</u> (Newstead and Carter) 1911	Africa
<u>stokesi</u> Evans 1929	Africa

Mediolineatus Group

<u>mediolineatus</u> (Theobald) 1901	Oriental Region
<u>nigrostriatus</u> (Barraud) 1927	India, Burma
<u>pallidostriatus</u> (Theobald) 1907	India, Ceylon, Thailand
<u>trimaculatus</u> (Theobald) 1905	India

Minutus Group

<u>albocephalus</u> (Theobald) 1903*	Tropical Africa, Madagascar, Seychelles
<u>falabreguesi</u> Hamon 1957	Ivory Coast
<u>filicis</u> Ingram and De Meillon 1927	Union S. Africa

<u>grenieri</u> Hamon, Service, Adam, Taufflieb 1961	Ivory Coast
<u>lokojensis</u> Service 1959	Nigeria
<u>lottei</u> Hamon and Brengues 1965	Ivory Coast
<u>minutus</u> (Theobald) 1901	Africa
<u>nyounae</u> Hamon and Adam 1958 (1959)	Ivory Coast
<u>phyllolabis</u> Edwards 1929*	Central Africa
<u>pseudotarsalis</u> Someren 1946*	Kenya
<u>reali</u> Hamon and Adam 1958 (1959)	Ivory Coast
<u>smithburni</u> Someren 1950	Uganda
<u>tarsalis</u> (Newstead) 1907	Africa
<u>wendyae</u> Service 1959	Nigeria
<u>yangambiensis</u> De Meillon and Lavoipierre 1944	Liberia, Belgian Congo
<u>yvonneae</u> Edwards 1941	Belgian Congo

Nummatus Group

<u>nummatus</u> Edwards 1923	India
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Ochraceus Group

<u>ochraceus</u> (Theobald) 1901*	Tropical Africa
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Quasiunivittatus Group

<u>bevisi</u> (Edwards) 1915	Natal, Cape Province
<u>caliginosus</u> (Graham) 1910	Nigeria
<u>cumminsii cumminsii</u> (Theobald) 1903*	Africa
<u>c. holocinctus</u> Edwards 1941	Kenya, Uganda, Ethiopia
<u>dentatus</u> (Theobald) 1904*	Africa
<u>gibbinsi</u> Edwards 1935	Uganda, Kenya
<u>pachyurus</u> Edwards 1936	Union of S. Africa
<u>pubescens</u> Edwards 1925	Central Africa

<u>quasiunivittatus</u> (Theobald) 1901*	Africa
<u>rickenbachii</u> Hamon and Adam 1959	French W. Africa
<u>subdentatus</u> Edwards 1936	Union of S. Africa
<u>Vexans Group</u>	
<u>arabiensis</u> (Patton) 1905	Aden, Saudi Arabia, Eritrea, Sudan
<u>caecus</u> (Theobald) 1901	Oriental Region, New Guinea, Mariannas
<u>centropunctatus</u> (Theobald) 1913	Sudan, British W. Africa
<u>durbanensis</u> (Theobald) 1903	Africa
<u>fowleri</u> (Charmoy) 1908*	Ethiopian Region
<u>hirsutus hirsutus</u> (Theobald) 1901*	Tropical Africa
<u>h. adenensis</u> Edwards 1941	West Aden Protectorate
<u>natronius</u> Edwards 1932	Yemen, Africa
<u>pipersalatus</u> (Giles) 1902	India, Ceylon
<u>stenoetrus</u> (Theobald) 1907	Ceylon, India, Thailand
<u>syntheticus</u> Berraud 1928	India
<u>taeniorhynchoides</u> (Christophers) 1911	India, Ceylon, Thailand, Hainan
<u>vexans</u> (Meigen) 1830*	Holarctic, Oriental, Pacific Islands, Transvaal

In the descriptions which follow, the term mesal and mesad wherever used designate structural areas toward the midline of the head capsule and not toward the midline of the structure itself. Conversely, the terms lateral and laterad are used to designate structural areas away from the midline of the head capsule.

## DESCRIPTIONS

Aedes alboscuteUellatus (Theobald)

(AlboscuteUellatus Group)

Maxilla. Cardostipes roughly oval-shaped, narrower than in A. vexans. Maxillary brush consisting only of simple hairs; these hairs somewhat less in number than in A. vexans, approximately twice length of cardostipes, stout, very long, sharply pointed; most maxillary brush hairs arise from cardogalea, remainder along apical region of chitinous ridge; a distinct strong hair arising subapically on chitinous ridge, this hair heavily pigmented, directed distoventrad. Chitinous ridge less pigmented than in A. vexans. Maxillary spurs long, slender, roughly equal in length. Mesal elements of cardolacinal mat with long branched spines proximally, long sharply pointed simple spines distally. Seta 3-MP long, slender, directed mesad, same location as in A. vexans; 4-MP and 5-MP equal in length; 6-MP sharply pointed, less stout than that of A. vexans. Sensoria 4 in number;  $S_1$  strongest;  $S_2$  small, roughly 0.7 length of  $S_1$ ;  $S_3$  longest, roughly twice length of  $S_1$ ;  $S_4$  small, 0.7 length of  $S_1$ ; sometimes a tiny accessory sensorium near  $S_4$ .

Mandible (Figures 2a, b). Pectinate hairs of cutting organ 4-5 in number; slender, slightly curved, fringed posteriorly. Ventral blade very long, much longer than in A. vexans; minutely serrate along posterior margin. Ventral tooth similar to that of A. vexans. Anterior dorsal tooth with a single denticle; posterior dorsal tooth with 3-6 denticles, most lateroanterior one closer to main posterior dorsal tooth than to other denticles. Dorsal spines 2 in number; mesal one slightly curved, directed mesocaudad; lateral one slender, rather straight, directed mesocephalad. Membranous process with somewhat straight cephalic margin, divided into 2 parts distally as in A. vexans. No single row of long hairs arising dorsally from membranous process and extending toward mandibular brush. Mandibular hairs, 10-15 in number, lateral hairs with branched tips, mesal hairs with sharply pointed tips. Mandibular brush fan-shaped; consisting of 72-79 bristles; these bristles much slenderer than those in A. vexans. Mandibular comb composed of 10-13 elongate teeth; lateral 6-8 teeth plumose, bristlelike; remainder stout, but slightly thinner than in A. vexans. Mandibular spurs 3 in number; most ventromesal spur shorter than other two but longer than in A. vexans; other two slenderer and longer than in A. vexans, curved; dorsolateral one darker and slightly longer than ventrolateral one. (5 specimens, British Solomon Islands)

Aedes argenteopunctatus (Theobald)

(Argenteopunctatus Group)

Maxilla. Cardostipes egg-shaped, smaller and narrower than in A. vexans. Maxillary brush approximately equal in length to cardostipes, consisting of 4 types of hairs, similar to those of A. vexans except pectinate hairs less serrate; most maxillary brush hairs arise from cardogalea, remainder along subapical region of chitinous ridge; no



distinct hair present. Chitinous ridge less pigmented than in A. vexans. Maxillary spurs similar to those of A. vexans, located near median portion of chitinous ridge, rather strong, approximately equal in length. Mesal elements of cardolacinial mat with longer branched spines proximally, short slightly-stout simple spines distally. Maxillary seta 3-MP long, slender, directed mesocephalad; 5-MP almost twice length of 4-MP; 6-MP lost in my specimens. Sensoria 4 in number;  $S_1$  strongest,  $S_3$  and  $S_4$  of about same length, 0.7 length of  $S_1$ ;  $S_3$  equal to  $S_1$  in length but thinner.

Mandible (Figures 2c,d). Pectinate hairs of cutting organ 3-5 in number, same size as in A. vexans, fringed posteriorly. Ventral blade blade-like, bearing small elongate teeth along posterior margin. Ventral tooth similar to that of A. vexans. Anterior dorsal tooth with or without a small denticle; posterior dorsal tooth with 3-6 small denticles. Dorsal spines 2 in number; mesal one rather strong, slightly curved, directed mesad; lateral one slender, directed mesodistad. Membranous process with somewhat straight anterior margin, divided into 2 parts distally similar to A. vexans. No single row of long hairs arising dorsally from membranous process and extending toward mandibular brush. Mandibular hairs 8-13 in number, lateral hairs with branched tips, mesal hairs with sharply pointed tips. Mandibular brush fan-shaped, consisting of 47-59 bristles, these bristles slightly stronger than in A. vexans. Mandibular comb composed of 9-12 elongate teeth; lateral 1-5 teeth plumose, bristle-like; remainder stout, same size as in A. vexans. Mandibular spurs 3 in number, most ventromesal spur shortest; other two rather strong, roughly equal in size. (5 specimens, Kenya)

Aedes tricholabis bwamba Someren

(Irritans Group)

Maxilla. Cardostipes egg-shaped, as wide as that of A. vexans. Maxillary brush approximately 1.5 length of cardostipes, consisting of 2 types of hairs: very short pectinate hairs and more numerous long pointed-tipped simple hairs; total number of hairs somewhat less than in A. vexans; most maxillary brush hairs arise from cardogalea, remainder along apical region of chitinous ridge; no distinct strong hair arising subapically on chitinous ridge. Chitinous ridge less pigmented than in A. vexans. Maxillary spurs located near medial portion of chitinous ridge, almost equal in length. Mesal elements of cardolacinial mat with shorter less-branched spines distally, long highly branched hairs proximally. Maxillary seta 3-MP very long, slender, sometimes difficult to find due to light-colored appearance; 4-MP, 5-MP relatively smaller than in A. vexans; 5-MP twice length of 4-MP; 6-MP long with sharply pointed ending. Sensoria 4 in number;  $S_1$  strongest of all;  $S_2$  small, only 0.5-0.7 length of  $S_1$ ;  $S_3$  longest, 1.3-1.5 length of  $S_1$ ;  $S_4$  small, 0.3-0.7 length of  $S_1$ .

Mandible (Figures 2e, f). Pectinate hairs of cutting organ 4-6 in number, less strong than in A. vexans; slightly curved, shortly fringed along posterior margin. Ventral blade longer than in A. vexans, bearing elongate tiny teeth caudally. Ventral tooth slenderer than in A. vexans.

