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MOSQUITO STUDIES (Diptera, Culicidae) XXXIV.

A revision of the Albimanus Section of the subgenus Nyssorhynchus of Anopheles

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MOSQUITO STUDIES (Diptera, Culicidae)

XXXIV. A REVISION OF THE ALBIMANUS SECTION OF THE SUBGENUS *NYSSORHYNCHUS* OF *ANOPHELES*[1]

By

Michael E. Faran[2]

INTRODUCTION

Zavortink (1973:4), when he was reviewing the subgenus *Kerteszia* of *Anopheles*, stated, ". . . the systematics of *Nyssorhynchus* are too poorly known and hopelessly confused." In 1942, L. E. Rozeboom (1942b) used only one couplet in a key to the adult females for 9 different species in the Albimanus Section. The reason for this, as the pioneering work of W. H. W. Komp (1942:25-26) and Rozeboom recognized, is that many of the characters that have been used to distinguish the adult females in the Albimanus Section are extremely variable and unreliable for species identification. On the basis of one character alone it is often impossible to identify with any confidence an adult female as belonging to a particular species in this section, which includes several important vectors of malaria. The purpose of this revision is (1) to describe and illustrate, in detail, all the currently known species in the Albimanus Section, (2) to reconcile some of the systematic problems that have resulted in this aura of confusion and (3) to develop effective keys that use more than one character, when possible, for all stages of the life cycle for the species in this section.

I am subdividing the subgenus *Nyssorhynchus* into 2 sections, the Albimanus Section and the Argyritarsis Section. These sections are very closely allied and form a tight, well-defined unit. The entire subgenus is restricted to the Neotropics except for *albimanus* which extends into the Nearctic. The Albimanus Section is distinguished from the Argyritarsis Section in the adults primarily by the basal dark band on hindtarsal segment 5, and in the male genitalia by the variously developed fused ventral claspette. Only on the basis of these 2 characters can these sections be readily differentiated. The *Myzorhynchella* group has been excluded from consideration because of the paucity of material available for study and because of its uncertain taxonomic position.

In the present revision 14 species are recognized in the Albimanus Section. The nominal species *sanctielii* is not included because of the lack of material. *An. gorgasi*

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is removed from synonymy with *albimanus* and relegated to status of a *nomen dubium* as is *evansi* which was formerly considered to be the senior synonym of *strodei*. The synonymy of *metcalfi* is changed from *oswaldoi* to that of *noroestensis*. *An. triannulatus* is treated as a single, although variable, form, *not* as being composed of 2 separate subspecies, *t. triannulatus* and *t. davisi* (or *t. bachmanni*).

An attempt has been made to assemble the species into distinct monophyletic groups on the basis of correlated characters in the adults and immatures. The character state, ancestral or derived, of the taxonomically important features has been determined whenever possible and evolutionary trends stated in formulating the phylogenetic relationships within the section. I am dividing the section into 2 groups, the monotypic Albimanus Group and the Oswaldoi Group. *An. albimanus* is the least derived species in the section, possessing several ancestral features which it shares with some of the ancestral species in the Argyritarsis Section. *An. albimanus* is easily differentiated from the Oswaldoi Group by several correlated unique features in the adult, male genitalia and larva.

I am separating the Oswaldoi Group into 2 subgroups, the monotypic Triannulatus Subgroup and the Oswaldoi Subgroup composed of 12 species, further separated into the Oswaldoi Complex and the Strodei Complex.

The Oswaldoi Complex consists of 9 species. Within the complex, 2 separate phyletic lines are discernible on the basis of the structure of the ventral claspette of the male genitalia. One line is composed of *oswaldoi, galvaoi, noroestensis, aquasalis, ininii* and possibly the relict *anomalophyllus,* and the other by *rangeli, trinkae* and *nuneztovari.*

The Strodei Complex contains *strodei, rondoni* and *benarrochi. An. strodei* and *rondoni* are very closely related, but their relationship to *benarrochi* is difficult to determine as *benarrochi* is the most derived species in the section. *An. benarrochi* has been placed in the Strodei Complex only because of the similarity of its male genitalia with those of *strodei* and *rondoni.*

The larvae and pupae of the Albimanus Section occur primarily in ground water habitats. All the species breed in fresh water, except for *aquasalis* and often *albimanus* which are often found in brackish water. The females feed predominantly on large mammals. The adults are active either crepuscularly or nocturnally; *triannulatus* is the only species reported to bite occasionally during the day.

Two species, *albimanus* and *aquasalis,* are major vectors of malaria in Central and South America and the islands of the Caribbean. *An. nuneztovari* is the primary vector of malaria in western Venezuela and northern Colombia and possibly a vector in Suriname. *An. triannulatus, strodei* and *norestensis* have been implicated in the transmission of malaria, since they have been found naturally infected. *An. rangeli* has been suspected of transmitting malaria in Ecuador. Two viruses, Venezuelan Encephalitis virus and Tlacotalpan virus, have been isolated from *aquasalis* and *albimanus* respectively. Nothing is known about the medical importance of the remaining species.

I would like to express my deep gratitude to John N. Belkin for his constant support and guidance. I thank the other members of my doctoral committee, A. Ralph Barr, George A. Bartholomew, Walter Ebeling and Peter Vaughn, for their encouragement and helpful advice.

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During my field studies I have been assisted by many people. I would especially like to thank Nelson Papavero of the Museo de Zoologia, Sao Paulo, Oscar de Souza Lopes and his staff of Instituto Adolfo Lutz, Sao Paulo, and Herbert C. Barnett and Ricardo Iglesias Rios of Instituto de Microbiologia, Rio de Janeiro.

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MATERIAL AND METHODS

MATERIALS. This taxonomic revision is based on a study of 14,792 specimens: 2816 males, 774 male genitalia, 6078 females, 2088 pupae and 3036 larvae, including 1682 individual rearings (755 larval, 741 pupal, 186 incomplete) and 30 progeny rearings. Individually reared specimens were available for 11 of the 14 species (all but *benarrochi, galvaoi* and *rondoni*); progeny rearings were available for 5 species (*benarrochi, oswaldoi, rangeli, triannulatus* and *trinkae*). Except for *galvaoi* and *rondoni*, larvae and pupae of all species were available for study. For 2 of the medically more important species (*albimanus* and *aquasalis*), abundant individually reared material from almost their entire geographic range was examined, permitting the analysis of intra- and interpopulational variation(s) within these 2 species.

The majority of the material for the present study was collected (or otherwise acquired) by the project "Mosquitoes of Middle America" (MOMA); this material has recently been transferred from the University of California at Los Angeles to the "Medical Entomology Project" (MEP) at the U. S. National Museum of Natural History [USNM]. In the Distribution section for each species, the specimens listed are all deposited at the USNM, unless otherwise noted by the presence of the abbreviation for the depository in brackets. In order to conserve space, specimens from the MOMA collection for which collection data have been published are listed only by code and collection number under the correct locality (example: "Humazones, HON 59"). All other specimens are listed individually by number and type, along with locality, date and collector. Most collection localities are not given in detail, but only by the nearest town. The number and types of specimens are summarized and listed directly after the country or major political division. The collection records of the

"Mosquitoes of Middle America" project have been published in the following series of papers: Belkin, Heinemann and Page 1970; Belkin and Heinemann 1973, 1975a, 1975b, 1976a, 1976b, 1976c; Heinemann and Belkin 1977a, 1977b, 1977c, 1978a, 1978b, 1978c, 1979. These papers should be consulted for complete data for the following codes: ANT, BAH, BH, BRA, BRB, CAY, COL, COM, CR, CUB, DOM, ECU, FWI, FWIM, FG, FGC, GG, GR, GRR, GUA, GUY, HAC, HAR, HAT, HON, JA, LAR, LU, MAR, MEX, MNT, MX, NI, NIC, NVS, PA, PER, PR, PRA, PRX, RDO, SAL, SUR, VI, VZ.

The only other major sources of material were the USNM and the School of Public Health, Johns Hopkins University. Additional individually reared material collected by John F. Reinert and Donald R. Roberts from Para, Brazil has been particularly important in this study since it included the only specimens of *ininii*. Other sources of material include collections by A. Gabaldon, P. Cova Garvia, J. B. Kitzmiller, R. F. Darsie, Jr., R. S. Panday, W. H. W. Komp, F. M. Root and L. E. Rozeboom. Material was also borrowed from Paul H. Arnaud, California Academy of Sciences, San Francisco [CAS]; A. Ralph Barr, University of California, Los Angeles [UCLA]; Margaret Thayer, Museum of Comparative Zoology, Harvard University, Cambridge [MCZ]; Henry S. Dybas, Field Museum of Natural History, Chicago [FMNH]; Peter F. Mattingly and Graham B. White, British Museum (Natural History), London [BM]; L. L. Pechuman, Cornell University, Ithaca [CU]; Selwyn S. Roback, Academy of Natural Sciences, Philadelphia [ANS]; Milan Trpis, Johns Hopkins University, Baltimore [JH]; and Pedro W. Wygodzinsky, American Museum of Natural History, New York [AMNH]. Recently, valuable material was collected and field observations made by John N. Belkin, J. Hal Arnell, Thomas E. Rogers, Kenneth J. Linthicum and myself in the state of Sao Paulo, Brazil, January to March 1975, and by John N. Belkin, George K. Bryce and myself in the state of Rio de Janeiro, December 1975 to March 1976; the data for these collections are given in Heinemann and Belkin 1979. I have examined the types of *davisi, anomalophyllus, emilianus, dunhami, galvaoi* (paratype), *goeldii, gorgasi, metcalfi* and *strodei* [USNM]. J. N. Belkin has examined the types of *galvaoi, noroestensis, rondoni, cuyabensis, albimanus* and *albipes.*

TAXONOMIC PROCEDURES. The methods and techniques utilized in this study are essentially those of comparative morphological taxonomy as described by Belkin, Schick, Galindo and Aitken (1965:10; 1967:10-11). An attempt has been made to assemble the species described here into separate monophyletic taxa. In almost all cases this was done on the basis of the correlation of several derived features in the larva, adult and male genitalia. The determination of the character states, derived (apomorph) or ancestral (plesiomorph), was accomplished using the methods previously described and discussed by Mayr (1969:181-257) and Hennig (1966). Bionomics and distributional data also were employed as taxonomic characters in an attempt to explore evolutionary trends within the section.

DESCRIPTIONS. The terminology, abbreviations and form of presentation are essentially those of Belkin (1962) with the modifications of Belkin (1968a:49). The descriptions are all composites based on as many specimens as were available. In most cases the chaetotaxy of the immatures was based on at least 10 individuals, unless otherwise stated, and is listed as 2 sets of figures for all the setae that are considered to be taxonomically important. The first set of numbers after the hair is the modal condition, representing the frequency of at least 75% of the observations. The set of numbers following the modal condition is the entire range of all observations. A few special terms are used for the wing spots and the male genitalia. These terms are discussed in the chapter on Taxonomic Characters. Most measurements were

made from slides with the aid of a calibrated ocular micrometer in the eyepiece of a compound microscope, except for a few of the adults in which measurements were made in a similar fashion with a stereoscopic dissecting microscope. Intra- and interpopulational variations and any anomalous forms are analyzed in the Discussion sections.

SYSTEMATICS. The taxonomic history, when pertinent, and systematics are discussed for each species. This includes affinities, evolutionary trends, possible centers of origin, intrapopulational and geographical variations, and any other information relevant to the systematics of the species. In the discussions under the groups, subgroups and complexes particular attention has been given to the interrelationships of the species within each taxon and the taxon's relationships with other related taxa.

BIONOMICS. Much of the information regarding the bionomics of the species for which there was adequate material collected by the project "Mosquitoes of Middle America" was extracted from the field collection data forms on file at UCLA. Most of this data has since been published in the "Collection records of the project 'Mosquitoes of Middle America' " series (see p 4). The data from the collection forms are combined with information condensed from the literature about the natural history of each species.

MEDICAL IMPORTANCE. A brief summary of the medical importance of each species is included following the bionomics. This section is only a summary and does not in any way attempt to be an inclusive discussion of the literature on this subject. It pertains primarily to malaria and what is known concerning the vector capacity of each species.

DISTRIBUTION. The known distribution is given for each species followed by a list of the material examined (see p 3-4). In the "Table of Distributions," under each species for the different countries, a solid circle is used to indicate that a specimen (or specimens) of that species was examined from that locality. A starred circle indicates a distribution record taken from what is believed to be a reliable reference. The distribution for each species is outlined in figures 1-3. On the figures, a solid line broken by a dotted line implies uncertainty regarding the distribution of that particular species within the area bordered by the dotted line.

TAXONOMIC HISTORY

Several good reviews have been published on the taxonomic history of the Albimanus Section, previously referred to as "Tarsimaculatus Series," "Tarsimaculatus Complex," "Albimanus Series" or "Albimanus Group" (Root 1926b; Lima 1928; Gabaldon 1940; Rozeboom and Gabaldon 1941; Komp 1941b; Galvao and Lane 1938; Galvao 1940, 1943; Floch and Abonnenc 1943a; Causey, Deane and Deane 1945; Bejarano 1957). For this reason I will only briefly summarize the history of this group, indicating some of the major taxonomic problems which have led to considerable confusion. Most of the problems relating to a particular species will be dealt with in the Discussion section for the species concerned. The single most perplexing problem in the past regarding the species in the Albimanus Section has resulted from the use of the name "*tarsimaculatus*." This one taxonomically invalid name has hindered the understanding of this group of mosquitoes more than any other factor. The taxonomic history of the Albimanus Section is, in many ways, the history of "*tarsimaculatus*."

The oldest species in the subgenus *Nyssorhynchus* is *albimanus*, which was describ-

ed by C. R. W. Wiedemann in 1820. A few years later, J. B. Robineau-Desvoidy (1827) described *argyritarsis*, the first species now recognized in the other major section of *Nyssorhynchus* bearing its name. Theobald (1901) described *albipes* as a variety of *argyrotarsis* [*sic*] which, he stated, differed from *argyrotarsis* only by the presence of a black basal band on the last hindtarsal segment. The type locality was not specified. Theobald (1903:110-113) raised *albipes* to specific rank, placing it in his new genus *Cellia*, which included New World as well as Old World species of *Anopheles*. Shortly afterward, Goeldi (1905), after studying material in Para, Brazil, proposed the name *tarsimaculata* as an emendation for Theobald's *albipes* in order to avoid confusion with the name *albitarsis*. Coquillett (1906:8, 13) synonymized *albipes* with *albimanus*. Dyar and Knab (1906b:160-161) also correctly synonymized *albipes* with *albimanus* and recognized that *tarsimaculatus* was proposed as a substitute for *albipes*. However, they mistakenly concluded that since the material Goeldi examined was not *albimanus* or *argyritarsis*, Goeldi's name *tarsimaculata* was available for the specimens they had examined from Sao Paulo and Manaus, Brazil, and Trinidad. In 1907, Dyar and Knab described a new species, *gorgasi*, based on a badly damaged, mutant specimen collected by A. H. Jennings on the Pacific side of the Panama Canal Zone. The same year Theobald (1907:106-109) synonymized *cubensis* Agramonte 1900, *albipes* and *tarsimaculata* with *albimana*. Theobald (1910:69) in a footnote stated, "All the long series [of *tarsimaculatus*] sent me by Professor Goeldi from Para are the same as those received from many other places, and are undoubtedly *albimana*." Knab (1913), like Theobald, synonymized *albipes* and *cubensis* with *albimanus*; however, he synonymized *gorgasi* with *tarsimaculata*. In their fourth volume of "The mosquitoes of North and Central America and the West Indies," Howard, Dyar and Knab (1917:975-979) interpreted *tarsimaculata* as being a valid species even though they realized Goeldi had not proposed a new species and stated, "There is therefore no original description, but the species is figured and with a discussion the new name is published. We have therefore felt justified in recognizing Goeldi's name as the first valid name for the species before us." They also recognized 2 other species in *Nyssorhynchus, albimanus* and *argyritarsis*.

Subsequently, after Howard, Dyar and Knab accepted *tarsimaculatus* as being valid, almost all the species in the Albimanus Section have at some time been designated as *tarsimaculatus* or as synonyms of *tarsimaculatus*. Root (1924b:460-462) studied the male genitalia of "*oswaldoi*," *tarsimaculata* and *albimanus*. He stated that *tarsimaculata* is easily distinguished from *albimanus*; however, he could not find any genitalic differences between *tarsimaculata* and *oswaldoi*, so he "relegated" the name *oswaldoi* as a synonym of *tarsimaculata*. Root (1926b) described *strodei* and listed *albimanus, tarsimaculatus, bachmanni,* and tentatively *rondoni, triannulatus* and *cuyabensis*, plus a number of other species in the Argyritarsis Section, in the subgenus *Nyssorhynchus*. Concerning *tarsimaculatus,* Root stated that the range of variation in the black area on the second hindtarsal segment is continuous, ranging from 8 to 35%, and the larvae, pupae and male genitalia of the *Cellia oswaldoi* type of the Brazilians, "seem to be quite identical with those of normal *tarsimaculatus*." Therefore he saw no reason for retaining the name *oswaldoi*.

Christophers (1924:38-41) recognized *albimanus* and 5 different varieties of the species *tarsimaculatus* which included *oswaldoi, rondoni, cuyabensis, triannulatus* and a Bonne variety from Surinam (Bonne 1923, and Bonne and Bonne-Wepster 1925, recognized 2 types of *tarsimaculatus,* one on the coast and one in the interior). Dyar (1928:434-446) in his monograph "The Mosquitoes of the Americas," as did Root, considered *oswaldoi* a synonym of *tarsimaculatus*, listing 15 "species" in *Nys-*

sorhynchus of which 7, *albimanus, bachmanni, rondoni, cuyabensis, triannulatus, evansi* and *tarsimaculatus*, are now included in the Albimanus Section. Later Curry (1932) described 2 more varieties of *tarsimaculatus*, var. *aquasalis* and var. *aquacaelestis.* Curry recognized, however, that his *aquacaelestis* could be synonymous with *oswaldoi* or possibly a valid species, and not merely a variety of *tarsimaculatus.*

To unnecessarily complicate matters, Townsend (1933a:102) stated that the *tarsimaculata* of Howard, Dyar and Knab 1917 was not the *tarsimaculata* of Goeldi 1905, and proposed *gorgasi* as an available name for the former species. In another paper Townsend (1933b) stated, "It seems strange that the name *tarsimaculatus* was ever adopted from Goeldi by Howard, Dyar and Knab." Unfortunately, as Komp (1941b: 793) stated, "He [Townsend] plunged the subject into confusion by making several unwarrantable assumptions." Townsend believed that *albitarsis* and *albimanus* (the *tarsimaculatus* that Townsend thought Goeldi examined) were both present in Belem during the time Goeldi collected there, and later these 2 species were replaced by *gorgasi* of Townsend and *An. (Nys.) darlingi* Root 1926. Townsend called specimens he collected at Rio Tapajos, Boa Vista, Para, Brazil *gorgasi.* Some of this latter material was identified as *goeldii* by Rozeboom and Gabaldon (1941:97). When Komp (1941b) examined mounts of the male genitalia from Boa Vista labelled by Townsend *tarsimaculatus* Goeldi, he discovered some of them to be *triannulatus.*

In 1937 Galvao and Lane revalidated *oswaldoi* and stated that *tarsimaculatus* of Root 1926 is really a variety of *oswaldoi* which they called *oswaldoi* var. *metcalfi. An. metcalfi* was based principally on a description of an egg by Root (1926b:700). Galvao and Lane, at a meeting of the Sociedade de Biologia de Sao Paulo, 15 September 1937, described the varieties *metcalfi* and *noroestensis*, but their published descriptions did not appear until later (Galvao and Lane 1938:169-178). At this meeting they also stated that they recognized *tarsimaculatus* Goeldi 1905 as being valid because of Article 21 of the International Code of Zoological Nomenclature which stated, "The author of a scientific name is that person who first publishes the name in connection with an indication, a definition, or a description, unless it is clear from the contents of the publication that some other person is responsible for said name and its indication, definition, or description." So by 1937, Galvao and Lane recognized *tarsimaculatus* separately from *oswaldoi,* the latter composed of 3 varieties, *oswaldoi, metcalfi* and *noroestensis.* Lane (1939:27-29), in his "Catalogo das mosquitos neotropicos," listed *gorgasi, evansi, aquasalis* and *aquacaelestis* as synonyms of *tarsimaculatus.*

Three years later Rozeboom and Gabaldon (1941:96) stated, ". . . we do not see how Article 21 applies to this [*tarsimaculatus*] case. Goeldi did not realize that he was dealing with a new species, as he proposed '*tarsimaculata*' simply because *albipes* has the same meaning that *albitarsis* has and might lead to confusion. Therefore, Goeldi proposed his name illegally, for Article 32 of the International Rules states, 'A generic or specific name, once published, cannot be rejected, even by its author, because of inappropriateness.' " Komp (1941b:793) was in agreement with the latter authors and proposed a new species, *emilianus* from Belem, Para, in order to "obviate further difficulties in the nomenclature of the species in this group. . . ." *An. emilianus* was supposedly the species Goeldi worked with in 1905. One year later, Galvao and Damasceno (1942), for exactly the same reasons as given by Komp, synonymized *emilianus* with *tarsimaculatus.* Since then *tarsimaculatus* (=*aquasalis*) has continued to be used as recently as 1958 (Rachou 1958; Andrade 1958a, b) and possibly even more recently in Brazil.

