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ASSISTED BY F. W. EDWARDS, M.A., Sc.D.

DIPTERA.

VOL. IV.

Family CULICIDÆ.

Tribe ANOPHELINI.

BY

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AUTHOR'S PREFACE AND ACKNOWLEDGMENTS.

THE present work is an attempt to give an up-to-date account, likely to be useful for reference to those working on the subject, of the species and varieties of Anophelini so far recorded from the Indian area.

In such a task the author has found it necessary in certain directions to incorporate very largely the work of others, and some acknowledgments in this respect are necessary.

The account of larval characters and the descriptions of the larvæ here given are entirely based on the very complete work of Puri, especially his Memoir. I am also greatly indebted to this author for much kind personal help. The Key for the Identification of the Larvæ of Indian Species, after Puri, given in Part II., is taken, with the author's and Government's permission, from 'Health Bulletin,' no. 16, 1930*.

Pupal characters are to a large extent taken in an abbreviated form from Senevet, but the classification in part, and some new descriptions, are my own. The pupal characters of the Indian species have as yet been very inadequately worked out, and those given here must be regarded as very brief and provisional.

Data on the distribution of the species in India, and on the relation of different species to malaria transmission, have been taken from the two very full memoirs dealing respectively

* For details of various publications mentioned, see Bibliography at end of volume.

AUTHOR'S PREFACE AND ACKNOWLEDGMENTS.

with these subjects and subsequent publications by Covell. Covell's very useful summary by districts of the distribution of the species in India, given here as an Appendix, has been taken, with the author's and Government's permission, from 'Health Bulletin,' no. 17, 1931.

Full use has been made of the papers by Sinton and Covell and Barraud and Covell on pharyngeal structure, and I am also indebted to these authors for kind permission to use their preparations. Further studies have, however, been made by me since the publication of their works, and much now given under this head is new.

Much of the systematic work has been taken, brought up to date, from my Catalogue of 1924. The synoptic table for adults, given in Part II., is based on the table published by the Malaria Survey of India in 'Health Bulletin,' no. 10, in the compilation of which I took part.

Finally, I am greatly indebted to Dr. F. W. Edwards for very kindly allowing me to use his MSS., before publication, of the section on Anophelini in his recent comprehensive work on the classification and systematics of the Culicidæ, published in 'Genera Insectorum.' So far as possible, use made of this has been acknowledged in the text, but its early consultation has given me many facilities which I can only acknowledge here.

S. R. CHRISTOPHERS.

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LIST OF IMPORTANT RECENT SYNONYMS OF INDIAN SPECIES.

SYNONYM.	PRESENT CORRECT NAME.
<i>A. fuliginosus</i> Giles.	<i>A. annularis</i> Van der Wulp.
<i>A. listoni</i> Liston.	<i>A. fluviatilis</i> James.
<i>A. ludlowi</i> var. <i>sundaicus</i> Rodenw.	<i>A. sundaicus</i> Rodenw.
<i>A. maculipalpis</i> var. <i>indienensis</i> Theo.	<i>A. splendidus</i> Koidzumi.
<i>A. plumbeus</i> var. <i>barianensis</i> James.	<i>A. barianensis</i> James.
<i>A. rhodesiensis</i> Theo. (Eastern).	<i>A. dhali</i> Patton.
<i>A. rossii</i> Giles.	<i>A. subpictus</i> Grassi.
<i>A. sinensis</i> Wied. (Oriental).	<i>A. hyrcanus</i> var. <i>nigerrimus</i> Giles.

ABBREVIATIONS USED IN KEYS AND DESCRIPTIONS

(in the order usually employed in the descriptions).

Adult.

<i>t</i>	Torus (of antenna).
<i>fs</i>	Flagellar segments (of antenna).
<i>rbs</i>	Rudimentary basal segment (of palp).
<i>apn</i>	Anterior pronotal lobes (prothoracic lobes).
<i>ap</i>	Anterior promontory of mesonotum.
<i>af</i>	Anterior forked cell.
<i>pf</i>	Posterior ditto.

Larva.

