

THE CLASSIFICATION AND IDENTIFICATION OF THE ANOPHELES MOSQUITOES OF MEXICO, CENTRAL AMERICA, AND THE WEST INDIES

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THE systematist finds in his material "certain regular correlations, associations of a limited number of characters that occur regularly in individuals, amid a very great amount of individual variation. It is this correlation that constitutes the basis of species-diagnosis" (Robson, G. C. and Richards, O. W. 1936). Species, the unit of classification, is a concept, existing only in the mind of the taxonomist, and not corresponding to any sharp separation recognizable in nature. Minor variations are present which must be recognized and given a place in the scheme of classification. These minor variations, below the rank of what are usually considered species, are called varieties, subspecies, or races. The usual connotation of variety is geographical; that of race is physiological, although here no uniformity of usage exists.

For the purposes of this paper, it seems advisable to adopt the following definitions: A taxonomic species is an assemblage of individuals in which certain regular associations of structural or colorational characters are found. In the Anophelini, the most useful structural characters are found in the male sexual organs, the terminalia. A variety is a subdivision of a species occurring in one part of the range of the species, and set off from it by slight but constant differences in color-markings, but showing no constant differences in the structure of the male sexual organs. A race is a purely physiological concept, based upon differences in behavior, which may or may not be reflected in differences in structure. As instances of these categories, the concept of a species may be represented by *A. albimanus*, which agrees throughout its

range in possessing certain association of characters in all its stages, so that it can be recognized by the trained entomologist by examination of the larvae and the male terminalia. The concept of a variety may be represented by C. C. Hoffmann's two forms of *A. albimanus*, *A. bisignatus* and *A. trisignatus*, found in southern Mexico (Hoffmann 1938a); these forms have male terminalia indistinguishable from those of *A. albimanus* as found elsewhere, but have extra black bands on the hind tarsal segments. The physiological race is exemplified by the two kinds of *A. albimanus* found respectively in Panama and in Venezuela. These are indistinguishable from color or structural characters, so far as now known, but the Panama race will mate in small cages, while Gabaldon tells me he has failed to obtain mating under such conditions.

Something must be said concerning the recent use of egg-characters in taxonomy. The classic example is of course the separation of the European *A. maculipennis* into six or more forms on the basis of differences in the eggs. Under the classification indicated above, all these forms of *A. maculipennis* are included in a single taxonomic species; opinion is at present divided as to whether these six forms shall be considered varieties or races. Apart from the eggs, apparently only two morphological differences have been found to separate these forms: variations in the form of a hair of the larva and in the shape of the spine on the elaspette lobes of the male terminalia; but Hackett states that these differences are so small and overlap so much that they are "not sufficient in themselves for the classification of any given specimen." So by

definition these forms would be regarded as physiological races, unless we admit that the characters of the eggs differentiate higher categories than the race.

Marston Bates (1940), in a closely reasoned paper, makes out a strong case for regarding the forms of *A. maculipennis* found in Europe as distinct species. Much of his argument is based on the varying sexual behavior of the forms; he has found that the males of some forms mate readily with those of others, but in few instances are fertile eggs obtained. Some of his argument is based on egg-characters, it apparently being true that certain forms which can be distinguished by distinct sexual behavior lay eggs which are easily differentiated from those of other forms. Probably when as much study has been applied to some of our tropical forms as has been given to the European *A. maculipennis*, similar differences, possibly correlated with observable differences in egg-structure, will be found. At present we are not in a position to state that such differences occur, as very little study has been given to this aspect of taxonomy, in American mosquitoes.

Some work has been done in Brazil and Panama on the egg-characters of the species of *Nyssorhynchus*, among which are the principal vectors of malaria in the New World. Ayroza Galvão and Barretto (1938) have shown that the eggs of *A. darlingi* exhibit great variations in the form of the floats, frill and terminal collar of the egg. Rozeboom in Panama (1938b) and Ayroza Galvão (1940) in Brazil, have shown that the eggs of *A. strodei* are exceedingly variable; Rozeboom distinguishes three types from his relatively scanty material; Ayroza Galvão also distinguishes three types, and gives photomicrographs of other anomalies which bear no resemblance to these types.

In Panama, at least, the various types of *A. strodei* eggs apparently do not indicate physiological races, as they were all obtained from the same locality at approximately the same time. Ayroza Galvão has not studied the possibility that his types represent true physiological "races," but hints that this may be the case.