Anterior dorsal tooth with 1-2 small denticle(s); posterior dorsal tooth with 4 elongate denticles, most anterior denticle closer to main posterior dorsal tooth than to other denticles, 3 posterior denticles arising from same base. Dorsal spines 2 in number; mesal one slightly curved, directed mesocaudad; lateral one rather straight, directed mesally. Membranous process slightly longer than in A. vexans, with somewhat straight anterior margin; divided into 2 parts distally, posterior portion broader than that of A. vexans and longer than anterior portion; no single row of long hairs arising dorsally from membranous process and extending toward mandibular brush. Mandibular hairs 9-14 in number, lateral hairs with branched tips and mesal hairs with sharply pointed tips. Mandibular brush fan-shaped; consisting of 76-78 bristles, these bristles similar to those of A. vexans. Mandibular comb composing of 12-16 elongate teeth; lateral 3-6 teeth plumose bristle-like; remainder stout, pointed-tipped, rather straight, slightly slenderer than in A. vexans. Mandibular spurs 3 in number, most ventromesal spur shortest, very lightly pigmented, other two slender, curved; dorsolateral one darkest and largest. (2 specimens, Kenya)

Aedes lamborni Edwards

(Lamborni Group)

Maxilla. Cardostipes cone-shaped, similar to that of A. vexans. Maxillary brush roughly same length as cardostipes; consisting of 4 types of hairs, similar to those of A. vexans except pectinate hairs slenderer in this species; maxillary brush hairs arising from apex of cardostipes; no distinct strong hair arising subapically on chitinous ridge. Chitinous ridge as dark as in A. vexans. Maxillary spurs located near medial portion of chitinous ridge; slender, long, almost of same length or sometimes anterior spur slightly longer. Mesal elements of cardolacinial mat with entirely branched long spines; no short, stout spines present in this area. Maxillary seta 3-MP very long, slender, sharply pointed, directed mesocaudally; 5-MP 1.5 times length of 4-MP; 6-MP very long with branched apex. Sensoria 4 in number;  $S_1$  strongest,  $S_2$  0.5-0.7 length of  $S_1$ ,  $S_3$  longest, 1.3-2.0 length of  $S_1$ ;  $S_4$  0.3-0.7 length of  $S_1$ ; 1-2 accessory sensoria sometimes existing near  $S_4$ , not minute, 0.3-1.0 length of  $S_1$ .

Mandible (Figures 2g,h). Pectinate hairs of cutting organ 6-10 (usually 8) in number; longer, slenderer, less curved than in A. vexans; bearing fringed posterior margin. Ventral blade blade-like, with small teeth along posterior margin. Ventral tooth (Vt) similar to that of A. vexans. Anterior dorsal tooth (Dt) with or without a small denticle; posterior dorsal tooth with 2-3 denticles. Dorsal spines 2 in number; mesal one curved, bending mesoproximad; lateral one small, straight, directed mesad. Membranous process with somewhat straight anterior margin, narrower than in A. vexans; divided into 2 parts distally, posterior portion narrower and longer than in A. vexans. Single row of 5-12 long curved hairs arising dorsally and extending from membranous process to near basal area of cutting organ, these hairs smaller mesally and larger laterally. Mandibular hairs, 11-16 in number, lateral hairs with branched tips and mesal hairs with sharply pointed tips. Mandibular brush fan-shaped, consisting of 60-78 bristles, these bristles much slenderer than those in A. vexans. Mandibular comb composed of 15-19

elongate teeth; lateral 4-6 teeth plumose bristle-like, remainder strong, slenderer than those of A. vexans. Mandibular spurs 3 in number; most ventromesal spur shortest, very lightly pigmented; dorsolateral spur more heavily pigmented and slightly longer than mesolateral one. (6 specimens, Rep. of South Africa)

Aedes capensis Edwards

(Marshallii Group)

Maxilla. Cardostipes roughly oval-shaped, narrower than in A. vexans. Maxillary brush roughly 1.5 times length of cardostipes; lighter pigmented than in A. vexans; consisting of 4 types of hairs similar to those of A. vexans but branched-tipped simple hairs longer and slenderer, pointed-tipped simple hairs comprising principal component of brush; most maxillary brush hairs arise from cardostipes, remainder from subapical region of cardogalea or along chitinous ridge; no distinct strong hair arising subapically on chitinous ridge. Chitinous ridge lightly pigmented. Maxillary spurs longer than those of A. vexans; anterior spur longer. Mesal elements of cardolacinal mat with only long branched spines. Maxillary seta 3-MP long, slender with sharply pointed tip, directed mesad, situated closer to chitinous ridge than that of A. vexans; 5-MP long, about 3 times length of 4-MP; 6-MP quite long with branched apex. Sensoria 4 in number;  $S_1$  strongest;  $S_2$  smallest, 0.3-0.5 length of  $S_1$ ;  $S_3$  equal to  $S_1$  or slightly longer;  $S_4$  slightly shorter than  $S_1$ .

Mandible (Figures 3a, b). Pectinate hairs of cutting organ 4-6 in number; long, very slender, slightly curved, finely fringed posteriorly. Ventral blade longer than in A. vexans, rather straight, minutely serrate along caudal margin. Ventral tooth similar to that of A. vexans. Anterior dorsal tooth with one denticle, posterior dorsal tooth with 2-3 denticles. Dorsal spines 2 in number; mesal one arises from dorsal surface of ventral tooth, bending mesodistad; lateral one much smaller, rather straight, sharply pointed, directed mesad. Membranous process with anterior margin convex; divided into 2 parts apically; posterior portion much smaller than in A. vexans. Single row of 15-20 distinct hairs arising dorsally and extending from proximal portion of membranous process toward mandibular brush. Mandibular hairs 12-13 in number, lateral hairs with branched tips and mesal hairs with sharply pointed tips. Mandibular brush fan-shaped, consisting of 50-70 long and slender bristles, these bristles slightly thinner than in A. vexans. Mandibular comb consisting of 3-4 delicate plumose bristle-like teeth laterally, stout elongate teeth mesally. Mandibular spurs 2-3 in number; ventromesal spur small, short, sometimes indistinct; most dorsolateral one strongest and longest. (3 specimens, Rep. of South Africa)

Aedes haworthi Edwards

(Marshallii Group)

Maxilla. Cardostipes egg-shaped, narrower than in A. vexans. Maxillary brush slightly longer than in A. vexans; consisting of 4 types of hairs similar to those of A. vexans except more plumose hairs present in this species; total number of hairs about same as in A. vexans; most maxillary brush hairs arising from cardogalea, remainder from cardolacinia or along chitinous ridge; no distinct strong hair arising subapically on chitinous ridge. Chitinous ridge heavily pigmented. Maxillary spurs near proximal half of chitinous ridge; anterior spur much stronger, twice length of posterior one. Mesal elements of cardolacinial mat with all branched stiff long spines. Maxillary seta 3-MP long, slender, directed mesad, same location as in A. vexans; 5-MP about 2.0-2.5 times length of 4-MP; 6-MP rather long with sharply pointed tip. Sensoria 4 in number;  $S_1$  rather strong;  $S_2$  0.3-0.5 length of  $S_1$ ;  $S_3$  longest, approximately 1.0-1.2 length of  $S_1$ ;  $S_4$  small, roughly 0.3 length of  $S_1$ .

Mandible (Figures 3 c, d). Pectinate hairs of cutting organ usually 4, sometimes 6 in number; more weakly developed than in A. vexans. Ventral blade long, somewhat straight, posterior margin minutely serrate. Ventral tooth similar to that of A. vexans. Anterior dorsal tooth with 1-2 denticle (s), posterior dorsal tooth usually with 3 large denticles. Dorsal spines similar to those of A. vexans. Membranous process with anterior margin convex, divided into 2 parts, posterior portion extremely small. Single row of 13-18 distinct hairs arising dorsally and extending from membranous process toward mandibular brush. Mandibular hairs 9-14 in number, lateral hairs with branched tips and mesal hairs with sharply pointed tips. Mandibular brush similar in shape to that of A. vexans, consisting of 60-66 long slender bristles. Mandibular comb composed of 11-14 (usually 12-13) elongate teeth; lateral 1-4 teeth delicate, plumose, bristle-like; remainder stout, acute. Mandibular spurs 3 in number; most mesoventral spur shortest, sometimes indistinct; other two spurs stronger, slightly different in length, usually laterodorsal spur more heavily pigmented than lateroventral one. (3 specimens, Kenya)

Aedes kennethi Muspratt

(Marshallii Group)

Maxilla. Cardostipes roughly oval-shaped, narrower than in A. vexans. Maxillary brush longer than cardostipes; formed by a great number of hairs; these hairs of 4 types similar to those in A. vexans except pectinate hairs longer and not as stout; branched-tipped simple hairs slenderer and longer than in A. vexans (comprising principal component of brush); most of maxillary brush hairs arise from cardogalea and apical region of chitinous ridge, remainder from cardolacinia; no distinct strong hair arising subapically on chitinous ridge. Chitinous ridge pigmented as in A. vexans. Maxillary spurs near proximal half of chitinous ridge; anterior spur roughly 1.5 times length of posterior one. Mesal elements of cardolacinial mat with long slender slightly-branched

spines distally, heavily branched spines proximally. Maxillary seta 3-MP long, slender, with sharply pointed tip, directed mesad, situated as in A. vexans; 4-MP minute, much shorter than 5-MP; 6-MP very long, usually with sharply pointed tip, sometimes with branched apex. Sensoria 4 in number;  $S_1$  strongest;  $S_2$  and  $S_4$  approximately equal in length, roughly 0.3 length of  $S_1$ ;  $S_3$  longest of all, almost 1.3 length of  $S_1$ .