<i>oc</i>	Outer clypeal hair.
<i>ic</i>	Inner ditto.
<i>pc</i>	Posterior ditto.
<i>is</i>	Inner shoulder hair (inner submedian prothoracic).
<i>ms</i>	Middle ditto.
<i>da</i>	Dorsal anterior pleural hair of (1) pro-, (2) meso-, or (3) metathorax, respectively.
<i>va</i>	Ventral anterior ditto.
<i>dp</i>	Dorsal posterior ditto.
<i>vp</i>	Ventral posterior ditto.
<i>spc</i>	Spiracular chitinisation.
<i>mps</i>	Median plate of scoop.
<i>ps</i>	Postspiracular hair.
<i>osc</i>	Outer submedian caudal.
<i>isc</i>	Inner ditto.
1-3	Thoracic segments.
I-VIII	Abdominal segments.

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Order DIPTERA.

Family CULICIDÆ.

Tribe ANOPHELINI.

PART I.—GENERAL.

I. INTRODUCTION.

MOSQUITOES of the tribe Anophelini are commonly spoken of as the Malarial Mosquito, Anopheline mosquitoes, Anophelines, or "Anopheles." They resemble in their chief characters other mosquitoes, but are generally to be recognized at once by their spotted wings and their characteristic attitude when at rest on walls or other objects*.

According to entomological definition, the Anophelini are distinguished from other mosquitoes by the long female palpi, which are about the same length as the proboscis. In the male the palpi have the last two segments swollen and somewhat flattened, forming a characteristically shaped club not unlike the head of a golf-club, which appearance, together with the spotted wings and attitude, usually suffices to distinguish the males of Anophelini from those of other mosquitoes†.

* Actually many species possess entirely unspotted wings. The commoner species in the tropics, however, mostly have spotted wings, though sometimes in dark species the pale spots are very small, and scarcely distinguishable without a lens.

Some Tipulidæ (small crane-flies) and Chaoborinæ (proboscis-less mosquitoes) may show a similar resting attitude, but no other Culicidæ. Some Anophelini, on the other hand, have a somewhat *Culex*-like attitude, though a typical hunch-back (*Mansonia*-like) attitude is practically confined to the rare and aberrant South American genus *Chagasia*.

† For details of characters of the tribe, see description of parts given in Section III. of this part of the volume.

During life the palpi of the female (except when the insect is feeding) are held closely approximated to the proboscis, so that the

The attitude of Anophelini when resting is very characteristic and is often referred to. Both in Culicini and Anophelini the fore and mid-legs are usually placed with the sharply flexed tibio-femoral joint directed upwards and the last tarsal segment or so only resting on the supporting surface, so as to give, with the first two pairs of legs, four *points d'appui*, more or less corresponding to the corners of a square; these legs form four approximately equal arches, supporting at a central point the weight of the body. In *Culex* the body is so slung as to be horizontal, the coxæ of all the legs being equally distant from the supporting surface, whereas in Anophelini the body is strongly tilted downwards at the head-end, each pair of coxæ from before backwards being progressively further away from the supporting surface. Taken in conjunction with the shape of the body, this causes the abdomen to point markedly away from the surface and the whole body to form with this an angle which may even approach 90° (fig. 1). The hind legs as a rule take little or no part in supporting the body, though they are often placed so as to touch the supporting surface, and even at times are used to give support. As also in some Culicini, these legs are very commonly held in the air, often high above the abdomen*.