Regarding the higher classification of the group, Theobald described the genus *La-*

verania in 1902 with the type *argyrotarsis* [*sic*]. At the time Theobald (1902) described *Laverania* he also described the genus *Cellia*, with *pharoensis* as type species. *Cellia* included also *pulcherrimus, squamosus* and *bigotii*. The same year Blanchard (1902) proposed *Nyssorhynchus* as a replacement for *Laverania* Theobald 1902, because the name was preoccupied by *Laverania* Grassi and Feletti 1890. In 1903, in Volume 3 of his "Monograph of the Culicidae of the World," Theobald catalogued the species *argyrotarsis* and *albipes* in *Cellia*, even though he synonymized *Laverania* with *Nyssorhynchus*. By 1910, in Volume 5, Theobald included *argyrotarsis* and *albimana* of *Nyssorhynchus* in the genus *Cellia*, along with several Old World species. Unfortunately Theobald based his classification on the adult scalation patterns. Knab (1913:34), criticizing the classification of *Anopheles*, wrote, ". . . the subject [*Anopheles*] was made needlessly difficult by hasty work and by the sub-division of the old genus *Anopheles* into numerous ill-defined and fancifully differentiated genera."

Christophers (1915) studied the male genitalia of *Anopheles* and stated that although he was not at that time concerned with nomenclature, generic subdivision of anophelines would include the following 3 amended genera, *Anopheles, Myzomyia* and *Nyssorhynchus*. Root (1923:266) agreed in general with Christophers' classification but considered *Nyssorhynchus* to be of subgeneric rank. Lima (1928) followed Christophers' interpretation, but divided the genus *Nyssorhynchus* into 2 subgenera, *Nyssorhynchus* and *Kerteszia*; he further subdivided the subgenus *Nyssorhynchus* into 2 groups, Group A (in part Argyritarsis Section) and Group B which included 11 "species" now in the Albimanus Section. Edwards (1932:43-46) separated the subgenus *Nyssorhynchus* into 3 groups, Group A being *Nyssorhynchus* excluding *Myzorhynchella*, which was divided into 3 series, Argyritarsis, Tarsimaculatus and Rondoni. The Tarsimaculatus series included species with a basal dark band on the second and fifth hindtarsal segments, hindtarsal segments 3 and 4 being entirely white. The Rondoni series comprised those species which had dark bands on hindtarsal segments 3 and 4 in addition to hindtarsal segments 2 and 5.

It was not until 1940 that Gabaldon divided the Tarsimaculatus series of Edwards, which he called the Albimanus Series, into 3 subseries based on the presence or absence of setae on the ventral claspette of the male genitalia. These subseries were the monotypic Albimanus Subseries, the Triannulatus Subseries (*triannulatus* and *strodei*) and the Oswaldoi Subseries (*oswaldoi, aquasalis, anomalophyllus* and *nuneztovari*). By 1952 (Gabaldon and Cova Garcia 1952:178), *benarrochi* and *rondoni* had been added to the Triannulatus Subseries, and *galvaoi, ininii, konderi, noroestensis, rangeli* and *sanctielii* had been placed in the Oswaldoi Subseries.

In another interpretation of the phylogenetic relationships within the subgenus, Galvao (1943:141-142) divided *Nyssorhynchus* into 2 series, the Argyritarsis Series and the Tarsimaculatus Series corresponding to Lima's Groups A and B respectively. He further separated the Tarsimaculatus Series into a monotypic group, *albimanus*, and 3 complexes: the *tarsimaculatus* Complex (*tarsimaculatus, oswaldoi, aquasalis, anomalophyllus, noroestensis, rangeli* and *nuneztovari*), the *rondoni* Complex (*rondoni* and *strodei* including subspecies *albertoi, arthuri, artigasi* and *lloydi*) and the *triannulatus* Complex (*triannulatus triannulatus, t. davisi, t. chagasi* and *benarrochi*).

In 1949 Levi-Castillo divided the subgenus *Nyssorhynchus* into the Albimanus Group and the Argyritarsis Group. The Albimanus Group was divided into 3 series, Albimanus, Oswaldoi and Triannulatus which corresponded to the subseries of Gabaldon. However, in addition to *strodei, triannulatus, rondoni* and *benarrochi*, Levi-Castillo also included *galvaoi* and *nuneztovari* in the Triannulatus Series. Until the

present revision no other major changes have been made in the higher classification of the Albimanus Section.

TAXONOMIC CHARACTERS

I have attempted, whenever possible, to determine the character state, whether ancestral (plesiomorph *sensu* Hennig 1966) or derived (apomorph *sensu* Hennig 1966), of the taxonomically important characters, in order to facilitate the hypothesis of the probable phylogenetic relationships among the species within the Albimanus Section (fig. 4). In some cases it has been very difficult to ascertain the character state of certain features because of the tremendous number of similarities among the species resulting from convergent and parallel evolution, and/or secondary loss of morphological traits.

When possible, I have stated evolutionary trends which may have taken place within the section, regarding individual characters in the adult, male genitalia, pupa and larva. In developing and interpreting the proposed phylogeny of the Albimanus Section I have relied on the correlation of as many derived characters as possible in all the life stages. Ancestral characters, along with certain derived features, were important in determining the phylogenetic relationships of the 2 more ancestral monotypic taxa, the Albimanus Group and the Triannulatus Subgroup.

The most reliable characters for species identification are in the male genitalia and the larva. The external morphology of the adult and pupa, particularly in the case of the Oswaldoi Subgroup, is very similar interspecifically, and usually quite variable intraspecifically. For this reason, the keys for the adults and pupae are not always entirely reliable when used by themselves. It is *highly* recommended that one refer to the species descriptions and discussions when attempting to identify any species in this subgroup, and that one correlate those data with the information given on the bionomics and distribution. As has been emphasized by Belkin (1962), it is best to examine more than one specimen. And to be certain of an identification, the immatures should be individually reared and slides prepared of their exuviae and of the genitalia of the corresponding males to permit the correlation of characters in the different life stages. Where morphologically similar species occur sympatrically it is doubly important to use more than one developmental stage. Lastly, it must be emphasized that not all the populations from every locality where each species exists were examined. Thus, the range of variation reported is conservative, may not be inclusive and may be exceeded in some individuals. Also, as indicated by Arnell (1973: 5), the illustrations of the larvae and pupae show only the modal condition of the setal branching and cannot represent the range of variation which occurs in a species.

ADULTS

The important characters for differentiating the females are seen in the (1) penultimate segment [4] of the palpus, (2) presence or absence of scales on the mesepimeron, (3) banding pattern of the legs, (4) relative length of wingspots and (5) dark caudolateral scale tufts of the abdomen.

HEAD. The only character which varies appreciably among the species is the light color of the scales vesting the penultimate segment of the palpus and, to a much lesser extent, the erect scales on the vertex. The trend in the scale pattern of the fourth palpal segment appears to be a shift from predominantly dark in the ancestral condition to mostly light in the derived. In the Albimanus Group palpal segment 4 is dark

or almost completely dark; whereas, throughout the Oswaldoi Subgroup this segment is conspicuously light, at least mediolaterally. The Triannulatus Subgroup has an appreciable amount of light scaling on palpal segment 4 but generally less than in the Oswaldoi Subgroup.

THORAX. Very few differences are found in the thorax. Primitively, there was probably an upper mesepimeral patch of light scales which has been lost in all species except *rangeli*, and occasionally *trinkae* and *noroestensis*. The premise of the antiquity of these scales is based on an out-group comparison, the fact that several species in the Argyritarsis Section also possess upper mesepimeral scales. *An. triannulatus* is distinguished by the key feature, a patch of light scales on the anterior mesepimeron, rather than on the upper mesepimeron. This character is present only in one other species in *Nyssorhynchus, darlingi* of the Argyritarsis Section.

LEGS. The hindtarsus was consistently studied in the past with little regard for the banding patterns of the fore- and midtarsus. In the fore- and midtarsus, as in the hindtarsus, there seems to have been a trend toward the development of a larger and more extensive light apical band. In *albimanus* foretarsal segments 4 and 5 are almost completely dark. In *triannulatus* foretarsal segment 5 is all dark, but foretarsal segment 4 has a large apical light band. Throughout the Oswaldoi Subgroup the apical light band varies in size, but is usually present on foretarsal segments 1, 2, 3 and 5, with segment 4 being largely dark. The extreme condition in seen in *ininii* where all the foretarsal segments are largely light, with dark scales occasionally present only as a narrow dorsobasal stripe. The midtarsal segments are usually similarly banded; however, the light apical band is much less conspicuous, smaller and usually cream or golden, rarely white. There is no apical light band on midtarsal segments 3 or 4 in *albimanus*. Midtarsal segment 4 of the Oswaldoi Subgroup is usually all dark or with a rather inconspicuous apical light band, except in *ininii* where a distinct apical light band is present. Primitively the second hindtarsal segment probably possessed a large basal dark band, 0.5 or more the length of the segment. In all taxa above the species level, there is at least one species that retains this character. There has been an independent reduction in the size of the dark basal band in the Oswaldoi and Strodei Complexes, the band being smallest in *oswaldoi* and *ininii*. In other species, such as *rondoni* and *aquasalis*, the large dark basal band of hindtarsal segment 2 may be independently derived.

WING. The terminology used for the wing spots is modified from Zavortink (1973: fig. 5). The trend has been for the reduction in size of the dark spots along the costal vein and corresponding spots on the more posterior veins. The basal dark spot of the costal vein is moderately large in *albimanus* and large in *triannulatus*. In the Oswaldoi Subgroup it is small, usually less than the length of the humeral light spot, except in *nuneztovari* and some *trinkae*, where it is large and may be independently derived. In general the wings are very similar throughout the Oswaldoi Subgroup except for *rangeli* and *rondoni*. In *rangeli* there has been a very definite increase in the size of the light spots of veins C, R, Rs, R_1, R_2 and R_{4+5}. In *rondoni* the opposite has occurred and the dark spots are much more extensive. The subbasal, presectoral and sectoral dark spots on vein C usually are fused into a very long, single dark spot. Correspondingly, the dark spots on the posterior veins are in general very large. The preapical dark spot of vein M in *rondoni* extends unbroken onto vein M_{1+2}.

ABDOMEN. I believe that the dark caudolateral scale tufts were primitively present on segments II-VII. In *albimanus* the scale tufts are absent on II.

MALE GENITALIA. The male genitalia offer the best and most easily identifiable

group characters. In the Albimanus Section, the male genitalia are complex and highly derived with respect to other anopheline groups. The terms dorsal and ventral in this study refer to the orientation of structures of the male genitalia prior to rotation, that is, the morphological tergal and sternal surfaces respectively.

The subgenus *Nyssorhynchus* is characterized by the fusion of the ventral claspettes to form a single median structure, and by the single parabasal spine on the sidepiece. The male genitalia of the Albimanus Section have been studied extensively by previous workers and have been regarded as being of primary importance in species identification. Characters and structures seldom examined in the past are sternite IX, the relative length of the parabasal spines, the setal pattern of the sidepiece, and features of the dorsal claspette. There are no good group characters on segment VIII.

Sternite IX. In ventral aspect, the sternite appears short and subrectangular in the Albimanus Group and moderately long to long and subtrapezoidal to subtriangular in the Oswaldoi Group. Along the anterior margin there is an apodeme (anterior apodeme) which is very short and inconspicuous in the Albimanus Group and moderately narrow and subrectangular, to broad and subtriangular in the Oswaldoi Group.

Sidepiece. There is a trend for a relative shortening of the parabasal spine in several species within the Oswaldoi Complex. The parabasal spine and tubercle are, in general, longer in *albimanus, triannulatus* and the Strodei Complex, and shorter in the Oswaldoi Complex.

Dorsal Claspette. Although not important as a section feature, the morphology of the dorsal claspette may aid in identification of species within the section and should be used in correlation with other characters of specific value.

Ventral Claspette. The fused ventral claspette best delimits the taxa within the section and has been used most often to divide the section into different groups (Gabaldon 1940; Galvao 1943; Levi-Castillo 1949). The various components of the ventral claspette, the (1) basal lobules, (2) preapical plate (Gabaldon 1940), (3) refringent structure (Gabaldon 1940), (4) mesal cleft, (5) membranous area and (6) median sulcus, are illustrated in figure 10. The trend has been for the acquisition of setae on the ventral claspette; this appears to have occurred in a more or less stepwise fashion. The ancestral condition is represented in *albimanus, triannulatus* and all members of the Argyritarsis Section, by the complete absence of setae. In the Strodei Complex setae are present; however, they do not extend to the apex. The most derived condition is represented by the species comprising the Oswaldoi Complex (except *ininii*) in which setae are continuous on the lateral and ventral surfaces, extending to or nearly to the apex. The preapical plate has also tended to increase in size from an inconspicuous spot in the Albimanus Group to a very large, heavily sclerotized plate in some species in the Oswaldoi Complex.

Phallosome. Primitively the phallosome in the Albimanus Section probably had a pair of large, serrated leaflets as seen in several species in the Argyritarsis Section. These leaflets have been lost except in *anomalophyllus*, a relict species in the Oswaldoi Complex. Remnants of the leaflets are still present in many of the species in the latter complex as unserrated, membranous, basolateral expansions at the apex of the aedeagus. Whenever width of aedeagus is used, this refers to width of aedeagus at base of apex (subapex where lateral sclerotizations extend ventromedially to form an incomplete tube, fig. 10). Length of apex of aedeagus refers to distance from subapical, collarlike, subtriangular, lateral sclerotizations to apex of aedeagus (fig. 10).

PUPAE

As in several other groups of mosquitoes, the pupae in the Albimanus Section are remarkably similar. They exhibit few features that vary consistently throughout the group, and are of phylogenetic importance only when correlated with the significant group characters in the other life stages. For this reason I have not included them in the descriptions of the groups, subgroups and complexes except for the monotypic taxa. The only group trends that are apparent occur in the trumpet and "caudolateral spines" (hair 9-II-VIII). In the ancestral condition of the trumpet, the pinna is long, usually greater than 3.0 length of the meatus. The pinna is proportionately long in *triannulatus, benarrochi, strodei, rangeli, trinkae* and *ininii*. The pinna is highly derived and shortest in 2 species in the Oswaldoi Complex, *oswaldoi* and *nuneztovari*. Likewise, hairs 9-II-VIII are shorter in the more derived state. Hairs 9-VII,VIII are 0.5 or less the length of the corresponding abdominal segment in *oswaldoi, anomalophyllus, benarrochi, noroestensis* and *nuneztovari*; in the other species, these hairs are at least 0.5 the length of the segment. There is also a correlation between the short pinna and the short caudolateral spines in *oswaldoi* and *nuneztovari*. The shape of the pinna is described in lateral aspect (as in figs. 3, 25) from dissected pupal exuviae mounted on microscope slides (Belkin 1962:77). In living specimens when the trumpet is open at the water surface, the margins of the meatal cleft are widely separated. This separation is much wider apically in some species than in others; the wider this opening is, the narrower the sides of the pinna appear to be, so that in lateral view on a microscope slide the pinna may appear to be tapered toward the apex.

CHAETOTAXY. The chaetotaxy is of little phylogenetic value, but is important for species differentiation. On the cephalothorax, the relative lengths of the individual branches of hair 7-C are significant, since in many species one branch is considerably longer than the other(s). The relative lengths of hairs 10-12-C are also of specific value. In most species 10-C is subequal to 11-C, whereas in *triannulatus* 10-C is much shorter than 11-C. On the abdomen, the length of hair 2-I, the number and the point of origin of branches, correlated with the relative length of hair 3-I, are important distinguishing characters in some species. The relative lengths of hairs 6,7,9-I and 6,7-II are good secondary key characters. Also the derived feature, insertion of hair 3-II very near the caudal margin of the segment adjacent to hair 1-II, is diagnostic for *benarrochi*.

PADDLE. The shape of the paddle and/or the relative length of the buttress do not show any phyletic relationships. The length of hairs 1,2-P and the distance the marginal fringe of spicules extends along the inner margin of the paddle are secondary diagnostic characters in some species.

TERMINAL SEGMENTS. The male genital lobe and its apical mammilliform protuberance are more strongly developed in some species, but show no phylogenetic relationships.

FOURTH INSTAR LARVAE

Many characters in the larvae of the Albimanus Section correlate with characters in the adult and the male genitalia to clearly define the separate taxa. The chaetotaxy is very important for species identification; therefore I have included in the species descriptions the mode (at least 75% of the observations) and range for all the setae of taxonomic significance. It is important to consider the amount of intraspecific variation in larval "hairiness" when examining any of the species in the section.

HEAD. In the ancestral condition, the clypeal hairs (2,3-C) are widely spaced, with short to minute barbs, occasionally appearing as simple spiniform hairs (hair 3-C in this condition is shorter than 2-C). In the derived state the inner clypeals (2-C) may be (1) closely approximated, (2) of subequal length and/or (3) with long, simple or dendritic branches. The relationship between the approximation of the inner clypeal hairs (2-C) and the outer clypeal hairs (3-C) is given by the clypeal index, which is the distance between the inner and outer clypeals on one side divided by the distance separating the inner clypeals. *An. anomalophyllus* in the Oswaldoi Complex, and *strodei* and reportedly *rondoni* in the Strodei Complex, are characterized by approximated inner clypeals. This character has supposedly evolved independently in the 2 complexes. In the Oswaldoi Subgroup, for some species, the trend has been toward more extensive branching of the clypeal hairs along with longer branches, so that either or both the inner and outer clypeals may be plumose. The most derived condition is found in *oswaldoi*, where the clypeal branching is often dendritic. Hair 4-C is long in the Albimanus Group and short throughout the Oswaldoi Group except in *nuneztovari* and *trinkae*, where it is strongly developed. Hairs 8,9-C do not show any phylogenetic relationships; however, they are important to characterize species, being strongly developed in some species and more weakly developed in others. The collar tends to be wider, dorsomedially, in the more derived species than in the more ancestral, and is of group importance, although this character is highly variable.

ANTENNA. Hair 1-A in the ancestral condition is small; it is large and independently derived in *benarrochi* and *ininii*.

THORAX. Primitively, hair 1-P was plumose and multibranched; this condition is found only in the monotypic Albimanus Group. The trend has been toward the development of palmate hairs with fewer, broader, lanceolate leaflets. Hair 1-P in *triannulatus* may represent the intermediate condition with numerous, weakly lanceolate branches. The branching of hair 2-P and the presence or absence of a common sclerotized tubercle for hairs 1,2-P or 1-3-P show some group relationships. However, these characters are unreliable because of considerable intraspecific variation. The length of the dorsoventrally flattened shaft, and the number and length of the branches of hair 14-P are characteristic, to some extent, of *triannulatus* and some species in the Oswaldoi Group.

ABDOMEN. Derived group characters include the following: (1) small, usually numerously branched hair 13-I-IV in Oswaldoi Subgroup, with *triannulatus* somewhat intermediate between Albimanus Group and Oswaldoi Subgroup and (2) large, 5-7 branched hair 11-I in *triannulatus*. Important characters for species identification within the Oswaldoi Group include (1) location and size of hair 5-I,II, (2) size and branching of hairs 0-II and 13-IV and (3) width of palmate hair 1-II-VII.

SPIRACULAR LOBE. In the ancestral condition the lateral arms of the spiracular apparatus were moderately short. There has been an independent increase in the size of the arms in the Triannulatus Subgroup and to a lesser degree in *ininii* of the Oswaldoi Subgroup. The dentition of the pecten, although not of group importance, is of value as a secondary key character in species diagnosis within the Oswaldoi Group.

ANAL SEGMENT. In the Section there appears to be a trend in the migration of the point of insertion of hair 1-X from a dorsal position, within the saddle, to a position on or near the ventral margin of the saddle. In the most derived case (*oswaldoi*), hair 1-X is not inserted on the saddle at all, but ventrad of it. Hair 1-X is moderately long to long in all species except *benarrochi*. The anal gills are short in *aquasalis* and sometimes in *albimanus*; in all other species they are moderately long to very long.

