THE SPECIES OF THE SUBGENUS KERTESZIA OF ANOPHELES

(Diptera, Culicidae)

BY

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This subgenus of Anopheles, which contains a small but interesting group of mosquitoes which breed in the water in bromeliads, and more rarely in bamboo, has been, taxonomically speaking, in rather a chaotic condition in the past. This has been due in part to inaccurate observation of specific characters, in part to the variability of color-markings in the species, and partly to lack of adequate material for study.

Recent observations and collections made by the author have, it is hoped, helped to clarify the nomenclature in this group, and to define and delimit to some extent the distribution of the species. The author has authentic material, larvae, males and females, of all the hitherto known species, and recently collected three new species in Colombia. On the basis of his observations and collections, it seems that there are at least 7 valid species in the group, instead of 2, with their subspecies, as stated by F. W. Edwards (1), or 3 species, as stated by Dyar (2). Three of these species, *Anopheles (Kerteszia) boliviensis* Theobald 1905, *Anopheles (Kerteszia) bellator* D. & K. 1906, *Anopheles (Kerteszia) cruzii* D. & K. 1908, have been recognized as valid species by Dyar; another species, *Anopheles (Kerteszia) neivai* H. D. & K. 1917, relegated to the synonymy of *cruzii* by both Dyar and Edwards, will be shown to be valid; in addition, 3 species, all collected in Colombia by the author, will be described as new on the basis of larval characters, characters of the male terminalia, and color-markings of the adult.

The observations on which the author bases his conclusions, together with an analysis of the nomenclature, form the subject of this paper.

A word may not be out of place here on the material before those who have described the various species, their findings from such material, and the methods and material used by the author in coming to his conclusions.

[1]From the Gorgas Memorial Laboratory, H. C. Clark, Director, Panama City, Rep. de Panama.

The genotype of the group, *Anopheles (Kerteszia) boliviensis* Theobald, was described from a single female collected in Bolivia, South America, in 1905 (3). No other similar material was collected until 1911, when C. H. T. Townsend collected a series of 10 female specimens from Huarascaray and Rio Charape along the eastern slope of the Peruvian Andes (4). This series is in the U. S. National Museum. The male and larva were found in Restrepo, Colombia, in 1935, and were described by the author and Dr. E. Osorno M. in 1936 (5). The mesosome of the male is without leaflets.

Anopheles (Kerteszia) cruzii was described by Theobald in 1901 (6) under the name *Anopheles lutzii*. As this name was preoccupied, the name *cruzii* was proposed by Dyar and Knab in 1908 (7). The type locality is Rio de Janeiro, Brazil, from which Dr. Lutz sent Theobald 3 female specimens. Other specimens, apparently the same, were taken at São Paulo, Brazil, by Dr. Lutz; no males of this species were described. Dyar's description of the male (8) was probably taken from a specimen of some other species which he "lumped" under the synonymy of *cruzii*. As he thus relegated *neivai* to *cruzii*, it is probable that he described what was actually the male of *neivai*. Dr. Alan Stone of the U. S. National Museum kindly informed me that no authentic male material from the type locality, Rio de Janeiro, Brazil, is in the U. S. National Museum. Lately, through the good offices of Dr. P. C. A. Antunes of the Staff of the Yellow Fever Service of the Rockefeller Foundation, a single male and the associated larval skin were presented to the author, the locality being São Paulo, Brazil, from whence also Dr. Lutz sent specimens to Theobald. On mounting the male terminalia, the writer found them quite distinct, and not at all like Dyar's purported description, in that the mesosome possessed a pair of slender tubular leaflets.[2]

Anopheles bellator D. & K. was described from Trinidad, British West Indies, in 1906 (9). The original description does not mention whether males were among the types, but in 1917 Howard, Dyar and Knab (10) described the male of this species. The state of the art at this time may be judged by the fact that

[2]Since the preparation of this paper, material of *A. cruzii* has been received rom Dr. A. da Costa Lima, from Angra dos Reis, State of Rio, Brazil, and Dr. P. C. A. Antunes, from Campos do Jordão, State of São Paulo, Brazil, altitude 1600 meters. The male terminalia of these specimens have long, backwardly directed leaflets on the mesosome, and in other respects correspond to the description of *A. cruzii* as here given.

the mesosome is not mentioned in the description of the male terminalia, nor is it shown in the figure 256 of the same work. Root (11) says "the genitalia (of *bellator*) agree in every detail with those of *Anopheles neivai*, so far as I could see." Root probably was examining a poor mount of *bellator*, in which the mesosomal leaflets which are present were not apparent.

The writer visited Trinidad in the summer of 1936, and collected large numbers of *Anopheles bellator*. Larvae were found in bromeliads, and several males from associated larvae were obtained. These had distinct tubular leaflets on the mesosome, well down from the tip.[3]

Anopheles neivai Howard, Dyar and Knab, was described from 2 females from Porto Bello Bay, Panama, in 1917 (12). Dr. Stone reports that the mounted terminalia of a single male from Costa Rica is in the U. S. National Museum collection. Root (13) (14) described the male terminalia and larva quite accurately, giving a recognizable figure of the former. Root's material is stated to have come from Panama. The writer has collected many larvae and pupae from bromeliads, both terrestrial and arboreal, in Panama, and has abundant material of all stages of the species. *Anopheles neivai* is the only species of the group *Kerteszia* that has been found in Panama. The mesosome of the male is without leaflets.

Summarizing this information, it can be said that *boliviensis*, *bellator*, *cruzii* and *neivai* were all originally described from females alone. What purports to be a description of the male terminalia of *Anopheles cruzii* by Dyar (2) was actually a description of *Anopheles neivai*, as Dyar had no authentic male from Brazil. No description of the male terminalia from Brazilian specimens is known to the writer.

The male terminalia of *bellator* are likewise incorrectly described by Dyar (2), as the description is word for word the same as that of the male terminalia of *cruzii* (described from *neivai* male) on the preceding page, and no mention is made of the mesosomal leaflets present in *bellator* from the type locality, Trinidad. No correct description or figure of the male terminalia of *bellator* is known to the writer.

The male terminalia of *Anopheles neivai* were inadequately

[3]A single male specimen collected by Dr. H. W. Kumm, at Caravellas, State of Bahia, Brazil, and forwarded through the kindness of Dr. D. B. Wilson, of the Rockefeller Foundation laboratory at Rio de Janeiro, extends the range of *A. bellator* considerably to the southward along the Brazilian coast.

described in the original description (10), but Root (13) figures them correctly. So it is evident that of the four species discussed, the true males of only two, *boliviensis* and *neivai*, have been known or adequately described.

The situation is similar in the larvae. The larva of *boliviensis* remained unknown until 1936. The larva of *bellator* which Dyar purported to describe (2) was really the larva of *neivai*, as may be seen from the description of the single elements of the palmate hairs. As this description is word for word the same as that of *cruzii*, which differs from the larva of *neivai*, Dyar's purported description of *cruzii* is incorrect. The larva of *cruzii* was correctly described by Peryassú (15) in 1908, the locality being Ilha Grande, Brazil. The larva of *neivai* was correctly described by the authors of the species in the original description (12). Thus the larva of *Anopheles bellator* is undescribed; no modern description of the larva of *Anopheles cruzii* is available; the larvae of *neivai* and of *boliviensis* have been adequately described

In addition to the valid species mentioned, Dyar and Knab erected several species and races, on females alone, all of which Dyar later relegated to the synonymy of *cruzii* (16) and *bellator*. These are *hylephilus* D. & K., described from what we now know to have been a mixture of species, from specimens taken in Venezuela, Ecuador, and Panama (17). Race *bromelicola* Dyar was described from females from Venezuela, and is probably only a variety of *bellator*. Without males, it is impossible to state with certainty to which valid species these two forms should be referred. Probably *hylephilus* is a mixture of *neivai* and some other species, while race *bromelicola* is probably *bellator*.

The subgenus *Kerteszia* was erected by Theobald in 1905, with *Anopheles* (*Kerteszia*) *boliviensis* as the genotype, by original designation. As the species possessed abdominal scales, and, as Theobald used scale-characters extensively in defining genera, Dyar (18) believed it necessary to erect a separate subgenus, *Dendropaedium*, for the bromelicolous *Anopheles* species which did not possess such abdominal scales. Later Dyar (19) abandoned this subgenus, as he stated "Christophers has shown that *Dendropaedium*, the name proposed for the bromelicolous species, falls to *Kerteszia*" (20).

In the papers already published by the writer on the species collected during an entomological survey in Colombia (21) (5) several errors in the nomenclature of the *Kerteszia* species found

must be corrected on the basis of later knowledge. In the first paper, the reference to *boliviensis* (p. 68) is correct. The reference to *bellator* refers to three species, here described as *bambusicolus*, *homunculus*, and *anoplus*. The Panama species mentioned is *neivai*, not *cruzii*. *Bellator* was not found in Colombia. In the second paper (p. 419) the name *bellator* should be changed to *neivai*, throughout.

It is now well established that the basis of classification of the Anophelini rests upon the characters of the male terminalia. Many species of *Anopheles*, indistinguishable in the adult female, are easily separable on the characters of the male terminalia. Examples from the Old World fauna are *Anopheles aitkeni* James and *Anopheles insulaeflorum* Swellengrebel and Swellengrebel, indistinguishable in the adult female, but separable on characters of the mesosome of the male. *Anopheles tarsimaculatus* Goeldi and *Anopheles strodei* Root are examples from the neotropical fauna.

MALE GENITALIA IN KERTESZIA

As many of the author's conclusions are based on a study of the male terminalia, it may not be out of place to describe the appearance of these parts in the *Kerteszia* group, and to show the necessity for adequate dissection of the parts, so that the distinguishing characters of the mesosome and claspette lobes may be seen.