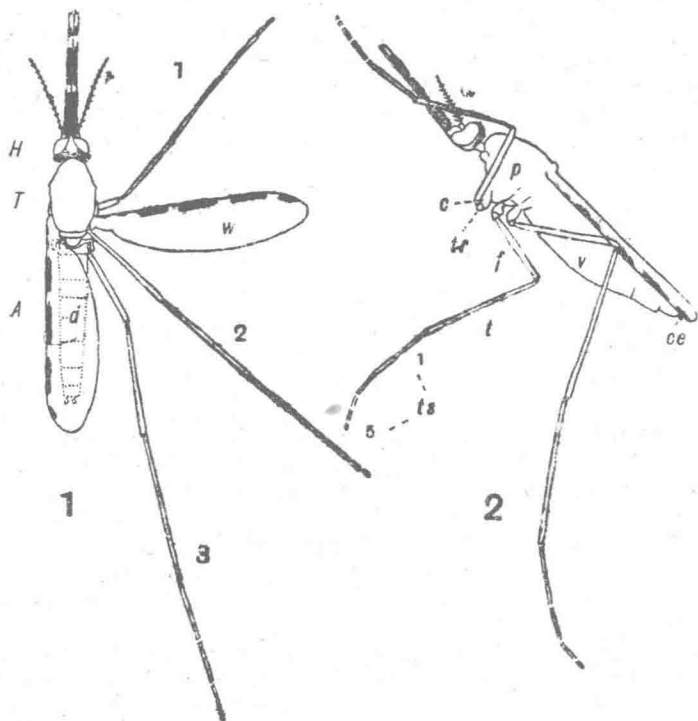
The exact angle made by the insect's body with the supporting surface varies considerably not only with the species, but also according to whether the insect is resting on a vertical or horizontal surface or suspended from the latter, and, also, whether the insect is in a fed or gravid condition or not, or is fresh and lively or weak. A more or less *Culex*-like attitude is seen among Indian species in *A. aitkeni* and in

two palps and the proboscis give the effect of a single organ. In the living condition all that an examination under a lens may show, especially when the palps are thin and delicate, is that, in Anophelini, the finger-like or bud-like palpi seen at the base of the proboscis in culicine mosquitoes are not to be made out. When the insect is dead, and the tissues somewhat dried, the palpi separate, and these organs, with the proboscis, may give a trident-like effect (fig. 2).

* In the female anopheline the tip of the labium and the palpi are brought so close to the object rested upon that they are almost in contact with it. The tips of the tibiae of the fore legs, which, both in Anophelini and Culicini, reach to a level slightly below the head, are in Culicini so situated as to lie behind the head, whereas in Anophelini they are in front of the head, and in side view usually cross the line of the proboscis or are entirely in front of this. The mid-femora and tibiae, which in *Culex*, in lateral view, cross the line of the abdomen, are usually, in Anophelini, entirely below this structure. Accentuating the distinction in attitude is the fact that the tarsus in Anophelini is usually relatively longer than in most Culicini, and the insect is, therefore, raised higher.

A. culiciformis and *A. sintoni*. In *A. culicifacies* the body is held rather close to the surface, and in fed or gravid females may have a very *Culex*-like appearance; but, though the angle formed is small, the anopheline attitude is generally quite

Fig. 1.



General structure and resting attitude of living insect:—1. Dorsal view of unfed ♀, showing position of wings folded and expanded. 2. Lateral view of an anopheline (*A. annularis*) resting on a vertical surface. The specimen is engorged to some degree.

A, Abdomen.
c, Coxa of fore leg.
ce, Cercus.
d, Dorsum of abdomen (tergites).
f, Femur.
H, Head.
p, Pleura.
T, Thorax.

t, Tibia.
tr, Trochanter of fore leg.
ts, Tarsus (segments 1-5) of mid-leg.
w, Wing.
v, Venter of abdomen (sternites).
1-3, Fore, mid-, and hind leg respectively.

distinct in the unfed female, especially when suspended. The majority of species form angles with the surface on which they rest of from 30 to 45°. In *A. hyrcanus* and *A. barbirostris* the angle is very exaggerated, and approaches almost a right angle.

Equally characteristic of the tribe is the straight configuration of the body, the head and proboscis being nearly in the same line as the rest of the body. As a consequence, the angle formed by the under surface of the head with the prosternal region of the thorax is much larger in anopheline than in culicine mosquitoes (120° as against 90° or less). The attachment of the abdomen, further, is such that its axis forms about a right angle with a line joining the middle coxa with the middle of the dorsum of the thorax, whereas in culicine mosquitoes the angle is much smaller, in some cases less than 45°. Even when the attitude is somewhat *Culex*-like, e. g., in *A. culicifacies*, the straight configuration of the body still largely holds good.