So it will be seen that considerable study must be made of the eggs of the species of the subgenus *Nyssorhynchus* before it can be decided whether their characteristics denote physiological races, or are possibly valid indicators of taxonomic "species."

With these preliminary remarks, it should be evident that the taxonomy of the Anophelini is not static but in a state of flux. However, the broad outlines of generic classification are fixed. It is very likely that the number of good taxonomic "species" will be materially increased when adequate collections are made in Central and South America, and even more probable that many so-called species will have to be split up into varieties and physiological races.

For the purposes of this paper, only taxonomic species will be considered, that is, species which can be recognized by some outward and visible structural or color character, or lacking this, by the characters of the larvae and male terminalia.

CLASSIFICATION

In 1924 the late F. M. Root (1924a) listed 34 species found in North and South America, of which three are now known to be synonyms, making a total of 31 species. During the past 16 years, our knowledge of the Anophelini of the American tropics has increased very materially, not only as to the number of species, but in regard to their eggs, larvae, the characters of the male terminalia, their distribution, and their ability to transmit malaria. For instance, the list of species found in North and South America, as of January 1, 1940, stands more or less at 64 species, of which 27 are found north of South America and south of the southern boundary of the United States, and including the Caribbean islands, the region with which we have to deal.

The list of these 27 species, and the manner in which they are classified, is given in the following table:

Family Culicidae	
Subfamily Culicinae	
Tribe Anophelini	
Genus CHAGASIA	
<i>bathanus</i> Dyar	1

Genus ANOPHELES

Subgenus *Stethomyia**kompi* Edwards.....2Subgenus *Anopheles*Group *Anopheles*Series *Anopheles**quadrifasciatus* Say.....3*maculipennis* Meigen.....4*atropos* D. & K.....5*crucians* Wied.....6*punctipennis* Say.....7*pseudopunctipennis* Theob.....8*parapunctipennis* Martini.....9*hectoris* Giaquinto.....10*eiseni* Coq.....11*xelajuensis* De Leon.....12Series *Cyclolepteron**grahamii* Theob.....13*vestitipennis* D. & K.....14Group *Arribalsazia**neomaculipalpus* Curry.....15*punctimacula* D. & K.....16*apicimacula* D. & K.....17Subgenus *Nyssorhynchus*Series *argyritarsis**argyritarsis* R.-D.....18*darlingi* Root.....19*albitarsis* Arrib.....20Series *tarsimaculatus**albimanus* Wied.....21*triannulatus* Neiva &

Pinto.....22

strodei Root.....23*tarsimaculatus* Goeldi.....24*oswaldoi* Peryassu.....25*anomalphylis* Komp.....26Subgenus *Kerteszia**neivai* H. D. & K.....27

This classification is adapted from Edwards (1932), and differs from his in one minor modification. The writer believes that Edwards' group *Kerteszia* should be elevated to a subgeneric rank, co-equal with

subgenus *Nyssorhynchus*. Edwards, in a personal communication, has agreed with this contention.

Most of these species are strictly neotropical, but a few species penetrate the area from the north and are found mostly at higher elevations on the Mexican plateau. These species are *A. punctipennis*, *A. maculipennis*, *A. quadrifasciatus*, *A. crucians*, and *A. atropos*. One neotropical species, *A. albimanus*, penetrates to the northern limit of the area, being found in the lower Rio Grande valley.

The characters of the male terminalia are the basis of classification of the Anophelines into genera and subgenera. It is possible to classify all the 27 species of the area under consideration into these categories by noting the arrangement of the spines on the side-piece of the terminalia. The following table shows how this is done:

CHARACTERS OF MALE TERMINALIA

Of the genera and subgenera noted above, *Chagasia*, *Stethomyia*, *Nyssorhynchus* and *Kerteszia* are easily recognizable by the characters of the spines on the sidepieces of the male terminalia. But the subgenus *Anopheles* is divided into a number of groups and series, which are rather more difficult to separate on male terminalia characters. The group *Anopheles* contains two series, *Anopheles* and *Cyclolepteron*. In the series *Anopheles*, the leaflets of the mesosome may be variable in number of pairs, but all the leaflets are alike in form. In the series *Cyclolepteron*, a single pair