SYSTEMATICS

The nominal species *sanctielii* Senevet and Abonnenc 1938 is not included in this revision because of the lack of material.

I no longer consider the nominal species *gorgasi* as a synonym of *albimanus* but as a *nomen dubium*. After examination of the damaged adult female holotype of *gorgasi*, collected by A. H. Jennings at La Boca, Panama Canal Zone, I have concluded that this specimen is probably not a mutant of *albimanus*. Contrary to the condition in *albimanus*, this specimen possesses dark caudolateral scale tufts on abdominal segments II-VII, and the penultimate segment of the palpus appears to have been white. It lacks upper mesepimeral scales and is too large to be considered *triannulatus*. Hindtarsal segment 2 of this female is brown in about 0.5, and segment 3 has a brown spot slightly less than half the length of the segment. This anomalous specimen most likely belongs to either *strodei, oswaldoi* or *aquasalis*. Previous workers (Rozeboom 1941; Curry 1932) have rejected *aquasalis* since it is very rarely ever collected on the Pacific side of Panama, even though it is probably the most likely candidate based on morphological characters. In any case, *gorgasi* is not easily recognizable as any species, since mutations of the sort found in *gorgasi* are now known to occur in many different species in this section.

I am dividing the Albimanus Section, composed of those species in the subgenus *Nyssorhynchus* characterized by the presence of a basal dark band on hindtarsal segment 5, into 2 clearly defined groups: a monotypic Albimanus Group and the Oswaldoi Group consisting of 13 species. The 2 groups are easily separated on the basis of 9 correlated characters in the adults, male genitalia and larvae. *An. albimanus* is the least derived species in the Albimanus Section and retains many ancestral characters that it shares with several species in the Argyritarsis Section. The **Albimanus Group** is characterized, primarily, in the **female** by (1) dark palpal segment 4, (2) absence of dark caudolateral scale tufts on the second abdominal segment and (3) predominantly dark foretarsal segment 5; in the **male genitalia** by (1) short sternite IX, (2) ventral claspette completely without setae and with the ventral surface produced into 2 large, inflated, ovoid, bulbous lobes and (3) very small circular to oval, weakly sclerotized preapical plate; and in the **larva** by (1) hair 1-P plumose with filiform branches, (2) hair 9-P,T pectinate and (3) hair 13-I,III, IV moderately large, with few branches. Most of these characters that distinguish the Albimanus Group from the Oswaldoi Group are ancestral, and are found nowhere else in the section. Exceptions are the 2 derived features, the short ninth sternite in the male genitalia and the pectinate hair 9-P,T in the larva.

I believe that the evolutionary lineage which has resulted in *albimanus* separated from the main phyletic line of the Albimanus Section very early in the evolution of the section. *An. albimanus* retains many characters shared by relict species in the Argyritarsis Section, which indicates that it diverged from the *Nyssorhynchus* phylogenetic tree soon after the separation of the 2 sections, Albimanus and Argyritarsis. It is even possible that the Albimanus Section is of polyphyletic origin, although not very probable for the reasons enumerated below. The principal character, the dark basal band on hindtarsal segment 5, separating the Albimanus Section from the Argyritarsis Section, is extremely stable throughtout the Albimanus Section. K. L. Linthicum (personal communication; who is presently revising the Argyritarsis Section) states that he has never observed any specimen in the Argyritarsis Section with a dark band present on hindtarsal segment 5. Conversely, I have never observed a speci-

men in the Albimanus Section with the dark fifth hindtarsal band completely absent, although it is sometimes considerably reduced. Parallel evolution and the very close phylogenetic relationship of the Albimanus and Argyritarsis Sections may help to explain the absence of other consistent characters distinguishing the 2 taxa. For example, in both sections there has been a tendency for some members to independently lose the apical leaflets on the phallosome of the male genitalia and for the larval hair 1-P,I to become palmate. The divergence within the subgenus *Nyssorhynchus* is probably of very recent origin.

The **Oswaldoi Group** is characterized in the **female** by (1) palpal segment 4 light, (2) presence of dark caudolateral scale tufts on abdominal segment II and (3) foretarsal segment 5 usually about 0.5 to completely light (except in *triannulatus* and some *strodei*); in the **male genitalia** by (1) moderately long to long, subtriangular to subtrapezoidal sternite IX, (2) presence of setae on the ventral claspette or, if bare, apex expanded laterally into large auriculate lobe and (3) absence of bare, ventral, inflated, ovoid lobes on the ventral claspette; and in the **larva** by (1) hair 1-P palmate, (2) hair 9-P,T long and single and (3) hair 13-I,III,IV small to moderate or, if large, hair 11-I large and 5-7 branched.

I am dividing the Oswaldoi Group into 2 subgroups: the monotypic **Triannulatus Subgroup** and the Oswaldoi Subgroup. I have separated *triannulatus* from *strodei* and *rondoni*, as did Galvao (1943), since it differs from all species in the Oswaldoi Subgroup by several correlated characters in all stages except the pupa. The **adults** of *triannulatus* are unique in possessing a patch of white scales on the anterior mesepimeron. Several reliable characters in the **larva**, particularly the length of the lateral arms of the spiracular apparatus and the development of hairs 1,14-P, 11-I, 13-I,III, IV, clearly separate *triannulatus* from the Oswaldoi Subgroup. The ventral claspette of the **male genitalia** of *triannulatus* lacks setae, as in *albimanus*, and the apex is expanded laterally into a pair of large auriculate lobes. The reason for including *triannulatus* in the Oswaldoi Group is on the basis of (1) presence of caudolateral tufts on the second segment of the abdomen in the adult, (2) more or less lightly colored palpal segment 4 in the female, (3) hair 1-P palmate in the larva, (4) the intermediate character of hair 13-IV in the larva and (5) overall general similarity of the male genitalia, particularly with the Strodei Complex.

The **Oswaldoi Subgroup** is characterized in the **female** by (1) predominantly white palpal segment 4, (2) absence of anterior mesepimeral scales, (3) absence of a large, apical, white band on foretarsal segment 4, except for some *nuneztovari, trinkae* and *ininii* and (4) foretarsal segment 5 about 0.5 to completely light, except in some *strodei*; in the **male genitalia** by the presence of setae at least on the basal lobules of the ventral claspette; and in the **larva** by (1) palmate hair 1-P usually with fewer than 16 leaflets, (2) 14-P with a short to moderately short shaft, (3) 11-I moderately large, 2-4 branched, (4) 13-I small to moderately large, usually more than 3 branched, (5) 13-III small, with numerous branches and (6) lateral arms of the spiracular apparatus short to moderately long, except in *ininii*.

The Oswaldoi Subgroup is an assemblage of closely related species, which I believe is composed of 2 major phyletic lines: the **Strodei Complex** and the Oswaldoi Complex. As indicated above, on the basis of the **male genitalia**, the Strodei Complex is more closely allied to the Triannulatus Subgroup than is the Oswaldoi Complex. The apex of the ventral claspette is expanded laterally, and the sidepiece possesses a long parabasal spine and tubercle as in *triannulatus*. Setae are present on the ventral claspette but do not extend to the apex. Within the Strodei Complex, 2 of the species, *rondoni* and *strodei*, are very closely related and represent one clearly defined line;

benarrochi, a highly derived species, represents the other. *An. rondoni* appears to be a very recent species that may have evolved from an isolated gravid female or an anomalous population of *strodei*, later becoming reproductively isolated. The relationship of *benarrochi* to *strodei* is more difficult to understand, since *benarrochi* is the most highly derived species in the Oswaldoi Subgroup, possessing several unique characters; only on the basis of the male genitalia is it possible to see its relationship with *rondoni* and *strodei*.

The **Oswaldoi Complex** is characterized in the **male genitalia** by (1) setae on the lateral margins of the ventral claspette extending to or nearly to the apex (except in *ininii*), (2) apex of the ventral claspette not expanded into a pair of lateral lobes and (3) usually moderately short parabasal spine and tubercle. The Oswaldoi Complex is composed, I believe, of 2 separate monophyletic lines in addition to one relict species, *anomalophyllus*. *An. nuneztovari, trinkae* and *rangeli* compose one phyletic line, and *oswaldoi, galvaoi, aquasalis, noroestensis* and *ininii* form the other clearly defined line, as based on the male genitalia, larvae and adults. Within each phyletic line of the Oswaldoi Complex the male genitalia are clearly distinct. Also, in the *oswaldoi* phyletic line, there is a tendency in the larvae for the acquisition of long branches on the clypeal hairs as observed in *oswaldoi* and *aquasalis*. The relationship of *anomalophyllus* to the rest of the species in the complex is unclear. *An. anomalophyllus* retains a pair of strongly developed serrated leaflets at the apex of the aedeagus. Also, it shares with the Strodei Complex several larval characters such as the closely approximated inner clypeals. It may possibly be that *anomalophyllus* represents an annectent species between the Oswaldoi Complex and Strodei Complex. Within the complex several other species, *nuneztovari, rangeli, ininii* and (rarely) *oswaldoi*, often have remnants of aedeagal leaflets evident as very small, membranous, pointed projections.

BIONOMICS

The immature stages of the Albimanus Section are found predominantly in ground water. They occur in a variety of habitats, such as ponds, lakes, stream and river margins, canals, seepage and drainage areas, ditches, flooded meadows or pastures, reservoirs, swamps, ground pools, borrow pits, and animal and vehicle tracks. *An. albimanus*, although usually collected from ground pools of various sorts and stream margins, has been found also in crab holes, tree holes, large artificial containers and brackish swamps. *An. aquasalis* is the only species primarily restricted to the coast and preferentially occurs in brackish water such as in mangrove swamps and coastal ground pools. However, *aquasalis* is capable of breeding in fresh water, and often is collected several kilometers from the coast. *An. anomalophyllus* may be restricted to stream margins in Costa Rica and northern Panama. *An. triannulatus* and *ininii* are found commonly in lakes, ponds or large ground pools. *An. triannulatus* is the only species clearly shown to be often closely associated with a specific plant; it is usually collected in or between the rosette crowns of *Pistia* sp. Some species are fairly habitat specific. *An. oswaldoi, ininii* and *triannulatus* adults are usually collected in the interior of forests, although the larvae may be collected from ground pools in interspersed secondary growth areas. *An. noroestensis* is usually collected in drier regions than the forest species, in cultivated areas or areas of secondary vegetation.

Regarding altitudinal distribution, *strodei* breeds at the highest elevations for any species in the Albimanus Section (1600m), although it also occurs at lower elevations.

An. rangeli, and to a lesser extent *benarrochi*, are principally found at intermediate elevations (200-1000m) such as in the upper Amazon and the llano plateau region of Colombia extending south into Mato Grosso and Bolivia. *An. albimanus* and *aquasalis*, on the other hand, normally breed on or near the coast in wet areas, usually at elevations less than 400m. *An. nuneztovari* is found at low elevations usually in or at the margins of forests. *An. trinkae* breeds in habitats similar to those of *rangeli*, often in areas of secondary growth at intermediate elevations. *An. rondoni* breeds in ditches, puddles, flooded meadows, etc., in southern Brazil and northern Argentina, and is never found farther north than the southern margin of the upper Amazon. *An. ininii* has been collected only in French Guiana and in Para, Brazil in the interior of the forest.

Host preference studies for several species indicate that these mosquitoes feed predominantly on large mammals such as dogs, cats, cattle, pigs, goats, donkeys and man, although some do feed on fowl. In all known cases, the species feed readily on man when given the opportunity; however, *anomalophyllus, ininii, trinkae* and *galvaoi* have not been studied in this respect. The adults are active either crepuscularly or nocturnally, except *triannulatus* which is somewhat diurnal (Rozeboom 1935:527). Most of the species are predominantly exophilic and zoophilic and become a serious health or pest problem only when occurring in high densities without abundant alternate hosts. However, during the peak seasons certain species, such as *albimanus, aquasalis, nuneztovari* and possibly *rondoni* and *strodei*, are commonly found inside houses. Marked capture and release studies indicate that *aquasalis* and *albimanus* are both strong fliers capable of migrating considerable distances. Flight ranges for the remaining species have not been studied in detail.

MEDICAL IMPORTANCE

An. albimanus is the major vector of malaria in coastal Central America and northern South America, extending to the Paria Peninsula in Venezuela and into the Greater Antilles. It does not seem to be predominantly anthropophilic or endophilic, but, because it occurs in such tremendous numbers during certain times of the year, it is the most common anopheline found inside houses feeding on man. *An. albimanus* has been found naturally infected with *Plasmodium* sp in nearly every country in which it is encountered.

An. aquasalis is a primary vector of malaria in the Lesser Antilles, and in Trinidad and Tobago. Along the coast of Brazil, the Guianas and possibly Venezuela, it is always a potential vector but usually only important when it occurs in large numbers. *An. aquasalis* feeds readily on man and is commonly collected in houses. In the past it has been an important vector of malaria in coastal Brazil.

An. nuneztovari is a primary vector of malaria in western Venezuela and northern Colombia, and is a probable vector in Suriname; in some areas where it occurs, spleen indices have been close to 100% (Gabaldon and Guerrero 1959). The vector potential of *nuneztovari* has been reported to depend on the density of the nearby vegetation surrounding regions of habitations, which may be correlated with the greater life expectancy and vector density in the forest (Hamon, Mouchet *et al.* 1970).

An. triannulatus has been implicated as a vector of malaria in Venezuela, and once was found to have a natural oocyst infection (Gabaldon and Cova Garcia 1946b). Several authors have succeeded in experimentally infecting *triannulatus* with *Plasmodium vivax* and *P. falciparum*; however, it is much more refractory to infection than is *albimanus.*

According to Correa (1938), *strodei* transmitted malaria at the Fazenda Santa Alice, Sao Paulo, Brazil. He reported a natural infection rate of 1.2%. Other Brazilian workers have experimentally infected *strodei* with *Plasmodium vivax*, although there have not been any other reports implicating *strodei* as a vector.

Very little is known regarding the vector potential of *rangeli, noroestensis, rondoni* and *oswaldoi. An. noroestensis* was found naturally infected once in Ribeira, Sao Paulo, Brazil by Correa and Ramos (1942b:385-386). Lucena (1940b) reported finding *oswaldoi* var. *metcalfi* naturally infected in Pontesinha, Brazil; however, Lucena may have been studing *aquasalis* rather than *noroestensis. An. oswaldoi* has been experimentally infected with *P. vivax* and *P. falciparum* (Fonseca and Fonseca 1942; Rozeboom 1942a). *An. rangeli* has been suspected of transmitting malaria in Ecuador (Forattini 1962), but it has never been shown to be naturally infected. *An. rondoni* was investigated in Jujuy, Argentina during the malaria season by Davis and Shannon (1928), and it was not found to be naturally infected nor was it possible to experimentally infect it with *P. falciparum, P. vivax* or *P. malariae* in 3 different experiments. Nevertheless, Shannon and Del Ponte (1927) stated that Davis was able to infect *rondoni* in other experiments. Nothing is known about the vector potential of *ininii, galvaoi, trinkae* or *anomalophyllus.*

Two viruses have been isolated from 2 species in the Albimanus Section. *An. aquasalis* was found naturally infected with Venezuelan Encephalitis virus (VE) during the 1962-1964 outbreaks in Venezuela (Sellers, Bergold *et al.* 1965). Tlacotalpan virus, in the Bunyamwera group, was isolated from *albimanus* in Tlacotalpan, Mexico (Scherer, Campillo-Sainz *et al.* 1967:79-91).

TAXONOMIC TREATMENT

ALBIMANUS SECTION

FEMALES (fig. 5). Small to large, wing 2.5-4.0 mm. Head, thorax, abdomen and legs predominantly dark scaled with distinct markings of light scales and pruinose integumentary patterns. **Head:** Integument light brown to dark brown, usually somewhat pruinose. Interocular space moderately wide, 2-7 ommatidial diameters. Vertex and occiput with many erect, moderately long to long, cuneate to lanceolate or weakly forked scales, white anteriorly on vertex, becoming progressively darker caudad and laterad on occiput and postgena. Vertex with a few decumbent light scales. Interorbital and upper orbital lines with white decumbent scales. Strong, long, curved, dark orbital setae present. Frontal tuft conspicuous, composed of 10-20 long, slender, white setiform scales. Clypeus prominent, bare, pruinose. Proboscis much longer than forefemur, entirely dark scaled; labella slightly lighter than labium; with 3-6 basal bristles. Palpus subequal in length to proboscis; predominantly dark scaled; appearing weakly metallic when viewed at an angle; with an apical light band on segments 2,3; band on 3 usually broader than that on 2; segment 4 either light or dark scaled, when light scaled, a basal and an apical dark, narrow band present, and occasionally a darker stripe on ventral surface; segment 5 white, occasionally with a small basal dark band; segments 2,3 with varying amounts of dorsal and dorsolateral speckling of light scales; segment 1 less than 0.1 of palpal length; segment 2 about 0.7-0.9 of segment 3; combined length of segments 4 and 5 slightly greater than length of segment 2 and less than that of segment 3; segments 1,2 and basal 0.3-0.5 of 3 with erect scales, progressively less outstanding from base of segment 1 to seg-

ment 3; remainder of palpus with decumbent scales. **Antenna:** 0.60-0.75 length of proboscis. Torus with dorsolateral row of light scales and a few short lateral and ventral setae. Lateral margin of proximal flagellar segments (1-5) with small, light scales; flagellar segment 1 subequal to combined length of segment 2 and 3, with long bristles on all surfaces except midventral, bristles most abundant on dorsolateral surface, and with long, oblanceolate to setiform, white scales on dorsomesal surface and shorter scales basally; segments 2-13 each with basal whorl of 6-10 long, curved bristles and with short, silver setae distally; segment 13 pointed at apex and slightly longer than 2-12. **Thorax:** Scutum small to large, length on midline 0.9-1.4 mm; integument generally pruinose; with 2 pairs of bare, light pruinose, longitudinal stripes, when viewed at an angle from the front as follows: (1) submedian stripe just laterad of acrostichal bristles, extending from scales of anterior promontory to about middle of scutum, becoming much less distinct in posterior half of scutum, (2) broad, subdorsal stripe laterad of posterior dorsocentral and lateral prescutellar bristles extending caudad from a pair of prominent, bare, nonpruinose rectangular or subtriangular areas at caudal margin of posterior fossa, ending at small nonpruinose area anterior to scutellum; acrostichal and posterior dorsocentral lines nonpruinose or distinctly less pruinose than remainder of scutum; fossal region slightly less pruinose than general surface of scutum. Scutum with small, lanceolate to obovate, silver or yellow to white, decumbent scales in (1) acrostichal line, extending from anterior promontory to prescutellar bare space, and anterior and posterior dorsocentral lines, the scales becoming less defined into distinct regions posteriorly, (2) fossal area and (3) supraalar and antealar areas; with elongate, narrow erect, lanceolate scales on median anterior promontory and along lateral margin of antealar area extending posteriorly onto supraalar area; humeral tuft with numerous moderately short to long, light scales above and numerous, short, obovate or cuneate, dark scales below. Scutum with numerous moderately long to long, dark setae on acrostichal line, dorsocentral line, posterior median scutal area and supraalar area; with scattered short, light to dark setae on fossa, antealar area and lateral prescutum. Parascutellum with a single long seta. Prescutellar bare space appearing dark from above, weakly pruinose, triangular or horseshoe shaped. Scutellum rounded, with obovate light scales, very long, dark setae and shorter, light setae along posterior border; posteromedian border usually with a few long, light setiform scales. Postnotum bare. Pleural integument dark, with gray or silver to reddish pruinose pattern. *Apn* reniform, with moderately long setae on dordal surface along ventral margin, and with a dorsal patch of erect, obovate, dark scales, usually with a few light scales; *ppl* with 2,3 (1-4) setae; *sp* with 1-9 short to moderately long setae and a few elongate light scales; *pra* with 4-10 light setae and a patch of elongate light scales; upper *stp* with 2-8 setae and a patch of 4-18 light scales; lower *stp* with 1-3 setae and 2-10 light scales oriented either in a horizontal arc or diagonal patch; upper *mep* with 3-10 setae in horizontal or diagonal row and occasionally 1-4 light scales; anterior *mep* bare or with a cream to white scale patch in *triannulatus*; remainder of pleuron without scales or setae. **Legs:** Forecoxa larger than mid- or hindcoxa. Integument of coxae and trochanters dark. Forecoxa with a row of long, strong, dark setae anteriorly and a cluster of 1-4 long, dark setae caudoventrally; a patch of light scales dorsolaterally; caudoventral surface with a row of light and dark scales, light scales usually somewhat cephalad of dark scales. Midcoxa laterally with 1-3 long, dark setae 0.3 from base; anteriorly with a small patch of short spiniform setae and a horizontal line of yellow to white scales; antero- and posteroapical borders with 1,2 long, dark setae and usually a light scale patch; anteroapically also with a row of short, dark setae. Hindcoxa with 1,2 long, dark setae and dorso-