The spotting of the wings* is very characteristic of Anophelini, though not entirely confined to this tribe of Culicidæ, whilst many species of the tribe do not show it. The common European species *A. maculipennis* has wings spotted with small dark spots due to aggregations of scales on the wing-field; but the more usual and typical form of spotting, and that which is seen in the majority of species, is due to pale spots on the costa and wing-veins caused by the veins being alternately clothed with dark and pale scales. The effect is to give rise to linear dark or pale spots, these appearing either as pale spots on a dark ground or *vice versa*, though about an equal amount of pale and dark is common.

Other features characteristic of the adult insect are noted under the Key to Genera and Subgenera and in the systematic part of the work. The most important are the bar-shaped scutellum, with the scutellar hairs forming an unbroken row†, the single large claw on the fore legs in the male, and the absence of a regular imbricated vestiture of scales on the abdomen, as is universal in Culicini. Though numerous scales may be present in some Anophelini on the dorsum, the sternites are always in large part bare.

So far as is known, the median acinus of the salivary gland in Anophelini is saccular, thus differing from *Culex*, where it is tubular, with a narrow duct. The female carries a single

* For a study of the wing-spotting in *Anopheles*, see Christophers, Ann. Trop. Med. and Par. vii, p. 45, 1913.

† The rare genus *Chagasia* is, however, exceptional in these respects (see Key to Genera in Part III.).

spermatheca, three being the usual number in Culicini, though a single spermatheca may be present in some forms.

The larvæ of Anophelini* are distinguished from the larvæ of other mosquitoes by the absence of a supporting tube (siphon) to the spiracular apparatus†, by their horizontal attitude when at rest or moving at the surface of the water, and by the fact that, when supported at the surface, their bodies are actually in contact with the surface-film by means of their abdominal float-hairs, which cause little dimples in the surface. A further character of the larva is the ability to rotate the head through 180° to allow of feeding at the surface. They are also peculiar in possessing eversible organs on the thorax (eversible organs of Nuttall and Shipley), and the large hairs are for the most part pinnately branched in one plane. The larvæ of Anophelini are found in nature almost exclusively in natural waters and, unlike many Culicini, are rarely found in pots and other domestic collections of water‡.

The egg is also characteristic, being usually boat-shaped, with a demarcated upper surface and laterally situated floats§.

The total number of species known in the world is about 170, of which 42 species, with 10 varieties representing local forms or subspecies, have been recorded from the Indian area.

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For an elementary and semi-popular account of the characters and bionomics of Anophelini and their relation to disease, etc., see Daughlish, 'The Anopheline Mosquito,' John Murray, 1911; Edwards, 'Mosquitoes and their Relation to Disease,' Brit. Mus. (Nat. Hist.), Econ. Ser. no. 4, ed. 4, 1931 (price 4d.); Edwards and James, 'British Mosquitoes and their Control,' Brit. Mus. (Nat. Hist.), Econ. Ser. no. 4a, 1925 (price 6d.); Crawford and Chalam, 'Mosquito Reduction and Malaria Prevention,' 1926, Oxford Univ. Press (price 3 rupees), Covell, in Ghosh, 'A Treatise on Hygiene and Public Health,' 7th ed. 1930, Calcutta, Sci. Publ. Co. A very excellent little book, giving much information, is Hegh's 'Les Moustiques,' Brussels, 1921.

Complete monographs on Anophelini of a modern character do not exist, but the following are monographic studies dealing with

* For characters of the larva, see Section III. ("Characters used in Identification and Classification").

† The whole of the respiratory apparatus of *Anopheles* is represented by the parts at the tip of the siphon in Culicini.

‡ A common and important Indian species, *A. stephensi*, however, is noted for its power of breeding in cisterns and other artificial breeding places. Most species are rarely, if ever, found in artificial receptacles unless these give breeding places in some degree approaching natural collections of water. A number of species of Anophelini breed entirely in holes in trees; no fewer than four species in the Indian area adopt this special habit.