The arrangement of the spines on the sidepiece is characteristic of the group. There is a single long, slender, sinuate parabasal spine from a tubercle near the inner dorsal margin of the sidepiece, at the base. The paired accessory spines have migrated well above their usual position near the middle of the sidepiece, and are situated well beyond this point, on the dorsointernal aspect. The single internal spine is much thicker than usual, and has migrated towards the base from its usual position, and lies on the ventral aspect of the sidepiece, between the distally placed accessory spines and the basal parabasal spine. The anal lobe is high and conical, with many parallel ridges in the membrane; the paraprocts are not very heavily sclerotized. The ninth sternite has a form characteristic of the group, as it is broad, with a median inwardly-directed ridge, and a deep semicircular emargination on each side of it, so that the distal margin shows three points. The mesosome may be without leaflets, or it may have a pair of slender tubular leaflets, attached

either near the tip, or some distance below it, and usually directed ventrally (away from the anal lobe). The dorsal lobes of the claspette consist of a tubular column, at whose tip are two sets of long, slender, sinuate, contorted leaflets. The ventral lobe is variable in form, being characteristic in most cases of the species. It is usually composed of two flattened plates, very hairy towards the tip, which is usually somewhat expanded. The ventral lobe is so situated that its plane is at right angles to the cover-glass, if a whole mount of the terminalia is made. Therefore, the true shape of the ventral lobe cannot usually be made out in such mounts. The author has been able to dissect out these characteristic parts, so that their actual form can be seen, and to photograph them. The separation of the various species, of which the male is known, becomes relatively easy when the parts are dissected out; without such dissection it is oftentimes impossible to see the true form of the ventral claspette lobes, and sometimes even the mesosomal leaflets may be obscured among the folds of the anal lobe. As the color-characters of the species are variable, and as several species resemble each other closely in external characters, it is necessary to resort to the characters of the terminalia for correct determination. Without adequate dissection, little can be seen of the distinguishing characters of the mesosome and ventral claspette lobes, and determinations based on whole mounts of the terminalia are a matter of guesswork. To emphasize this point, the reader is referred to the descriptions of two new species contained in this paper, *Anopheles (Kerteszia) homunculus*, and *Anopheles (Kerteszia) anoplus*, which are separable only on the combined characters of the mesosome and ventral claspette lobes.

NOTES ON THE LARVAE OF KERTESZIA

The larvae of the seven species here treated are known. The larvae of *cruzii*, *bellator*, *homunculus*, sp. n. and *anoplus*, sp. n. are very similar in all particulars. As is usual in the larvae of Anopheles breeding in restricted habitats, such as tree-holes (e. g., *A. barberi*), the head-hairs are simple, rarely branched at tip. The antennae have the hair simple, well down towards the base, and on the dorso-external aspect. Palmate hairs are absent on the metathorax, and may be present, or absent (*neivai* and *boliviensis*), on the first abdominal segment. The single elements of the palmate hairs are lanceolate and sharp-

pointed in all species except *neivai*, in which the tips are truncate. The form of the palmate tufts approaches that found in the common species of *Nyssorhynchus*, but differs in that there is a long, conical, calyx-like base, from which the relatively short elements arise (except in *bambusicolus*). In most balsam mounts the elements are not expanded, forming a rosette, as is ordinarily the case in *Nyssorhynchus*, but are usually contracted, giving a brush-like appearance to the tuft; in such cases the elongate conical base is well displayed.

The lateral abdominal hairs on the 4th, 5th, and 6th segments are long, simple and lightly feathered. Long lateral hairs are also present on segment 7.

The pecten is small, with about 18–20 teeth, long, subequal and fringed, usually on both sides, with long spines. The spiracular apparatus is reduced, somewhat narrowed posteriorly, but normal in form. Hair No. 9, the long postspiracular hair, arising ventral to the dark bar connecting the pectens of the two sides, is simple (except in *bellator*).

NOTES ON THE ADULTS OF KERTESZIA

The adult females resemble each other very closely. They are all characterized by the peculiar markings of the mesonotum of the thorax, which has two wide median and two subdorsal bare black longitudinal lines, making four in all, impressed on a grayish integument, which is clothed with gray bristles. There is sometimes a very narrow median black line between the wider paired inner lines. The paired median lines from the anterior edge of the mesonotum extend more than half way posteriorly to the antescutellar space; the subdorsal lines do not quite reach the anterior border of the mesonotum, and extend to the posterior margin. Sometimes the anterior fossa is enclosed within a grayish line in the integument.

The wing-markings are variable, but when fully developed there are five white spots on the costal margin, and a white apical fringe-spot. The markings of the legs are also variable, particularly in the relative amounts of black and white on the hind tarsi. Melanotic forms are common, in which the white spotting of the wings is reduced, and in which the general color of the specimen is much darker than in other specimens taken at the same time.

As a matter of historical interest, Dyar's conclusions as recorded in 1923 (22) concerning the varieties of the bromelicol-

ous *Anopheles* known to him at the time are quoted: "I cannot determine more than one species of *Anopheles* in Bromeliaceae, with slight local variation. The whitish shading on the third vein is distinct in the southernmost form (*cruzii*), in which the tip of the fifth hind tarsal is white. In Trinidad, the white persists on the third vein, though fainter, while the fifth hind tarsal is dark (*bellator*). Coming westward, we find *hylephilus*, described from Venezuela, Ecuador and Panama. Eliminating the latter locality, we find the third vein dark, or with only the faintest trace of white, the costal spots of the wing of good size, the outer three reaching the costal edge. In Panama, the coloration is the same, except that the wing-spots tend to be small, often breaking away from the costal edge. In the type of *neivai*, the two basal spots have so broken away; but in another, only the second spot has done so, while in a third the outer spot is missing. There is no constancy in the character, and I am inclined to refer all the Panama material to *neivai*, including those formerly listed under *hylephilus*, among which is one of the types of *hylephilus*. The specimens from Costa Rica mentioned in the Monograph (Vol. IV, p. 988) are in too poor condition to make out the characters, while those from Mexico were not bred to the adult state."

Later Dyar (23) revised his opinion, stating that he believed that two species of bromelicolous *Anopheles* existed. (He apparently overlooked Theobald's *boliviensis*). In this paper he states that *hylephilus* is the normal form, of which *neivai* is an aberration. Yet, aside from minor variations in the spotting of the costa, the original descriptions are alike, both forms having a minute white spot at the base of the third vein, and both having the hind tarsal segments more than half white, with a black ring at the base of the 5th segment. Both forms were described from a few females. In the articles quoted Dyar gives the following key:

"Hind tarsi with the joints more white than black.
Third vein white except near base and tip.....*cruzii* D. & K.
Third vein dark.....Race *neivai* H. D. & K.
Hind tarsi with the joints more black than white.
Third vein white except near base and tip.....*bellator* D. & K.
Third vein dark except a few white scales.....Race *bromelicola*, new."

The records given in this article for *cruzii* we now know refer to a mixture of species. The only locality in the list of which we can be certain for *cruzii* is São Paulo, Brazil. The two Peruvian records are for *boliviensis* (see discussion of this species in the

present paper). The Surinam record probably refers to a new species, described in the present article under the name *anoplus*. The specimen from Manoa, Venezuela, cannot be referred to any known species with certainty. The material from Ecuador, Panama and Costa Rica is probably all *neivai*.

Following are discussions of the four known species, with references to the original descriptions; the salient distinctions between the species are given, and descriptions of the male terminalia, hitherto undescribed or incorrectly described, are given for *bellator* and *cruzii*. Three new species, *Anopheles (Kerteszia) homunculus* sp. n., *Anopheles (Kerteszia) anoplus* sp. n., and *Anopheles (Kerteszia) bambusicolus* sp. n., are described. Finally, keys to the adult females, male terminalia, and larvae, so far as they are known, are given.

ANOPHELES BOLIVIENSIS THEOBALD

During the course of an entomological survey made in the region around Restrepo, in the Intendencia of Meta, near Villavicencio, at the foot of the eastern slope of the Andes in Colombia, the writer found among material collected previous to his arrival, and later himself collected, female specimens of an *Anopheles* of the subgenus *Kerteszia*. On close examination, all these females were found to have dark scales, as well as hairs, on all the abdominal tergites except the first, and white scales on the sternites. Theobald (3) described *Anopheles (Kerteszia) boliviensis* in 1905, stating "Abdomen deep brown clothed with rather irregular large black scales and with deep brown lateral and posterior 'border-bristles'." The type locality is Songo, Bolivia. The Colombian material collected by the author differs slightly from Theobald's description, for he states that "the greater part of the second hind tarsal is white (a minute black base), the other hind tarsals dark brown"; in the Colombian material the second to fifth hind tarsal segments have broad black bases and narrow white tips. Among material in the collection of the U. S. National Museum, the writer found a series of 10 specimens of a species of *Kerteszia* from Huarascaray and Rio Charape, along the eastern slope of the Peruvian Andes, collected in September, 1911, by C. H. T. Townsend, then Entomologist for the Peruvian Government. These specimens agree with the writer's Colombian material and with Theobald's description of *Kerteszia boliviensis* in having abdominal scales. Knab (24), however, threw the nomenclature of the

group into initial confusion by overlooking these abdominal scales in Townsend's Peruvian material, and stated "the only observable difference between the Brazilian species (=*cruzii*) and those from Peru (=*boliviensis*) is that on the hind tarsi the black line along the dorsal surface of the first segment is somewhat heavier in the latter." He made *cruzii* a synonym of *boliviensis*, as *boliviensis*, being described earlier, had priority. This error was carried on through many articles by Dyar, and was never corrected with reference to the Peruvian material, as Dyar (18) in 1918, stated "*Kerteszia*, therefore is unknown to us in nature," although Townsend's material which has abdominal scales, was before him. In later papers, *cruzii* was recognized as a distinct species, not agreeing with Theobald's *boliviensis*, on the fact that *cruzii* did not possess abdominal scales.

We now have sufficient material (Townsend's, and the writer's, from Colombia) to state definitely that a species of *Kerteszia* with abdominal scales occurs along the eastern slope of the Andes; this is probably the species described by Theobald as *boliviensis*.

The hitherto unknown male and larva of this species were found near Restrepo, Colombia, and were described by the writer and Dr. E. Osorno M. in 1936 (5). The mesosome of the male terminalia is without leaflets. The shape of the ventral lobe of the harpago (claspette lobe) is characteristic of the species. The larva has abdominal palmate hairs on segments 2 to 7; with the single elements lanceolate, sharp-pointed, as in *cruzii* and *bellator;* the anterior external clypeal hairs are very stout and short in *boliviensis*, while they are slender like the anterior internal clypeal hairs in *cruzii*, *bellator*, and *neivai*.

ANOPHELES CRUZII DYAR AND KNAB

This species was described by Theobald in 1901, under the name *lutzi* (6). As this name was preoccupied by *A.* (*Nyssorhynchus*) *lutzii* Cruz 1901, the name *cruzii* was proposed by Dyar and Knab in 1908.

A single male from São Paulo, Brazil, previously mentioned, was examined, and the ventral lobes of the claspette were found to have a characteristic shape, and the mesosome had two long tubular leaflets, attached near the tip.

Peryassú (15) in "Os Culicideos do Brazil," on two unnumbered plates following the list of errata after page 407, gives a colored plate of the larva of "*Myzomyia lutzi* Theobald"

(=*cruzii* D. & K.), and a plate showing the details of the larva of this species. Figure E of this second plate shows the abdominal palmate tuft with distinctly lanceolate elements, although these are not mentioned in the formal description of the larva on pp. 328–329. In the discussion on p. 988 of Vol. 4 of "The Mosquitoes of North and Central America and the West Indies," by Howard, Dyar, and Knab, under *Anopheles neivai*, it is stated that Dr. Arturo Neiva of Rio de Janeiro, on a visit to the U. S. National Museum, pointed out that *neivai* H. D. & K. differs in the larva from the Brazilian species figured by Peryassú in the shape of the elements of the palmate hairs, which are ligulate and truncate in *neivai*, but lanceolate and sharply pointed in Peryassú's *Myzomyia lutzi* Theobald (=*cruzii* D. & K.). The type locality for *lutzi* (*cruzii*) is Rio de Janeiro, and Peryassú gives the locality for his material as Ilha Grande, Brazil.