Mandible (Figures 3 e, f). Pectinate hairs of cutting organ 3-6 in number, rather long, slender, finely fringed posteriorly. Ventral blade blade-like, posterior margin minutely serrate. Ventral tooth similar to that of A. vexans. Anterior dorsal tooth with one denticle, posterior dorsal tooth with 2-3 elongate large denticles. Dorsal spines 2 in number, mesal one larger, curved, directed meso-proximad; lateral one situated marginally, rather straight. Membranous process with anterior margin convex; divided into 2 parts apically, posterior portion relatively larger than that of other species in "Marshallii group." Single row of 14-15 distinct hairs arising dorsally and extending from membranous process toward mandibular brush. Mandibular hairs 10-14 in number, lateral hairs with branched tips and mesal hairs with sharply pointed tips. Mandibular brush fan-shaped, consisting of 64-68 long and slender bristles, these bristles slightly longer and thinner than in A. vexans. Mandibular comb consisting of 12-15 (usually 12) elongate teeth; lateral 1-3 teeth plumose, bristle-like; remainder long, less curved and less stout than in A. vexans. Mandibular spurs 3 in number; most mesal one shortest; others strong, slightly different in size. (3 specimens, Rep. of South Africa)

Aedes marshallii (Theobald)

(Marshallii Group)

Maxilla. Cardostipes oval-shaped, narrower than in A. vexans. Maxillary brush slightly longer than cardostipes; consisting of 4 types of hairs as in A. vexans except branched-tipped simple hairs fewer in number, pointed-tipped simple hairs more numerous than in A. vexans; maxillary brush hairs equal in number to A. vexans, arising from apex of cardostipes and along apical region of chitinous ridge; no distinct strong hair arising on chitinous ridge. Chitinous ridge heavily pigmented as in A. vexans. Maxillary spurs located near central portion of chitinous ridge; long, rather slender; distal spur slightly longer than proximal one. Mesal elements of cardolacinial mat composed entirely of long slender branched spines. Maxillary seta 3-MP very long, slender, sharply pointed, directed mesoproximal; 5-MP very long, rather strong, twice length of 4-MP; 6-MP extremely long with sharply pointed tip. Sensoria 4 in number;  $S_1$  strong,  $S_2$  roughly 0.5 length of  $S_1$ ;  $S_3$  long, straight, 1.2-1.5 length of  $S_1$ ;  $S_4$  small, also 0.5 length of  $S_1$ .

Mandible (Figures 3 g, h). Pectinate hairs of cutting organ 3-6 in number, slenderer than in A. vexans, finely fringed posteriorly. Ventral blade narrower than in A. vexans, posterior margin minutely serrate. Ventral tooth similar to that of A. vexans. Anterior dorsal tooth single with no denticle; posterior dorsal tooth with 3-4 large

elongate denticles. Dorsal spines similar to those of A. vexans. Membranous process with anterior margin convex; divided into 2 parts, posterior portion extremely small. Single row of 13-17 long and curved distinct hairs arising dorsally and extending laterodistad from membranous process toward mandibular brush. Mandibular hairs 9-13 in number, lateral hairs with branched tips and mesal hairs with sharply pointed tips. Mandibular brush similar in shape to that of A. vexans, consisting of 65-78 slightly curved bristles. Mandibular comb composed of 14-16 (usually 14) elongate teeth; lateral 1-5 teeth plumose, bristle-like; remainder stout, acute. Mandibular spurs 3 in number, similar to those of A. vexans; most mesal spur shortest, not conspicuous; other two spurs strong, slightly different in size. (3 specimens, Kenya)

Aedes simulans (Newstead and Carter)

(Marshallii Group)

Maxilla. Cardostipes roughly oval-shaped, narrower than in A. vexans. Maxillary brush roughly 1.5 times length of cardostipes; consisting of 4 types of hairs, similar in type and number to A. vexans; most of brush hairs arise from apex of cardogalea, remainder from apical region of cardolacinia and chitinous ridge; no distinct strong hair arising subapically on chitinous ridge. Chitinous ridge heavily pigmented. Maxillary spurs situated near medial portion of chitinous ridge, anterior spur longer than posterior one. Mesal elements of cardolacinial mat mostly very long, slender simple spines. Seta 3-MP situated between chitinous ridge and cardolacinial line, not long; 5-MP long, about twice length of 4-MP; 6-MP very long with sharply pointed tip. Sensoria 4 in number;  $S_1$  rather strong;  $S_2$  small, only 0.5 length of  $S_1$ ;  $S_3$  longest, about 1.5-2.0 times length of  $S_1$ ;  $S_4$  small, 0.3-0.7 length of  $S_1$ .

Mandible (Figures 4a, b). Pectinate hairs of cutting organ 4-6 (usually 4) in number, slenderer than in A. vexans, finely fringed posteriorly. Ventral blade slender, posterior margin finely serrate. Ventral tooth similar to that of A. vexans. Anterior dorsal tooth with one denticle, posterior dorsal tooth with 2-3 elongate denticles. Dorsal spines 2 in number; mesal one curved, bending mesoproximad; lateral one much smaller, straight, sharply pointed, directed mesad. Membranous process with anterior margin convex, divided into 2 parts; posterior portion much smaller than in A. vexans. Single row of 12-20 long curved hairs arising dorsally and extending laterodistad from membranous process toward mandibular brush. Mandibular hairs 10-11 in number, lateral hairs with branched tips and mesal hairs with sharply pointed tips. Mandibular brush fan-shaped, consisting of 63-69 bristles, these bristles slightly slenderer than those of A. vexans. Mandibular comb composed of 12-15 (usually 13) elongate teeth; lateral two teeth plumose, bristle-like, less stout than others; the other teeth stout, simple, sharply pointed, slightly curved distally. Mandibular spurs 3 in number, most mesoventral spur shortest, very lightly pigmented; dorsolateral one darkest, largest. (3 specimens, Kenya)

Aedes albocephalus (Theobald)

(Minutus Group)

Maxilla. Cardostipes cone-shaped, similar to that of A. vexans. Maxillary brush consisting of 4 types of hairs as in A. vexans. Maxillary brush hairs somewhat less in number than in A. vexans; most hairs arise from apex of cardostipes, remainder from subapical region of cardogalea or along apical region of chitinous ridge; no distinct strong hair arising subapically on chitinous ridge. Chitinous ridge heavily pigmented. Maxillary spurs similar to those in A. vexans. Mesal elements of cardolacinial mat with longer branched spines proximally, short stout simple hairs distally. Maxillary seta 3-MP short, directed mesad, same location as in A. vexans, not easily found in some cases due to indistinct nature; 5-MP 2-3 times length of 4-MP; 6-MP single, longer than in A. vexans. Sensoria 4 in number;  $S_1$  strongest;  $S_2$  and  $S_4$  almost equal in length, roughly 0.5 length of  $S_1$ ;  $S_3$  longer but slenderer than  $S_1$ .

Mandible (Figures 4c, d). Pectinate hairs of cutting organ 4-6 in number, slenderer than in A. vexans, finely fringed posteriorly. Ventral blade slightly narrower than in A. vexans, posterior margin distinctly serrate. Ventral tooth with relatively smaller first denticle ( $Vt_1$ ) than in A. vexans. Anterior dorsal tooth with 1-2 denticle(s); posterior dorsal tooth with 3-5 small denticles. Dorsal spines 2 in number; mesal one rather strong, curved, directed mesoproximad; lateral one small, rather straight, sharply pointed. Membranous process shorter than in A. vexans; distally divided into 2 parts; posterior portion narrow, longer than anterior portion. No single row of long hairs arising dorsally from membranous process and extending toward mandibular brush. Mandibular hairs 13-19 in number, lateral hairs with branched tips, mesal hairs with sharply pointed tips. Mandibular brush fan-shaped, consisting of 58-74 bristles, these bristles similar to those of A. vexans. Mandibular comb composed of 10-17 elongate teeth; lateral 2-4 teeth plumose, bristle-like; remainder stout, pointed-tipped, slightly slenderer than in A. vexans. Mandibular spurs 3 in number; most mesal spur not very small; other two spurs slightly different in length, dorsolateral spur stronger, more heavily pigmented than ventrolateral one. (5 specimens, Kenya)

Aedes phyllolabis Edwards

(Minutus Group)

Maxilla. Cardostipes cone-shaped, similar to that of A. vexans. Maxillary brush roughly 1.5 times length of cardostipes; consisting of 3 types of hairs: shorter pectinate hairs, long soft lightly colored plumose hairs, and extremely long pointed-tipped simple hairs. Total number of hairs about same as in A. vexans; most maxillary brush hairs arising from cardogalea, remainder along apical region of chitinous ridge, no distinct strong hair arising on chitinous ridge. Chitinous ridge less pigmented than in A. vexans. Maxillary spurs slender, roughly equal in length, located near medial portion of chitinous ridge. Mesal elements of cardolacinial mat with long stiff simple spines distally, slightly shorter branched spines proximally. Maxillary seta 3-MP long, slender, directed mesad; 5-MP slightly longer than 4-MP; 6-MP single with sharply pointed tip, less developed than in A. vexans.

Sensoria 4 in number;  $S_1$  strongest;  $S_2$ ,  $S_4$  nearly equal in size, 0.3-0.5 length of  $S_1$ ;  $S_3$  usually longest of all, 1.0-1.5 times length of  $S_1$ .

Mandible (Figures 4 e, f). Pectinate hairs of cutting organ 4-6 in number, slender with relatively long fringe posteriorly. Ventral blade narrower than in A. vexans, posterior margin finely serrate. Ventral tooth similar to that of A. vexans. Anterior dorsal tooth bearing 1-2 elongate denticle (s), posterior dorsal tooth with 2-3 long denticles. Dorsal spines 2 in number, lateral one difficult to see, mesal one less curved than in A. vexans. Membranous process same size as in A. vexans, divided into 2 parts, small posterior portion longer than anterior portion. No single row of long hairs arising dorsally from membranous process and extending toward mandibular brush. Mandibular hairs 11-17 in number, lateral hairs with branched tips, mesal hairs with sharply pointed tips. Mandibular brush fan-shaped, consisting of 53-65 bristles, these bristles thinner than those of A. vexans. Mandibular comb composed of 9-13 elongate teeth; lateral 1-3 teeth delicate, plumose, bristle-like; remainder stout, pointed-tipped, slightly thinner than in A. vexans. Mandibular spurs 3 in number, most mesoventral spur shortest, lightly colored; latero-dorsal spur strongest and darkest. (5 specimens, Kenya)

Aedes pseudotarsalis Someren

(Minutus Group)

Maxilla. Cardostipes cone-shaped, similar to that of A. vexans. Maxillary brush about equal in length to cardostipes, consisting of 4 types of hairs, similar to those of A. vexans, no distinct strong hairs arising subapically on chitinous ridge; maxillary brush hairs arising from apex of cardostipes or apical region of chitinous ridge. Chitinous ridge pigmentation similar to that of A. vexans. Maxillary spurs located near medial portion of chitinous ridge, appearing slender, anterior spur slightly shorter than posterior one. Mesal elements of cardolacinial mat with entirely branched long stiff spines. Maxillary seta 3-MP long, slender, in same location as in A. vexans; 5-MP about twice length of 4-MP; 6-MP single, with sharply pointed tip, about equal in size to that of A. vexans. Sensoria 4 in number;  $S_1$  strongest;  $S_2$  and  $S_4$  roughly equal in length, 0.5 length of  $S_1$ ;  $S_3$  longest, 1.3-1.5 times length of  $S_1$ ; an accessory sensorium present, minute, 0.1-0.4 length of  $S_1$ , located near  $S_4$  or  $S_2$ .