§ For further description, see Section III.

Anophelini of various countries or regions (commonly along with other mosquitoes):—

Palearctic Region.—Edwards, "A Revision of the Mosquitoes of the Palearctic Region," Bull. Ent. Res. xli, p. 267, 1921; Martini, in Lindner, "Die Fliegen der Paläarktischen Region," Lf. 38, 40, 46 and 53 (index); also Lang, 'A Handbook of British Mosquitoes,' 1920.

North Africa and Mediterranean.—Seguy, "Les Moustiques de l'Afrique Min., etc.," Encyclop. Entom., Lechevalier, Paris, 1924.

Egypt.—Kirkpatrick, 'The Mosquitoes of Egypt,' Cairo, 1925.

Tropical and South Africa.—Bedford, in 13th and 14th Repts. Director Vet. Educ. and Research, Pretoria, 1928; Evans, Mem. no. 3, n. s. L'pool Sch. Trop. Med.

India.—James and Liston, 'Anoph. Mosq. of India,' 2nd ed., 1911. Also Synopses, etc., published by the Malaria Survey of India, in Govt. India Publ. H. Bulletins (see list of important recent works at beginning of Bibliography in this volume.)

Dutch East Indies.—Swellengrebel, "Die Anoph. v. Ned. Oost Indie," 1921, Kolon. Inst. Amsterdam, Meded. xv; Swellengrebel and Rodenwaldt, *ibid.*, Gustav Fischer, Jena, 1932.

Philippines.—Recent papers by W. V. King (see full Bibliography at end of this volume).

Japan.—Yamada, Sci. Repts. Govt. Inst. Inf. Dis. iii, p. 215, 1924; iv, p. 447, 1925.

Australia.—Edwards, Bull. Ent. Res. xiv, p. 351, 1924.

America.—Howard, Dyar, and Knab, 'Mosq. N. and C. America,' iv, 1917, and ii, 1912 (plates); Dyar, 'The Mosq. of the Americas,' 1928; Costa Lima, 'Trat. de Parasit.' ii, p. 648, 1930; also papers by Root, Shannon, and Davis (see Bibliography).

For catalogues of world species, etc., see Christophers, Ind. Med. Res. Mem. no. 3, 1924; Covell, *ib.* no. 7, 1927; Edwards, 'Gen. Insect,' Fasc. 194, 1932.

For internal structure, see Christophers, Repts. Mal. Comm. Roy. Soc. ser. 4, 1901; Nuttall and Shipley, Journ. of Hyg. i, pp. 45-77, 269-276, 451-484; ii, pp. 58-84, 166-215; Thomson, Proc. Boston Soc. of Nat. Hist. xxxii, 145-202, 1905; Imms, Journ. of Hyg. vii, pp. 291-318, 1907; *id.*, Parasit. i, pp. 103-132, 1908 (larva); Hurst, Trans. and Ann. Rept. Manchester Microsc. Soc. 1890 (pupa); Roy, Ind. Journ. Med. Res. xiv, p. 995, 1927 (oesoph., divert., and sal. glands). See also under "Mouth-parts," "Thorax," "Wing," and "Hypopygium."

II. CLASSIFICATION.

The classification adopted in this volume * is, as regards the genera and subgenera, that given by Edwards in his most recent work, which appears most satisfactorily to display what is known up to date of the affinities of the main groups and of the aberrant forms of Anophelini. Of the three genera recognized, the genus *Anopheles*, which alone occurs in the Indian area, includes the great majority of species

* In the main the classification is that given by me in 1915 and 1924, since extended by Edwards in the work referred to. For the classification as it affects species recorded from India, see the Systematic Index. For a fuller statement, see Part III. (Systematic) of this work.

in the tribe. Structural differences such as can be used satisfactorily for classification have for the most part been brought to light only comparatively recently. The classification of Theobald and others on scale-structure has shown itself, in the course of time, inadequate and misleading, chiefly because it is evident that scale-structure in the tribe has progressed on somewhat parallel lines in a number of distinct phylogenetic stems. This classification has now been abandoned for others of a more satisfactory character.