CLASSIFICATION OF THE ANOPHELINI ON BASIS OF SPINES OF SIDE-PIECE

Division	Basal lobe	Parabasal spines	Accessory spines	Internal spine
Genus CHAGASIA	Present	Undifferentiated	Undifferentiated	None
Genus ANOPHELES	Absent	(See below)	(See below)	(See below)
Subgenus <i>Stethomyia</i>	"	One, large	Absent	One, large
<i>Anopheles</i>	"	Two	"	One
<i>Nyssorhynchus</i>	"	One	Two	One, between accessory spines and tip of side-piece
<i>Kerteszia</i>	"	One	Two	One, between parabasal spine and accessory spines

of very large leaflets is present, with or without a smaller pair. In the group *Arribalzagia*, the number of pairs of leaflets is variable, but the largest pair differs in shape and size from the smaller pairs. Subgenus *Nyssorhynchus* is easily recognized because the dorsal lobes of the claspette are fused to form a single median structure, the form of which is characteristic in most of the species. In subgenus *Kerteszia*, the position of the internal spine, lying as it does between the parabasal and the two accessory spines, is characteristic.

A rather complete knowledge of the characters of the male terminalia is required for the separation of the species of the subgenera *Nyssorhynchus* and *Kerteszia*. As Root has well said, "The adult markings of species of this subgenus (*Nyssorhynchus*) are unusually variable, and in working out the fauna of a region which has not been carefully studied previously, it is essential to base identifications on larval and hypopygial characters, which are comparatively stable, instead of on the variable characters of the adult coloration." Because of limitations of space, it is impossible to do more than to indicate the characters by which species may be identified. Students desiring to obtain further information on the use of the characters of the male terminalia are referred to the separate works listed in the bibliography.

LARVAL CHARACTERS

In many instances, particularly among the neotropical species, the larvae show better differential characters than the adults. This is particularly true of the subgenus *Nyssorhynchus*. The principal characters used in differentiating species are: the form and spacing of the anterior clypeal hairs of the head; the shape of the inner hair of the prothoracic submedian hair-group; the shape of the pleural hairs; the shape and number of the lateral abdominal hairs; the number of pairs of palmate hairs of the abdomen and the form of the individual leaflets; the shape and arrangement of teeth of the comb of the eighth abdominal segment; and in a few species, the

peculiarities of the form of the respiratory apparatus. A number of other characters are of use in differentiating certain species, but most of the larger groups may be separated on the characters enumerated above.

PUPAL CHARACTERS

Very little attention has been paid to the pupal characters of the Neotropical Anophelines, as in most cases the differences are very slight and variable. In genus *Chagasia*, series *Cyclolepteron*, and group *Arribalzagia*, however, the pupal trumpets have characteristic shapes, and afford better means of separation of species than either the larvae or the female adults. In one important species of subgenus *Nyssorhynchus*, *A. darlingi*, the pupal trumpets are unique in form, and afford excellent characters for identification.

CHARACTERS OF THE FEMALE ADULTS

A large number of characters has been used to define the various genera and subgenera, and smaller divisions. Probably one of the most useful gross characters is the color of the legs. The tarsi of all the legs are black in *Stethomyia kompi*, and in the 10 species of the series *Anopheles*. In the series *Cyclolepteron* and group *Arribalzagia*, the legs are speckled and banded irregularly with spots of white or yellow. In the subgenus *Nyssorhynchus*, the hind tarsi have the first segment black, the base of the second segment black, the apex white, while all the remaining three segments are either pure white, or have a narrow black basal band on the fifth segment.

The scaling of the body is another important group character. The species of the series *Anopheles* have no scales on the dorsum of the abdomen. Those of the group *Arribalzagia* have prominent lateral scale tufts on the abdominal segments, as do the species of subgenus *Nyssorhynchus*. *Kerteszia* lacks these scale tufts, no dorsal abdominal scales being present except in one species, which is not found in our area.

The wing-pattern, composed of aggregations of scales of different colors, disposed along the wing-veins, is of use in determin-

ing species, but because of the great variations which may occur, it is less useful than might at first appear. The principal regions in which spots of definite value are found are the costa, the leading edge of the wing; the third vein; and the sixth vein. All the species of the subgenus *Nyssorhynchus* have very similar wing-patterns, and there are great variations within the species, making it impossible in many instances to identify females by these patterns. In the series *Anopheles*, the wing-pattern of each species is distinctive, and usually will serve to distinguish species readily. In the *Arribalzagia* group, the pattern is very similar in most of the species, and other characters, such as the shape and color of the wing-scales, offer better means of separation.

The color-markings of the palpi are also important characters used in distinguishing species. Usually the color of the last two segments is of some value in separating related species.

In the following section, keys to the female adults, larvae, and male terminalia of the 27 species of the *Anopheline* species found in the region are given. The key to the female adults includes all the species found in the region.