Mandible (Figures 4 g, h). Pectinate hairs of cutting organ 4-6 in number; long, slender with fringe along posterior margin. Ventral blade narrower than in A. vexans, posterior margin finely serrate. Ventral tooth similar to that of A. vexans. Anterior dorsal tooth with a tiny denticle distally; posterior dorsal tooth with 3-4 elongate denticles. Dorsal spines 2 in number; mesal one curved, strong, directed mesoproximad; lateral one rather straight, smaller than mesal one. Membranous process with anterior margin straight; distally divided into 2 parts; posterior portion small, slightly longer than anterior portion. No single row of long hairs arising dorsally from membranous process and extending toward mandibular brush. Mandibular hairs 8-16 in number, lateral hairs with branched tips and mesal hairs with sharply pointed tips. Mandibular brush fan-shaped; consisting of 57-65 bristles;



these bristles similar to those of A. vexans. Mandibular comb composed of 14-17 elongate teeth; lateral 2-3 teeth plumose, bristle-like; remainder stout, pointed-tipped, slightly slenderer than in A. vexans. Mandibular spurs 3 in number; most mesal spur not very small; other two spurs strong, dorsal lateral one slightly longer, more heavily pigmented than ventral lateral one. (4 specimens, Kenya)

Aedes tarsalis (Newstead)

(Minutus Group)

Maxilla. Cardostipes cone-shaped, similar to that of A. vexans. Maxillary brush slightly longer than cardostipes; consisting of 4 types of hairs as in A. vexans; maxillary brush hairs abundant as in A. vexans, arising from apex of cardostipes, subapical region of cardogalea or along chitinous ridge; no distinct strong hair arising subapically on chitinous ridge. Chitinous ridge less pigmented than in A. vexans. Long maxillary spurs situated near medial portion of chitinous ridge, approximately equal in length. Mesal elements of cardolacinial mat with rather long stout simple spines distally, long thinner slightly branched spines proximally. Maxillary seta 3-MP long, rather straight, slender, sharply pointed, directed mesad; 5-MP 1.5-2.0 times length of 4-MP; 6-MP rather strong, long, with branched or sharply pointed apex. Sensoria 4 in number;  $S_1$  strong, about 0.7 length of  $S_1$ ;  $S_3$  slightly longer than  $S_1$ ;  $S_4$  very small, only 0.3 length of  $S_1$ .

Mandible (Figures 5 a, b). Pectinate hairs of cutting organ 5 in number; long, slender with slightly longer fringe than in A. vexans. Ventral blade similar to that of A. vexans, posterior margin distinctly serrate. Ventral tooth with more elongate denticles. Anterior dorsal tooth with or without a small denticle, posterior dorsal tooth with 3 elongate denticles. Dorsal spines 2 in number; mesal one curved, rather strong, directed mesoproximad; lateral one straight, smaller than mesal one. Membranous process with anterior margin straight, distally divided into 2 parts, small elongate posterior portion slightly longer than anterior portion. No single row of long hairs arising dorsally from membranous process and extending toward mandibular brush. Mandibular hairs 11-13 in number, lateral hairs with branched tips, mesal hairs with sharply pointed tips or sometimes with slightly branched tips. Mandibular brush fan-shaped, consisting of 69-71 bristles, these bristles roughly same size as in A. vexans. Mandibular comb composed of 15-16 elongate teeth; lateral 5 teeth plumose, bristle-like; remainder stout, pointed-tipped, same size as in A. vexans. Mandibular spurs 3 in number; most ventromesal spur not very small; other two spurs strong, dorsolateral one slightly longer than ventrolateral one. (2 specimens, Kenya)

Aedes ochraceus (Theobald)

(Ochraceus Group)

Maxilla. Cardostipes cone-shaped, similar to that of A. vexans. Maxillary brush consisting only of simple hairs; these hairs somewhat less in number than in A. vexans, approximately 1.5 times length of

cardostipes, long, slender sharply pointed; most of maxillary brush hairs arise from cardogalea, remainder along apical region of chitinous ridge; sometimes a distinct strong hair arising apically on chitinous ridge, directed ventrad. Chitinous ridge broader, less pigmented than in A. vexans. Maxillary spurs similar to those of A. vexans, roughly equal in length, located near medial portion of chitinous ridge. Mesal elements of cardolacinal mat long simple spines distally, long branched spines proximally. Maxillary seta 3-MP located immediately adjacent to cardolacinal line, slender, rather long, sharply pointed, directed mesad; 5-MP twice length of 4-MP; 6-MP stout, pointed-tipped, shorter than in A. vexans. Sensoria 4 in number;  $S_1$  strongest;  $S_2$  0.5-0.7 length of  $S_1$ ;  $S_3$  1.0-1.3 length of  $S_1$ ;  $S_4$  0.5 length of  $S_1$ ; usually  $S_3$  and  $S_1$ ,  $S_2$  and  $S_4$  equal in length.

Mandible (Figures 5 c, d). Pectinate hairs of cutting organ 4-6 in number; slightly slenderer than in A. vexans, fringed posteriorly. Ventral blade larger than in A. vexans, finely serrate posteriorly. Ventral tooth rather large with second denticle ( $Vt_2$ ) as large as main tooth ( $Vt_0$ ). Anterior dorsal tooth single, or sometimes with one small denticle; posterior dorsal tooth with 2-3 denticles. Dorsal spines 2 in number; mesal one rather strong, slightly curved, directed mesoproximad; lateral one very small and slender, rather straight, sharply pointed, directed mesad; sometimes mesal dorsal spine difficult to see. Membranous process shorter than in A. vexans; divided into 2 parts; posterior portion relatively larger than in A. vexans. No single row of long hairs arising dorsally from membranous process and extending toward mandibular brush. Mandibular hairs 9-16 in number, lateral hairs with branched tips, mesal hairs with sharply pointed tips. Mandibular brush fan-shaped, consisting of 55-67 bristles, these bristles slightly stronger than in A. vexans. Mandibular comb composed of 8-10 elongate teeth; lateral 1-3 teeth plumose; remainder stout, acutely tipped, much stronger than in A. vexans. Mandibular spurs 3 in number; lightly pigmented; mesal one relatively larger than in A. vexans, other two roughly equal in length. (3 specimens, Kenya)

Aedes cumminsii (Theobald)

(Quasiunivittatus Group)

Maxilla. Cardostipes cone-shaped, broader than in A. vexans. Maxillary brush shorter than cardostipes, consisting of 4 types of hairs: medium-length pectinate hairs; branched-tipped stout simple hairs (comprising principal component of brush); pointed-tipped simple hairs of same length as those in A. vexans but fewer in number; plumose hairs similar to those of A. vexans, also fewer in number; most maxillary brush hairs arise from cardogalea, remainder along apical region of chitinous ridge; no distinct strong hair arising subapically on chitinous ridge. Chitinous ridge rather dark. Maxillary spurs located more distally than in A. vexans, roughly equal in length. Mesal elements of cardolacinal mat with longer branched spines proximally, short stout simple spines distally. Seta 3-MP rather long; 4-MP about 0.7 length of 5-MP; 6-MP short, rather stout, darker than other maxillary setae. Sensoria 4 in number;  $S_1$  stronger than others;  $S_2$  small, about 0.3-0.7 length of  $S_1$ ;  $S_3$  equal to  $S_1$  or slightly longer;  $S_2$  and  $S_4$  equal in length.

Mandible (Figures 5 e, f). Pectinate hairs of cutting organ 3-5 (usually 4) in number, as strong as in A. vexans, fringed posteriorly. Ventral blade long, finely serrate along posterior margin and medial portion of anterior margin. Ventral tooth similar to that of A. vexans except mesobasal margin bearing 2-4 tiny accessory teeth (Tt). Anterior dorsal tooth with 1-2 small denticle(s); posterior dorsal tooth with 3-6 small denticles, most laterodistal denticle situated closer to main posterior dorsal tooth than to other denticles. Dorsal spines 2 in number, mesal one slightly curved; lateral one not very slender, straight, directed mesad. Membranous process with anterior margin straight, divided distally into 2 parts; posterior portion relatively larger than in A. vexans. No single row of long hairs arising dorsally from membranous process and extending toward mandibular brush. Mandibular hairs 12-15 in number, lateral hairs with branched tips, mesal hairs with sharply pointed tips. Mandibular brush fan-shaped, consisting of 61-67 bristles, these bristles slenderer than in A. vexans. Mandibular comb composed of 16-20 elongate teeth; lateral 2-9 teeth plumose bristle-like; remainder stout, same size as in A. vexans. Mandibular spurs 3 in number; most mesal spur not very small; other two spurs strong, dorsolateral one slightly larger, more heavily pigmented than ventrolateral one. (5 specimens, Kenya)

Aedes dentatus (Theobald)

(Quasiunivittatus Group)

Maxilla. Cardostipes cone-shaped, similar to that of A. vexans. Maxillary brush roughly same length as cardostipes; consisting of three types of hairs: pectinate hairs medium size, longer than in A. vexans; branched-tipped simple hairs strong (being the main component of maxillary brush); plumose hairs long, lighter; no distinct strong hair arising subapically on chitinous ridge. Chitinous ridge heavily pigmented, rather broad. Maxillary spurs situated near apical 0.3 of chitinous ridge, roughly equal in length. Mesal elements of cardolacinal mat with longer branched spines proximally, short stout simple spines distally. Maxillary seta 3-MP long, slender, directed mesad, same location as in A. vexans; 5-MP roughly twice length of 4-MP, stronger and darker; 6-MP branched, about same length as in A. vexans. Sensoria 4 in number;  $S_1$  strongest;  $S_2$  0.5 length of  $S_1$ ;  $S_3$  equal to or slightly longer than  $S_1$ ;  $S_4$  0.3-0.5 length of  $S_1$ ; sensoria in this species smaller than in A. vexans.