caudally with a patch of light scales; posteroapical margin with moderately short setae, occasionally 1,2 long, dark setae and a row of light scales; anteroapical border with a long, curved, dark seta directed ventrad. Trochanter with short setae and yellow to white scales. Forefemur shorter than midfemur; latter subequal to hindfemur. Forefemur largely dark scaled, with a band of light scales at base; anterior surface mottled and occasionally with an indistinct, longitudinal streak of light scales; basal, dorsal and anterior surfaces speckled with light scales; distal 0.3-0.5 of dorsal, posterior and ventral surfaces with cream to yellow scales. Midfemur with basal light band followed by a narrow dark band; posterior surface light; anterior surface predominantly dark scaled, with a distal, variously shaped, light (anteroapical) spot just anterior and basad of distinct dorsal knee spot and with a longitudinal streak extending from near base to near anteroapical spot; apex with row of moderately strong setae. Hindfemur predominantly dark, with a basal light band, speckled with scales, and with a light spot of variable length in distal 0.25; knee spot present or absent; ventral surface light; apex with moderately long setae and whitish scales. Foretibia subequal to midtibia; hindtibia longest. Tibiae predominantly light on ventral and posterior surfaces; fore-, mid- and occasionally hindtibia with a yellowish longitudinal streak on anterior and dorsoanterior surfaces broadening at apex, occasionally appearing as speckling on foretibia; apices of tibiae yellow to white, usually light scaling weakly developed on foretibia, progressively more extensive on mid- and hindtibia; dorsal surface of apex with strongly developed apical spines. Hindtarsal segment 1 longer than hindtibia. Dorsal surface of fore- and midtarsal segment 1 predominantly dark, speckled with light scales, and with a light apical band usually less than 0.1 length of segment. Foretarsal segments 1 and 2 with double row of spiniform setae on plantar surface. Ventral surfaces of fore- and midtarsal segments 1,2 light; segments 3-5 often speckled with dark scales, varying from completely light to dark. Foretarsal segment 1 with an apical band, when present, white to golden; segment 2 with a narrow to wide, light scaled band in apical 0.15-0.95; segment 3 with a broad, light scaled band in apical 0.2-0.9; segment 4 from dark to predominantly light; segment 5 from dark to light. Midtarsal markings generally as in foretarsus except that ventral surface usually darker and apical light bands, when present, white to golden and usually darker than on foretarsus; dorsal surfaces of segments 2,3 from completely dark to light in apical 0.4; segment 4 usually dark, occasionally with apical light band (*ininii*); segment 5 from completely dark (*albimanus* and *triannulatus*) to completely light. Hindtarsal segment 1 predominantly dark with speckling of light scales on ventral surface and a longitudinal light streak on anterior surface, apex with or without yellow to white band; segment 2 with highly variable, white band in apical 0.10-0.95; segments 3,4 completely white or with dark basal band present on either one (mutants) or both segments (*rondoni*, mutants); segment 5 with white to pale yellow band in about apical 0.5. Pretarsi simple, claw of foreleg largest; claw of midleg larger than that of hindleg. Wing (fig. 5): As figured but extremely variable. Vein C with basal, humeral, subbasal, presectoral, sectoral, subcostal and preapical light scaled spots usually present; subbasal, presectoral and subcostal light spots sometimes absent. Integument of wing usually darkened in region of scales on C and R. Rs-R_{2+3} variable, more or less predominantly dark, with 3 or 4 dark spots and 2 or 3 light spots; with or without an extra subcostal light spot. R_2 with 2 light spots of varying lengths. R_3 usually with 3, occasionally only 2, light spots. R_{4+5} with 2 small to moderate size dark spots, one subcostal, the other preapical. M with or without sectoral dark spot of variable length and subcostal dark spot that may reach furcation. M_{1+2} with 2 dark spots and M_{3+4} with one dark spot. Base of Cu light with a small to medium sectoral

dark spot usually not reaching furcation. Cu_1 largely light, with 3 small, dark spots, 2 toward base in sectoral-subcostal region and one preapical. Cu_2 all light except for small to moderate preapical dark spot. Vein A largely light, with 2 dark spots, 1 subbasal and 1 subcostal. Apical light fringe spot conspicuous, small to large; fringe of remainder of wing largely dark with light areas where veins intersect wing margin except for R_1; usually additional moderately long, light fringe spot present between base of wing and A. **Haltere**: Stem pale; apex of knob with small patch of dark brown scales, surrounded by subapical light scales, particularly abundant laterally. **Abdomen**: Integument of tergites predominantly light to dark brown, with light mottling occasionally present on II-VII, when present usually more extensive on V-VII. Long setae present along lateral and apical margins of tergites I-VII; and short, scattered setae medially. Tergites II-VII with patches of light scales; patches triangular, with bases toward apex of segment on proximal segments, and subrectangular and longer on more distal segments. Caudolateral margins of tergites and sternites of segments II-VII (III-VII in *albimanus*) with conspicuous, outstanding, dark scale tufts. Sternite I with or without setae. Moderately long setae present on sternites II-VII in submedian row and along caudal border; sternite I usually with a few inconspicuous light scales; sternites II-VII with a submedian, longitudinal patch of light scales, followed posteriorly by tuft of dark scales which extend laterally along caudal border of sternite to meet caudolateral tufts of tergite.

FEMALE GENITALIA. Segment VIII: About as long as wide, slightly narrower than segment II-VII; with scattered moderately long, dark setae; tergite densely covered with light scales; sternite usually with median longitudinal tuft of dark scales along caudal border; remainder of sternite with light scales. **Tergite IX**: Ribbonlike dorsally, expanding laterally into curved plate projecting slightly ventromesad. **Tergite X**: With curved subtriangular lateral plates directly caudad of tergite IX, narrowing abruptly medially, and not continuous dorsally. Tergites IX and X densely covered with short, fine spicules. **Cercus**: Large, subcylindrical, curved dorsally; densely covered with lanceolate scales and moderately long, dark setae; scales darker at base, cream at apex. **Postgenital Plate**: Moderately long, subtriangular, rounded apically, covered with short fine spicules, with 2 long, strong, subapical setae. **Upper Vaginal Lip**: Strongly sclerotized. **Insula**: Discoid, without distinct margin, usually with 20 or more short spiniform setae originating from large conspicuous alveoli. **Atrial Plates**: Strongly sclerotized, triangular, laterally articulating with tergite IX. **Lower Vaginal Lip**: Membranous, spiculose. **Spermatheca**: One, spherical, strongly sclerotized, dotted with numerous small, circular, membranous regions.

MALES (fig. 5). Essentially similar to females except for sexual characters. Coloration and scale patterns as in females. **Head**: Clypeus smaller than in females. Proboscis longer than in females, usually apically retrorse, light reddish brown to dark brown. Palpus 5 segmented, subequal to or slightly longer than proboscis, segment 1 short, 0.06-0.08 of palpal length; segment 2 long, shorter than segment 3, 0.25-0.30 of palpal length; segment 3 long, 0.32-0.39 of palpal length; segments 4 and 5 moderately short, each 0.10-0.16 of palpal length; segments 1, 2 and 3 ankylosed; 3 expanded dorsoventrally at apex and with segments 4 and 5 forming a laterally compressed, dorsoventrally expanded, conspicuous club; palpus bent near apex of segment 3 so that segments 4 and 5 are directed anterolaterally; segments 1 and 2 with dark, erect scales, becoming decumbent toward apex of 2; apex of segments 2 and 3, and base of segment 3, each with a white band; segment 3 and occasionally 2 with a few dorsal, light scales; base and occasionally ventral surface and apex of segment 4 dark, remainder of lateral surface of segment 4 cream or white, somewhat darker in

albimanus; lateral surface of segment 5 dark in about basal 0.33 of segment and on ventral surface, remainder of segment 5 white; dorsal and ventral surfaces of apices of palpal segments 2 and 3 with numerous, long, apically directed setae. **Antenna**: Length 0.65-0.85 length of proboscis; segment 1 slightly longer than segments 2-11, with long, light scales on inner margin; segment 12 very long, about 0.20-0.25 of antennal length; segment 13 about 0.5 length of segment 12; flagellar whorls on segments 1-12 strongly developed, with numerous, long setae; setae on inner margins of whorls 1-5 occasionally white. **Legs**: Basal plantar surface of foretarsal segment 5 with about 6-9 short to moderately long, spiniform setae; setae longer toward apex; shorter spiniform setae medially between longer setae. Single claw on foreleg long, slightly curved, acuminate, with a blunt to acuminate submedian tooth and a curved, usually blunt, short to moderately short, external basal tooth. Mid- and hindleg with 2 claws; claws on midleg larger than on hindleg. Empodium spinulose, about 0.75 length of claw. **Wing**: Narrower than in female.

MALE GENITALIA. Segment VIII: Not retracted into segment VII; as narrow as or slightly narrower than segment VII; densely covered with lanceolate to truncate, obovate scales except on proximal border and with moderately long, dark setae scattered over surface. Tergite often with a median longitudinal patch of dark scales surrounded by light scales, and with long, dark setae along distal and lateral margins. Sternite covered with light scales, with or without median subtriangular, dark scale patch. **Segment IX**: Spiculose. Tergite small, membranous, without lateral lobes, articulated caudally with proctiger and laterally with sidepiece. Sternite well developed, sclerotized; narrowly subrectangular to broadly subtriangular, curved and tapered dorsolaterally, extending a short distance dorsad as a small, sclerotized, subrectangular lobe; articulating with proctiger and sidepiece; with ribbonlike to triangular, darker, sclerotized, nonspiculose, apodeme projecting along anteromedian border; apodeme occasionally with a median protuberance. **Sidepiece**: Sclerotized, spiculose, cylindrical to subconical, moderately narrow, curved mesally. Tergal surface with a submedian longitudinal row of 4-6 long (about 0.67 length of sidepiece), strong (tergomedial) bristles arising from large, conspicuous alveoli; basal 3 or 4 bristles separated from more apical bristles; rows of weaker moderately long setae, one row mesad, and usually one laterad, of long bristles. Tergolateral surface with large, spatulate scales extending onto sternal surface, usually darker laterally. Basal tergomesal margin with a single, large, very stout, blunt, retrorsely hooked, parabasal spine inserted on a moderately short to long, protruding tubercle, directed tergomesally. Basomesal margin of sidepiece cephalad of parabasal spine modified into a long (0.16-0.25 length of sidepiece), heavily sclerotized, blunt apodeme articulating mesally with basal piece of phallosome; apodeme equal to or slightly less than length of parabasal spine. Tergomesal surface of sidepiece with 2 long, apically flattened, blunt-hooked, accessory spines inserted on 2 adjacent, prominent tubercles that arise 0.40-0.52 from base of sidepiece; the more dorsal spine about 0.5 length of sidepiece; shorter more ventral spine 0.58-0.80 length of dorsal spine. Mesal surface with a long, curved, internal spine arising 0.45-0.60 from base, subequal in length to more ventral accessory spine. Apicomesal border usually with one long, subapical seta at base of clasper. Sternomesal and mesal margins with moderately short, weak setae. **Clasper**: Subequal in length to sidepiece, curved mesally, slender beyond base. Ventromesal margin with a row of about 10-14 short spinules, from near base to apex. Spiniform thin to thick, blunt to acuminate. Seta *b* weak, moderately short to moderately long; subequal to slightly longer than spiniform, arising from small crest immediately basolaterad of spiniform. **Claspette**: Divided into a dorsolateral claspette

and an apically fused, membranous, mesoventral claspette. **Dorsal Claspette**: Base continuous ventrally with phallosome and ventral claspette, and laterally with sidepiece; basal portion modified into sclerotized pedicel with a rounded semispherical base usually curved mesad, occasionally with a conspicuous internal apodeme; distally developed into 3 long, broad, membranous, lanceolate leaflets, longest about 0.3-0.5 length of claspette, each curving mesally, with a medial supporting rib; ventral leaflet subequal to middle leaflet; dorsal leaflet shortest, with a variously developed, mesally directed, basal projection (basomesal projection). **Ventral Claspette**: Highly variable, supported mesally by 2 sclerotized "rods" arising from a sclerotized bridge which extends mesad from sidepieces; basally produced into 2 small to large basal lobules interconnected by an inconspicuous spiculose membrane, area ventrad of membrane between 2 lobules referred to as mesal cleft; setae present or absent on basal lobules. A thickened rooflike refractile structure, known as refringent structure, extends across vertex of fusion of basal lobules and basad a short distance along inner margin of each lobule, occasionally with lateral extensions or arms. Fused apical portion of ventral claspette differentiated into (1) a hairless dorsal lobe which apposes the aedeagus (possibly to form the external gonopore) and (2) a variously shaped, ventral lobe with or without setae. Subapicomedial region of ventral claspette with a small to large, variously shaped, sclerotized, preapical plate. Area immediately basad of preapical plate transparent and membranous, in shape of an inverted U or V, basal margins being formed by refringent structure. **Phallosome**: Composed of a central aedeagus, a pair of parameres and a pair of basal pieces, all fused into one sclerotized structure. Sides and most of apex of aedeagus sclerotized; apex with or without leaflets; subapically with a pair of subtriangular, lateral sclerotizations extending ventromedially to form an incomplete tube; outer border of apex membranous; aedeagus weakly to moderately curved dorsally toward proctiger. Aedeagus basally contiguous with triangular, highly sclerotized parameres. Basal piece laterally connected to paramere by a narrow, sclerotized bridge. A dorsocaudal extension of basal piece articulates with dorsal claspette; a lateral arm of basal piece extending laterally, basad of sidepiece, and appearing to be attached to sidepiece by a tendinous apodeme. Phallosome usually equal to or longer than ventral claspette. **Proctiger**: Conical, apex hooked ventrally, spiculose, with sclerotized sides and triangular base, articulating laterally with sidepiece and tergite IX.

PUPAE. Cephalothorax: Weakly to strongly pigmented; often with longitudinal pigmented stripes on wing cases. Vertical plate about as long as wide, more sclerotized along anterior border, and produced apicomedially into small protuberance. Hairs 1-3-C 2,3 branched (1-4), moderately developed; 1,2-C adjacent. Hairs 4-7-C usually few branched, moderately to strongly developed; 4,5-C shorter than 6,7-C; 7-C laterad or caudolaterad of 6-C. Hair 8-C single (1-3 branched), moderately long, inserted near lateral ridge. Hair 9-C usually forked, weak, moderately long, inserted caudolaterad of trumpet base. **Trumpet**: Length and shape highly variable. Moderately to strongly pigmented. Inserted very close to wing base. Pinna angusticorn; strongly tuberculate, varying from short, flared and truncate to long, narrow and tapered; meatal cleft short to long. Tracheoid not developed. **Metanotum**: Hair 10-C single, shorter than or about equal to 11-C; 11-C multiple, branched or forked. Hair 12-C single or 2-4 forked, longer than 10,11-C. **Abdomen**: Float hair (1-I) dendritic, large. Hairs 2,3-I approximated, inserted cephalolaterad of the base of hair 1-I; 2-I multiple, moderately to strongly developed; 3-I 0.5 of to about equal to 2-I. Hair 4-I multiple, short, inserted caudolaterad of 2,3-I. Hair 5-I single or 2-4 forked, long, inserted laterad of 4-I. Hairs 6,9-I single or double, moderately long to long. Hair 7-I

2-7 forked, strongly developed. Hair 0-II-VII multiple, medium; 0-VIII 1-3 branched (1-4). Hair 1-II,III multiple, moderately large to large; 1-IV-VII single, very long, 1.0-2.0 length of segment. Hair 2-II,III multiple, moderately large, inserted cephalolaterad of hair 1 of segment; 2-IV-VII usually 1-5 branched, inserted cephalolaterad or cephalomesad of hair 1 of segment. Hair 3-II,III 1-3 branched, inserted well cephalad of caudal margin of segment (except in *benarrochi*) and between hairs 1 and 2; 3-IV multiple, moderately developed; 3-V single or 1-5 forked; 3-VI single or forked, inserted on caudal margin of segment mesad of hair 1-VI; 3-VII branched or forked. Hair 4-II inserted cephalomesad of 5-II; 4-III-VII always inserted cephalad or cephalolaterad of hair 5 of segment; 4-II-IV branched, small to moderately long; 4-V-VII 1-7 forked, moderately long; 4-VIII forked, inserted cephalomesad of hair 9-VIII. Hair 5-II multiple, small to moderately large; 5-III-VII inserted on caudal margin of segment between hairs 1 and 9; 5-III,IV 1-13 branched, moderately large to large; 5-V-VII single, occasionally double or triple, about equal to length of segment. Hair 6-II 1-3 branched, moderately long to long, inserted immediately cephalad of hair 7-II; 6-III-VI 1-2 branched (1-6), moderately long; 6-VII single, moderately short. Hair 7-II 2-7 branched, equal to or shorter than 6-II; 7-III-VII inserted laterad of or arising from oblique sublateral ridge, caudad of hair 8 of segment; 7-III-V 1-7 branched, small to moderate; 7-VI,VII usually single (1-4 branched), moderately long to long. Hair 8-III-VII 1-7 branched, short, inserted mesad of oblique sublateral ridge. Hair 9-II-VIII (caudolateral spines) highly variable, spiniform, inserted on caudolateral margin of segment; 9-II minute, unpigmented; 9-III thin to bulletlike, minute to short, pigmented or unpigmented; 9-IV-VIII darkly pigmented; 9-IV short to medium, heavy, straight or slightly curved; 9-V-VIII moderately short to long, thin to thick, straight or curved. Hair 10-III-V,VII inserted mesad of hair 7 and very near caudal border of segment; 10-III single or 2-6 forked; 10-IV,V single, long; 10-VI absent; 10-VII single or double, moderately short to medium. Hair 11-III-VII single or occasionally double, small. Hair 14-III-VIII minute and inconspicuous, inserted submedially near anterior margin of segment. **Terminal Segments:** Hair 1-IX 1-3 branched, minute. Median caudal lobe short, dorsobasally covering genital and cercal lobes. Genital lobe of female covering about basal 0.75 of cercal lobes. Cercal lobe about 0.5 of segment VIII. Male genital lobe about as long as segment VIII and usually mammillated distally. **Paddle:** Elliptical or obovate, often distally truncate and emarginate, always longer than wide. Midrib moderately developed, not reaching apex. Buttress strongly developed, serrated distally. Outer margin distad of buttress with short, fine spicules; inner margin with or without very short spicules. Hair 1-P single or double, strong, moderately short; 2-P forked, subequal to 1-P.