That portion of the key to the female adults which includes the subgenus *Nyssorhynchus* must be used with caution, for the species in this subgenus resemble one another closely and are extremely variable in color-characters. This is particularly true of the species of the *tarsimaculatus* series, in which are the most dangerous vectors of malaria.

KEY TO ADULT FEMALES OF TRIBE ANOPHELINI,
FOUND IN THE NEOTROPICAL REGION
NORTH OF SOUTH AMERICA

1. Scutellum trilobed; a medium-sized shaggy brown species, with dark shaggy palpi; mesonotum with erect black scales before wing-bases; wings heavily clothed with broad ovate scales, mixed dark and light, not forming definite spots; second to fifth hind tarsal segments broadly white basally, black apically, with a narrow black ring near base of each segment (Atlantic coast of Costa Rica and Panama) (Genus *CHAGASIA*)

BATHANUS

Scutellum not trilobed, crescent-shaped; mesonotum without erect scales before wing-bases; legs not marked as above 2

2. Slender black species, without scales on body; mesonotum dark brown, with a narrow white median line in integument; wing-scales all black; legs very long and slender, all black (Atlantic coast of Costa Rica, and Panama) (Subgenus *STETHOMYIA*) *KOMPI*
Body with scales, at least on anterior promontory of thorax; mesonotum without median white line 3
3. Hind tarsi all dark 4
Hind tarsi with some or all of the terminal segments white; or variously spotted, speckled or banded with white 12
4. Scales on wings all dark; thorax without median gray stripe 5
Scales forming wing-markings white and black; thorax with broad median gray stripe 6

5. Wings very dark, the scales aggregated into four indistinct patches on origin of second vein, on cross-veins, and at bases of forks of 2nd and 4th veins; palpi with white rings at bases of terminal segments (rarely absent) (southwest Cuba) *ATROPOS*

Wings lighter, the scales forming four distinct darker spots on origin of second vein, on cross-veins, and at bases of forks of 2nd and 4th veins; palpi without white rings

MACULIPENNIS

QUADRIMACULATUS

6. Hind tibia with broad white apical band; wing-scales dark, except for a small white spot at basal third of first vein, and one large and one small white spot at apex of wing (Panama to Mexico) *EISENI*
Hind tibia all dark; white wing-spots not as above 7
7. Hind femur with narrow white apical band; wing-scales dark, except for white areas at apex of wing on tip of costa and on tip of first vein; wing-fringe white at this point (Guatemala) *XELAJUENSIS*
Hind femur and all other segments of leg dark; wings with many areas of black and white scales 8
8. Palpi all dark, without white rings; a broad white spot on costa, also involving first vein and base of second vein; another at tip of first vein, remainder of costa dark; sixth vein dark at both ends, white in middle (Mexico) *PUNCTIPENNIS*
Palpi with white rings on some of the segments; wings variously marked, but sixth vein not as above 9
9. Palpi marked with white on terminal segment and on two preceding segments; costa of