The palmate hairs of the single larva from São Paulo, from which the male sent by Dr. Antunes was reared, have the single elements sharp-pointed. These hairs are present on abdominal segments 1 to 7.

As the male terminalia have never been correctly described, a description is given later in this paper, taken from a specimen from São Paulo, Brazil. As it is recognized that more than one species of the subgenus may occur in a given locality, it is proposed to restrict the name *cruzii* to the species which has leaflets on the mesosome, and ventral claspette lobes as here described and figured.

ANOPHELES NEIVAI H. D. & K.

This species, so far the only one of the subgenus to be found in Panama, was described from 2 females from Porto Bello Bay, Panama, in 1917 (12). It has been known under many names (see section on synonymy following), and has been confused with *cruzii*. The name which must be used for the Panama species, according to the rules of nomenclature, is *neivai* H. D. & K. as it is the first species to be described from Panama, where apparently it is the only species of the subgenus present. The number of pairs of palmate hairs and the character of the single elements of these hairs fixes the species, as they are absent on the first abdominal segment, and the single elements are "ligulate (strap-like) with straight truncate tips."

Dyar (9) states that the abdominal palmate hairs of the larvae of both *cruzii* and *bellator* also have the elements ligulate,

with straight truncate tips, failing to mention the larval differences between these species and *neivai*, which were plainly before him in the literature (12) (14), and upon which a separation of *neivai* from the other species of *Kerteszia* can easily be made.

In Panama, where the author has made many collections of *neivai* larvae during the past six years, the larvae are usually found in the water in the leaf-bases of a large terrestrial bromeliad locally known as "pita," a species of wild pineapple, *Ananas magdalenae* (André) Standl. The larvae are sometimes of a dull red color.

The male terminalia are somewhat variable in the number and width of the filaments of the dorsal lobe of the claspette. The species is certainly separable on terminalic characters from *A. cruzii* and *A. bellator*, as no mesosomal leaflets are present, and the form of the ventral claspette lobes is characteristic. Scales are not present on the abdominal segments, except the terminal one, of the adults.

The list of localities as given by Dyar in "The Mosquitoes of the Americas" needs revision, on the basis of our present knowledge. It is believed that the records under *A. cruzii* (p. 469) for Mexico, Costa Rica, Panama, Ecuador, and Peru are correct for *neivai*, while those for Brazil refer in part to *cruzii*, as discussed in this paper. Larvae of *neivai* are known from Panama and Mexico only, and as larvae or males are required for accurate determination of species, we may only infer its presence in the localities named above from our knowledge of faunal regions.

As the Central American fauna extends down the moist northwestern coast of South America, it is probable that *neivai*, being certainly present in Panama, is the species recorded from the coasts of Ecuador and Peru.

DESCRIPTIONS OF FEMALE ADULTS, MALE TERMINALIA, AND LARVAE OF THE KERTESZIA SPECIES

Anopheles (Kerteszia) bolivensis Theobald

(Pl. I, figs. 1 and 2)

The male and larva of this species have recently been described (5). The adult female resembles *neivai* and *cruzii* rather closely, but can be immediately recognized by the scaling of the abdomen; dark brown scales are present on the dorsum, and some white scales are present on the ventral surface. None of the other known species possess such abdominal scales. The palpi of *boliviensis* from Colombia are conspicuously white-banded, four such bands being present, while the palpi of *neivai* and *cruzii* are nearly all black. The markings of the

third vein of *boliviensis* apparently are variable, the majority of the specimens having this vein all black, and others having a small white basal spot, the middle broadly white, the remainder black, as in *bellator*. The second vein has a broad patch of white scales at the fork. There are white fringe-spots at apices of all veins, a very broad one at tip of lower branch of fifth vein. The second, third, and fourth hind tarsal segments are less than half black basally, the remainder white. Fifth segment white with narrow black basal ring.

Anopheles (Kerteszia) cruzii Dyar & Knab.

(Pl. I, figs. 3 and 4)

The adult does not differ materially in thoracic markings from *neivai*, *bellator* or *homunculus*. The abdomen is without scales. The wing-markings show the white spots well-developed, and there are other small differences, so that the wing is herewith described.

WING:

The white markings enlarged, distinct. Costa with five large white spots, in addition to extreme base; black from basal white spot to humeral cross-vein, then a white spot shorter than preceding black area, followed by a black area four times the length of preceding white spot. Three large white spots, nearly evenly spaced, on outer half of costa, the most apical at junction of costa and 1st vein. A small black area beyond, and a white fringe-spot at tips of lower branch of 2nd and of 3rd vein. First vein white at base, a small black spot at humeral cross-vein, then a long white area followed by a black spot one-third its length. Then four white spots opposite corresponding white spots on costa, the most distal at junction of costa and first vein. Second vein black from base to fork, bases of each branch white, remainder dark; a few white scales opposite white spot at junction of costa and first vein. Third vein all white. Fourth vein dark-scaled, except a few lighter scales at cross-veins. Fifth vein alternating black, white, black, white, the latter white area involving fork and bases of the two branches; a few white scales on upper branch at cross-vein; remainder of each branch black. Sixth vein with small white spot basally, followed by an equal black spot; then white-scaled to middle, black beyond to tip.

Legs as in *neivai*, the amount of white on the hind tarsi somewhat greater, the fifth segment white with a black basal ring.

MALE TERMINALIA:

Sidepiece rather short and stout, with scales and setae on outer aspect. A single long, slender, tapering, sinuate parabasal spine, with blunt tip, from a prominent tubercle from dorso-internal margin of sidepiece, at base. A pair of long, flattened, subequal accessory spines from a prominence slightly beyond middle of sidepiece. A single long, stout internal spine from a tubercle on ventro-internal aspect, between parabasal and accessory spines, slightly nearer the latter.

Clasper slightly longer than sidepiece; slender, curved, with moderate terminal spine; one or two fine setae on outer aspect near tip.

Mesosome with leaflets; shaft long, straight, hardly curved dorsally towards anal lobe, with slightly enlarged tip; the base with a triangular emargination ventrally. Leaflets stout, tubular (possibly trough-shaped?), pointed, about one-quarter the length of the mesosome; attached to ventral margin just below tip, and directed downwards and backwards (basad and ventrad) nearly at right angles to shaft of mesosome. Basal plates moderate, quadrangular, with upturned margins.

Claspette lobes. Dorsal lobe consisting of a low prominence, from which arise two groups of sinuate filaments, narrow and straight at base, acutely angled before middle, then greatly widened, curving over the ventral lobe, then gently recurving to tapering sharp tips. Ventral lobe very hairy, the base flattened, long, with a narrow sclerotized supporting strip on the internal face; internal margin straight. The expanded apex longer than broad, rounded, the inner margin with an area of very dense, radiating hairs; the outer apical margin somewhat serrate, incurving, the lateral basal margin produced, thin, rounded, and less hairy.

LARVA

HEAD:

Anterior internal clypeal hairs long, slender, usually simple; sometimes frayed at tip.

Anterior external clypeal hairs stout, about two-thirds length of inner clypeals; shaft somewhat frayed; set very close to inner clypeals.

Posterior clypeal hairs very long, nearly twice as long as the external clypeals; set well behind and somewhat external to the external clypeals. Shaft somewhat frayed near tip.

Subantennal hair long, much branched beyond middle.

Frontal hairs. Inner frontals long, somewhat frayed beyond middle; well separated. Middle frontals about two-thirds length of the inner, more slender, simple. Outer frontals nearly as long as the inner pair, stout, shaft somewhat frayed near tip. Set near edge of occipital suture.

Inner occipital hairs long, very slender, simple, tips exceeding bases of inner frontals; set well inside suture.

Outer occipital hairs long, very slender, simple, set close to edge of suture.

Antenna sparsely spined towards tip. Tuft a simple hair, one-third length of shaft; set near base on dorso-lateral aspect of shaft.

Sabres very long, pointed, infuscated; cone moderate; finger short.

Terminal hair simple, slightly exceeding sabres.

THORAX:

Dorsal submedian prothoracic hair-group with inner hair weak, with few lateral branches from slender shaft; set well apart from middle hair; middle hair stronger and longer, with many fine lateral branches; outer hair short, simple.

Large mesothoracic dorsal hair No. 1 very long, slender, finely feathered, the base somewhat thickened.

Small dorso-lateral hair short, with one or two branches near base. Metathoracic palmate hair absent.

Prothoracic pleural hair-group with one of the anterior pair very long, as long as hair No. 8 lying next to it, finely feathered; the other anterior hairs bifid, not laterally branched. Posterior ventral hair long, one-half length of ventral hair; usually split into two equal branches beyond middle. Spur very small.

Mesothoracic pleural hair-group with two long anterior hairs with few fine lateral branches. Posterior ventral hair short, about one-third length of the shorter anterior hair; bifid or trifid beyond middle. Posterior dorsal hair microscopic.

ABDOMEN:

Palmate hairs present on abdominal segments 1 to 7; those on 1 and 7 smaller than rest. The base from which the elements arise is long, conical, the elements arising from the free margins; single elements flattened, slender, with sharp-pointed tips.

Lateral hairs on abdominal segments 1 and 2 double, long, strong, much feathered. On abdominal segment 3 single, long, slender, slightly feathered; on segments 4, 5, and 6 single, long, slender, slightly feathered. Lateral long branched hair also on 7th abdominal segment. Hair No. 3 on abdominal segment 4 very long, strong, simple. Hair No. 2 on 5th segment long, strong, simple.

Respiratory apparatus proportionately rather smaller than in most Anopheline species.

Postspiracular hair simple.

Pecten with about 20 long, subequal, densely spaced teeth, coarsely fringed almost to tip.

Anal segment with posterior hair long, simple; dorso-lateral margin fringed with many fine spines.

Anopheles (Kerteszia) bellator Dyar & Knab.

(Pl. III, figs. 11 and 12)

The adult female resembles *neivai* and *cruzii* closely. The anterior edge of the wing generally appears somewhat darker than the posterior part, because of denser scaling. The costa has five white spots; a large white fringe-spot involves the tip of the lower branch of the second vein and the tip of the third vein, and smaller fringe-spots are at the tips of the other veins. Third vein with small white basal spot, the middle broadly white, remainder black.

The legs are much blacker than in any of the other species. The first segment of hind tarsus with black basal ring; dorsally black beyond, ventrally white, to narrow white apical ring; second, third, and fourth segments basally four-fifths black, a narrow white ring on apical fifth; fifth segment all black.