LARVAE. Head: Ovoid, usually slightly longer than wide, widest at ocular bulge; light brown to black; with various patterns of pigmentation, from small patches to extensive mottling. Collar darker than rest of head, highly sclerotized, narrow to moderately wide. Mental plate with 3,4 teeth on each side of median tooth; median tooth varied from narrow to broad and from sharply pointed to blunt. Labial plate subtrapezoidal; maxillary suture not contiguous with posterior tentorial pit. Mouth brushes with numerous, simple filaments. Median labral plate bilobed and small. Mandible and maxilla normal. Hair 1-C strong, moderately long, curved ventromedially, arising from lateral lobes of median labral plate. Inner clypeal hairs (2-C) closely approximated or widely spaced, single and simple, barbed or plumose with branches short to long, occasionally dendritic. Outer clypeal hair (3-C) shorter than or about equal to 2-C. Posterior clypeal hair (4-C) 1-5 branched; 4-C simple, forked, branched or dendritic, inserted caudomesad of outer clypeal hairs. Hairs 5-7-C plu-

mose, long, with long branches; 5-C longest; 5,6-C usually extending beyond anterior margin of head; distance between hairs 5-C equal to or greater than distance between 5-C and 6-C. Hair 8-C branched, forked or dendritic, with 2-10 branches. Hair 9-C usually slightly longer than 8-C and occasionally with a few more branches. Hair 10-C 3 branched (2-4), small. Hair 11-C plumose, long, inserted basolaterad of antenna. Hair 12-C 2-6 branched, small to large. Hair 13-C 4-6 branched, inserted immediately caudad of 11-C, moderately long. Hair 14-C 2-5 branched, short, inserted caudoventrad of cibarial bar. Hair 15-C varied in length, inserted immediately mesad of maxillary suture. *Bmh* branched or dendritic, moderately short to moderately long. **Antenna**: Same color as or darker than head with a darker basal band, slightly tapering toward apex. About 0.5 length of head capsule, with spicules on mesal or ventral surfaces, spicules longer on mesal margin; dorsal surface occasionally with very short spicules. Hair 1-A 2-7 branched (2-10), small to large, inserted on dorsolateral surface about 0.25-0.33 from base. Hairs 2,3-A long, saberlike, usually serrated on basomesal margin; 2-A inserted dorsomesad of 3-A at apex of antenna. Hair 5-A short, spiniform, inserted at apex of antenna. Hair 6-A short, thick, blunt, peglike. **Thorax**: Uniformly pigmented and with a few small sclerotized plates dorsomedially on meso- and metathorax. Integument without spicules. Pro-, meso- and metathoracic pleural group hairs all arising from large common tubercles; tubercles laterally modified into a large spine. Submedian prothoracic group (1-3-P) with hair 1-P palmate with unserrated, narrow to broad, lanceolate leaflets or, in *albimanus*, plumose with filiform branches; 2-P plumose, moderately long, with an elongate dorsoventrally flattened shaft; 1,2-P with or without a common tubercle; 3-P single and simple, short. Hairs 4,5-P plumose, strongly developed, each arising from a separate tubercle; 4-P shorter than 5-P. Hair 6-P single and simple, long, arising from same large tubercle as 5-C. Hairs 7,8-P plumose, very long; 7-P inserted immediately ventrad of 6-P; 8-P arising from strong tubercle mesad of prothoracic pleural group (9-12-P). Hairs 9,10,12-P single and simple (except 9-P pectinate in *albimanus*), long; 9-P shorter than 10-P; 11-P forked at various distances from base, shortest of pleural group, about 0.4-0.6 length of 10-P; 12-P longest of pleural group. Hair 13-P with a highly variable number of branches, moderately large. Hair 14-P moderately large to large, 5-15 branched from short to long, dorsoventrally flattened stalk. Hair 1-M moderately long, strongly plumose, with an elongate, dorsoventrally flattened shaft, arising from fairly large tubercle. Hair 2-M single or forked, moderately short. Hairs 3,5-M single and simple, long. Hair 4-M branched or dendritic, short. Hair 6-M 2-4 forked near base, long. Hair 7-M 3-5 branched, moderately large. Hair 8-M moderately plumose with 25-30 branches, long, inserted in small tubercle. Hairs 9,10-M single, long; 10-M about 1.1-1.4 length of 9-M. Hair 12-M single, moderately short, about 0.33 length of 10-M. Hair 13-M multiple, small. Hair 14-M numerously branched or weakly pectinate, small. Hairs 1,2-T single; 1-T short; 2-T moderately short to moderately long; 1-T usually about 0.5 length of 2-T. Hair 3-T always palmate and either brushlike or with spreading leaflets, usually unpigmented. Hair 4-T 3,4 branched, very small. Hairs 5, 7,8-T strongly plumose, very long, arising from moderately developed tubercles. Hair 6-T 2,3 forked, moderately long. Hair 9-T single (except pectinate with 3-5 branches in *albimanus*), long; 10-T single, longer than 9-T. Hair 12-T 2,3 forked, moderately long. Hair 13-T 2,3 branched, large. **Abdomen**: Integument without spicules except on anal segment. Large, strongly sclerotized, median tergal plates present on anterior margins of segments I-VII. Usually small, median and submedian, sclerotized spots present immediately caudad of tergal plates; median spot larger than submedian spot, occasionally connected to plates. Chaetotaxy, in general, as in genus. Hair 0-II-VII

2-9 branched (1-12), moderately small to moderately large (0-II very small in *trinkae*). Hair 1-I-VII palmate, with unserrated, narrow to broad, lanceolate, blunt or pointed leaflets; 1-I 8-18 branched, unsclerotized or weakly sclerotized; 1-II-VII about 20-30 branched. Hair 5-II,III 3-12 branched, small to moderately large. Hairs 6-I-III and 7-I,II strongly plumose, very long. Hair 6-IV-VII single, very long. Hair 7-III-V 2-4 branched, moderately long. Hair 8-II-VI 2-4 branched, moderately small. Hair 9-I usually 3-7 branched, rarely 6-9 branched (*triannulatus*); 9-II-VII 6-13 branched, moderately large. Hair 11-I 2-5 branched (5-7 in *triannulatus*), large. Hair 13-I 4-10 branched (2-4 in *triannulatus, benarrochi* and *albimanus*); 13-II,III small to moderate (moderately large to large in *triannulatus* and *albimanus*); 13-IV 3-7 (2-8) branched (rarely 10-13 in *benarrochi*). **Segment VIII:** Hair 0-VIII 2-5 branched (rarely single in some *benarrochi*), very small. Hairs 1,4-VIII moderately long; 4-VIII always longer than 1-VIII. Hairs 2,3-VIII branched, large, highly variable. **Spiracular Lobe:** Pecten with 11-22 teeth, highly variable in length; teeth usually as follows beginning ventrally: (1) 1 long, (2) numerous, mixed short to moderate, (3) 1 long, (4) 4-6 short to moderate and (5) some combination of long and short, or with 2,3 long; teeth sabrelike, dorsally curved, serrated in basal half. Lateral arms of spiracular apparatus varied in length, extending or not extending to spiracular openings. Hair 2-S 5-9 branched, moderately small. Hair 6-S single or forked. Hairs 8,9-S small to moderately large, 3-7 branched (3-8), rarely 6-9 branched (*ininii*). **Anal Segment:** Saddle strongly sclerotized, extending about 0.5 around segment; light brown to brown. About caudal 0.6 of saddle and most of anal segment finely spiculose; caudal margin with thicker, stronger spicules. Hair 1-X single, strongly developed, as long as or longer than saddle; inserted on or not inserted on saddle. Hair 2-X strongly plumose, 15-20 branched, long. Hair 3-X 7-10 branched, longer than 2-X. Ventral brush with 8 pairs of long, strongly plumose hairs. Anal gills varying from less than length of saddle to greater than 2.0 length of saddle.

KEYS TO GROUPS AND SPECIES

FEMALES

(*3. galvaoi* and *7. anomalophyllus* not included)

1. Dark caudolateral scale tufts absent from abdominal segment II; palpal segment 4 all dark *or* yellow to golden brown on mediolateral surface, never white or cream; foretarsal segment 5 usually all dark (fig. 5) (**Albimanus Group**) . . . . . ***1. albimanus***

Dark caudolateral scale tufts present on abdominal segment II; palpal segment 4 with at least some white or cream on mediolateral surface; foretarsal segment 5 variable (**Oswaldoi Group**) 2

Oswaldoi Group

2(1). Anterior mesepimeron (*mep*) with a conspicuous patch of light scales; foretarsal segment 4 with a light band in apical 0.40-0.65; foretarsal segment 5 predominantly dark; hindtarsal segment 2 dark in basal 0.4-0.7; humeral light spot of vein C small, 0.5-1.3 length of basal dark spot; small species (fig. 7) (**Triannulatus Subgroup**) . . . . . ***14. triannulatus***

Anterior mesepimeron (*mep*) without a patch of light scales; foretarsal segment 4 predominantly dark, *or if* light in more than apical 0.3 *then* foretarsal segment 5 about 0.5 apically light *and/or* hindtarsal segment 2 less than 0.4 basally dark; humeral light spot of vein C small to large; moderately large to large species (**Oswaldoi Subgroup**) 3

Oswaldoi Subgroup

3(2). Hindtarsal segment 3 dark in basal 0.20-0.35; vein C predominantly dark, subbasal, presectoral and sectoral dark spots fused into one large spot; preapical dark spot of vein M extending uninterrupted onto vein M_{1+2} (fig. 7) . . . . . ***12. rondoni***

Hindtarsal segment 3 completely white; subbasal, presectoral and sectoral dark spots of vein C not fused into large spot; preapical dark spot of vein M not extending onto vein M_{1+2} 4

4(3). Hindtarsal segment 2 with basal dark band usually less than 0.25 length of segment; vein C humeral light spot greater than 1.5 length of basal dark spot 5

Hindtarsal segment 2 with basal dark band usually equal to or greater than 0.25 length of segment, *if* less than 0.25 *then* vein C humeral light spot less than 1.5 length of C basal dark spot 6

5(4). Foretarsal segment 4 all light to rarely more than 0.3 basally dark; midtarsal segment 4 with a light band in apical 0.15-0.25; foretarsal segments 3-5 predominantly cream to white, dark scales often present only on dorsobasal surface of segment; foretarsal segment 2 light in apical 0.35-0.55; foretarsal segment 3 light in apical 0.70-0.86 . . . . . ***6. ininii***

Foretarsal segment 4 all dark to at least 0.3 basally dark; midtarsal segment 4 all dark; dark basal bands on foretarsal segments 3-5 almost completely encircling each segment, dark scales occasionally absent from ventral surface; foretarsal segment 2 light in apical 0.20-0.45; foretarsal segment 3 light in apical 0.50-0.85 . . . . . ***2. oswaldoi***

6(4). Subcostal light spot of vein C usually greater than 0.5 (0.45-1.00) length of subcostal dark spot; upper mesepimeron (*mep*) often with 1-4 light, obovate scales; hindtarsal segment 2 usually dark in basal 0.25-0.35; humeral light spot of vein C usually large, 1.8-3.5 (1.0-3.7) length of basal dark spot (fig. 6) . . . . . ***8. rangeli***

Subcostal light spot of vein C almost always less than 0.5 length of subcostal dark spot; upper mesepimeron (*mep*) usually without light scales; hindtarsal segment 2 and humeral light spot of vein C variable . . . 7

7(6). Hindtarsal segment 2 dark in about basal half, 0.40-0.55 (0.3-0.6); light wing spots at least on veins C and R light cream to yellowish, not white . . . . . ***5. aquasalis***
13. benarrochi

Hindtarsal segment 2 dark in less than basal 0.40, *or if* greater than 0.40 *then* light wing spots white, not light cream to yellowish 8

8(7). Vein C humeral light spot less than 2.0 length of basal dark spot . . . 9

Vein C humeral light spot equal to or greater than 2.0 length of basal dark spot 10

9(8). Light spots on wing usually very light, white or very light cream; vein C with humeral light spot 1.3-2.0 of basal dark spot (fig. 7) . ***9. trinkae***

Light spots on wing usually cream, at least on anterior veins; vein C with humeral light spot 0.7-1.3 (0.7-1.7) of basal dark spot (fig. 7) . . . . . ***10. nuneztovari***

10(8). Light scales on wing (at least anterior veins) and coxae (usually) gray to cream to yellow, not white; foretarsal segment 5 cream, gray or golden in apical 0.3-0.5 . . . . . ***4. noroestensis***

Light scales on wing and coxae usually white or very light cream; foretarsal segment 5 variously banded 11

11(10). Midtarsal segment 5 usually cream in less than apical 0.3; foretarsal segment 2 with a cream to white band in apical 0.25 (0.18-0.35), segment 5 usually golden to brown, occasionally differentiated into 0.5 dark, 0.5 light; vein C humeral light spot usually 2.0-4.0 (1.2-4.1) of basal dark spot (fig. 7) . . . . . ***11. strodei***

Midtarsal segment 5 cream in apical 0.3-0.7; foretarsal segment 2 with a cream to white band in apical 0.31-0.46, segment 5 cream to white in about apical 0.5; vein C humeral light spot 2.0-2.5 (1.3-4.0) of basal dark spot (fig. 7) . . . . . ***9. trinkae***

MALE GENITALIA

1. Ventral claspette without setae, apex rounded and not expanded laterally into large auriculate lobe; preapical plate of ventral claspette very small, weakly sclerotized; apex of aedeagus slightly broader than long; sternite IX short, subrectangular (fig. 8) (**Albimanus Group**) . . ***1. albimanus***

Ventral claspette with setae, *or if* without setae *then* apex expanded laterally into large auriculate lobe; preapical plate of ventral claspette and aedeagus variously developed; sternite IX moderately long to long, subtrapezoidal to subtriangular (**Oswaldoi Group**) 2

Oswaldoi Group

2(1). Ventral claspette without setae, apex expanded laterally into large, auriculate lobe, preapical plate small, oval and heavily sclerotized; apex of aedeagus about 1.5 as long as wide (fig. 31) (**Triannulatus Subgroup**) . . . . . ***14. triannulatus***

Ventral claspette with setae at least on basal lobules, apex with or without lateral expansion, preapical plate various; apex of aedeagus less than 1.5 as long as wide (**Oswaldoi Subgroup**) 3

Oswaldoi Subgroup

3(2). Ventral claspette with apex rugose or deeply striated, and moderately to strongly expanded laterally into rounded or pointed lobe, setae on lateral margins not extending toward apex as far as level of apical margin of preapical plate; apex of aedeagus without leaflets (**Strodei Complex**) . 4

Ventral claspette with apex neither rugose nor deeply striated nor laterally expanded, setae extending to apex or at least as far as level of apical margin of preapical plate; apex of aedeagus with or without leaflets (**Oswaldoi Complex**) 6

Strodei Complex

4(3). Ventral claspette small, about 0.33 length of sidepiece, apex moderately expanded laterally, apicolateral margins sharply angled and moderately pointed; basal lobule of ventral claspette small, narrow, curving mesad, with setae along basal margin short, about equal to or slightly longer than width of aedeagus; preapical plate of ventral claspette heavily sclerotized (fig. 29). . . . . ***13. benarrochi***

Ventral claspette large, about 0.5 length of sidepiece, apex strongly expanded laterally, apicolateral margin produced into large, rounded lobe with basal and lateral margins convex and apical margin weakly concave; basal lobule of ventral claspette large, with setae along basal margin long, about 2.0-3.5 width of aedeagus; preapical plate of ventral claspette very weakly to moderately sclerotized 5

5(4). Ventral claspette with setae on lateral margins extending toward apex to base of apicolateral lobe, preapical plate weakly to moderately sclerotized and moderately well-defined (fig. 27) . . . . . ***11. strodei***

Ventral claspette with setae usually on basal lobule only, not extending to base of apicolateral lobe, preapical plate very weakly sclerotized and ill-defined (fig. 12) . . . . . ***12. rondoni***

Oswaldoi Complex

6(3). Apex of aedeagus with a pair of long, sclerotized, serrated leaflets about 0.4 length of aedeagus; ventral claspette with large basal lobule with setae along basal margin 1.5-2.0 width of aedeagus, preapical plate oval to semicircular and moderately sclerotized (fig. 19). . ***7. anomalophyllus***

Apex of aedeagus without leaflets or occasionally with very small, membranous leaflets; ventral claspette with large or small basal lobule, preapical plate variously developed 7

7(6). Ventral claspette strongly conoid, with a very small median sulcus at apex, setae on lateral margins (exclusive of basal lobule) short and extending toward apex only as far as level of apical margin of preapical plate, setae along basal margin of basal lobule long about 2.0-3.0 width of aedeagus, preapical plate very large, crescent shaped and heavily sclerotized (fig. 17) . . . . . ***6. ininii***

Ventral claspette not strongly conoid, either truncate or with a moderately small to large median sulcus at apex, setae on lateral margins extending to or nearly to apex, setae along basal margin of basal lobule short to long, preapical plate small to large 8

8(7). Ventral claspette with a concentration of long setae about 1.5 width of aedeagus on basomesal margin of basal lobule and directed caudally into mesal cleft, wide at apex (width 0.4-0.5 length of claspette) with abruptly angled, rounded lateral margins, preapical plate small, oval and heavily sclerotized (fig. 21) . . . . . ***8. rangeli***

Ventral claspette without setae concentrated on basomesal margin of basal lobule, shape and preapical plate varied 9

9(8). Ventral claspette with apex moderately broad to broad, width at apex 0.4-0.6 length of claspette, lateral margins of claspette not tapering appreciably medially toward apex, lateral margins of apex abruptly angled, preapical plate moderately small and semicircular to oval. 10

Ventral claspette with apex moderately narrow to narrow, width at apex about 0.3 length of claspette, lateral margins of claspette tapering toward apex, lateral margins of apex evenly curved, preapical plate variously developed 11

10(9). Length of aedeagus 1.33-1.60 (1.31-1.89) length of ventral claspette; ventral claspette moderately short, 0.25-0.40 length of sidepiece, width of apex 0.50-0.60 (0.50-0.64) length of claspette (fig. 25) . . . . . ***10. nuneztovari***

Length of aedeagus 1.00-1.20 (1.00-1.33) length of ventral claspette; ventral claspette moderately long, 0.40-0.50 length of sidepiece, width of apex 0.43-0.50 (0.38-0.54) length of claspette (fig. 23) . . ***9. trinkae***

11(9). Aedeagus truncate at apex; preapical plate of ventral claspette large, semicircular to oval, heavily sclerotized (fig. 13). . . . . ***4. noroestensis***

Aedeagus rounded at apex; preapical plate of ventral claspette variously developed 12

12(11). Ventral claspette with setae along basal margin of basal lobule moderately short about equal to or slightly longer than width of aedeagus, setae usually not reflexed, preapical plate moderately small, circular to oval and weakly to moderately sclerotized (fig. 15) . . . . . ***5. aquasalis***
Ventral claspette with setae along basal margin of basal lobule long about 2.0 or more width of aedeagus, setae often reflexed caudally, preapical plate large and moderately to strongly sclerotized 13

13(12). Ventral claspette with setae along basal margin of basal lobules about 2.0 width of aedeagus, preapical plate large, usually crescent shaped and moderately to strongly sclerotized (fig. 10) . . . . . ***2. oswaldoi***
Ventral claspette with setae along basal margin of basal lobules very long about 3.0 width of aedeagus, preapical plate strongly sclerotized, large and circular to semicircular with small basolateral projections (fig. 12) . . . . . ***3. galvaoi***

PUPAE

(***3. galvaoi***, ***7. anomalophyllus*** and ***12. rondoni*** not included)

1. Hair 9-VII long, usually more than 0.33 length of segment 2
Hair 9-VII short, less than or equal to 0.33 length of segment 9

2(1). Hair 9-V less than 2.3 length of 9-IV; 9-VI relatively short, 9-VII 1.4-2.0 length of 9-VI 3
Hair 9-V 2.3 or more length of 9-IV, rarely 2.0; 9-VI long, 9-VII 1.0-1.5 length of 9-VI 5

3(2). Hair 9-VII usually less than 0.5 length of segment (fig. 13) . . . . . ***4. noroestensis***
Hair 9-VII about 0.5 or more length of segment 4

4(3). Sum of branches of hairs 1-III, 5-III and 0-VI less than 18 (fig. 27) . . . . . ***11. strodei***
Sum of branches of hairs 1-III, 5-III and 0-VI greater than 20 (fig. 17) . . . . . ***6. ininii***

5(2). Pinna of trumpet very long, about 4.0-6.5 (3.4-8.0) length of meatus and narrow, not appearing to taper toward apex; hair 9-V-VIII very long, slender, acuminate; 9-III small, unpigmented, slightly longer than 9-II; 7-C with one branch very long, about 1.5-2.0 length of other branch(es); 6-I,II very long and 9-I subequal to 6-I; 3-I subequal to 2-I; 2-I 3-6 branched; size small (fig. 31) . . . . . ***14. triannulatus***
Pinna of trumpet usually equal to or less than 4.0 length of meatus and moderately wide, *if* longer than 4.0 *then* tapered *or* hair 9-V less than 2.3 length of 9-IV *or* 9-III about 2.0 length of 9-II; hair 9-V-VIII moderately slender to heavy; 9-III small to moderate, variously pigmented; 7-C variously developed; 6-I,II and 9-I short to long; 2,3-I variously developed; size moderately large to large 6

6(5). Hair 9-III strongly pigmented, heavy and usually thick, at least 2.0 length of 9-II; 6-II 2.0 or more length of 7-II; 2-I moderately developed, 3-5 branched (2-6), forked about 0.5 distance from base; 3-I subequal to 2-I (fig. 8) . . . . . ***1. albimanus***

Hair 9-III usually less than 2.0 length of 9-II, *if* longer *then* weakly to moderately pigmented and not thick and heavy; 2,3-I and 6-II varied 7

7(6). Hair 2-I moderately short, usually with 4-8 (2-10) branches arising near or at base (fig. 15) . . . . . ***5. aquasalis***

Hair 2-I moderately long to long, forked, branches arising at least 0.20 distad of base 8

8(7). Sum of branches of hairs 0-II and 0-III usually greater than 8 (8-14); 0-II moderate, usually 5-7 branched (4-7); 7-C with branches subequal or one branch slightly longer than other(s) (fig. 21) . . . . . ***8. rangeli***