Mandible (Figures 6 a, b). Pectinate hairs of cutting organ 4-5 (usually 4) in number; as strong as in A. vexans; fringed posteriorly. Ventral blade same size as in A. vexans, posterior margin finely serrate. Ventral tooth similar to that of A. vexans. Anterior dorsal tooth bearing 1-3 denticle(s); posterior dorsal tooth bearing 5-9 small denticles. Dorsal spines 2 in number, mesal one rather strong, slightly curved, directed mesoproximad; lateral one not very slender, straight, directed mesad. Membranous process with anterior margin slightly curved, divided distally into 2 parts; posterior portion relatively larger than in A. vexans. No single row of long hairs arising dorsally from membranous process and extending toward mandibular brush. Mandibular hairs 15-19 in number, lateral hairs with branched tips, mesal hairs with sharply

pointed tips. Mandibular brush fan-shaped; consisting of 59-69 elongate teeth; lateral 2-6 teeth plumose bristle-like; remainder stout, same size as in A. vexans. Mandibular spurs 3 in number; most ventromesal spur not very small; other two spurs strong, dorsolateral one slightly larger than ventrolateral one. (6 specimens, Rep. of South Africa)

Aedes quasiunivittatus (Theobald)

(Quasiunivittatus Group)

Maxilla. Cardostipes oval-shaped, narrower than in A. vexans. Maxillary brush approximately same length as cardostipes; consisting of 4 types of hairs as in A. vexans; maxillary brush hairs approximately as numerous as in A. vexans, arising from apex of cardostipes, subapical region of cardogalea or along apical region of chitinous ridge; no distinct strong hair present. Chitinous ridge less pigmented than in A. vexans. Maxillary spurs located near central portion of chitinous ridge; almost equal in length as in A. vexans. Mesal elements of cardolacinal mat with longer slenderer branched spines proximally, short stout simple spines distally. Maxillary seta 3-MP long, slender, directed mesocephalad; 5-MP roughly 1.5 length of 4-MP; 6-MP long, with sharply pointed tip. Sensoria 4 in number;  $S_1$  strongest of all;  $S_2$  small, only 0.7 times length of  $S_1$ ;  $S_3$  twice length of  $S_1$ ;  $S_4$  0.7 times length of  $S_1$  to roughly equal.

Mandible (Figures 6 c, d). Pectinate hairs of cutting organ 4-6 (usually 5) in number; as strong as in A. vexans; fringed posteriorly. Ventral blade long, posterior margin strongly serrate. Ventral tooth similar to that of A. vexans except mesobasal margin bearing 2-4 tiny teeth (Tt). Anterior dorsal tooth with 1-2 denticle(s); posterior dorsal tooth bearing 3-5 denticles, with most laterodistal denticle closer to main posterior dorsal tooth than to other denticles. Dorsal spines 2 in number; mesal one slightly curved; lateral one not very small, straight, directed mesad. Membranous process with anterior margin somewhat straight, divided distally into 2 parts; posterior portion relatively larger than in A. vexans. No single row of long hairs arising dorsally from membranous process and extending toward mandibular brush. Mandibular hairs 12-19 in number, lateral hairs with heavily branched tips, mesal hairs with sharply pointed tips. Mandibular brush fan-shaped, consisting of 58-74 bristles, these bristles similar to those of A. vexans. Mandibular comb composed of 10-17 elongate teeth; lateral 2-5 teeth plumose, bristle-like; remainder stout, roughly same size as in A. vexans. Mandibular spurs 3 in number; most mesal spur usually difficult to see, but sometimes pigmented, appearing slender and sharply acute; other two spurs pigmented, slightly different in size. (4 specimens, Kenya)

Aedes fowleri (Charmoy)

(Vexans Group)

Maxilla. Cardostipes cone-shaped, similar to that of A. vexans. Maxillary brush approximately same length as cardostipes, consisting of 4 types of hairs as in A. vexans except pointed-tipped simple hairs longer: maxillary brush hairs very numerous, arising

from apex of cardostipes, subapical region of cardogalea, or along subapical region of chitinous ridge; no distinct strong hairs arising subapically on chitinous ridge. Chitinous ridge rather thick, heavily pigmented. Maxillary spurs located near medial portion of chitinous ridge; nearly equal in length. Mesal elements of cardolacinial mat with longer branched spines proximally, short stout simple spines distally. Maxillary seta 3-MP slender, rather long, directed meso-distad located closer to chitinous ridge than that of A. vexans; 5-MP twice length of 4-MP; 6-MP short with branched apex. Sensoria 4 in number;  $S_1$  rather thick, strongest of all;  $S_2$  and  $S_4$  equal in length, roughly 0.5 length of  $S_1$ ;  $S_3$  equal to or twice length of  $S_1$ .

Mandible (Figures 6e, f). Pectinate hairs of cutting organ 3-5 (usually 4) in number, similar to those of A. vexans, longer fringed posteriorly. Ventral blade also similar to that of A. vexans in shape, posterior margin finely serrate. Ventral tooth as in A. vexans. Anterior dorsal tooth usually with 2 denticles; posterior dorsal tooth with 2-4 small denticles. Dorsal spines 2 in number; mesal one slightly curved as in A. vexans; lateral one small, situated submarginally of ventral tooth as in A. vexans. Membranous process with anterior margin convex; divided into 2 parts; posterior portion small, relatively same size as in A. vexans. No single row of long hairs arising dorsally from membranous process and extending toward mandibular brush. Mandibular hairs 9-14 in number, lateral hairs with branched tips and mesal hairs with sharply pointed tips. Mandibular brush fan-shaped, consisting of 57-68 bristles, these bristles slightly stronger than in A. vexans. Mandibular comb composed of 11-13 elongate teeth; lateral 1-3 teeth plumose; remainder stout, sharply pointed. Mandibular spurs 3 in number, ventromesal one smallest, other two roughly equal in size. (3 specimens, Kenya)

Aedes hirsutus (Theobald)

(Vexans Group)

Maxilla. Cardostipes cone-shaped, similar to that of A. vexans. Maxillary brush about same length as cardostipes; consisting of approximately equal numbers of pectinate and simple hairs; pectinate hairs longer and more numerous than in A. vexans; total number of hairs somewhat less than in A. vexans; most maxillary brush hairs arise from cardogalea, remainder along apical region of chitinous ridge; no distinct strong hair arising subapically on chitinous ridge. Chitinous ridge lightly pigmented, rather broad. Maxillary spurs situated near distal 0.3 of chitinous ridge, roughly equal in length. Mesal elements of cardolacinial mat with longer branched spines proximally; short stout simple spines (sometimes serrated) distally. Seta 3-MP long, slender, directed mesad, same location as in A. vexans; 5-MP about 3-4 times length of 4-MP; 6-MP single, elongate, rather long. Sensoria 4 in number;  $S_1$  usually strongest;  $S_2$  small, 0.5 length of  $S_1$ ;  $S_3$  thinner but slightly longer than  $S_1$ ;  $S_4$  0.5-0.7 length of  $S_1$ ; sometimes a tiny accessory sensorium near  $S_4$ .

Mandible (Figures 6g, h). Pectinate hairs of cutting organ 3-4 in number; slender, slightly curved with fringed posterior margin. Ventral blade blade-like; posterior margin with relatively large teeth alternating with smaller teeth. Ventral tooth similar to A. vexans except mesobasal margin bearing several tiny teeth (Tt). Anterior dorsal tooth with 1-3 denticle(s); posterior dorsal tooth with 7-12 denticles, these denticles gradually reduced in size from laterodistad to mesoproximad. Dorsal spines 2 in number; mesal one curved, directed mesoproximad; lateral one small, rather straight, directed mesad. Membranous process with anterior margin somewhat straight; divided distally into 2 parts; posterior portion same size as in A. vexans. No single row of long hairs arising dorsally from membranous process and extending toward mandibular brush. Mandibular hairs 13-17 in number; lateral hairs usually with heavily branched tips, mesal hairs with branched and sharply pointed tips. Mandibular brush fan-shaped; consisting of 58-64 bristles; these bristles slightly slenderer than in A. vexans. Mandibular comb composed of 8-12 elongate teeth; lateral 1-3 teeth plumose bristle-like; remainder stout, roughly same size as in A. vexans. Mandibular spurs 3 in number; most ventromesal spur small, dorsolateral spur slightly larger than ventrolateral one. (4 specimens, Kenya)

KEY TO SELECTED A. (AEDIMORPHUS) SPECIES  
BASED UPON MATURE LARVAL MAXILLAE AND MANDIBLES

1. Mesal elements of cardolacinial mat with sharply pointed simple spines distally and branched spines proximally.....2  
     Mesal elements of cardolacinial mat with branched spines only  
     or with long simple spines only..... 12
2. Mesal elements of cardolacinial mat with long sharply pointed simple spines distally and long branched spines proximally..... 3  
     Mesal elements of cardolacinial mat with short, stout, sharply pointed simple spines distally and long branched spines proximally..... 6
3. Maxillary brush consisting only of simple hairs, a distinct hair arising subapically on chitinous ridge..... 4  
     Maxillary brush consisting of 3 or 4 types of hairs, no distinct separate hair present on chitinous ridge..... 5
4. Maxillary brush approximately twice length of cardostipes; posterior dorsal tooth with 3-6 denticles.....A. alboscuteatus  
     Maxillary brush approximately 1.5 times length of cardostipes; posterior dorsal tooth with 2-3 denticles..... A. ochraceus
5. Maxillary brush consisting of 3 types of hairs, about 1.5 times length of cardostipes..... A. phyllolabis  
     Maxillary brush consisting of 4 types of hairs, slightly longer than cardostipes (less than 1.5 times)..... A. tarsalis