- wing all dark, except for a white spot at apex, involving also the tips of first vein and upper branch of second vein; sixth vein with three dark spots (Antilles; Yucatan to Honduras)*CRUCIANS*
Palpi white-marked; costa of wing not as above; sixth vein variously marked10
10. Costa of wing with two white spots, one at junction of subcosta, and another at apex of wing, both also involving areas opposite on first vein; sixth vein basally white, apically dark*PSEUDOPUNCTIPENNIS*
Sixth vein not basally white, apically dark11
11. Costa of wing with three large white spots, one at junction of costa and subcosta, another between this and base of wing, and a third at apex of wing, involving also tip of first vein; sixth vein white, with a central dark area and one at apex
PARAPUNCTIPENNIS
Costa of wing with two white spots, one at junction of costa and subcosta, broadly involving first vein, and another at apex of wing, involving tip of first vein also; three dark spots on sixth vein, one at base and one in middle small, the spot at apex of vein larger; another small black spot near origin of fourth vein (Mexico, Guatemala)
HECTORIS
12. Hind tarsi with apical portion of second segment white, all of third, fourth and fifth segments white, with or without a narrow black basal ring on fifth segment (subgenus *Nyssorhynchus*)13
Hind tarsi not so marked20
13. Hind tarsi with fifth segment all white14
Hind tarsi with narrow black basal ring on fifth segment16
14. First abdominal sternite with two parallel lines of white scales; mid tarsal segments with white rings; second hind tarsal segment nearly half black, half white (Panama, Costa Rica)*ALBITARSIS*
First abdominal sternite bare, without lines of white scales15
15. Mid tarsal segments with narrow white rings; next to last segment of palpi with many white scales, terminal segment white; second hind tarsal segment usually half black (sometimes more); a narrow white ring at apex of first hind tarsal segment (British Honduras and Guatemala)*DARLINGI*
Mid tarsal segments without white rings; next to last segment of palpi all black, terminal segment only white; second hind tarsal segment about one-third black; first hind tarsal segment without apical white ring (Panama to Mexico)*ARGYRITARSIS*
16. Second hind tarsal segment about one-sixth black at base (Panama, Costa Rica)
OSWALDOI
Second hind tarsal segment more than one-sixth black at base17
17. Last two segments of palpi white18
Terminal segment of palpi white; preceding segment all black, or with few white scales19
18. Second segment of hind tarsi about half black, half white (breeds in salt water, Atlantic coast of Panama)*TARSIMACULATUS*
Second segment of hind tarsi less than half black (*strodei* in fresh-water ponds, Panama to Mexico, *anomaloptyllus* in running streams, Atlantic coast of Panama and southern Costa Rica)*STRODEI*
.....*ANOMALOPHYLLUS*
19. Large species, the white spots on costa of wing broad; spot B2 (the costal white spot second from base) larger than preceding black spot (Panama to Brownsville, Texas; Greater Antilles)*ALBIMANUS*
Smaller species, the white spots on costa of wing reduced; spot B2 usually smaller than preceding black spot (Panama, Costa Rica).
.....*TRIANNULATUS*
(Formerly *BACHMANNI*)
20. Mesonotum gray, with four bare black lines; costa of wing with four or five alternating subequal black and white spots; hind tarsal segments narrowly black basally, broadly white apically; abdomen without scales (subgenus *Kerteszia*; Panama northward).
.....*NEIVAI*
Mesonotum, wings, and legs not as above; femora and tibiae spotted21
21. Costa of wing with a prominent bend or "kink" at junction of subcosta; lateral abdominal scale-tufts present (group *Arribalzagia*)22
Costa of wing straight, without such a kink; hind tarsi with narrow light rings at the joints; lateral abdominal scale-tufts absent (series *Cyclolepteron*)24
22. Costa of wing with only two large dark spots; black spot at apex of wing usually large, distinct; fifth vein speckled with light and dark scales (Panama, Costa Rica, probably northward)*NEOMACULIPALPUS*
Costa of wing with three large dark spots; brownish or blackish species, with pale scales of wing either white or yellow23
23. Large brownish species; wings with brown, white, and yellow scales; fifth vein speckled with dark and pale scales; dark spot at apex of wing diffuse, about the same size as the

dark spot between it and the third large costal spot (Panama to Mexico)

PUNCTIMACULA

Smaller black species; wings with black and white scales only; fifth vein black on stem and lower fork; black spot at apex of wing prominent, larger than black spot between it and the third large costal spot (Panama northward)

APICIMACULA

24. A small species, wings mostly white-scaled; edge of costa black; with a conspicuous dark spot at middle; dark wing-scales large, some nearly circular (West Indian islands)

GRABHAMII

A large brown species, wings mostly dark-scaled, scales narrow; a few small yellow spots on costa and apex of wing; hind tarsi usually with narrow yellow rings on both ends of segments (sometimes absent) (Greater Antilles, Dominica, southern Mexico, British Honduras southward along Atlantic coast to northern Panama)

VESTITIPENNIS

KEY TO THE LARVAE OF THE ANOPHELENI FOUND IN THE NEOTROPICAL REGION NORTH OF SOUTH AMERICA

1. Without apparent and functional palmate hairs; a long annulated process ending in a split bristle arises from each lateral flap of respiratory apparatus (Panama, Costa Rica) (subgenus *Stethomyia*)
- KOMPI
- With three or more pairs of well-developed abdominal palmate hairs; lateral flaps of respiratory apparatus not as above
- 2
2. Integument very hairy; palmate hairs with racket-shaped elements present on third, fourth and fifth abdominal segments; a single long filament arises from anterior plate of respiratory apparatus (stream-breeder, Panama, Costa Rica, British Honduras) (Genus *CHAGASIA*)
- BATHANUS
- Integument not hairy; with more than three pairs of well-developed abdominal palmate hairs; respiratory apparatus not as above
- 3
3. Lateral abdominal hairs on segments 4, 5 and 6 with coarse lateral branches
- 4
- Lateral abdominal hairs on segments 4, 5, and on 6, if present, without coarse lateral branches
- 5
4. Outer and inner anterior, and posterior clypeal hairs long, simple, subequal; mesothoracic and metathoracic pleural hairs much thickened, spine-like; tips of posterior plates of respiratory apparatus produced into two long black upcurving tails
- PSEUDOPUNCTIPENNIS
- Anterior internal clypeal hairs notably longer and stronger than external hairs; meso- and metathoracic pleural hairs slender, normal,

not thickened; tips of posterior plates of respiratory apparatus rounded (Guatemala, at high altitudes)