Sum of branches of hairs 0-II and 0-III usually less than 8 (3-9); 0-II small, single to triple (1-4); 7-C with one branch about 1.5 length of other branch(es) (fig. 23) . . . . . ***9. trinkae***

9(1). Pinna of trumpet short, about 1.6-2.1 length of meatus, appearing apically flared in lateral aspect, meatal cleft appearing narrow and basally pointed; hair 6-II equal to or slightly longer than 7-II (fig. 10). . ***2. oswaldoi***

Pinna of trumpet moderately long to long, 3.0-5.5 length of meatus, not appearing apically flared in lateral aspect, meatal cleft moderately pointed to rounded at base; hair 6-II conspicuously longer than 7-II . . 10

10(9). Pinna of trumpet moderately long, 3.5-4.5 (3.0-4.8) length of meatus, appearing broad medially and tapered toward apex in lateral aspect; hair 10-C less than 0.5 length of 12-C; 6-I usually more than 2.0 length of 7-I (fig. 25) . . . . . ***10. nuneztovari***

Pinna of trumpet long, 4.5-5.1 (4.4-5.5) length of meatus, not appearing to taper toward apex in lateral aspect; hair 10-C more than 0.5 length of 12-C; 6-I about 1.5-2.0 length of 7-I (fig. 29) . . . . . ***13. benarrochi***

LARVAE

(*3. galvaoi* and *12. rondoni* not included)

1. Hair 1-P plumose, with filiform branches; 9-P,T pectinate, usually 4-6 branched (4-7); 13-I-IV moderately large to large; 4-C moderately long to long, usually extending to anterior margin of head capsule (fig. 9) (Albimanus Group) . . . . . ***1. albimanus***

Hair 1-P palmate; 9-P,T single; 13-I-IV small to large; 4-C short or long (Oswaldoi Group) 2

Oswaldoi Group

2(1). Hairs 2-C widely spaced, clypeal index about 1.0-2.0, single to plumose . 3

Hairs 2-C closely approximated, clypeal index about 2.5-4.0, single, and simple or barbed 11

3(2). Hair 11-I large, usually 5-7 branched (3-7); 13-I very large, usually 3 branched (2-4); lateral arm of spiracular apparatus long, directed laterally; 1-P with 15-20 (13-20) very narrow to narrow lanceolate leaflets (rarely filiform); 2-C single, and simple or barbed (fig. 32) (**Triannulatus Subgroup**) . . . . . ***14. triannulatus***

Hair 11-I moderately large, 2-4 branched; 13-I small to moderately large, usually more than 3 branched; lateral arm of spiracular apparatus very short to moderately long (except long in *ininii*); 1-P with usually 9-16 (8-18) narrow to broad lanceolate leaflets; 2-C single to plumose (**Oswaldoi Subgroup**) 4

Oswaldoi Subgroup

4(3). Hair 3-C, and usually 2-C, plumose in about apical half, with distinct, moderately long to long branches 5

Hairs 2,3-C single, and simple or barbed 7

5(4). Hair 1-A long, at least 2.0 width of antenna at point of insertion; 13-IV small, usually 10-13 branched (6-13); 1-X moderately short, as long as or slightly longer than saddle; 3-C with moderately long branches and 2-C barbed (fig. 30) . . . . . ***13. benarrochi***

Hair 1-A short to moderately short, always less than 2.0 width of antenna at point of insertion; 13-IV moderately large, usually 5-7 branched (3-8); 1-X longer than saddle; 2,3-C with branches subequal in length or branches of 3-C slightly longer than those of 2-C. 6

6(5). Hair 1-X inserted on saddle, on or near ventral margin; anal gills usually short, about 0.5 length of anal segment; 2,3-C with simple branches, rarely dendritic; lateral arm of spiracular apparatus very short; pecten with median teeth mixed medium and short (fig. 16) . . . ***5. aquasalis***

Hair 1-X not inserted on saddle; anal gills long, as long as or longer than anal segment; 2,3-C with usually dendritic branches; lateral arm of spiracular apparatus moderately long; pecten with median teeth mostly subequal (fig. 11). . . . . ***2. oswaldoi***

7(4). Hair 4-C single or forked, moderately long to long, usually extending to near or beyond base of 2-C, *if* moderately long (0.30-0.60 length of 3-C) *then* 13-V 4-6 branched (4-7) 8

Hair 4-C variously branched, short to moderately long, usually not extending to base of 2-C, *if* moderately long (0.30-0.45 length of 3-C) *then* 13-V almost always 3 branched (3-5) at least on one side of larva . . 9

8(7). Hair 0-II very short, about 0.5 or less length of leaflets of 1-II, inconspicuous, single to triple; 3-C 0.5-0.8 length of 2-C; 4-C long, 0.7-1.0 length of 3-C; 13-IV moderately large, 3,4 branched, 1.5-2.0 length of leaflets of 1-IV (fig. 24) . . . . . ***9. trinkae***

Hair 0-II moderately long, subequal to or longer than length of leaflets of 1-II, conspicuous, usually 5-8 branched (4-10); 3-C 0.76-0.90 length of 2-C; 4-C moderately long, 0.3-0.6 length of 3-C; 13-IV moderate, usually 4-6 branched (3-6), equal to or slightly longer than leaflets of 1-IV (fig. 26) . . . . . ***10. nuneztovari***

9(7). Hair 1-A long, about 2.0 width of antenna at point of insertion; lateral arm of spiracular apparatus long, directed laterally (fig. 18) . . . ***6. ininii***

Hair 1-A short, as long as or slightly longer than width of antenna at point of insertion; lateral arm of spiracular apparatus short to moderately short, directed caudolaterally 10

10(9). Hair 5-I short, inserted 0.75-1.00 its length from lateral margin of abdomen; 2-III relatively short, 1.5-2.0 length of leaflets of 1-III; 2,13-IV moderately short, slightly longer than leaflets of 1-IV (fig. 22) . . . . . ***8. rangeli***

Hair 5-I moderately short, inserted less than 0.75 its length from lateral margin of abdomen; 2-III longer than 2.0 length of leaflets of 1-III; 2,13-IV moderately long, about 1.5 length of leaflets of 1-IV (fig. 14) . . . . . ***4. noroestensis***

11(2). Hair 1-P with 13-17 narrow leaflets; 2-P 16-24 branched; 1-M 31-35 branched; 1,2-P rarely sharing common tubercle; 1-X inserted on saddle near ventral margin, or rarely on ventral margin at base of indentation (fig. 28) . . . . . ***11. strodei***

Hair 1-P with 9-12 moderately broad to broad leaflets; 2-P usually 12-14 branched (12-17); 1-M usually 20-30 branched (20-32); 1,2-P arising from a common tubercle; 1-X inserted usually on ventral margin of saddle at base of indentation, or less often on saddle near ventral margin (fig. 20) . . . . . ***7. anomalophyllus***

ALBIMANUS GROUP

1. Anopheles (Nys.) albimanus Wiedemann

Figs. 1, 4, 5, 8, 9

1820. *Anopheles albimanus* Wiedemann 1820:10. TYPE: *Holotype* female, Santo Domingo (Dominican Republic) [NMW]. Specimen in poor condition (abdomen and antennae missing, legs missing or incomplete except for complete left hindleg), with following labels, //[red square]//albimanus/det Wiedem//albimanus/Wied/St. Domingo// (Belkin 1968b:8).

1900. *Anopheles cubensis* Agramonte 1900:460-464. TYPE: *Syntypes* males and females, several localities in Cuba [LU]. Synonymy with *albimanus* by Theobald (1907:106-109).

1901. *Anopheles argyrotarsis* (!) *albipes* Theobald 1901:125-128. TYPE: *Lectotype* male with the following labels, //16.XII.99//8.2.00 Jamaica Dr. Grabham//Type//Anopheles argyritarsis var. albipes Theobald (Type)// [BM; designation of Belkin 1968b:8-9]. Originally described from unspecified number of males and females from Jamaica, Guyana, Rio de Janeiro, Antigua and India. Synonymy with *albimanus* by Coquillett (1906:8, 13).

1905. *Cellia tarsimaculata* Goeldi 1905:133. TYPE: Same as for *albipes* [BM; designation by Belkin 1968b:8-9]. Unjustified emendation for *albipes* Theobald 1901.

1938. *Anopheles albimanus bisignatus* Hoffmann 1938:176-177. TYPE: *Syntypes* adults, Gonzalez (Tamaulipas), Nov; Tampico (Tamaulipas), June, Oct, Nov, Dec, Jan; Altamira (Tamaulipas), June; El Mante (Tamaulipas), July; San Jeronimo, Laguna de Tamiahua (Veracruz), June, July, Mexico [UM], (Belkin, Schick and Heinemann 1965:34).

1938. *Anopheles albimanus trisignatus* Hoffmann 1938:177-178. TYPE: *Syntypes* adults, region of Tampico (Tamaulipas), Mexico, Dec, Jan [UM], (Belkin, Schick and Heinemann 1965: 34).

Anopheles (Nyssorhynchus) albimanus of Dyar (1922:103; 1925:187, 188, 194; 1928:103, 434-435); Root (1922a:322; 1922b:384-389, 390-391; 1923:267, 269, 276; 1924b:460-462; 1926a: 51; 1926b:709; 1932:779-782); Christophers (1924:38-39, 89); Barraud and Covell (1928:674); Lima (1928:94-95); Boyd and Aris (1929:309-399); Kumm (1929:6-8; 1941a:359; 1941b:93-97, 99-100); Hill (1930:712); Carley (1931:293-296); Edwards (1932:45); Senevet (1932:252; 1938:181-182; 1948c:437, 439); Townsend (1933a:101-102); Rozeboom (1936b:480-489; 1938a:95, 99-100; 1938b:289-301; 1942:237; 1963:110-114); Kumm and Ruiz (1939:437-438, 441); Lane (1939:19-21; 1944:263-265; 1949:401-402; 1953:256-259); Simmons (1939:124-125); Gabaldon (1940:3-7); Gabaldon, Lopez and Ochoa Palacios (1940:33); Gabaldon, Aquilera and Arevalo (1941:59); Komp (1941a:88, 92-97; 1942:5, 40, 43, 67-69, 80, 115-117, 132, 154-156); Rozeboom and Gabaldon (1941:95-97); Simmons and Aitken (1942:38, 45, 53, 60, 80-84); Cova Garcia (1943:467-472); Ross and Roberts (1943:35-36); Matheson (1944:115-116); Floch and Abonnenc (1945:1-3; 1946b:3-5); Levi-Castillo (1945:2, 7, 92-104; 1949:9, 10, 15, 27, 32, 57, 58, 67, 72, 76, 81, 85); Carpenter, Middlekauff and Chamberlain (1946:80-83); Gabaldon and Cova Garcia (1946a:19-32; 1952:181); Arnett (1947:194-196; 1950:106, 110, 112, 114); Vargas (1948:153-163; 1959:376, 382); Penn (1949:52, 68-69); Thompson (1950: 692-695); Vargas and Martinez Palacios (1950:119-123; 1953:326-327; 1956:119-122); Belkin (1952:121, 123, 130; 1965:14; 1968b:8-9); van der Kuyp (1954:49-50); Carpenter and La Casse (1955:55-57); Frizzi and Ricciardi (1955:403, 404, 406); Horsfall (1955:172-177); Perez Vigueras (1956:180-186); Vargas V. (1956:27, 29; 1957; 1958a; 1958b; 1961a:97-105; 1961b:153-170); Bejarano (1957:326-332); Rozeboom and Kitzmiller (1958:244); Schreiber and Guedes (1959b:128-129; 1960:356-357); Stone, Knight and Starcke (1959:30); Forattini (1962:371-376); Montchadsky and Garcia Avila (1966:32); Porter (1967:36); Elliott (1968:244); Keppler and Kitzmiller (1969:31); Belkin, Heinemann and Page (1970:24-27); Keppler, Kitzmiller and Rabbani (1973:42-49); Cova Garcia and Sutil O. (1976:30; 1977:14, 45, 63, 87); Cova Garcia, Pulido F. and Amarista M. (1977:157); Knight and Stone (1977:60).

Anopheles albimanus of Robineau-Desvoidy (1827:411); Wiedemann (1828:13); Dyar and Knab (1906a:175-176); Busck (1908:57); Darling (1909:2051-2053); Knab (1913:34-37, 40-42); Christophers (1915:390-391); Zetek (1915:221-271); LePrince and Orenstein (1916:43-114); Howard, Dyar and Knab (1917:979-984); Johnson (1919:424); Evans (1921:446-451; 1922:

213); Root (1924a:207); Gowdey (1926:74); Hoffman (1926:377; 1930:358); Senevet (1931: 76-79); Earle (1932:381-384); Hoffmann (1932:523-529; 1938:167-180); Clark (1934:643); Curry (1934:644-651); Hill (1934:425-428); Martini (1935:14, 15); Rozeboom (1935:521-528; 1936a:471-478; 1941:98-104; 1953:1116; 1962:668); Clark, Komp and Jobbins (1940:62-67); Kumm, Komp and Ruiz (1940:388-391, 419); Vargas (1940a:199-200; 1940b:67; 1941:112, 114, 116, 118; 1976:88, 89); Carr, Melendez and Melendez (1941:749-750); Kumm and Ram (1941:559); Carr and Hill (1942:600-601, 604, 606); Carr and Melendez (1942:59-60); Carr, Melendez, Ros and Melendez (1942:70-71); Kumm and Zuniga (1942:401, 404; 1944:8-15); Kumm, Bustamante and Herrera (1943:374); Russell, Rozeboom and Stone (1943:20, 26, 29, 30, 41); Eyles (1944:2, 10-11); King, Bradley and McNeal (1944:39); Weathersbee (1944:25-28); Carpenter, Chamberlain and Wanamaker (1945:402); Hill and Hill (1945:3; 1948:36-37); Paul and Bellerive (1947:63-66); Thompson (1947:78); Castellanos, Murrieta, Lassmann and Ortiz (1949:34-35); Burgess (1950:108); Senior-White (1950:4-5); Muirhead-Thomson (1951: 1114-1117); Charles and Senevet (1953:1109-1115); Rozeboom (1953:1116; 1962:668); van der Kuyp (1953:144, 145); Floch (1954:4); Vargas and Martinez Palacios (1955:82-121, 123); Jensen and Jones (1957:464-469); Vargas V. (1958c:1, 3); Foote and Cook (1959:112-113); Cova Garcia (1961:33-34, 68, 85-86, 113, 122-123, 154, 178); Fauran (1962:73-80; 1964:52-53); Hobbs (1962:245-251; 1973:420-423); Vincke and Pant (1962:2-11); Davidson (1963:25-33); Rachou, Lyons, Mourra Lima and Kerr (1965:32-61); Fauran and Courmes (1966:105); Stojanovich, Gorham and Scott (1966a:11, 19, 28; 1966b:19, 31, 38); Taylor (1966:393-397); Gorham, Stojanovich and Scott (1967:14, 45, 49; 1973:110, 136, 140); Scherer, Campillo-Sainz, Dickerman, Diaz Najera and Madalengoitia (1967:79-91); Central America Malaria Research Station (1968:8-37; 1969:5-53; 1970:5-41; 1971:9, 12-18, 24-41, 48-50, 55-56, 70-71; 1972:5-13, 17, 21-27, 31-32, 37-41, 57); Wilton and Fay (1970:628-632); Morales-Ayala (1971: 139); Ali and Rozeboom (1972:574-579); Breeland (1972a:751-754; 1972b:62-72; 1972c:99-106); Elliott (1972:757); Rabbani and Kitzmiller (1972:421-432); Wilton and Fetzer (1972: 459-460); Wilton, Fetzer and Fay (1972:23-27); Lofgren, Boston and Borkovec (1973:187-189); Shelton (1973:3-4, 8, 10); Hobbs, Lowe and Schreck (1974:389-393); Cova Garcia and Sutil O. (1975a:21; 1975b:212); Lowe, Schreck, Hobbs, Dame and Lofgren (1975:160-168); Warren, Richardson and Collins (1975:549-551); Garcia-Aldrete and Pletsch (1976:76, 79); Pletsch and Garcia-Aldrete (1976:87-92); Bautista-Garfias, Mercado-Sanchez and Morilla-Gonzalez (1977: 15-18); Warren, Collins, Richardson and Skinner (1977:607-611).

Anopheles (Anopheles) albimanus of Bonne and Bonne Wepster (1925:516).

Anopheles (Cellia) albimanus of Dyar (1918:151).

Cellia albimana of Coquillett (1906:13); Theobald (1907:106-109 in part; 1910:69-70 in part); Surcouf and Gonzalez-Rincones (1912:274); Lutz, Souza Araujo and Fonseca Filho (1919:85); Neiva and Pinto (1922a:321; 1922b:356-357); Boyd (1926:31, 48).

Nyssorhynchus albimanus of Blanchard (1905:202-204); Autran (1907:10-11); Surcouf and Gonzalez-Rincones (1912:271-272); Townsend (1934:493, ?).

Cellia albipes of Theobald (1903:110-113; 1905a:15-17; 1905b:11); Prout (1909:487).

Nyssorhynchus cubensis of Blanchard (1905:204-205); Surcouf and Gonzalez-Rincones (1912:272-273).

Cellia argyrotarsis (!) of Theobald (1905a:4; 1905b:11; 1907:105; 1910:68); Prout (1909:487).

Anopheles argyrotarsis (!) of Theobald (1901:123-125); Johnson (1919:425).

Laverania argyrotarsis (!) of Theobald (1902:183).

Anopheles (Nyssorhynchus) rondoni of Martini (1935:14, 24).

FEMALE (fig. 5). Wing: 3.16 mm. Proboscis: 2.05 mm. Palpus: 1.95 mm. Forefemur: 1.45 mm. Abdomen: about 2.5 mm. **Head:** Integument brown to dark brown. Interocular width 3, 4 ommatidial diameters. Proboscis about 1.4 length of forefemur. Posterior vertex and occiput with large, erect, white, truncate, weakly forked scales becoming darker posteriorly; anteriorly, vertex with a few, small, obovate, decumbent scales along upper orbitals and longer, narrow, white, decumbent scales along interorbital line. Frontal tuft with 14-20 long, white, setiform scales. Proboscis brown to dark brown, with decumbent scales and short setae; appearing

metallic dark copper when viewed at angle; labella lighter than labium. Palpal segments 1-3 predominantly same color as labium; segments 2, 3 with a small cream to white band at apex; segment 4 either all dark or yellow to golden brown on mediolateral surface, never white or cream; segment 5 white. **Thorax:** Pruinose areas of scutum silver gray to reddish; nonpruinose regions light brown to dark brown. Median anterior promontory area with 10-15 long, erect, white scales and a few, long, light setae. Upper humeral tuft scales similar to those on median anterior promontory, lower tuft scales shorter, darker and obovate or cuneate. Prescutellar region moderately large, dark, horseshoe shaped to triangular; bare space extending onto median portion of scutellum. *Ppl* with 1, 2 long, dark setae. *Sp* with about 2-8 light setae and a few, lanceolate, light scales. *Pra* with 5-10 long, dark setae and a patch of long white scales. Upper *stp* with 2-4 long, dark setae and approximately 10 cream to yellow, truncate, spatulate scales in a horizontal arc. Lower *stp* with 1, 2 long, dark setae and a small patch of scales similar in shape and color to those on upper *stp*. Upper *mep* with 5-10 long, dark setae oriented horizontally or diagonally; scales absent. **Legs:** Light scales on coxae generally white. Femora and tibiae as in section description; midfemur with anteroapical spot and knee spot moderate to large. Foretarsal segment 1 with less than apical 0.15 cream to white; segment 2 cream to white in apical 0.15-0.35; segment 3 cream to white in apical 0.1-0.6; segments 4, 5 normally all brown, occasionally apex of 5 with cream to light brown scales; specimens from Caribbean islands with smaller apical light bands on foretarsus. Midtarsus usually with fewer extensive light areas than in Oswaldoi Subgroup, appearing very dark; segment 1 and occasionally 2 with a very small, golden, apical band; segments 3, 4 without an apical light band; segment 5 with or without a golden apical band. Hindtarsal segment 1 with a yellow to white apical band, often indistinct; segment 2 dark in basal 0.4-0.6 (0.4-0.8); apical portion of segment 2 and all of segments 3, 4 white; very rarely base of segments 3,4 with a brown ring; segment 5 brown in about basal 0.5, remainder cream to white. **Wing:** Apex moderately rounded, not strongly tapered. Light spots normally cream, particularly on veins C and R; dark spots varying from light brown to almost black; considerable variation in lengths of light and dark spots. Vein C usually with large dark spots; presectoral and/or sectoral light spots often absent; C humeral light spot about 1.0-2.0 (0.95-2.50) of basal dark spot (basal dark spot usually greater than or equal to 0.5 of humeral light spot); subcostal light spot about 0.25-0.40 of subcostal dark spot; preapical light spot 0.25-0.45 of preapical dark spot. R with 2 dark spots, presectoral and sectoral, moderately long and subequal in length. R_{2+3} about 0.5 of R_2. Rs-R_{2+3} predominantly dark, with 2 or 3 usually small, light spots. Base of M usually light followed by a moderately long to long sectoral dark spot; preapical dark spot of variable length. Cu sectoral dark spot not reaching furcation. Vein A subcostal dark spot moderately large, about 0.2 length of vein. Apical light fringe spot small to moderate; small, inconspicuous, light fringe spots at apices of R_{4+5}, M_{1+2}, M_{3+4}, Cu_1, Cu_2 and A; a moderate size, light fringe spot at level of 0.5 distance from base of A. **Abdomen:** Integument of tergites brown to dark brown; occasionally light mottling present on segments II-VII. Tergite I with light to dark, long setae laterally and along apical margin; without scales. Long setae in posterior 0.5-0.7 of tergites I-VII, and on mediolateral, lateral and apical margins; shorter setae more medially. Tergites II-VII with cream to golden, small, obovate scales in subtriangular pattern in proximal segments, and more extensive subrectangular pattern in apical segments; occasionally with darker median scales on tergites II-VII; caudolateral margin with large, conspicuous, outstanding, dark scale tufts on segments III-VII. Sternites II-VII with submedian and apical setae and submedian

white scales; caudomedian and caudolateral dark scale tufts on sternites III-VII similar to those on tergites, with a few light scales occasionally interspersed. Sternite VIII densely covered with small, cream to golden scales, medially with longitudinal stripe of dark scales.