6. Maxillary brush consisting of 2 or 3 types of hairs.....7  
 Maxillary brush consisting of 4 types of hairs..... 8
7. Posterior margin of ventral blade with relatively large teeth alternating with smaller teeth; seta 6-MP of maxilla with sharply pointed tip..... A. hirsutus  
 Posterior margin of ventral blade in normal condition, finely serrate; seta 6-MP of maxilla with branched tip..... A. dentatus
8. Cardostipes oval- or egg-shaped.....A. quasiunivittatus  
A. argenteopunctatus  
 Cardostipes cone-shaped.....9
9. Seta 6-MP of maxilla with branched apex.....A. fowleri  
 Seta 6-Mp of maxilla with sharply pointed apex..... 10
10. Maxillary brush shorter than cardostipes.....A. cumminisii  
 Maxillary brush not shorter than cardostipes.....11
11. Pectinate hairs of cutting organ slender; posterior portion of membranous process longer than anterior portion  
A. albocephalus  
 Pectinate hairs of cutting organ strong; posterior portion of membranous process about same length as anterior portion.....  
 ..... A. vexans
12. Mesal elements of cardolacinal mat all long simple spines  
 ..... A. simulans  
 Mesal elements of cardolacinal mat all long branched spines..... 13
13. Maxillary brush consisting of 2 types of hairs .....  
 .....A. tricholabis bwamba  
 Maxillary brush consisting of 4 types of hairs.....14
14. Single row of long hairs arising dorsally and extending from membranous process toward either cutting organ or mandibular brush..... 15  
 No such single row of long hairs present.....A. pseudotarsalis

15. Pectinate hairs of cutting organ more in number (6-10); single row of hairs arising dorsally and extending from membranous process toward cutting organ, less in number (less than 12); membranous process with anterior margin somewhat straight..... A. lamborni

Pectinate hairs of cutting organ less in number (3-6); single row of hairs arising dorsally and extending from membranous process toward mandibular brush, more in number (more than 12); membranous process with anterior margin convex.....16

16. Seta 6-MP of maxilla with branched ending; maxillary brush roughly 1.5 times length of cardostipes..... A. capensis

Seta 6-MP of maxilla with sharply pointed ending; maxillary brush slightly longer than cardostipes.....A. haworthi  
A. kennethi  
A. marshallii

#### Discussion

Differences in the maxillae of various species were noted in the shape of the cardostipes, the length of the maxillary brush, and in the types of hairs in the latter. Four groups could be distinguished based on the types of hairs forming the maxillary brush. The first group, possessing a single type of long simple hair, was represented by A. alboscuteclatus and A. ochraceus. A second group with two types of maxillary brush hairs included A. tricholabis bwamba and A. hirsutus. The third group, with three types of hairs, included A. phyllolabis and A. dentatus; while the rest of the species were in the fourth group with four types of hairs. Also specific differences were found in the mesal elements of the cardolacinial mat. In A. argenteopunctatus, A. albocephalus, A. cumminsii, A. dentatus, A. quasiunivittatus, A. fowleri, and A. hirsutus the mesal elements of the cardolacinial mat included branched spines proximally and short, stout, pointed simple spines distally. A. alboscuteclatus, A. phyllolabis, A. tarsalis, and A. ochraceus differ from the previous group in having long, sharply pointed spines distally. A third type was observed in which the mesal elements consisted entirely of branched spines. Included in this group was A. tricholabis bwamba, A. lamborni, A. capensis, A. marshallii, A. haworthi, A. kennethi, and A. pseudotarsalis. A fourth type occurs in A. simulans where there are only long simple spines present.

In all of the species observed, the cutting organ of the mandible possesses some distinctive features. It consists of four main parts, the pectinate hairs, a ventral tooth, two dorsal teeth, and two dorsal spines. However, in the different species seen, each of these parts varies in shape, length, and in number. The mandibular comb and mandibular brush are common to all species. However, the number of the elongate teeth of the mandibular comb and that of the



bristles of the mandibular brush vary among species as well as among individuals within a species. It is worth noting that a distinct single row of long hairs arising dorsally and extending from the membranous process toward the mandibular brush is present in all species seen of the Marshallii group. This row of hairs is also present in A. lamborni, but in this case, extends toward the basal area of the cutting organ.

Despite the many variable characters observed in the species studied, some differences among certain groups are constant enough to warrant their use in taxonomy.

#### SUMMARY

As a part of this study but reported elsewhere (Pao and Knight 1970), the gross morphology of the fourth stage larval mouthparts of Aedes vexans Meigen) was studied in detail. In an effort to determine the taxonomic usefulness of these structures, comparative descriptions of the mandibles and maxillae of an additional 19 species of Aedes (Aedimorphus) were prepared. Despite the large measure of similarity encountered, sufficient apparently constant specific differences were found to permit the writing of a reasonably effective key to the included species. However, a much more comprehensive study must be made before a full understanding of the taxonomic significance of larval mouthparts can be realized.

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## ABBREVIATIONS

BB	basal band
BPH	basal pectinate hair
BSH	branched-tipped simple hair
BSp	branched spine
CG	cardogalea
CL	cardolacinia
CLL	cardolacinial line
CLM	cardolacinial mat
CO	cutting organ
CR	chitinous ridge
CS	cardostipes
DS	dorsal spine
Dt	dorsal tooth
EnP	entoparartis
ExP	exoparartis
MA	membranous area
MdAp	mandibular apodeme
MdB	mandibular brush
MdC	mandibular comb
MddA	mandibular dorsal artis
MdH <sub>1</sub> , MdH <sub>2</sub>	mandibular hairs
MdSp	mandibular spur
MdvA	mandibular ventral artis
MP	membranous process
3MP, 4MP, 5MP, 6MP	mouthpart ring-based setae
MxAp	maxillary apodeme
MxB	maxillary brush
MxP	maxillary palpus
MxSP	maxillary spur
PB	pectinate brush
PF	palpifer
PH	plumose hair
PSH	pointed-tipped simple hair
S <sub>1</sub> , S <sub>2</sub> , S <sub>3</sub> , S <sub>4</sub>	sensoria
SSp	simple spine
Tt	tiny accessory teeth
UR	U-shaped rod
VB	ventral blade
VS	V-shaped suture
Vt <sub>0</sub> , Vt <sub>1</sub> , Vt <sub>2</sub> , Vt <sub>3</sub>	ventral tooth

## EXPLANATION OF FIGURES

(species names given on plates)

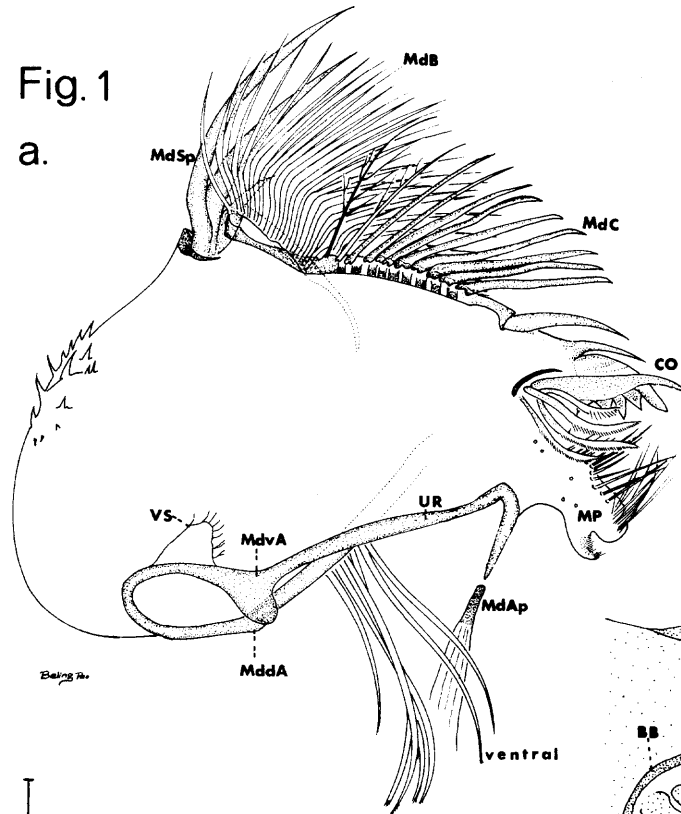
Fig. 1. a. Ventral aspect of mandible. b. Dorsal aspect of mandible.  
c. Ventral aspect of cutting organ. d. Dorsal aspect of cutting organ.

Figs. 2-6. Mandibular cutting organ.

Fig. 7. Maxilla a. Dorsal aspect. b. Ventral aspect.

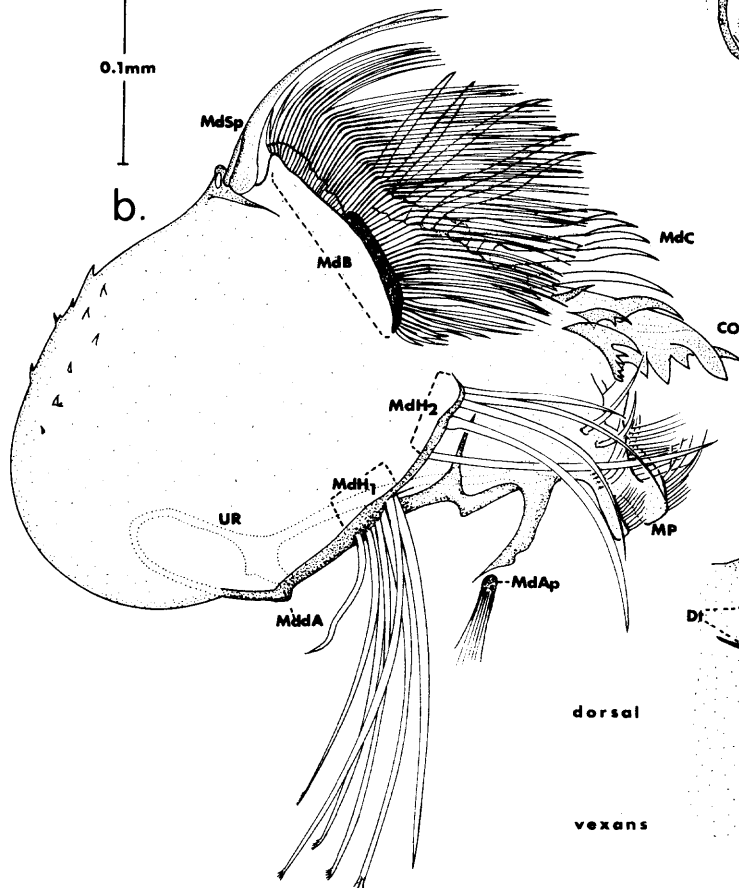
Fig. 1

a.