Palpi shaggy, black, except for a few white scales at tip of penultimate and ultimate segments.

Abdomen without scales, except on the cerci.

MALE TERMINALIA:

Sidepiece rather short, conical, with scales and setae on outer aspect.

A single long, slender, tapering, sinuate parabasal spine, with blunt tip, from a prominent tubercle from dorso-internal margin of sidepiece, at base. A pair of long, flattened, subequal accessory spines from a prominence slightly beyond middle of sidepiece. A single long, stout internal spine from a tubercle, on ventro-internal aspect, midway between parabasal and accessory spines.

Clasper slightly longer than sidepiece; slender, curved, with moderate terminal spine; one or two fine setae on outer aspect near tip.

Mesosome with leaflets. Shaft slightly curved dorsally (towards anal lobe), long, incompletely tubular, with slightly enlarged tip; the base with a triangular emargination ventrally. Leaflets long, smooth, tubular, pointed, attached postero-laterally at about one-fifth distance from tip of mesosome to base. Basal plates quadrangular, with upturned margins.

Claspette lobes. Dorsal lobe consisting of a tubular column with rounded tip, from which arise two groups of flattened sinuate filaments, narrow and straight at base, acutely angled before middle, then greatly widened, curving over the ventral lobe, then gently recurving to tapering sharp tips. Ventral lobe very hairy, the base long, triangular in cross-section, with narrow sclerotized supporting strip on internal face; internal margin straight; the expanded apex with an area of dense, long, radiating hairs on internal margin; the outer portion of apex expanded, flattened, curved, hood-shaped, with upcurving sclerotized apical tip, the lateral margin produced, rounded.

LARVA

The larva has never been correctly described, so a description is here given, taken from larval skins from Trinidad, from which associated adults were obtained. The larva is close to that of *cruzii*, but the postspiracular hair is definitely branched.

HEAD:

Anterior internal clypeal hairs long, slender, usually simple; set rather far apart.

Anterior external clypeal hairs short, about one-half length of internal hairs, somewhat stouter than the internal clypeals; usually simple.

Posterior clypeal hairs long, extending slightly beyond middle of anterior internal clypeals; simple, set somewhat external to the external clypeals.

Subantennal hair long, extending to tip of antenna; shaft simple at base, much branched at tip.

Frontal hairs. Inner frontals long, simple; tips extending to tips of external clypeals; bases set well apart. Middle frontals simple, about one-half length of the inner pair; the bases set somewhat posterior to those of inner pair. Outer frontals simple, very long, nearly as long as the inner pair; set near edge of occipital suture.

Inner occipital hairs simple, rather long, the tips reaching bases of inner frontals; set well inside suture.

Outer occipital hairs about one-half length of the inner occipital; usually simple; set close to suture, slightly anterior to the inner occipitals.

Antenna. Shaft slightly spined towards tip. Tuft a simple hair, about one-half the length of the shaft; set very near the dorsal aspect of the shaft.

Sabres very long, infuscated, sharp-pointed. Cone short, about one-fourth length of the sabres. Finger short.

Terminal hair simple, about same length as sabres.

THORAX:

Dorsal submedian prothoracic hair-group with inner hair weak, with few lateral branches from slender shaft; set well apart from middle hair; middle hair stronger and longer, with many fine lateral branches; outer hair short, simple.

Large mesothoracic dorsal hair No. 1 very long, slender, finely feathered, the base somewhat thickened.

Small dorso-lateral hair very long, sometimes with one or two branches near base; set close to base of large dorsal hair.

Prothoracic pleural hair-group with one of the anterior pair very long, as long as hair No. 8 lying next to it, finely feathered; the other anterior hair about two-thirds its length; much more coarsely feathered. Posterior ventral hair nearly as long as the anterior dorsal, simple. Posterior dorsal hair about one-half length of the ventral; simple, slender. Spur very short.

Mesothoracic pleural hair-group with one very long anterior hair, finely feathered; the other long, about two-thirds its length; much more coarsely feathered. Posterior ventral hair about one-half length of the shorter anterior hair, sometimes frayed near tip. Shaft slender, smooth. Posterior dorsal hair microscopic. Spur very short.

Metathoracic pleural hair-group with one hair very long, minutely feathered; the other hair about one-half its length, more coarsely feathered. Posterior ventral hair about one-half length of shorter hair, smooth, slender, with three or four terminal branches. Posterior dorsal hair microscopic. Metathoracic palmate tufts absent.

ABDOMEN:

Palmate hairs present on abdominal segments 1 to 7. Hairs very small; those on segments 1 and 7 smaller than the rest. The base from which the elements arise long, conical; the elements arising from the free margin; single elements flattened, lanceolate, with sharp-pointed tips.

Lateral hairs on abdominal segments 1 and 2 double, long, strong, much feathered; on abdominal segment 3 single, long, slender, slightly feathered; on segments 4, 5, and 6 single, long, slender, slightly feathered. Lateral long branched hair also on 7th abdominal segment. Hair No. 3 on abdominal segment 4 very long, strong, simple. Hair No. 2 on 5th abdominal segment long, strong, simple.

Respiratory apparatus proportionately rather smaller than in most Anopheline species.

Postspiracular hair apparently always branched.

Pecten with about 20 long, subequal, densely spaced teeth, fringed only on base.

Anal segment with lateral hair long, simple; dorso-lateral margin fringed with many long dense spines.

Anopheles (Kerteszia) neivai Howard, Dyar & Knab.
(Pl. II, figs. 5 to 8)

The adult female resembles *cruzii* and *homunculus* closely. The wing-pattern, shown in the photomicrograph accompanying this article, is characteristic of the subgenus as a whole. Individual specimens vary in the extent and distinctness of the wing-markings; in all specimens examined, however, the third vein had a small white spot at base, the remainder black. The hind tarsi have the first segment with a narrow basal white ring, followed by a wider black ring. Beyond, the segment is narrowly black above, broadly white below, to an indistinct black ring, followed by a broader white apical ring. Second, third, and fourth segments with base black, apical two-thirds of segments white; fifth segment with very narrow basal black ring, remainder white. The abdomen is clothed with long yellowish-brown hairs; scales are absent, except on the cerci. Palpi shaggy, dark brown, with a few white scales at extreme tip.

MALE TERMINALIA:

Sidepiece, clasper, anal lobe, and ninth sternite as in the other *Kerteszia* species.

Mesosome without leaflets. Shaft slightly curved dorsally (towards anal lobe), moderate, incompletely tubular, the tip slightly enlarged; the base with a triangular emargination ventrally. Basal plates moderate, quadrangular, with upturned margins.

Claspette lobes: Dorsal lobe a tubular column with rounded tip, from which arise two groups of flattened, sinuate filaments, widened and angled before middle, with long tapering tips. Ventral lobe as in accompanying photomicrograph; broad, somewhat triangular, the inner margin straight, somewhat thickened; the free margin thin, somewhat rounded, and clothed with dense long curving setae.

LARVA

As in *cruzii* and *homunculus*, except for the absence of palmate hairs on abdominal segment 1, and the form of the individual elements, which are ligulate (strap-like), with truncate (not sharp-pointed) tips. The postspiracular hair is simple.

Anopheles (Kerteszia) homunculus, n. sp.
(Pl. III, figs. 9 and 10)

During the course of the same survey mentioned previously in connection with *A. boliviensis*, an attempt was made to obtain the larvae of this species. Several *Kerteszia* larvae were collected from bromeliads, and adults reared from them, the cast larval skins being preserved. One male and two females were obtained, all from the same bromeliad. On dissecting and mounting the male terminalia, the mesosome was found to have two delicate tubular leaflets, attached well down on the sides.

The ventral claspette lobes had the form shown in the accompanying photomicrograph. The mesosomal leaflets in *homunculus* are much more slender than in either *cruzii* or *bellator*, and are attached well down from the tip of the mesosome. The appearance of the mesosome with its somewhat enlarged tip and dependent leaflets, suggests the appearance of a manikin, hence the descriptive name. The ventral claspette lobes differ in form from those of *cruzii* and *bellator*, and are as in *anoplus*, n. sp., but the mesosome in this latter species has no leaflets.

ADULT FEMALE

A small, delicate, grayish mosquito, with broadly white-banded hindlegs. Proboscis moderate, black. Palpi clothed with dense black outstanding scales, especially near the base; a few white scales at apex of penultimate segment, and at extreme tip of ultimate segment. Occiput with black scales, with a median line of triangular truncate scales mixed with obovate scales; these extend forward over the vertex as well. Vertex with a tuft of long white setae projecting forward over the clypeus.

Thorax with mesonotum gray, clothed with short gray setae, mixed with longer, stouter, black setae. Anterior prominence with a patch of white scales and setae; anterior edge of fossa outlined by a line of white scales. Disk of mesonotum with two bare black longitudinal lines on each side, making four longitudinal black stripes. A narrow, median, dorsal black line between the two inner lines. The inner lines extend only three-quarters of the distance towards the scutellum; their sides are parallel. The outer lines extend to the scutellum, widening beyond the middle, and narrowing towards their posterior ends. The anterior fossa is outlined by a gray line in the integument.

Pleura. Two parallel horizontal light lines across the pleura, the uppermost beginning posteriorly as a line of white scales slightly above middle of sternopleuron, continued as a grayish line in the integument of the mesanepisternum and the posterior pronotum, to the prothoracic lobes; the lower line, beginning posteriorly as a grayish line in the integument of the lower mesepimeral margin, extends anteriorly across the sternopleuron to the propleuron. Mid-mesepimeral setae absent; upper mesepimeral setae replaced by a small patch of white scales; upper sternopleural setae present; prothoracic and propleural setae present; prealar setae present.

Abdomen. Blackish, with many long brown hairs; a few lighter hairs on terminal segments. Scales absent, except on cerci.

Legs. Forelegs with femur somewhat swollen at base. A narrow basal black band, followed by a wider white band; the remainder irregularly streaked with black and white. Tibia with four longitudinal alternating stripes of black and white. Tarsus with first segment dorsally with basal white spot, ventrally black, followed by a black ring;

then a white spot on each side, followed by a black ring; apex with a white dorsal spot. Ventral surface all dark. Second segment with ventral surface all dark; a narrow basal black ring, followed by a dorsal white streak to tip. Third segment similarly marked. Fourth and fifth segments all dark.

Mid-Legs. Femur with very narrow white basal ring, followed by a narrow incomplete black ring. Dorsal and ventral surfaces black. Sides with narrow longitudinal white stripe, interrupted by black, then a long white streak and a black band at apex. Tibia with narrow basal white ring, followed by a narrow black ring. Dorsal and ventral surfaces black; sides white; apex of segment with narrow black ring. Tarsi with first segment with very narrow basal white ring. Ventral surface black, dorsal surface white; a narrow apical white ring. Second segment with narrow black basal ring; ventral surface black, dorsal surface white beyond basal ring, to apex. Third, fourth, and fifth segments all dark.