MALE (fig. 5). Wing: 3.05 mm. Proboscis: 2.35 mm. Forefemur: 1.5 mm. Abdomen: about 2.75 mm. Essentially as in female except for sexual characters. **Head**: Palpal segment 4 with a basal and an apical dark band; mediolaterally with mixed light and dark scales; extreme base and apex with a few light scales; ventral surface usually dark scaled. **Antenna**: About 0.7 length of proboscis. **Legs**: Forefemur 0.6 length of proboscis. Basal plantar surface of foretarsal segment 5 with about 5-8 moderately long, spiniform setae; setae longest toward apex. Claw on foreleg long, slightly curved; submedian tooth about 0.25 length of claw, acuminate and recurved at apex; external basal tooth subequal to submedian tooth and decurved.

MALE GENITALIA (fig. 8). **Segment VIII**: Tergite and sternite medially with numerous broad scales; scales more densely distributed on tergite. Posterior border of sternite with row of long setae. **Segment IX**: Sternite short, curved and subrectangular, anterior border almost parallel with posterior border, tapering at lateral margins. Slight, inconspicuous, ribbonlike, nonspiculose thickening (anterior apodeme) along anterior border of sternite. **Sidepiece**: Moderately narrow. Tergal surface usually with 4, 5 long, submedian tergomedial bristles and one long apicolateral bristle at base of clasper. Bristles laterad and mesad of tergomedial bristles 0.5 length of tergomedial bristles. Parabasal spine usually at least 2.0 length of its tubercle. Accessory spines long; longer more dorsal spine about 0.5 length of sidepiece; more ventral spine 0.58-0.70 of dorsal spine. Internal spine subequal to shorter accessory spine, apically retrorse. **Clasper**: Ventromesal margin with row of short spicules. Spiniform narrow and moderately short, subequal to seta *b*. **Dorsal Claspette**: About 0.5 length of sidepiece. Pedicel moderately long and narrow; base moderately curved mesad. Leaflets broad and lanceolate; longest equal to or slightly less than 0.5 length of claspette; basomesal projection of dorsal leaflet small. **Ventral Claspette**: About 0.32-0.40 of sidepiece; without setae; apex of ventral lobe produced into a pair of rounded, striated lobes, separated by a moderately shallow median sulcus. Immediately basad of sulcus a very small, circular to oval, weakly sclerotized preapical plate. Ventral surface of basal lobule produced into a large, inflated, ovoid, bulbous lobe, often deflated and not apparent on slide. **Phallosome**: Aedeagus about 1.4 length of ventral claspette; moderately wide; apex rounded, slightly broader than long, with distinct membranous border; without leaflets; subapical, ventromesal, triangular projections nearly meeting or meeting on midline of ventral surface.

PUPA (fig. 8). Abdomen: 2.7 mm. Trumpet: 0.5 mm. Paddle: 0.75 X 0.55 mm. **Cephalothorax**: Strongly pigmented, light brown to dark brown. Wing cases often with longitudinal dark stripes. Hairs 1-3-C 1-3 branched; 2-C shorter and weaker than 1,3-C. Hairs 4,5-C of subequal length; 4-C 2,3 branched (1-3); hair 5-C 2,3 branched (1-4). Hair 6-C single or forked. Hair 7-C 2-4 branched (2-5) near base, often one branch longer than other(s). Hairs 8,9-C subequal in length; 8-C single (1-3 branched), heavy; 9-C 1-3 forked about 0.3-0.5 from base. **Trumpet**: Weakly pigmented, light yellow to brown. Pinna moderately sclerotized and open; long, about 3.3-4.0 (2.9-4.5) length of meatus; in lateral aspect, appearing broad medially and tapered toward apex. Meatal cleft broad, and pointed or rounded at base. **Metanotum**: Hair 10-C single, subequal to 11-C. Hair 11-C 2-4 branched (2-6). Hair 12-C 1,2 forked 0.25-0.50 from base, 1.5-2.0 length of 10-C. **Abdomen**: Hairs with fewer branches in general than remaining species in section. Strongly pigmented, light

brown to dark brown, often with darker, median, longitudinal stripe. Float hair 1-I with 8-13 major branches, extensively dendritic apically. Hair 2-I 3-5 forked (2-6) about 0.5 from base, moderately developed; 3-I single, subequal to 2-I. Hair 4-I 3-6 forked (3-7) about 0.3-0.5 from base. Hair 5-I single to triple, long. Hair 6-I single, very long, usually 2.0 length of 7-I. Hair 7-I 2-4 branched. Hair 9-I single, very long, slightly shorter than or equal to 6-I. Hair 0-II-IV 2-5 branched (2-6); 0-VII 1-3 branched (1-5). Hair 1-II 5-9 branched (5-11); 1-III 3-6 branched (2-7); 1-IV-VII single or rarely double, very long, about 1.5-2.0 length of segment; 1-IV slightly shorter than 1-V-VII. Hair 2-III 3-5 branched (2-6). Hair 3-IV 3-6 branched (3-7), inserted very close to hair 4-IV; 3-V 1-3 branched. Hair 5-III 4-8 branched (4-10), large. Hair 6-II single, very long, 2.0 or more length of 7-II; 7-II 2-5 branched (2-6). Hair 6-III-VI single, long. Hair 7-III-V 2-5 branched (2-6), small to moderately small. Hair 8-III-VII 2-5 branched (2-6), small. Hair 9-II very small, unpigmented; 9-III pigmented, small, about 2.0 length of 9-II; 9-IV thick, about 2.0 of 9-III and 0.3 of 9-V,VI; 9-V-VII slightly curved, acuminate; 9-VIII almost straight; 9-VII,VIII long, about 0.5 of segment and about 1.2 of 9-V,VI. Hair 10-III 2,3 branched (1-4), moderately long. Hair 4-VIII 1-3 forked. **Terminal Segments:** Apex of male genital lobe with small, short, moderately distinct, mammilliform protuberance; lobe broad and heavy. **Paddle:** Large, obovate, broad and emarginate at insertion of hair 1-P. Midrib with lateral margin more sclerotized than mesal margin, distally becoming indistinct. External buttress 0.65 length of paddle, distally very finely serrated; moderately distinct, short (0.02 mm), fine, filamentous spicules distad of buttress, extending around apex a short distance and becoming shorter along inner margin. Hair 1-P single, long (0.1 mm); 2-P 1,2 forked, subequal to 1-P.

LARVA (fig. 9). Head: 0.6 mm. Antenna: 0.3 mm. Anal Saddle: 0.45 mm. **Head:** Integument usually extensively mottled, varying from greenish brown to dark reddish brown. Collar moderately wide (about 0.06 mm) and dark. Mental plate strongly sclerotized, almost black; median tooth moderately broad, about 1.5 as wide as adjacent tooth, tapered to a point. Inner clypeal hair (2-C) with about 8-10 barbs; outer clypeal (3-C) plumose with 8-10 short to moderately long branches; hairs 2-C widely spaced, clypeal index about 1.25. Hair 4-C single or forked apically, moderately long to long, usually extending to anterior margin of head capsule. Hairs 8,9-C 2,3 branched (2-4), large. Hairs 10,12-C 2-4 and 3-5 (3-6) branched respectively, moderately large. Hairs 13,15-C dendritic, strong and fairly long. **Antenna:** Mesal margin with numerous, moderately stout, acuminate spicules; ventral surface with fewer, shorter, stouter spicules; few or no spicules on dorsal surface. Hair 1-A 2-4 branched (2-5), small, slightly longer than width of antenna, inserted on basal third of antenna. Hair 4-A 2,3 forked (2-6), long. **Thorax:** Integument moderately to extensively pigmented, tawny to dark brown. Hair 1-P plumose, with a short to elongate flattened shaft and 21-24 (12-27) filiform branches; 2-P like 1-P but longer, 19-21 branched (19-29); hairs 1,2-P sharing common tubercle. Hair 9-P pectinate with 4-6 (4-7) long branches, long, subequal to 10-P. Hairs 10,12-P single and long. Hair 11-P 2,3 forked (2-4). Hair 14-P 5-10 branched (5-12), with a short flattened stalk. Hair 1-M 31-36 branched (21-46), with a broad, elongate, flattened shaft. Hair 2-M usually forked, 1-3 branched. Palmate hair 3-T with 10-14 (9-16) unsclerotized, moderately long, lanceolate leaflets. Hair 9-T pectinate with 3-5 branches (1-7) in apical half, very long. **Abdomen:** In general, the hairs with fewer and longer branches than in remaining species. Hair 0-II-VI 2-4 branched (2-6); 0-VI smallest; 0-VII 2 branched (1-4), small. Palmate hair 1-I with 12-14 (11-17) semitransparent, lanceolate leaflets; 1-II-VII with long, broad, heavily pigmented, lanceolate leaflets; 1-II,VII

smaller than 1-III-VI. Hair 2-II,III 3,4 branched (2-4), large; 2-IV,V single or rarely double, long; 2-V about 2.0 length of 2-IV. Hair 5-I 3 branched (3,4), moderate in size, located close to lateral margin; 5-III 5-9 branched (4-10), large. Hair 11-I 3,4 branched (2-5), large. Hair 13-I 3,4 branched (2-4), moderately large; 13-II 5,6 branched (3-8), moderately large; 13-III,IV 3,4 branched (2-4), large; 13-V 3-5 branched, very large; 13-VI 6-9 branched (3-10), moderately small. Tergal plate VII usually less than 2.0 size of plate VI. **Spiracular Lobe**: Pecten with 14-18 (13-21) acuminate teeth and with a conspicuous row of thin spinules on basal half of dorsal surface; teeth usually as follows beginning ventrally: (1) 1 long, (2) 5-12 mixed short to moderate, occasionally with a long interspersed, (3) 1 long, (4) 3-5 mixed short to moderate and (5) 2,3 long or combination of short and long. Lateral arm of spiracular apparatus very short to short, extending a short distance below the spiracular openings. Hairs 8,9-S 3,4 forked (2-5), with moderately long branches. **Anal Segment**: Hair 1-X single, very long, about 2.0 length of saddle, strongly developed; almost always inserted on saddle. Fine spicules over surface of anal segment except at base; spicules along apical border stronger and longer. Ventral brush (4-X) with 8 pairs of strongly developed, plumose hairs. Anal gills usually shorter than or equal to length of saddle, occasionally very short.

DISCUSSION. The monotypic Albimanus Group can be distinguished from the Oswaldoi Group in the **female** by the combination of (1) palpal segment 4 all dark or yellow to golden brown on mediolateral surface, never white or cream, (2) dark caudolateral scale tuft absent from abdominal segment II and (3) foretarsal segment 5 usually all dark; in the **male genitalia** by (1) sternite IX short, subrectangular, (2) ventral claspette completely without setae and with ventral surface produced into a pair of large, inflated, ovoid, bulbous lobes, (3) preapical plate very small, circular to oval, weakly sclerotized and (4) apex of ventral claspette rounded with a shallow median sulcus; in the **pupa** by the combination of (1) pinna of trumpet long, broad medially and appearing tapered toward apex, (2) hair 2-I 3-5 forked (2-6) about half distance from base, moderately developed, (3) hair 9-I very long, slightly shorter than or equal to 6-I, (4) hair 6-II single, very long, 2.0 or more length of 7-II, (5) hair 9-IV about 2.0 length of 9-III and (6) hair 9-VII,VIII long, about 0.5 length of segment; and in the **larva** by the combination of (1) inner clypeal hair (2-C) barbed and clypeal index about 1.25, (2) hair 4-C moderately long to long, (3) hair 1-P plumose with filiform branches, (4) hair 9-P,T pectinate, (5) hair 13-I,III,IV few branched, moderately large to large and (6) hair 1-X almost always inserted on saddle.

The external morphology of *albimanus* is very constant throughout its range. Usually the amount of intrapopulational variation is as great as or greater than the variation which occurs among populations, with the following exceptions. Many adults from southern Texas exhibit a greater proportion of dark basal banding on hindtarsal segment 2, often as much as 0.8 the length of the segment. Adults from the Antilles usually have proportionally smaller light areas on the foretarsus than those from the mainland. The extreme condition was observed in 4 specimens from Barbados that completely lack light apical rings on foretarsal segments 2 and 3. Similarly, hindtarsal segment 5 is predominately dark in several adults from Puerto Rico. The pupae from the Antilles often exhibit a greater number of branches than mainland specimens on many of the abdominal hairs. Noticeable characters in the larvae which vary among populations from different islands in the Antilles and also among different populations on the mainland are, (1) length of the median shaft of hair 1-P, which is usually moderately long but occasionally very short, (2) number and arrangement of pecten teeth and (3) size of the anal gills. Another variation, although not showing any

geographical pattern, occurs in several adults from Guayaquil (Ecuador), Acapulco (Mexico) and Barcelona (Venezuela); palpal segment 4 may be predominately light creamish brown, similar to that of *triannulatus*. Several of the specimens from Barcelona have a light apical band on foretarsal segment 4, also similar to that of *triannulatus*.

The small amount of morphological variation in *albimanus* is correlated with its genetic compatability and the stable banding pattern of the salivary chromosomes found among populations from several different localities. Hobbs (1962) examined 5 laboratory strains of *albimanus* from El Salvador, Guatemala, Mexico, Jamaica and the Gorgas Memorial Laboratory colony in Panama. He found that there were no heterozygous inversions and that the Mexico, El Salvador and Panama strains were interfertile. He concluded that there was no evidence for the existence of isolated strains and that *albimanus* is not polymorphic to any great degree. Similarly, Keppler and Kitzmiller (1969) showed complete reciprocal fertility between 4 field populations of *albimanus* from Mexico, Guatemala, Nicaragua, Costa Rica and one laboratory colony from El Salvador. Keppler, Kitzmiller and Rabbani (1973) examined the salivary chromosomes from the above 5 strains and found them to be "remarkably uniform," and after examining over 1000 slides discovered no individuals heterozygous for an inversion.

I believe that *albimanus* diverged from the main phyletic line very early in the evolution of the Albimanus Section (fig. 4). *An. albimanus* is the least derived species in the section and retains several ancestral characters which it shares with several species in the Argyritarsis Section of *Nyssorhynchus*. Almost none of these ancestral characters are found in the Oswaldoi Group except for a few in *triannulatus*. These characters are essentially those that distinguish the adult, male genitalia and larva of *albimanus* from the Oswaldoi Group, with the exception of the development of hair 9-P,T in the larva and the short ninth sternite in the male genitalia; the latter 2 characters seem to be derived since they occur nowhere else in the section.

Cytogenetically, *albimanus* is also quite distinct. In comparing the salivary gland chromosomes of *nuneztovari* with *albimanus, aquasalis* and *An. (Nys.) darlingi*, Kitzmiller, Kreutzer and Tallaferro (1973:443) stated that the similarities between *nuneztovari* and *albimanus* are not as "striking" as between *darlingi* and *aquasalis*. With respect to the banding of salivary chromosomes, *aquasalis* seems to be more like *darlingi* (of the Argyritarsis Section) than like *albimanus*. In comparing 3 species (*aquasalis, oswaldoi, albimanus*), Kitzmiller and Chow (1971:80-81) saw more homology between the salivary chromosomes of *aquasalis* and *oswaldoi* than they did between *aquasalis* and *albimanus*. Further they state, "If the *albimanus* salivary gland map is used as the standard map, it seems that many bands may probably have been added to *aquasalis* and *oswaldoi* by some process, perhaps duplication or translocation during evolution." The combination of these findings clearly indicate that *albimanus* is relatively remote from the remaining species in the Albimanus Section.

An. albimanus most likely evolved somewhere in Central America, radiating from its center of origin north and south along the Pacific and Atlantic seaboards. The species probably invaded the Greater Antilles via or south of the Yucatan Peninsula, becoming distributed throughout the Greater Antilles and the larger, more northern islands of the Lesser Antilles. Why *albimanus* has not invaded the southern islands of the Lesser Antilles is not known. The most likely explanation is that *albimanus* is still radiating from its center of origin and therefore has not yet been able to colonize the more southern islands in the Lesser Antilles. The rate at which colonization occurs is dependent on many factors and is different for each individual species. There

is considerable evidence that the Lesser Antilles are geologically more recent than the Greater Antilles (Martin-Kaye 1969; LePichon and Fox 1971), which *might* partially explain why *albimanus* has not yet extended its distribution into the Lesser Antilles.

Hoffmann (1938:176-178) described 2 interesting variations or mutants of *albimanus* (*bisignatus* and *trisignatus*) from the states of Tamaulipas and Veracruz, Mexico. These 2 "varieties" are distinguished by *bisignatus* having an additional black ring at the base of hindtarsal segment 3, and *trisignatus* having extra black rings at the bases of hindtarsal segments 3 and 4. Rozeboom (1963) established a colony of *bisignatus* and found that *trisignatus* individuals were fairly common in the F_4 generation. He stated that *trisignatus* apparently represents a more marked expression of the *bisignatus* gene or genes and that the trait was recessive. The occasional occurrence of these mutants probably led Martini (1935:24) to report *rondoni* from Mexico, most likely based on a female of *bisignatus*. I have examined specimens exhibiting either of these characters from Costa Rica, Guatemala and Texas.

BIONOMICS. Because of its medical importance, the literature on the bionomics of *albimanus* is voluminous. Several good reviews and/or studies concerning the natural history of *albimanus* include Breeland 1972a, c; Central America Malaria Research Station 1969-1972; Horsfall 1955:172-177; and Foote and Cook 1959:112-113.

The immatures have been found in the following aquatic habitats by the project "Mosquitoes of Middle America": potholes, drainage areas, spring seepages, borrow pits and ground pools (33%); ponds, lakes, dam spills and reservoirs (16%); streams and canals (21%); ditches (6%); swamps (6%); marshes (5%); crab holes (4%); animal and vehicle tracks (4%); rock holes (1%); and miscellaneous (4%). The immatures are tolerant of brackish water and were found in brackish habitats in about 3% of the collections. Previous studies indicate that *albimanus* can tolerate water up to and possibly greater than 0.67 seawater (Taylor 1966:394; van der Kuyp 1953; Horsfall 1955:172-177; Central America Malaria Reaearch Station 1970). The immatures are almost always collected in full sunlight or partial shade, although occasionally they are collected in deep shade. The breeding sites are usually characterized by abundant vegetation with scum and algae, and often are turbid with a muddy bottom. The immatures are often collected in polluted waters. The breeding sites are usually found in areas of secondary growth such as plantations, open woodlands and meadows. Aquatic plants often associated with the immatures are *Pistia* sp, *Elodea* sp, *Naias* sp, *Chara* sp and *Utricularia* sp.