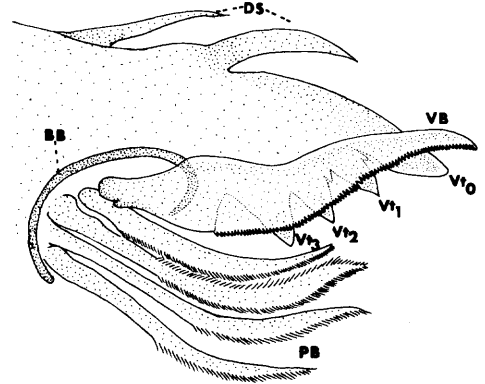


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b.



C.



0.01mm

d.

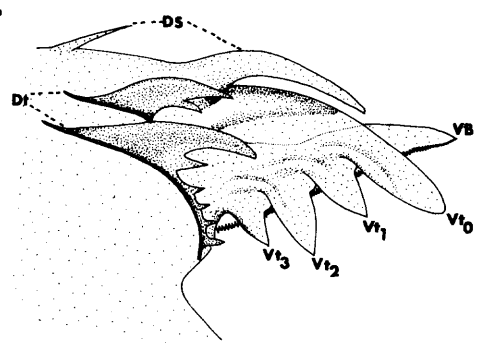


Fig. 2

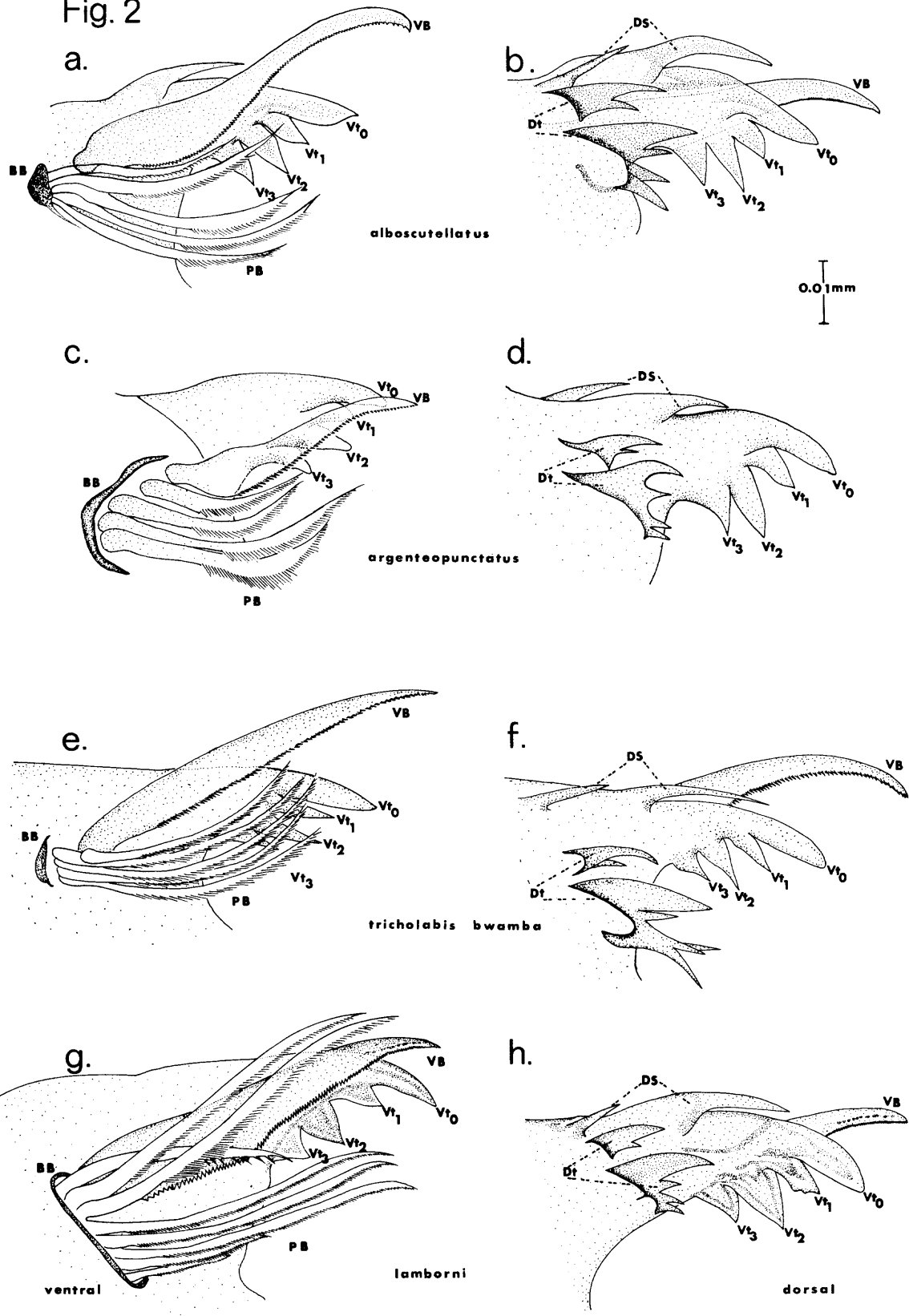