HECTORIS

5. Outer anterior clypeal hairs usually forming a fan-shaped tuft; inner clypeal hairs simple, set close together; well-developed palmate hairs on third to seventh segments only
- 6
- Outer anterior clypeal hairs never forming a fan-shaped tuft; inner clypeal hairs simple, set close together or far apart; palmate hairs present or absent on abdominal segments 1 and 2; present on segments 3 to 7
- 9
6. Anterior dorsal hair of prothoracic pleural hair-group with a few lateral branches; lateral hairs of abdominal segments 4 and 5 normally double, sometimes triple; ventral sabre of antenna with truncate, frayed tip.
- VESTITIPENNIS
- All long hairs of prothoracic pleural hair-group simple, unbranched; lateral hairs of abdominal segments 4 and 5 single or double
- 7
7. Ventral sabre of antenna squarely truncate, the tip frayed; outer anterior clypeal hairs normally forming a long tuft with many ultimate branches; lateral hairs of abdominal segments 4 and 5 single (Central and South American mainland, Trinidad)
- PUNCTIMACULA
- Ventral sabre of antenna pointed; outer anterior clypeal hairs forming a dense flattened tuft, shorter than inner clypeal hairs; lateral abdominal hairs of 4th and 5th segments branched
- 8
8. Branching of outer anterior clypeal hairs dichotomous, without additional fine branches; lateral hairs of abdominal segments 4 and 5 usually double from base (Caribbean Islands)
- GRABHAMII
- Branching of outer anterior clypeal hairs falsely dichotomous, with many fine simple elements in addition to dichotomous branches; lateral hairs of abdominal segments 4 and 5 variable, usually triply branched (sometimes more) from basal third (Caribbean coast from Yucatan to Spanish Honduras; Greater Antilles)
- CRUCIANS
9. Frontal hairs of head simple, at most finely frayed; lateral abdominal hairs of segments 4, 5, and 6 finely feathered; teeth of pecten all long, subequal; palmate hairs absent on first abdominal segment; leaflets straplike, with truncate tips (subgenus *Kerteszia*, bromeliad-inhabiting, Central America)
- NEIVAI
- Frontal hairs of head plumose; lateral hairs of abdominal segments 4 and 5, and on 6, if present, simple, not feathered; pecten teeth