Hind-Legs. Hind-femur with narrow basal white ring, followed by a black ring. Extreme tip dark. Dorsal surface black. Hind-tibia with narrow basal white ring; dorsal surface all dark beyond, to apex. Ventral surface white, an incomplete black ring beyond basal white ring. A conspicuous triangular white spot on outer lateral surface, before tip. First hind-tarsal segment with a very narrow white ring, followed by a broader black ring, which is followed by a white ring. Dorsal surface beyond, dark, to a conspicuous narrow apical white ring. Ventral surface white beyond first black ring, the white tapering towards apex, where it merges with the narrow apical white ring. Second segment basally slightly less than half black, apically white. Third segment basally one-third black, apically white. Fifth segment basally about one-third black, apically white.

Wing. Costa with extreme base white, followed by black to humeral cross-vein; a small white spot just beyond cross-vein, followed by a long dark area; three white spots nearly evenly spaced on outer half of costa, the most apical and largest at junction of costa and first vein. First vein with a few white scales before humeral cross-vein; a small black spot at cross-vein; white spots opposite each succeeding costal white spot; tip white at junction with costa. Second vein with a few white scales on upper branch before tip; remainder of vein and lower branch dark. Third vein with small white basal spot, and another white spot ending before middle of vein; remainder black. Fourth vein with small white spot at tip of lower branch. Fifth vein with four equal alternating areas of black and white from base; upper branch with small white spot at cross-vein between veins 4 and 5; remainder of both branches black. Sixth vein all dark. White fringe-spots at tip of lower branch of second vein, and at tips of lower branch of fourth, and upper branch of fifth veins.

MALE TERMINALIA:

Sidepiece rather short and stout, with scales and setae on outer aspect. A single long, slender, tapering, sinuate parabasal spine, with blunt tip, from a prominent tubercle from dorso-internal margin of

sidepiece, at base. A pair of long, flattened, subequal accessory spines from a prominence slightly beyond middle of sidepiece. A single long, stout internal spine from a tubercle on ventro-internal aspect, between parabasal and accessory spines, slightly nearer the latter.

Clasper slightly longer than sidepiece; slender, curved, with moderate terminal spine; one or two fine setae on outer aspect near tip.

Mesosome with leaflets. Shaft slightly curved dorsally (towards anal lobe), long, incompletely tubular, with slightly enlarged tip; the base with triangular emargination ventrally. Leaflets moderate, delicate, smooth, tubular, pointed, attached laterally at about one-fifth distance from tip of mesosome to base. Basal plates moderate, quadrangular, with upturned margins.

Claspette lobes. Dorsal lobe consisting of a tubular column with rounded tip, from which arise two groups of narrow, flattened, sinuate filaments, straight at base, acutely angled before middle, curving over the ventral lobe, then gently recurving to tapering sharp tips. The filaments arise in two groups of about three each, from tip of column. One or two of the dorsal group may be widened at the curve. Ventral lobe very hairy, the ventral aspect with a narrow, sclerotized supporting plate, on the inner surface; the triangularly expanded apex bearing on its inner margin dense radiating hairs, the curved apical margin with long curved hairs, the tip with dorsal margin produced and curved, somewhat beaked, with a median stiffening; the lateral basal angle thin, triangularly produced, nearly bare.

Ninth tergites without processes, membranous centrally, the lateral portions minutely pilose. Paraprocts not well developed.

Anal lobe moderate, conical, pilose.

Ninth sternites with slight median suture, somewhat sclerotized, the upper margin with two lateral semicircular emarginations, forming a median and two lateral apical sclerotized projections.

LARVA

HEAD:

Anterior internal clypeal hairs long, slender, usually simple, set rather far apart.

Anterior external clypeal hairs short, about one-half length of the internal clypeals, somewhat stouter.

Posterior clypeal hairs long, extending beyond the tip of the external clypeals, set slightly external to external clypeals.

Subantennal hair long, shaft simple, usually slightly branched at tip.

Frontal hairs. Inner frontals long, simple; tips extending to tips of external clypeals; insertions somewhat anterior to those of middle frontals, well separated. Middle frontals nearly as long as inner frontals, slender, simple, set well away from inner frontals. Outer frontals long, slender, usually simple, sometimes slightly frayed at tip; set near edge of occipital suture.

Inner occipital hairs very slender, simple, about as long as inner occipital hairs; set close to suture, slightly anterior to the inner occipitals.

Antenna minutely spined towards tip. Tuft a simple hair on dorso-lateral aspect, about one-third the length of the shaft; set very near the base.

Sabres long; cone long, about one-half length of sabres. Finger short.

Terminal hair scarcely exceeding sabres, very slender, simple.

THORAX:

Dorsal submedian prothoracic hair-group with inner hair weak, with few lateral branches from slender shaft. Middle hair stronger and longer, with many fine lateral branches. Outer hair long, simple.

Large mesothoracic dorsal hair No. 1 very long, slender, finely feathered, the base somewhat thickened.

Small dorso-lateral hair very long, slender, with a few lateral branches arising at base; set close to base of large dorsal hair.

Prothoracic pleural hair-group with one of the dorsal hairs very long, as long as the hair No. 8 lying next to it, finely feathered; the other dorsal hair shorter, more heavily feathered. The posterior ventral hair long, very slender, simple. The posterior dorsal hair unusually long, slender, simple, about two-thirds length of the ventral hair.

Mesothoracic pleural hair-group with two long anterior dorsal hairs, finely feathered. Posterior dorsal hair short, about four-branched just before middle. Posterior ventral microscopic.

Metathoracic palmate tufts absent.

ABDOMEN:

Palmate hairs present on segments 1 to 7; those on segments 1 and 7 smaller than the others. The base from which the elements arise is long, conical; the single elements rather short, flattened, lanceolate, sharp-pointed; each hair with about 25 elements.

Lateral hairs on abdominal segments 1 and 2 double, long, strong, much feathered. On abdominal segment 3 single, long, slender, slightly feathered; on segments 4, 5, and 6 single, long, slender, slightly feathered. Hair No. 2 on segment 4 very long and strong.

Respiratory apparatus proportionately rather smaller than in most Anopheline species.

Postspiracular hair long, simple.

Pecten with about 21 teeth, alternately long and short, particularly the central teeth; teeth moderately fringed at base only.

Anal segment with posterior hair simple; the posterior dorsal margin fringed with many fine setae.

TYPE MATERIAL: Three ♀ ♀, one ♂, the male terminalia in a balsam mount. Associated larval skins preserved. Material deposited in U. S. National Museum, Washington, D. C.

TYPE LOCALITY: Restrepo, Colombia, August, 1935. W. H. W. Komp, collector.

Anopheles (Kerteszia) anoplus, n. sp.
Pl. III, figs. 13 and 14)

Dr. E. Osorno M., who obtained the previously unknown larva and male of *A. boliviensis* in Restrepo, Colombia, and later described them with the author (5), also obtained a single male of another species, with associated larva, which he presented to the writer. This larva was found in a bromeliad, and was thought to be the same as that of *homunculus*. However, on examining the male terminalia, the mesosomal leaflets found in *homunculus* were not present in *anoplus*, although the form of the ventral lobes of the claspette is nearly the same. The larva is indistinguishable from that of *cruzii* (q. v.), and closely resembles that of *bellator* and *homunculus* also.

The characters of the male type are similar to those of *A. homunculus*. The only marked difference observed is in the markings of the third wing-vein.

MALE TERMINALIA:

As in *homunculus*, except for mesosome, which lacks leaflets.

Wing. Costa with extreme base white; a small black area before humeral cross-vein, followed by a white spot of equal length; then a long black area followed by a small white spot; three white spots nearly evenly spaced on outer half of costa, the most apical at junction of costa and 1st vein. First vein with base white to middle of first long dark costal area; white spots opposite each succeeding costal white spot; tip white at junction with costa. The 2nd vein with a few white scales on upper fork before tip, remainder of vein and lower branch dark scaled. 3rd vein white-scaled from base to outer fourth; then black to tip. 4th vein all dark. 5th vein with white spot beyond base; white scales at fork, extending along both branches; white scales on upper branch at cross-vein. 6th vein all dark. White fringe-spots at tip of both branches of 2nd vein, and at tip of 6th vein.

Legs. First hind tarsal segment with very narrow white ring followed by a broader black ring; then a white ring; middle of segment dorsally white, ventrally black; then a wide black ring followed by a narrow apical white ring. Second hind tarsal segment basally about two-thirds black, apically white. Third hind tarsal segment basally slightly less than half black, apically white. Fourth hind tarsal segment basally one-half black, apically white. Fifth hind tarsal segment basally about one-quarter black, apically white.

LARVA

As in *cruzii*, no distinguishing characters being noted.

Type, one male, the terminalia in a balsam mount; this material, together with associated larval skin, is deposited in

the U. S. National Museum. Type locality, Restrepo, Intendencia of Meta, Colombia; collector E. Osorno M., December, 1936.

It is believed that *anoplus* is the species found by the Bonnes (25) in Surinam (Dutch Guiana), which they call *bellator*, as their figure shows the mesosome without leaflets, and the palmate hairs of the larva with sharp-pointed tips. Dr. Stone of the U. S. National Museum kindly reported that there is a single mounted male terminalia in the collection, from Surinam, apparently without leaflets. In the Surinam specimens the markings of the third vein differ from those of the type of *anoplus*, as in the Bonnes' material this vein is said to have only a small white spot at the base, the rest black. Davis' species (26) may well be *anoplus*, but he gives no description of the male terminalia or larva, nor is the amount of white on the third wing-vein or on the segments of the hind tarsi specified.

Anopheles (Kerteszia) bambusicolus, n. sp.

Dr. Jorge Boshell, of the Staff of the Yellow Fever Service of the Rockefeller Foundation, working with the author in Colombia in 1935, obtained larvae of a *Kerteszia* species from a hitherto unreported and peculiar habitat, the unbroken joints of large bamboo, containing a small amount of water, the only entrance to which was through small worm-holes (21). The larvae were quite large for a *Kerteszia*, and were very dark in color. About a dozen larvae were obtained, but all died except three, from which three female adults emerged. These were recognized as new to science, and are herewith described, together with the larva. The species may be recognized by the dark costa of the wing, only one white spot being present; the fifth segment of the hind tarsus is pure white, a character also peculiar to the species.

ADULT FEMALE

A medium-sized, blackish mosquito, with small wing-spots, and conspicuously white-banded hind legs. Proboscis moderate, black. Palpi shaggy, clothed with many outstanding black scales, especially near the base; a few white scales at apex of penultimate segment; last segment wholly black. Occiput black, with erect black scales; a median line of triangular white scales with truncate tips extending forward over the vertex. Vertex with a tuft of long white setae projecting forward over the clypeus.