Fig. 3

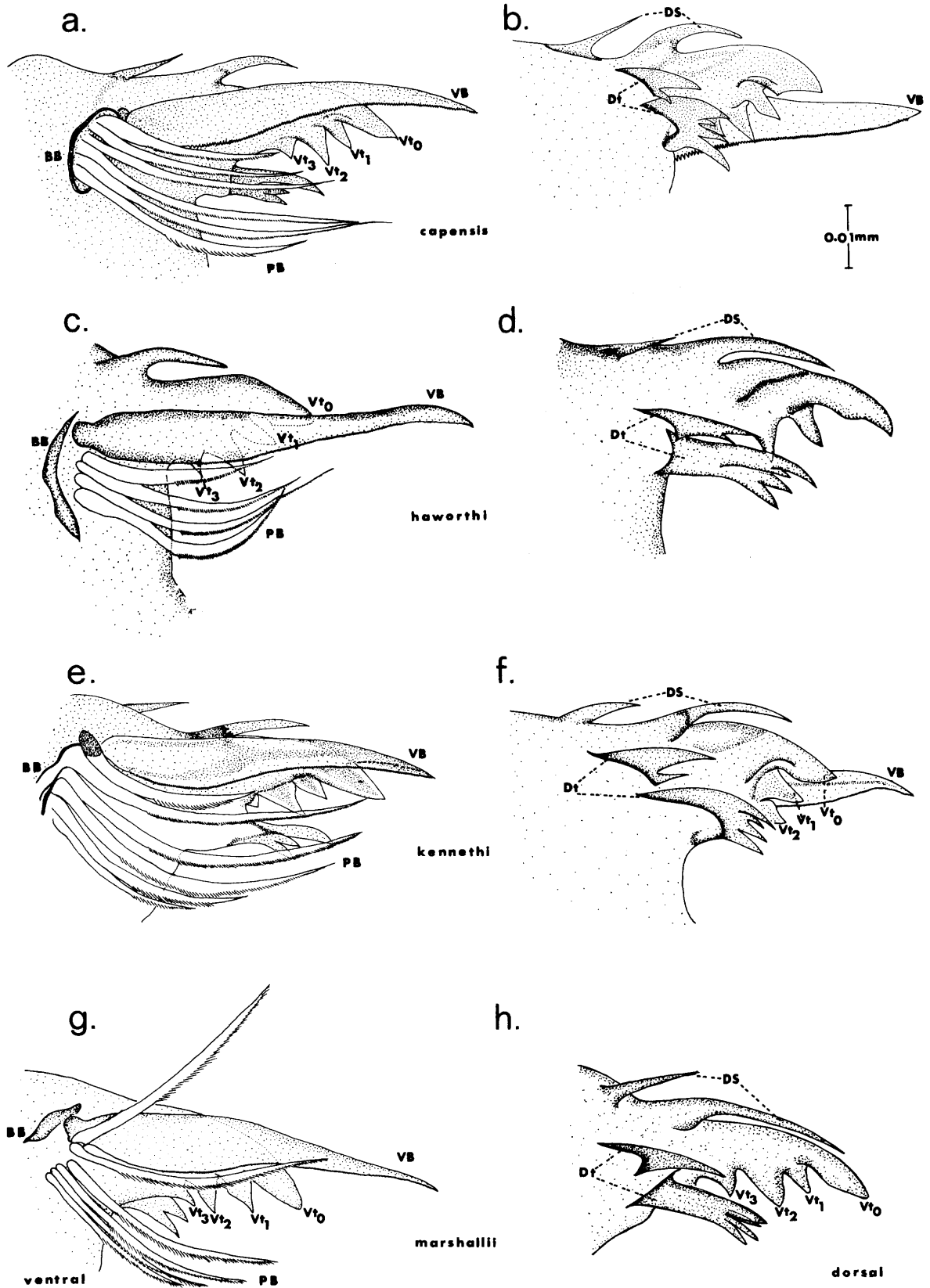


Fig. 4

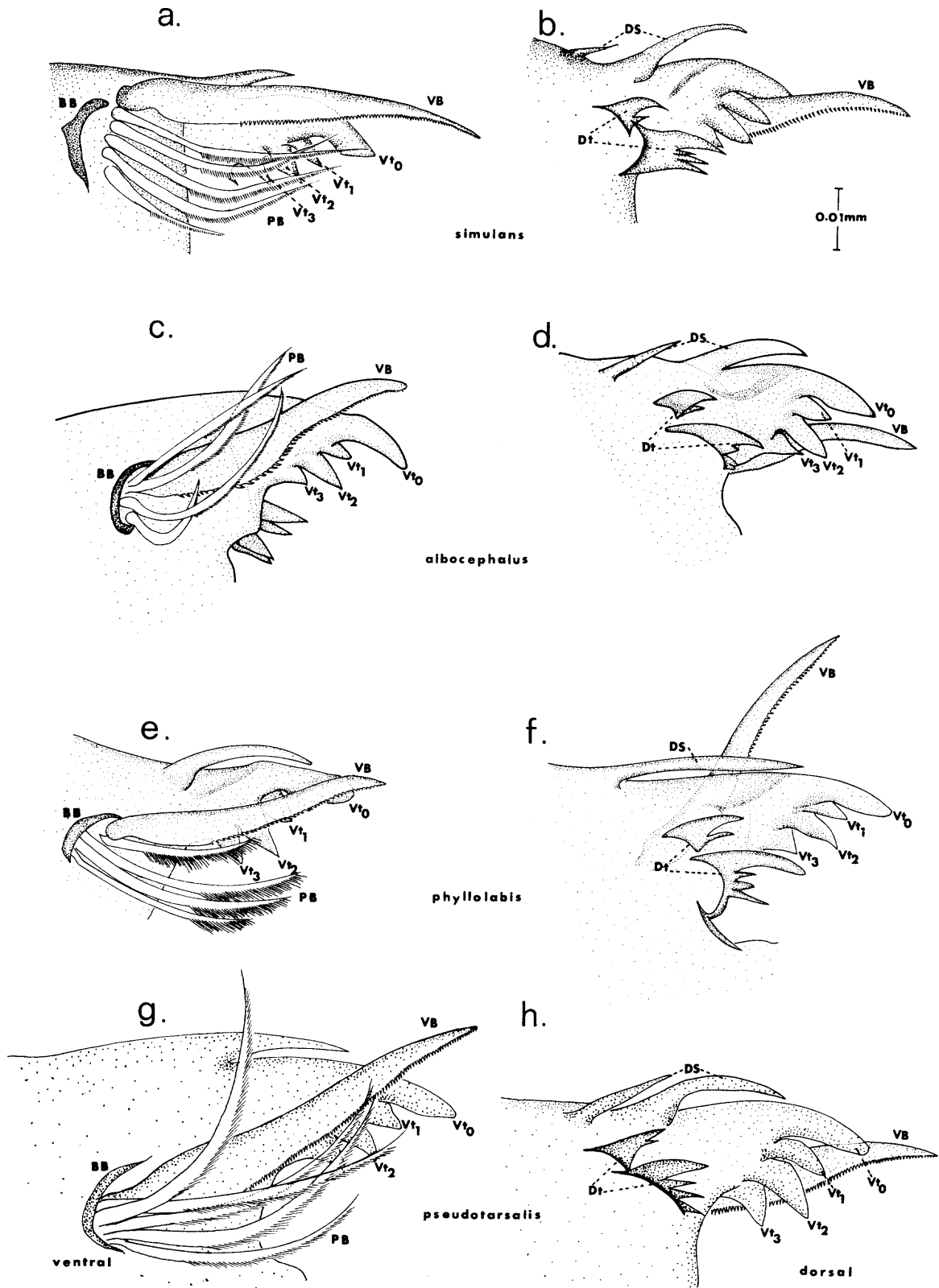


Fig. 5

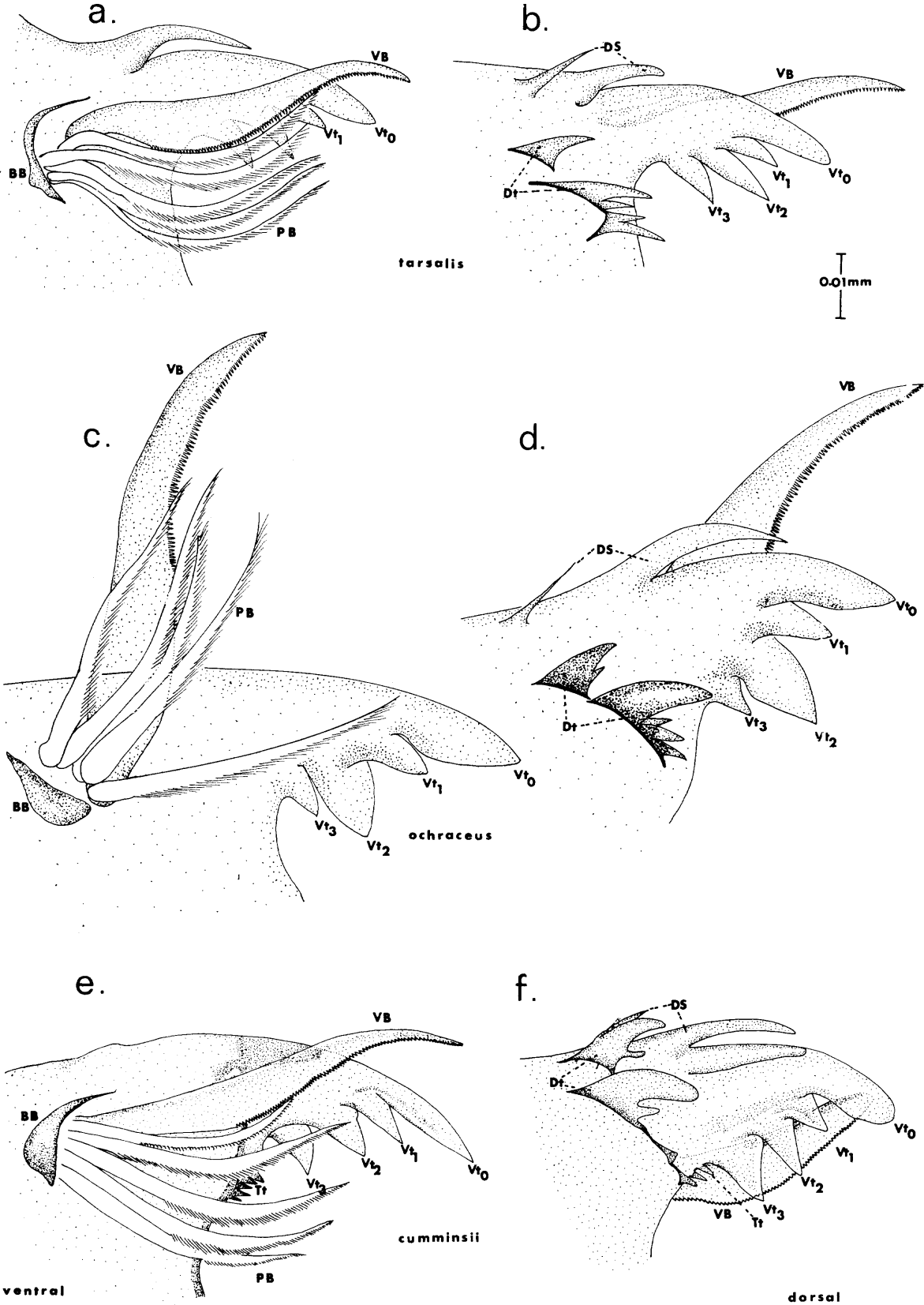




Fig. 6

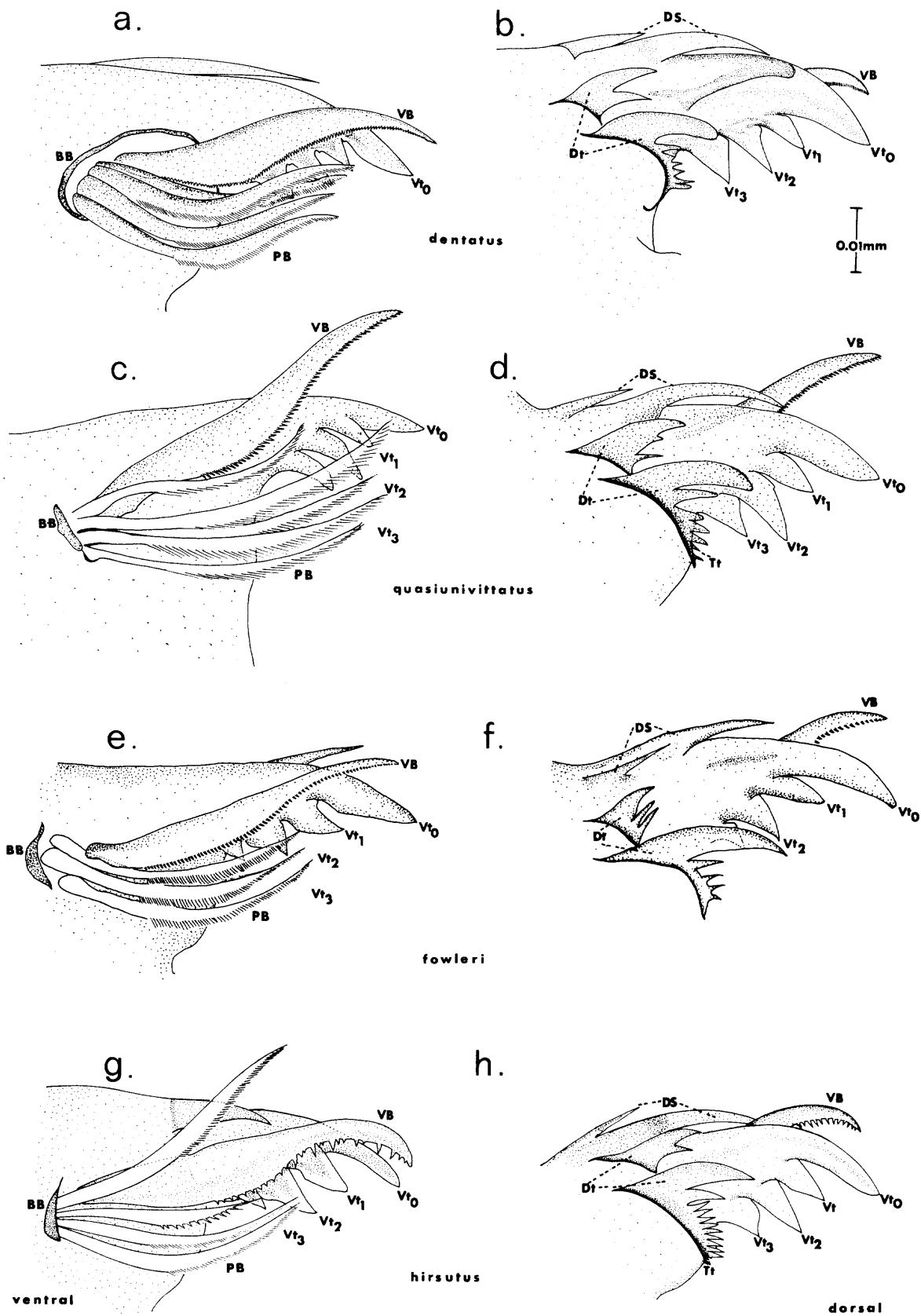


Fig. 7