Classification by Male Genitalic Characters.—After separation of the genera *Chagasia* and *Bironella* on the male tarsal claws, etc., the most satisfactory primary subdivisions appear to be those given by the male genitalic characters, i. e., on the number and arrangement of the parabasal spines. Such subdivisions are generally agreed to be most conveniently treated as subgenera. They are not only consistent with the general structure and ornamentation of the adult (Christophers, 1913, 1915, 1924), but also accord closely with subdivisions based on the recent work on pharyngeal characters by Sinton and Covell (1927) and Barraud and Covell (1928, 1929) and those based on the pleural hairs and other characters of the larva as recently shown by Puri (1929, 1931).

The characters and arrangement of the parabasal spines on which these subgenera are founded are sufficiently indicated in the Keys to Genera and Subgenera in Part III. The great majority of species fall under one or other of the subgenera *Anopheles*, *Nyssorhynchus*, and *Myzomyia*, only the first and last of which occur in the Indian area.

Classification by Pharyngeal and Larval Characters.—Subdivisions based on pharyngeal and larval characters follow in the main those made on genitalic characters, and serve to strengthen the subgenera; but, whilst in no instance contradictory*, they sometimes give greater or less emphasis to particular subgenera and groups than do the genitalic characters. This is especially noticeable with the subgenus *Nyssorhynchus* and group *Neomyzomyia* of subgenus *Myzomyia*.

On the whole the genitalic characters appear the most suitable for the primary definition of the subgenera owing to their certainty and preciseness. The pharyngeal and larval characters, besides supporting the subgeneric divisions, have a special value in establishing the groups.

The accompanying schema illustrates the general relationship of the classifications based on general adult characters, pharyngeal characters, and the pleural hairs of the larva:—

* The only real anomaly in the classification based on genitalia is the remarkable character of the hypopygium in *A. parangensis*, which is not specially peculiar in any other feature of its organization.

CLASSIFICATION OF ANOPHELINI.

Genus or Subgenus.	Group.	Adult characters (general).	Parabasal spines (♂.)	Pharyngeal armature (♀.)	Long pleural hairs (larva).
Genus <i>Chogasia</i> . . . . .	....	Distinct.	Peculiar.		Extra hair.
Genus <i>Bironella</i> . . . . .	....	Distinct.	Peculiar.		
Genus <i>Anopheles</i> :— Subgen. <i>Stethomyia</i> . .	....	Distinct.	One.	Absent.	
Subgen. <i>Anopheles</i> . .	{ <i>Anopheles</i> . <i>Arribalzagia</i> . <i>Christya</i> . }	Less than four main costal spots.	Two.		All simple.
Subgen. <i>Nyssorhynchus</i> .	{ <i>Nyssorhynchus</i> . <i>Myzorhynchella</i> . <i>Kerteszia</i> . }		One basal, two on coxite.	Single row, recurved.	
		Four main costal spots.		Single row.	
Subgen. <i>Myzomyia</i> . .	{ <i>Neomyzomyia</i> . <i>Pseudomyzomyia</i> . <i>Paramyzomyia</i> . <i>Myzomyia</i> . <i>Neocellia</i> . <i>Celia</i> . }		Four to five in one group.	Double row.	Some at least feathered.

Classification by Pupal Characters.—The pupal characters of a considerable number of species have been described by Senevet. As a general rule division into *Anopheles* and *Myzomyia* is indicated by the paddle-hair (short and straight in *Anopheles*; long and hooked in *Myzomyia*). *Nyssorhynchus* and also group *Neomyzomyia* * are akin to *Anopheles* in this and some other respects. The following is Senevet's provisional table for the genera and subgenera † :—

Spine VIII without lateral branches.

Hair C transformed into spine Genus CHAGASIA.

Hair C not so Subgen. NYSSO-

[RHYNCHUS.

Spine VIII with several lateral branches.

Paddle-hair short and straight Subgen. ANOPHELES ‡.

Paddle-hair long and hooked Subgen. MYZOMYIA.