- irregular in length; leaflets of palmate hairs always pointed10
10. Well-developed palmate hairs present on all abdominal segments (1 to 7); lateral abdominal hairs present on segments 4, 5, and 6; clypeal hairs variously arranged (subgenus *Nyssorhynchus*)15
- Well-developed palmate hairs present on abdominal segments 2 to 7 only; lateral abdominal hairs present or absent on segment 6; inner clypeal hairs close together; outer clypeal hairs simple11
11. Well-developed palmate hairs present on abdominal segments 2 to 7 only; lateral abdominal hairs present or absent on segment 612
- Well-developed palmate hairs present on abdominal segments 3 to 7 only; lateral abdominal hairs present on segments 4 and 5 only14
12. Lateral abdominal hairs present on segments 4, 5 and 6 single; one of the two long metathoracic pleural hairs branched at tip; palmate hairs with narrow, lanceolate, smooth leaflets ARGYRITARSIS
- Lateral abdominal hairs present on segments 4 and 5 only, absent on 6; both long metathoracic pleural hairs simple13
13. Lateral hair of third abdominal segment stout, plumose, normal; lateral abdominal hairs of segments 4 and 5 normally double; elements of palmate hairs wide, with serrations beyond middle; usually a small, transparent larva (Central and South American mainland) EISENI
- Lateral hair of third abdominal segment with slender, straight central shaft, with fine lateral branches difficult to see; lateral abdominal hairs of segments 4 and 5 simple, short, slender; elements of palmate hairs long, lanceolate, with faint serrations; a very large dark larva (Central America at high altitudes, syn. *chiriquiensis*) PARAPUNCTIPENNIS
14. Inner anterior clypeal hairs notably thicker and stronger than outer clypeal hairs; all the long hairs of the prothoracic pleural hair-group simple; lateral hairs of abdominal segments 4 and 5 usually single; a dorsal longitudinal white line usually present on thorax and abdomen NEOMACULIPALPUS
- Inner anterior clypeal hairs not notably thicker and stronger than outer clypeal hairs; anterior dorsal hair of the prothoracic pleural hair-group with a few lateral branches; lateral hairs of abdominal segments 4 and 5 usually double; dorsum of thorax and abdomen variously marked APICIMACULA
15. Posterior plates of spiracular apparatus with two long filaments arising from strong tubercles about midway of length of plate; spurs at bases of pleural hairs very long, strong; inner prothoracic submedian hair with fine branches from slender shaft DARLINGI
- Posterior plates of spiracular apparatus not as above, without long filaments; spurs at bases of pleural hairs moderate; inner prothoracic submedian hair not with fine branches from slender central shaft16
16. Inner prothoracic submedian hair with shaft thickened and widened, with many hairlike lateral branches; anterior dorsal hair of prothoracic pleural hair-group with many fine lateral branches ALBIMANUS
- Inner prothoracic submedian hair palmate; all the long hairs of the prothoracic pleural hair-group simple17
17. Inner anterior clypeal hairs so spaced that distance between them is more than one-third of the distance between the inner and the outer clypeal hairs18
- Inner anterior clypeal hairs so spaced that distance between them is less than one-third of the distance between the inner and the outer clypeal hairs; elements of abdominal palmate hairs notably very long, smooth, pointed21
18. Anterior clypeal hairs nearly evenly spaced, with few fine lateral branches19
- Anterior internal clypeal hairs closer than distance between inner and outer clypeal hairs, and with many coarse lateral branches20
19. Inner submedian prothoracic hair small, palmate, about one-third the length of the middle hair, with about 15 to 18 very fine, hairlike leaflets; larva small, usually dark green with white spots BACHMANNI
- Inner submedian prothoracic hair very large, about half the length of the middle hair, palmate, with about 15 narrow lanceolate leaflets, usually heavily infuscated; larva large, variously colored ALBITARSIS
20. Outer anterior clypeal hairs with many lateral branches from shaft; inner submedian prothoracic hair palmate, with about 12 broad lanceolate blunt-tipped leaflets; outer pair of frontal hairs of head not notably longer and stronger than other frontal hairs (brackish water breeder) TARSIMACULATUS
- Outer anterior clypeal hairs with few lateral branches from shaft; inner submedian prothoracic hair palmate, with about 10 broad lanceolate leaflets; outer pair of frontal hairs of head notably longer and stronger than other frontal hairs (fresh water breeder) OSWALDOI
21. Inner anterior clypeal hairs very close to

gether, less than one-third the distance between inner and outer clypeal hairs; inner submedian prothoracic hair palmate, with about 15 narrow lanceolate leaflets.....STRODEI
 Inner anterior clypeal hairs not so close together, about one-third the distance between inner and outer clypeal hairs; inner submedian prothoracic hair palmate, with about 10 narrow lanceolate leaflets (rapid stream breeder, Costa Rica)ANOMALOPHYLLUS

KEY TO THE MALE TERMINALIA OF THE NEOTROPICAL SPECIES OF THE ANOPHELENI ENCOUNTERED NORTH OF SOUTH AMERICA

1. Side-piece without parabasal spine; a large spinose sub-basal lobe present (genus CHAGASIA) BATHANUS
 Side-piece with parabasal spine or spines (genus ANOPHELES) 2
2. Side-piece with two spines, one very large parabasal, one internal (subgenus *Stethomyia*) KOMPI
 Side-piece with three spines, two parabasal, one internal (subgenus *Anopheles*) 3
 Side-piece with four spines, one parabasal, two accessory, one internal (subgenera *Nyssorhynchus* and *Kerteszia*) 12
3. Mesosome without leaflets; outer lobe of claspette with three long filaments, the tips much broadened and bent inwards, pipe-shaped; inner lobe with two or more narrow, flattened, pointed filaments, the outermost the longest (Guatemalan highlands) XELAJUENSIS
 Mesosome with leaflets; lobes of claspette not as above 4
4. Mesosome with leaflets all of the same general shape (series ANOPHELES) 5
 Terminal leaflets of mesosome always longer and broader than others (group *Arribalgazia* and series *Cyclolepteron*) 8
5. Mesosome with a single pair of long, black, serrate leaflets; mesosome long, slender, normal EISENI
 Mesosome with more than a single pair of leaflets; these leaflets small, transparent, difficultly visible; mesosome short, curved 6
6. Claspette lobes with two or three very long, inwardly curving setae at apex 7
 Claspette lobes with one or two fused bladlike filaments on outer lobe; inner lobe with a single long, pointed seta at apex, and a shorter slender seta on internal aspect at base; mesosome with one or two pairs of small, broad, shallowly serrate leaflets PARAPUNCTIPENNIS
7. Mesosome with two or three pairs of long, serrate leaflets; if three pairs, the middle pair the longest; outer lobe of claspette with