Thorax with mesonotum gray, clothed with short gray setae, mixed with longer, stouter black setae. Anterior prominence with a

patch of white setae and scales. Anterior edge of fossa outlined by a line of white scales. Disk of mesosotum with two bare black longitudinal lines on each side, making four longitudinal black stripes. A narrow median dorsal black line between the two inner lines. The inner lines extend only three-quarters of the distance towards the scutellum; their sides are parallel. The outer lines extend to the scutellum, widening out beyond the middle, and narrowing towards their posterior ends. The anterior fossa is outlined by a gray line in the integument.

Pleura very dark, crossed by two horizontal light lines, the upper beginning posteriorly as a grayish line below the upper mesepimeral setae, joining a line of white scales slightly above middle of sternopleuron, and extending anteriorly as a grayish line in the integument of the posterior pronotum to the prothoracic lobes, which have a few light scales; the lower line, beginning posteriorly as a grayish line in the integument of the lower mesepimeral margin, extends anteriorly across the sternopleuron to the base of the fore coxa. Mid-mesepimeral setae absent; upper mesepimeral setae very long, white, in a patch of white scales; upper sternopleural setae present; prothoracic and propleural setae present; prealar setae present.

Abdomen blackish, with many long brown hairs; scales absent, except on cerci.

Legs. Forelegs with femur somewhat swollen at base. A narrow basal white band, followed by a narrow black band; the remainder irregularly streaked with black and white. Fore-tibia with four longitudinal alternating stripes of black and white. Fore-tarsus with first segment with ventral surface all dark; dorsal surface with basal white spot, followed by a black ring; then a long white streak on each side, enclosing a black dorsal area, and joining a conspicuous white area at apex. Second segment with ventral surface all black; a narrow black basal ring; dorsal surface conspicuously white to tip. Third and fourth segments similarly marked; fifth segment all dark.

Mid-Legs. Mid-femur with extreme base white, followed ventrally by an incomplete narrow black ring; dorsal and ventral surfaces black; sides white. Mid-tibia with dorsal and ventral surfaces white, interrupted on dorsal surface before apex by black, followed by an apical white spot; sides black. Mid-tarsus with first and second segments with a very narrow basal black ring; dorsal surface white beyond to tip; ventral surface all black. Third and fourth segments all black, fifth segment black at base, very narrowly white at tip.

Hind-Legs. Hind-femur very narrowly white at base, followed by a narrow black ring. Dorsal and ventral surfaces black, sides white. Hind-tibia with dorsal and ventral surface black, sides white, widening conspicuously on outer surface just before tip; an incomplete narrow black ring before tip. Hind-tarsus with first segment ventrally all black; a wide basal black ring, dorsally interrupted by a small white spot. Dorsal surface white beyond basal black ring, to two-thirds distance to apex, then a wide black ring interrupted dorsally by a conspicuous white spot at tip. Second segment with narrow black ring at base, the black extending ventrally towards tip, underlying the white,

which forms a narrow white apical ring, and extends dorsally towards the base, overlying the black, the two colors dovetailing above and below. The general effect is that the segment is basally black-banded, apically white-banded, the portion between the bands being white dorsally, black ventrally. Third segment basally one-fourth black, apically white. Fourth segment basally one-half black, apically white. Fifth segment all white.

Wing. Very dark, the wing-spots much reduced; scales very narrow. Costal margin all dark from base to junction of costa with first vein, where there is a conspicuous white spot. First vein white at base, a small black spot at humeral cross-vein, followed by white, a black area and a smaller white spot. Then a black area followed by a white spot opposite the white spot on fork of 5th vein; then a dark area, followed by a conspicuous white spot opposite fork of second vein. Then a dark area followed by a white spot, coalescing with costal white spot at the junction of costa and 1st vein. Second vein all dark. Third vein with small white spot at base, remainder dark. Fourth vein all dark except extreme tip of lower branch, which is white. Fifth vein dark, with white spot beyond humeral cross-vein, at fork on both branches, and at cross-vein between upper branch and 3rd vein; extreme tip of lower fork white. Sixth vein all dark. Wing-fringe with usual apical white spot at tips of lower branch of second vein and third vein absent; a conspicuous white fringe-spot at tip of lower branch of fourth vein; another at tip of upper branch of fifth vein.

LARVA

HEAD:

Head capsule heavily sclerotized, very dark.

Anterior internal clypeal hairs short, slender, simple.

Anterior external clypeal hairs about one-half length of inner hairs; slender, simple.

Posterior clypeal hairs moderate, about as long as the anterior external clypeals; set well behind and slightly exterior to these.

Subantennal hair extending to tip of antenna; long, slender, simple.

Frontal hairs. Inner frontals short, not extending to insertion of posterior clypeals; well separated, smooth, simple. Middle frontals about one-half length of the inner, simple, set close to the inner frontals. Outer frontals as long as inner frontals, simple, set near edge of occipital suture.

Inner occipital hairs short, not extending to insertion of middle frontals, simple.

Outer occipital hairs very small, about one-half length of the inner occipital hairs; simple, set close to suture.

Antenna. Shaft nearly smooth; tip very dark, lighter towards base; a few very minute spines towards tip. Tuft a simple hair, about one-quarter length of shaft, set very near the base of the lateral aspect of the shaft.

Sabres much reduced, very short; cone about one-quarter length of sabres. Finger very short.

Terminal hair simple, hardly longer than sabres.

THORAX:

Integument very dark, opaque.

Dorsal submedian prothoracic hair-group with inner hair moderate, the central branch very long, about one-half length of the middle hair. Lateral branches few, slender. Middle hair stronger and longer, about twice the length of the inner hair, with many fine, long lateral branches. Outer hair long, simple.

Large mesothoracic dorsal hair No. 1 very long, slender, finely feathered, the base somewhat thickened.

Small dorso-lateral hair very long, usually simple, sometimes frayed, set close to base of large dorsal hair.

Prothoracic pleural hair-group with one of the anterior pair very long, as long as hair No. 8 lying next to it; nearly smooth, with a few minute branches on shaft. The other anterior hair about three-quarters length of the longest hair, smooth, simple. Posterior ventral hair not quite so long, simple. Posterior dorsal hair very short, about one-sixth the length of the ventral hair, usually branched at middle. Spur very short.

Mesothoracic pleural hair-group with two long anterior hairs; the longer hair thicker, feathered; the other hair about three-quarters its length, apparently simple. Posterior ventral hair very short, simple.

Metathoracic pleural hair-group with anterior dorsal hair long, finely feathered, much thicker than the anterior ventral, which is apparently simple, very slender, and two-thirds the length of the anterior dorsal. Posterior dorsal hair long, very slender, simple. Posterior ventral hair microscopic. Metathoracic palmate tufts absent.

ABDOMEN: Integument very dark.

Palmate hairs present on abdominal segments 1 to 7; those on segments 1 and 7 much smaller than the others. The base from which the elements arise is notably short; single elements very long, lanceolate, sharp-pointed, much like those of *A. albimanus*. Each palmate hair with about 20 leaflets.

Lateral hairs on abdominal segment 1 and 2 double, long, strong, finely feathered; on abdominal segment 3 single, long, slender, slightly feathered; on segment 4, 5, and 6 single, long, slender, slightly feathered. Hair No. 2 on 4th abdominal segment very long and strong, about three-fourths the length of the corresponding lateral hair. Hair No. 4 on 5th abdominal segment notably stout, but not so long.

Respiratory apparatus proportionately rather smaller than in most Anopheline species.

Postspiracular hair very short, simple.

Pecten with about 18 very long, slender, subequal teeth, becoming somewhat longer ventrally. The dorsal teeth fringed only at base, the ventral teeth nearly to tip.

Anal segment with lateral hair moderate, simple; the posterior dorsal margin usually fringed with a few very coarse spines.

TYPE MATERIAL: Three ♀ ♀, with associated larval skins, deposited in U. S. National Museum, Washington, D. C.

TYPE LOCALITY: La Union, Intendencia of Meta, Colombia, September, 1935, Dr. Jorge Boshell, collector.

The following keys will definitely separate the known males; the adult females of *boliviensis*, *bellator*, and *bambusicolus* are easily separable, but *cruzii* and *anoplus* are very similar, as are *neivai* and *homunculus*. The larvae of *neivai* and *bambusicolus* are easily identified, *boliviensis* less easily so, but no good characters to separate the other species have been found.

KEY TO ADULT FEMALES OF KERTESZIA

1. Abdomen with black scales on apices of tergites, except the first; second to fifth sternites with median white scales ..... **boliviensis**
   Abdomen without scales, except on cerci 2
2. Hind tarsi with segment 5 all dark; segments 3, 4, and 5 narrowly white at apices ..... **bellator**
   Hind tarsi with segment 5 partly or all white; segments 3, 4, and 5 broadly white at apices 3
3. Segment 5 of hind tarsi all white; wing with white markings reduced; only one white spot on costa, near tip ..... **bambusicolus**
   Segment 5 of hind tarsus with base black, apex white; wing with more than one white spot on costa 4
4. Third wing-vein nearly all white ..... **cruzii, anoplus**
   Third wing-vein with white spot at base 5
5. Third wing-vein with white spot at base only ..... **neivai**
   Third wing-vein with white spot at base, another long white area before middle, rest dark ..... **homunculus**

KEY TO MALE TERMINALIA OF KERTESZIA

1. Mesosome with two leaflets 2
   Mesosome without leaflets 4
2. Mesosome with leaflets attached near tip; ventral claspette lobes with distal portion rounded, not notably upturned and pointed ..... **cruzii**
   Mesosome with leaflets attached somewhat below tip 3
3. Mesosomal leaflets stout, ventrally directed, attached slightly below tip; ventral claspette lobes with distal portion upcurved, pointed ..... **bellator**
   Mesosomal leaflets delicate, apparently not ventrally directed, set well below tip; ventral claspette lobes with distal portion widened, flattened, with hood-like triangular apex ..... **homunculus**
4. Ventral claspette lobes widened and truncate at apex; apical margin not thickened, fringed with very long hairs ..... **neivai**
   Ventral claspette lobes not widened and truncate at apex; distal margin with hood-like triangular apex ..... **anoplus**
   Ventral claspette lobes rounded at tip, the distal margin not notably thickened, upturned, or pointed ..... **boliviensis**

KEY TO LARVAE OF KERTESZIA

1. Palmate hairs absent on first abdominal segment 2
   Palmate hairs present on first abdominal segment 3
2. Anterior external clypeal hairs short, much thickened, fusiform; elements of palmate hairs sharp-pointed ..... **boliviensis**
   Anterior external clypeal hairs longer, slender, not fusiform; elements of palmate hairs truncate and blunt at tips ..... **neivai**
3. Head-capsule and body-integument very dark; head-hairs all much reduced; subantennal hair simple; antennal sabres very short; palmate hairs large, with long lanceolate elements ..... **bambusicolus**
   Head-capsule and integument not heavily infuscated; head-hairs normal; subantennal hair branched at tip; antennal sabres long; palmate hairs small, the elements short, pointed 4
4. Postspiracular hair branched ..... **bellator**
   Postspiracular hair simple ..... **cruzii, homunculus, anoplus**

SYNONYMY

The synonymy of the earliest described species of the subgenus, *boliviensis*, *cruzii*, *bellator*, and *neivai*, has suffered many changes. It is impossible, within the limits of this paper, to quote full synonymies, but those species probably dealt with in the more important papers will be noted. The most important changes made necessary by the author's observations are the fixing of the name *neivai* for the common Panama species, and the restriction of the name *cruzii* to the Brazilian form in which the male possesses mesosomal leaflets.