The groups of subgen. *Anopheles* and, especially, of subgen. *Myzomyia* seem, however, also to some extent to be indicated. The following, in the main at least, holds good for the latter subgenus :—

Paddle-hair short and straight *Neomyzomyia*.

Paddle-hair long and hooked.

Spines IV–VII long, IV as long as or only { *Myzomyia*.
somewhat shorter than V and sharp. { *Paramyzomyia*.

Spines V–VII only long, IV abruptly reduced { *Neocellia*.
and usually blunt. { *Pseudomyzomyia*.

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See also (*adult*) Christophers, Ann. Trop. Med. and Par. vii, p. 45, 1913; (*hypopygium*) Christophers, Ind. Journ. Med. Res. iii, p. 371, 1915; Root, Amer. Journ. Hyg. iii, p. 264, 1923, and iv, p. 456, 1924; (*pharynx*) Sinton and Covell, Ind. Journ. Med. Res. xv, p. 301, 1927; Barraud and Covell, *ib.* xv, p. 671, 1928; *id.*, Trans. 7th Cong. F.E.A.T.M. iii, p. 98, 1929; (*Larva*) Puri, Ind. Journ. Med. Res. xvi, p. 519, 1928; *id.*, Ind. Med. Res. Mem. no. 21, 1931.

* Senevet describes only *A. smithi* and *A. punctulatus*, but descriptions of several more species in the group given here also show these characters.

† Tree-hole breeding species, as with the larvae, may form exceptions.

‡ Including *Stethomyia* and group *Neomyzomyia*.

III. CHARACTERS USED IN IDENTIFICATION AND CLASSIFICATION.

ADULT CHARACTERS *.

The nomenclature used for parts of the body is shown in fig. 1. The different parts are considered more in detail below.

HEAD.

The nomenclature of the head-structures is indicated in fig. 2. The *head-scales*, which cover the occiput and most of the vertex between the eyes, are of a single type, being erect, narrowly fan-shaped, truncated, and often slightly

* Among general characters of the adult which should, perhaps, be mentioned are size and colour. *Anopheles* of the group *Myzomyia* are as a rule distinctly small. The outstandingly large Indian species is *A. gigas*, specimens of which may almost equal the giant African species *A. implexus*. The index used for designating size in this volume is the length of the wing: this is about 3 mm. for small species, 4-4.5 mm. for moderate-sized species, and 5-6 mm. for very large species.

Coloration in the group varies from a lightish grey or fawn to shades of brown practically amounting to black, and, though subject to some variation in the same species, is often very helpful in identification. Sometimes specimens may show more pigmentation than is usual with the species, with an increase in the extent of dark markings on wing, tarsi, palps, etc., and often with bridging of costal spots and other anomalies of wing-ornamentation (*melanism*). A contrary effect is seen where the dark markings are abnormally restricted and spots normally present obliterated, or pigmentation may be defective in a capricious manner or almost entirely absent (*hypomelanism*). An extreme condition of hypomelanism gives rise to the *immaculatus* form referred to under *A. vagus*, but an almost similar condition has been observed in *A. stephensi* and *A. palliaus*.

Nomenclature of parts of the head:—1. Head of ♀, showing palpi, antennæ, etc., the palp of the side shown denuded of scales. 2. Ditto of ♂. 3. Head, showing arrangement of scales and hairs on vertex. 4. Lateral view of head. 5. Tip of mandible. 6. Tip of maxilla.

A, Antenna.

Ab, Apical pale band.

app, Anterior portion of postgena.

Bb, Intervening dark area between apical and subapical pale bands.

C, Clypeus.

Cb, Subapical pale band.

F, Frons.

Hs, Head-scales.

L, Labium.

Lb, Labella.

m, Tip of mouth-parts lying in labial sheath.

O, Compound eye.

Oc, Ocular chætæ.

Op, Occiput.

Os, Ocular scales.

P, Palp.

pg, Postgena.

pgc, Postgenal chætæ.

t, Torus.

V, Vertex.

Vc, Vertical chætæ.

Vt, Vertical tuft.

1-5, Segments of palpi (♂ and ♀).