- three somewhat fused, bladlike, pointed filaments HECTORIS
 Mesosome with one to four pairs of small, delicate, deeply serrate leaflets; outer lobe of claspette with two or three somewhat fused, bladlike, rounded filaments PSEUDOPUNCTIPENNIS
8. Mesosome with a single pair of very long, lanceolate leaflets, three-quarters the length of the mesosome VESTIPENNIS
 Mesosome with more than a single pair of leaflets 9
 9. Mesosome with two pairs of leaflets, the terminal pair large, the smaller pair less than half the length of the larger (Antilles) GRABHAMII
 Mesosome with more than two pairs of leaflets 10
 10. Terminal leaflets much larger than the other pairs, elongate diamond-shaped, with central rib and hyaline margins PUNCTIMACULA
 Terminal leaflets without hyaline margins 11
 11. Terminal leaflets about twice the length of the next smaller pair, saber-shaped; ventral claspette lobes very hairy APICIMACULA
 Terminal leaflets very wide, the other pairs, usually four, all very slender and nearly as long as the terminal pair; claspette lobes scarcely hairy, with one stout apical hair and two smaller accessory hairs NEOMACULIPALPUS
 12. Side-piece with internal spine between accessory spines and parabasal spine; mesosome slender, tapering, without terminal leaflets (subgenus *Kerteszia*) NEIVAI
 Side-piece with internal spine between accessory spines and apex of side-piece (subgenus *Nyssorhynchus*) 13
 13. Mesosome with a pair of leaflets 14
 Mesosome without leaflets 16
 14. Fused ventral lobes of claspette with long, hairy basal lobules, as in *oswaldoi*; mesosome with two long, straight, thick, tapering leaflets, coarsely serrate on outer terminal half ANOMALOPHYLLUS
 Fused ventral lobes of claspette low, without long, hairy basal lobules 15
 15. Tip of mesosome long, scoop-shaped; a pair of leaflets from slight offsets on sides; leaflets long, straight, somewhat widened at middle, deeply serrate on terminal half; fused ventral lobes of claspette with rounded apex, with microtrichia, and two small, hairless, wrinkled, pouchlike ventral projections basally DARLINGI
 Tip of mesosome very short, rounded; the pair of leaflets not from offsets, short, curved, serrate; fused ventral lobes of claspette low,

without pouchlike projections, but with curved ridges from apexARGYRITARSIS

16. Fused ventral lobes of claspette with columnar truncate apex, with distinct median emargination; the membrane below expanded into a pair of prominent, hairless, ovoid lobes
ALBIMANUS

Fused ventral lobes not as above17

17. Apex of fused ventral lobes of claspette notably modified, with raised striations or projections18

Apex of fused ventral lobes of claspette rounded, or slightly emarginate, not notably modified19

18. Apex of fused ventral lobes of claspette with lateral ear-like expansions; basal lobules small, with fine hairs; filaments of dorsal claspette lobes short, with rounded tips (syn. BACHMANNI)TRIANNULATUS

Apex of fused ventral lobes of claspette with erect, rugose lateral expansions; basal lobules large, with long hairs from free margin; filaments of dorsal lobes long, pointedSTRODEI

19. Fused ventral lobes of claspette with long, apron-like hairy basal lobules20

Fused ventral lobes of claspette without such basal lobules, low, rounded, obsolete striateALBITARSIS

20. A crescent-shaped chitinized area above basal supporting strip, below apex of ventral lobes; long, apron-like basal lobules with distal free margins fringed with very long, reflexed hairsOSWALDOI

A round chitinized spot just above supporting basal strip, below apex of ventral lobes; long, apron-like basal lobules with short, radiating hairs (*Aquasalis*)

TARSIMACULATUS