Anopheles (Kerteszia) boliviensis Theobald, 1905

Anopheles boliviensis Theobald, Ann. Mus. Nat. Hung. III, 66, 1905.
Anopheles boliviensis Theobald, Mon. Culic, VI, 118, 1907.
Anopheles boliviensis Knab, Rept. First Exped. to S. Amer., 1913. Harvard Univ. Press, p. 216, 1915.
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Anopheles boliviensis Dyar, Ins. Ins. Mens., VI, 148, 1918.
Anopheles boliviensis Christophers, Ind. Med. Res. Mem. III, 42, 1924.
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Anopheles boliviensis Dyar, The Mosquitoes of the Americas, 467, 1928.
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Anopheles boliviensis Komp, Proc. Ent. Soc. Wash. XXXVIII, 57, 1936.
Anopheles boliviensis Komp & Osorno, Ann. Ent. Soc. Amer., XXIX, 415, 1936.

Anopheles (Kerteszia) cruzii Dyar & Knab, 1908

Anopheles lutzi Theobald (not Cruz), Mon. Culic, I, 177, 1901.
Anopheles lutzii Lutz (not Cruz), Centralbl. Bact., etc., Abt. I, 283, 1903.
Myzomyia lutzii Lutz (not Cruz), Journ. Trop. Med., VI, 112, 1903.
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Anopheles cruzii Dyar & Knab, Proc. U. S. Nat. Mus. XXXV, 53, 1908.
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Anopheles (Kerteszia) bellator Dyar & Knab, 1906

Anopheles bellator Dyar & Knab, Proc. Biol. Soc. Wash., XIX, 160, 1906.
Anopheles bellator Theobald, Mon. Culic., V, 86, 1910.
Anopheles bellator Howard, Dyar & Knab, Mosq. No. and Cent. Amer. and W. I., 985, 1917.
Anopheles bellator Dyar & Knab, Ins. Ins. Mens., V, 40, 1917.
Anopheles bellator Dyar, Ins. Ins. Mens., VI, 145, 1918.
Anopheles bellator Root, Am. Journ. Hyg., III, 278, 1923.
Anopheles bellator Dyar, Ins. Ins. Mens., XI, 72, 1923 (in part).
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Anopheles (Kerteszia) neivai Howard, Dyar & Knab, 1917

Anopheles neivai Howard, Dyar & Knab, Mosq. North and Cent. Amer. and W. I., IV, 987, 1917.
Anopheles hylephilus Dyar & Knab, Ins. Ins. Mens., V, 38, 1917 (in part).
Anopheles neivai Dyar & Knab, Ins. Ins. Mens., V, 40, 1917.
Anopheles hylephilus Dyar & Knab, Ins. Ins. Mens., VI, 146, 1918 (in part).
Anopheles neivai Dyar & Knab, Ins. Ins. Mens., VI, 146, 1918.
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Anopheles bellator var. *neivai* Christophers, Ind. Med. Res. Mem. III, 42, 1924.
Anopheles bellator var. *hylephilus* Christophers, Ind. Med. Res. Mem., III, 42, 1924 (in part).
Anopheles neivai Edwards, Diptera, Fam. Culic., Genera Insectorum, Fasc. 194, 46, 1932.

Anopheles (Kerteszia) anoplus, n. sp.

?Anopheles bellator Bonne & Bonne-Wepster, Mosquitoes of Surinam, p. 504, 1925.
?Anopheles bellator Davis, Am. Journ. Hyg., VI, 119, 1925.

Anopheles (Kerteszia) bambusicolus, n. sp.

Anopheles bellator Komp, Proc. Ent. Soc. Wash., XXXVIII, 68, 1936.

This hitherto purely technical paper is closed by throwing a sop to that Cerberus, the "practical man," who is interested in the economic significance of the taxonomist's studies.

We know very little, comparatively, concerning the malaria-carrying powers of many Neotropical Anophelines. It may be that, as our knowledge increases, we shall find that slight differences in habitat, biting-habits, and life-history make considerable differences in the relative importance of species which are much alike in general appearance and biology. A knowledge of the exact species concerned in malaria transmission is of fundamental importance in its control. This fact has been abundantly confirmed by observations made in many parts of the world. The "practical men" who are in charge of anti-mosquito measures have been handicapped by lack of this knowledge, and have perforce called the mosquito they worked with by the name provided by the systematist. This name may or may not have applied to a single species. If two closely similar species were involved, confusion and loss ensued when control measures applicable to one were applied to the other species.

Hitherto the nomenclature of the *Kerteszia* group has been based on studies of scanty material, so much so that only 3 species have been previously recognized. Little account has been taken of the possibility that there may be species differences which involve differences in biology, and hence are of practical importance. It is hoped that this paper will help to clear up the problem of nomenclature in this group.

Several instances of malaria infection in species of the *Kerteszia* group are recorded in the literature. Root (27) reports the work of Galli-Valerio, who found one specimen with oöcysts; Davis (26), working in Brazil, reports the infection of a species which he calls *bellator*.

A striking commentary on the advance of our knowledge of the role of mosquitoes as vectors of disease, and the changes in view-point necessitated thereby, is furnished by the recent discovery of "jungle yellow fever" (28), which is carried by mosquitoes other than *Aedes aegypti*. A similar change in opinion regarding the hazards from one of the *Kerteszia* species is illustrated by the following quotations. Howard, Dyar & Knab (10) in 1917 state concerning the *Kerteszia* species in Trinidad, "We have received no specimens of *Anopheles bellator* (from Trinidad) since the original types. It is probably more widely spread, but, as it is not taken unless bred and occurs in such unusual situations, it is seldom collected."

A very different picture is given in the Administration Report of the Surgeon General for the Colony of Trinidad and Tobago for 1934 (29). A part of this report is given verbatim, with few omissions:

"It is especially interesting to note the change of behavior of this 'forest' anopheles and its effective methods of adaptation to the changed conditions which presented themselves when the forests in the Cumuto-Talparo-Tamana area gave way to the axe of the cocoa planter between about 1895 and 1905.

"Large tracts of forest were cut down and replaced by cocoa and its shade trees, the immortelle [*Erythrina* spp.].

"These trees grew rapidly under good soil conditions and with a favourable rainfall; but unfortunately these new conditions proved to be also particularly favourable to the growth of water holding bromeliads especially on the immortelle or shade trees, and to-day practically every such tree harbours malarial-carrying *Anopheles bellator*.

"As the cocoa estates developed, the human and stock (animal) population gradually increased but from the very outset Malaria proved to be a real scourge, and only a few estate houses and malarious villages now exist to show the uphill fight which has been waged by the cocoa planters.

"The Spleen rate of school children between 4–8 years of age at Four Roads-Tamana was found to be 66 per cent. and at Coryal Tamana 70 per cent. in 1934.

"During the months of May and June, 1934, following a report of the large prevalence of anopheles in the district, [Cumuto-Talparo-Tamana area] a special anopheles and topographical survey was made which disclosed a very surprising, interesting and disconcerting state of things. . . . towards evening between 4 and 8 p. m. large

numbers of *A. bellator* adults were found to be swarming in every house, and village in the district wherever they happened to adjoin a cocoa estate.

"In the forests also adults could always be seen to bite even during the daytime, but their numbers were conspicuously less here as well as in such houses as adjoined these forests. . . . They bite commonly between 4 and 8 p. m. on the main roads near cocoa cultivations, in the open yards and also inside the galleries and rooms of the houses and appear to feed equally on man or beast. In the early morning also as well as immediately after heavy showers of rain on cloudy days the labourers are freely attacked in the cocoa fields. . . ."

The author was able to verify these statements during a visit to Trinidad in the summer of 1936. It is fair to state, however, that the evidence is purely epidemiological on which Dr. Eric de Verteuil, who discovered the conditions outlined above, bases his conclusions as to the role of *bellator* as a vector of malaria. No dissections of wild-caught females have been made, nor have experimental infections been attempted. However, no other Anopheline occurs in sufficient numbers in the area to be considered a factor in transmission, and the epidemiological evidence, so far as it goes, is rather conclusive.

Dr. D. P. Curry, Assistant Chief Health Officer of the Panama Canal (30) reports being severely bitten by *Anopheles neivai* females, in the immediate vicinity of their breeding-places in "pita" plants, and in some locations on the Atlantic side of the Canal Zone the insects are a pest to the troops on duty at searchlight stations in the jungle, where the same plant is abundant. There are no records of dissections or experimental infections of this species in Panama, or elsewhere.

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EXPLANATION OF PLATES

Plate I

Figs. 1 and 2. *Anopheles (Kerteszia) bolivensis*, male. 1. Mesosome. 2. Claspette lobes.

Figs. 3 and 4. *Anopheles (Kerteszia) cruzii*, male. 3. Mesosome. 4. Claspette lobes.

Plate II

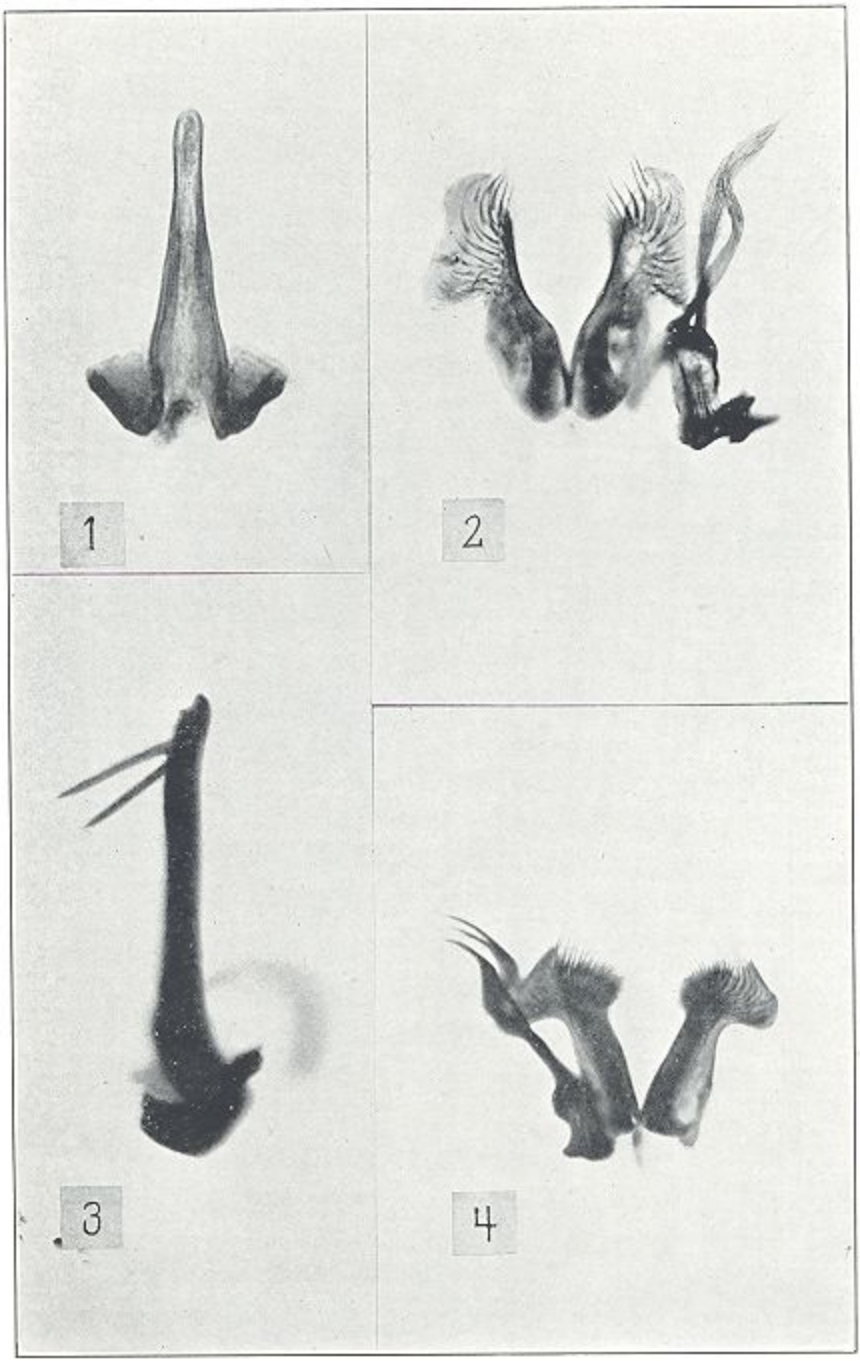
Figs. 5–8. *Anopheles (Kerteszia) neivai*, male. 5. Wing. 6. Ninth sternite. 7. Mesosome. 8. Claspette lobes.

Plate III

Figs. 9 and 10. *Anopheles (Kerteszia) homunculus*, male. 9. Mesosome. 10. Claspette lobes.

Figs. 11 and 12. *Anopheles (Kerteszia) bellator*, male. 11. Mesosome. 12. Claspette lobes.

Figs. 13 and 14. *Anopheles (Kerteszia) anoplus*, male. 13. Mesosome. 14. Dorsal lobe of claspette.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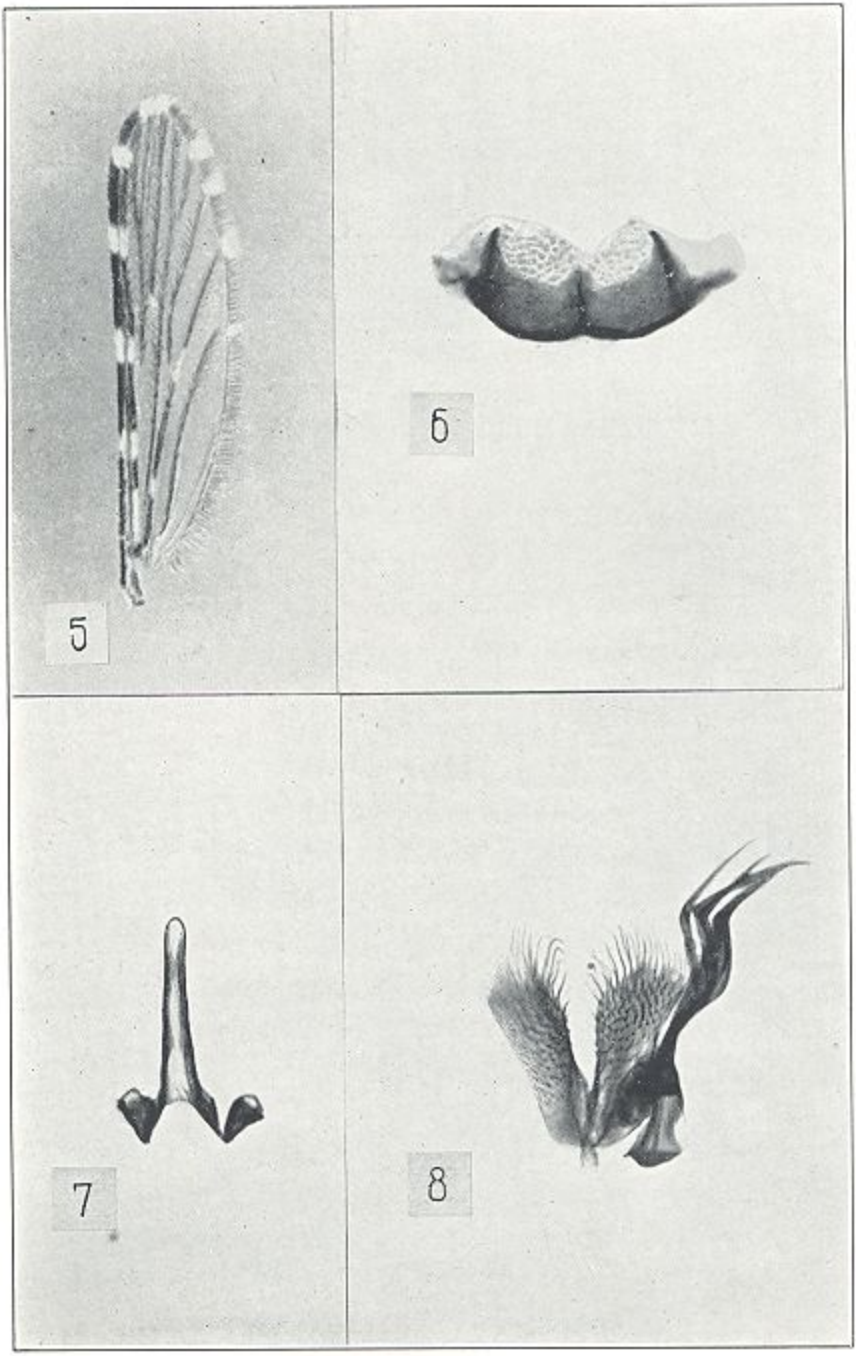
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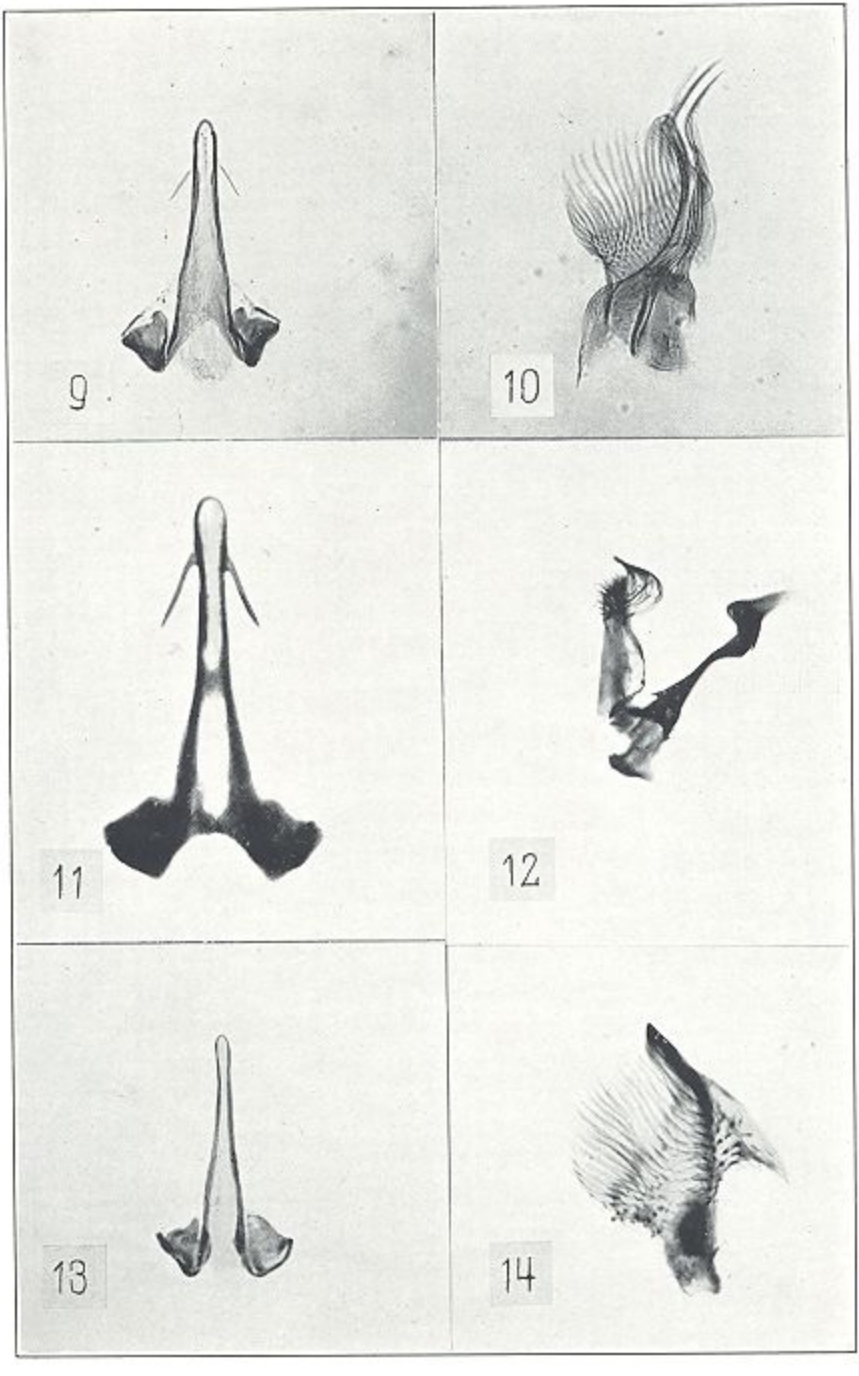
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