At least 51 species in the family Culicidae have been found associated with *albimanus* including 2 species of the Albimanus Section, *triannulatus* and *aquasalis*. *An. albimanus* was most often collected with the following species in the majority of the habitats in which this species occurs: *Culex (Mel.) atratus, Cx. (Mel.) erraticus, Cx. (Cux.) nigripalpus, Cx. (Cux.) coronator* group, *Anopheles (Ano.) grabhamii, Uranotaenia (Ura.) socialis*; and to a lesser extent, *Psorophora (Gra.) confinnis* group and *Cx. (Mel.) pilosus*. Species commonly found in ground pool type habitats with *albimanus* are *An. (Ano.) neomaculipalpus, An. (Ano.) pseudopunctipennis, Aedes (Och.) taeniorhynchus, Ae. (Och.) tortilis, Ae. (Och.) scapularis, Cx. (Mel.) bastagarius, Cx. (Mel.) chrysonotum, Cx. (Mel.) dunni, Cx. (Mel.) educator, Cx. (Mel.) iolambdis, Cx. (Mel.)* spp, *Ur. (Ura.) geometrica* and *Ur. (Ura.) lowii*; and occasionally *An. (Ano.) apicimacula, An. (Ano.) punctimacula, Ae. (Och.) angustivittatus, Ae. (Och.) sollicitans, Cx. (Mel.) conspirator, Cx. (Cux.) declarator* group, *Ur. (Ura.) pulcherrima, Ps. (Gra.) cingulata* group, *Ps. (Gra.) jamaicensis* and *Chagasia* sp. Species associated with *albimanus* in ponds, lakes and marshes are *An. (Ano.) crucians, Aede-*

omyia (Ady.) squamipennis, Cx. (Mel.) madininensis, Cx. (Mel.) ocossa, Cx. (Cux.) maracayensis (?), *Mansonia (Man.) dyari, Ma. (Man.) titillans, Ps. (Gra.) pygmaea, Ur. (Ura.) apicalis, Dixella* sp, *Corethrella* sp 23 and *Co.* sp 36. In streams and ditches the following have been collected with *albimanus*: *An. (Nys.) argyritarsis, Cx. (Mel.) inhibitator* and *Ps. (Pso.) howardii*. Found rarely with *albimanus* in crab holes have been *Cx. (Cux.) habilitator, Cx. (Cux.) janitor, Deinocerites pseudes* and *De. cancer.*

An. albimanus is primarily restricted to the humid lowlands of Middle America, being most numerous up to an altitude of about 400 m, but occasionally it is collected at higher elevations. Molley (in Hoffmann 1932:528) collected *albimanus* near Guatemala City, Guatemala at 1372 m, and Clark in the same paper claims to have collected *albimanus* at 915 m in Costa Rica and 457 m in Haiti. The highest recorded altitude I have found was in Morelia, Mexico at 1941 m (Vargas and Martinez Palacios 1950:5).

The seasonal distribution of *albimanus* seems to vary from one locality to the next. Rachou, Lyons *et al.* (1965:37) stated that in El Salvador, in 6 of the 8 localities studied, *albimanus* was most abundant during the wet season and, in 2 of the 8, was most numerous during the dry season. The Central America Malaria Research Station (1969, 1970) and Breeland (1972b) reported that in some areas along the Pacific Coast in El Salvador, *albimanus* is predominant during the dry season because of the abundance of estuaries, rivers and permanent bodies of water along streams that get flushed out during the rainy season. However, in other areas *albimanus* is most abundant during the rainy season, in habitats such as ditches, flooded pastures and marshes (Breeland 1972a; Kumm and Zuniga 1944; Vargas and Martinez Palacios 1953; Paul and Bellerive 1947:63-66; Elliott 1968:242).

Most reports indicate that the adults of *albimanus* are most active from dusk to midnight (Breeland 1972a), sometimes beginning a little later, as in Colombia at 2200-2400 hours (Elliott 1972:757) and occasionally earlier, 1730-2100 hours in Haiti (Taylor 1966). Daytime adult resting sites include almost any protected area such as large rocks in wooded areas (Breeland 1972c; Central America Malaria Research Station 1970). Wilton and Fetzer (1972) showed human breath stimulated mating, which was at a maximum one hour after sunset in the laboratory, agreeing with the time Rozeboom (1941) observed in nature.

Taylor (1966) reports that in Haiti 75-92% of the biting activity was outdoors. Elliott (1968) also found that biting is greater outdoors than indoors. However, several workers report that in some areas, *albimanus* is the predominant mosquito biting indoors. Kumm, Komp and Ruiz (1940:388-389) stated that 96.4% of the anophelines captured in houses in Costa Rica were *albimanus* and 93.3% of those collected in stables. Kumm and Zuniga (1942:400) reported that in El Salvador, 87.6% of the house captures were *albimanus*. The conclusion of the 1970 report of the Central America Malaria Research Station was that *albimanus* may be more zoophilic than anthropophilic and more exophilic than endophilic but because of the "overwhelming" numbers becomes a serious problem. Host preference tests generally indicate that *albimanus* feeds principally on man and domestic animals, such as horses, cows, pigs, dogs, goats and chickens, and on nondomestic animals such as raccoons. It also prefers larger hosts to smaller (Breeland 1972a; Central America Malaria Reaearch Station 1970; Taylor 1966; Hill 1934; Thompson 1950; Weathersbee 1944).

An. albimanus is capable of flying considerable distances. LePrince and Orenstein (1916:114) released adults marked with an aqueous solution of an aniline dye, and recaptured individuals 366 to 1905 m from the release site. Hobbs, Lowe and Schreck (1974) reported release-recapture studies using fluorescent powders during

the dry season in El Salvador; 85,750 adults were released of which 924 were recaptured up to 11 days after release. The maximum distance the mosquitoes traveled was 3 km from the release site. The females were recaptured an average of 548 m from the release site and the males an average of 460 m. Lowe, Schreck *et al.* (1975) performed the same experiment at the same locality during the wet season, finding that the adults survived up to 14 days and were captured an average of 1000 m from their release sites.

MEDICAL IMPORTANCE. Kumm (1941a) stated that in 17 of 20 countries in the Caribbean region *albimanus* is the principal vector of malaria. Throughout its range *albimanus* is a very important vector of malaria except on the islands of Guadeloupe and Marie Galante in the Lesser Antilles. In some areas such as El Salvador it may be the only vector (Breeland 1972a). As early as 1909 Darling experimentally infected *albimanus*. He fed 100 mosquitoes on patients infected with *Plasmodium vivax* or *P. falciparum* and found 70.8% of the females became infected. Rozeboom (1938b:291-292) in one experiment infected 87.5% of the females of *albimanus* feeding on a patient with *P. falciparum*. For all Rozeboom's experiments in which a total of 113 *albimanus* fed on infected patients, 32.7% became experimentally infected.

Hill (1928:355) was the first to report finding *albimanus* naturally infected. Since then *albimanus* has been reported to be naturally infected in virtually every country in which it occurs. In general, natural infection rates have been reported to be exceptionally low. At the Central America Malaria Research Station (1970) a total of 434 salivary glands and 241 midguts of different females were dissected and none was infected. Likewise, Rozeboom (1938b:297) reported a natural infection rate of 1.1% in Santa Rosa, Panama. Because of the low infection rate, *albimanus* is considered by many to have the attributes of a relatively poor malaria vector. Nevertheless, Hobbs, Lowe and Schreck (1974) stated that even during the dry season *albimanus* is capable of surviving 11 days, a time long enough to become infective. The reason that *albimanus* is such an effective and successful vector is probably partly dependent upon its longevity and most importantly "because of its close contact with human populations and its relatively high population level . . ." (Belkin, Heinemann and Page (1970:26).

Warren, Richardson and Collins (1975) described 4 inbred morphological pupal phenotypes (pupal pleiomorphism) of *albimanus* that had been selected from a strain "established in September-October 1971 from female mosquitoes collected in stables near Lake Apastepeque, El Salvador." Interestingly, Warren, Collins *et al.* (1977) reported that the females of 3 of these phenotypes show considerable variation in their susceptibility to infection by *Plasmodium* sp. Their results indicate that all the phenotypes are much less susceptible to infection with *P. falciparum* than with *P. vivax*. The relative susceptibility of the different variants to infection with *P. vivax* was as follows: the green nonstriped phenotype was the most refractory; the brown, nonstriped phenotype intermediate; and the brown striped the most receptive.

A possible arbovirus in the Bunyamwera Group has been isolated from *albimanus* in Tlacotalpan, Veracruz, Mexico (Scherer, Campillo-Sainz *et al.* 1967). The Tlacotalpan virus was recovered in 1961 from 160 specimens collected at a pig baited, modified Magoon trap. The native population, cattle and pigs at several localities along the southeastern coast in the states of Veracruz and Tabasco, and one cow from the western central coast in the state of Nayarit showed antibodies to the virus.

Recently, Bautista-Garfias, Mercado-Sanchez and Morilla-Gonzalez (1977) experimentally infected females of *albimanus* with Venezuelan Encephalitis virus TC-83

by permitting them to feed on infected suckling mice. In a second experiment, 10, 11, 12 and 13 days after exposure to the virus, the females were again allowed to feed on mice. On their second feeding, the mosquitoes that had had an infected blood meal 10 days earlier transmitted the virus to one of the 6 mice to which they were exposed. The infected mouse died on the fifth day after exposure, and the virus was then "isolated and neutralized with a specific VEE antiserum."

DISTRIBUTION (fig. 1). *An. albimanus* is predominantly a tropical lowland species most abundant at elevations less than 400 m and occuring in greatest abundance in coastal plains or along waterways running to the coast. *An. albimanus* occurs as far north as the Brownsville area in Texas on the Gulf of Mexico. It extends south through Mexico and Central America and east along the Caribbean coast of Colombia to the Paria Peninsula in Venezuela. On the Pacific side it extends from Baja California Sur, Mexico to northern Peru (Piura). *An. albimanus* occurs commonly throughout the Greater Antilles, the Bahamas, the Florida Keys, the Cayman Islands and the Leeward Islands in the Lesser Antilles as far south as Montserrat and Antigua; it is found only occasionally on Guadeloupe (Basse Terre) and Marie Galante. *An. albimanus* does not occur in the Windward Islands of the Lesser Antilles, Trinidad, Tobago or farther southeast than the Paria Peninsula in Venezuela. It was reported to have occured in the past on Barbados (Charles and Senevet 1953; Rozeboom 1953), but it has not been found there recently.

Material Examined: 5467 specimens: 1026 males, 142 male genitalia, 2566 females, 624 pupae, 1109 larvae; 516 individual rearings: 228 larval, 214 pupal, 74 incomplete.

ANTIGUA (258 specimens: 32M, 10Mgen, 33F, 57P&p, 126L&l; 44 ind rear:22 l, 19p, 3inc). **St. George:** Emersons Pond, ANT 34. Fitches Creek, ANT 66, 67. **St. John:** Golden Grove Mill, ANT 32, 57. Potters, ANT 52, 53, 79. **St. Mary:** Bolands, ANT 61. **St. Paul:** Liberta, 8 Sep 1938, H. Box, 1M [BM1939-219]; same locality, ANT 89, 91. **St. Peter:** All Saints, ANT 36. **St. Philip:** Freetown, ANT 69, 70, 72, 73, 75, 76. **Parish and locality not specified:** 11 Apr 1900, W. Forrest, 1F on slide [BM]; 27 Nov 1900, same collector, 1M; 2 Dec 1900, same collector, 2F.

BAHAMA ISLANDS. Eleuthera (Island) (14F): Governor's Harbour, 31 Mar 1953, L. Giovannoli, E. Hayden, 3F. James Cistern, 1 Apr 1953, L. Giovannoli, E. Hayden, 11F. **New Providence** (Island) (55 specimens: 2M, 3F, 12P&p, 38L&l; 8 ind rear: 5p, 3inc): Harold Pond, BAH 46. Lake Cunningham, BAH 3. Yamacraw Beach, BAH 18. **San Salvador** (Island) (3F): Cockburn Town, 18 Mar 1953, L. Giovannoli, 2F. Locality not specified, 4 Sep 1923, P. Bartson, 1F.

BARBADOS (1M, 3F). Locality not specified, received 24 Apr 1928, 1M, 3F [JH].

BARBUDA (2L). Low Pond, 5 Jul 1955, Hummelinck, 2L.

BELIZE (170 specimens: 17M, 2Mgen, 150F, 1 l). **Belize:** Belize, BH A164; same locality, KO 115A-13, 14, 1M, 20F. Freetown, BH A186. Ladyville, BH 362. **Cayo:** Cayo, BH L37. Central Farm, BH L20. **Corozal:** Locality not specified, KO 115A-19, 5M, 30F. **Stann Creek:** Stann Creek, 30 Jul 1941, W. Kumm, 11F; same locality, KO 115A-17, 6M, 45F; same locality, KO 115A-23, 1M, 12F; same locality, KO 115A-24, 1M, 16F; same locality, 1F; same locality, 1M. **Toledo:** Punta Gorda, 9F; same locality, KO 115A-12, 1F. **District and locality not specified:** 1F.

CAYMAN ISLANDS. Grand Cayman (Island) (47 specimens: 3M, 2Mgen, 37F, 1P, 4L): North Sound Estate, CAY 119. West Bay, CAY 2, 10B. Locality not specified, CAY 11A.

COLOMBIA (30 specimens: 24M, 5Mgen, 1F). **Atlantico:** Calamar, 1966, J. Bequaert, 1F [MCZ]. **Cordoba:** Monteria, COL 421, 422.

COSTA RICA (179 specimens: 33M, 14Mgen, 100F, 19p, 13L&l; 16 ind rear: 7 l, 9p). **Cartago:** Atirro, CR 590. Concepcion, 26 Oct 1920[?], A. Alfaro, 5F. Turrialba, CR 394; same locality, 6, 7, 19 Sep 1920, A. Alfaro, 7F. **Guanacaste:** Liberia, 27 Jul 1962, F. Truxal, 1F; same locality, H. Kumm, 1Mgen [CU]. Palo Verde, CR 438. **Heredia:** Bolson, Jan 1921, A. Alfaro, 7F. **Limon:** Bananito, CRR 53, 1F. Cahuita, H. Kumm, no. 183, KO H-18-9, 1M. Finca La Lola, CR 160. Limon, F. Knab, no. 3151a, 1F; same locality, 1F (A-20) [CU]; same locality, 1F. Matina, 16 Jul 1925, CRR 20, 3M, 8F; same data, CRR 21, 4F; same data, CRR 22, 6F; same data, CRR 25, 3F;

same data, CRR 26, 4F; same data, CRR, 27, 3F; same data, CRR 28, 2F; same locality, 3 Sep 1925, CRR 37, 1F. Pueblo Nuevo, CR 546. Puerto Viejo, 12, 15, 15 Jan 1921, A. Alfaro, 4F. Westfalia, CR 473. Zent, CR 543; same locality, 15 Jul 1925, CRR 16, 1F; same data, CRR 17, 2F; same locality, 2 Sep 1925, CRR 36, 1F. **Puntarenas:** Boca del Rio Barranca, CR 1, 29. Dominical, 28 May 1943, T. Aitken, CRM 19, 1F; same locality and collector, 1943, CRM 25, 4F; same data, CRM 26, 2M, 5F. Nicoya, H. Kumm, KO H-18-5, 5M. Puntarenas, CR 117. Tarcoles, CR 569. **Province not specified:** Bamos, 1F. Barranca, H. Kumm, no. 82, 1M [BM1938-696]; same locality, 1F (82A) [CU]; same locality, 1F (A-17) [CU]. Las Canas, 2F (A-5). Margarita, 21 Jan 1930, W. Komp, 1M (var. *trisignatus*). San Antonio, 20 Jul 1925, CRR 31, 1F; same locality, 27 Aug 1925, CRR 35, 2F. Santa Cruz, 10 Dec 1937, 1F. Locality not specified, 1938, H. Kumm, CRR 132, 2M, 2Mgen.

CUBA (81 specimens: 37M, 3Mgen, 41F). **La Habana:** Habana, Oct 1900, Carroll, 1F; same locality, 14 May 1902, Taylor, 1M; same locality, Cornell U. Expedition, 1M (1027-693) [CU]. San Antonio de los Banos, J. Pazos, 1F (201). **Oriente:** Banes, 1F (22) [MCZ]; same locality, 1M, 3F (24) [MCZ]; same locality, 1M (25) [MCZ]; same locality, 1M, 1F (26) [MCZ]; same locality, 2F (28) [MCZ]; same locality, 2M, 4F (32) [MCZ]; same locality, 1F (34) [MCZ]; same locality, 2F (36) [MCZ]. Guantanamo, U. S. Naval Station, 27 Oct 1953, K. Knight, coll. 449, 6M, 5F; same data except 28 Oct, coll. 454, 1M. Guaro, 3M, 1F (6) [MCZ]. Levisa, near Nicaro, 9 Jul 1953, K. Knight, coll. 381, 1M. Preston, 2M (13) [MCZ]. **Province not specified:** Soledad, 12 Apr 1926, 2M, 4F (45) [MCZ]; same locality, 12 Dec 1926, 1F (45) [MCZ]; same locality, 1926, 1M (43), 2F (45) [MCZ]. Locality not specified, Sep 1934, 8M; J. Pazos, 12F; K. Knight, coll. 447, 1M; CUB 32.

DOMINICAN REPUBLIC (262 specimens: 29M, 7Mgen, 131F, 41P&p, 54L&l; 37 ind rear: 17 l, 18p, 2inc). **Barahona:** La Haya, Jan 1928, 2F. **Distrito Nacional:** Arroyo Hondo, RDO 4, 6. Finca Engombe, RDO 28, 39, 69, 148, 159, 200, 256, 257, 267. Rio Haina, RDO 150, 204. Naiboa, RDO 162. **El Seibo:** Rio Magua, RDO 189. **La Vega:** Jima Abajo, RDO 5. Rincon, RDO 11. **Samana:** Santa Barbara de Samana, RDO 44. **Sanchez Ramirez:** La Mata, RDO 16. **San Cristobal:** Boruga, Canada, RDO 174. La Toma, RDO 23. San Cristobal, RDO 144. San Francisco mines, RDO 181; same locality, A. Busck, Sep 1905, 1F. Villa Altagracia, 10 Jun 1941, 6M, 6F. **San Pedro de Macoris:** San Pedro [de] Macoris, 31 Mar 1928, P. Ricart, 1M. **Valverde:** Arroyo de Aqua, RDO 232.

ECUADOR (105 specimens: 12M, 1Mgen, 62F, 2p, 28L&l; 2 ind rear: 1 l, 1p). **El Oro:** Locality not specified, 1943, E. Hopkins, ECUK 43, 1F. **Guayas:** Chongon, ECU 132. Guayaquil, Jan 1939?, H. Hanson, KO 155-28, 1F; same locality, Apr 1940, J. Murdock, 5M, 10F; same locality and collector, KO 115-23, 2M, 2F; same locality, Aug 1943, KO 111-4, 1F; same locality, 4 Mar 1964, R. Schuster, GAL 16, 14F; same locality, F. Campos R., 2M, 13F; same locality, ECU 102, 177. El Triunfo, ECU 2. **Los Rios:** Pichilingue, 16 Mar 1946, E. Hambleton, 8F. **Province not specified:** Rio Milagro, Oct 1943, R. Levi-Castillo, KO 115A-4, 1M, 1F. Locality not specified, F. Campos R., 1F; R. Levi-Castillo, 6F.

EL SALVADOR (39 specimens: 11M, 7F, 9p, 12L&l; 9 l ind rear). **Cuscatlan:** Locality not specified, Aug-Nov 1940, F. Figueroa, 1M, 4F. **La Libertad:** Congrejera, SAL 56. Hacienda Melara, SAL 55. **San Salvador:** Ilopango, 1M, 1F. **San Vicente:** Laguna de Apastepegue, SAL 54. **Usulutan:** Espiritu Santo [Island], 602, 2M.

GUADELOUPE. Basse Terre (1F, 3L): Jarry, FWI 1030. Viard, FWI 943. **Marie Galante** (Island) (1M, 1Mgen, 7L): Marie Galante Airport, FWI 921. St. Louis, FWI 264. Locality not specified, LAR 16.

GUATEMALA (107 specimens: 12M, 6Mgen, 25F, 25P&p, 39L&l; 23 ind rear: 9 l, 11p, 3inc). **Escuintla:** Amatitlan, GUA 45, 46, 49. Puerto de San Jose, GUA 35. **Izabal:** El Cedro, GUA 95. Entre Rios, GUA 104. Finca Yuma, GUA 92. Morales, GUA 75. Pt. Barrios, 18 Aug 1903, W. Stone, 1F. **Peten:** Pueblo Nuevo, Nov 1941, 8F. [Laguna] San Juan Acul, Apr 1942, 2F. **Retalhuleu:** Champerico, GUA 21, 126. **Zacapa:** Teculutan, GUA 14. **Department not specified:** Esquipulas, 1939, 1M, 3F (var. *bisignatus*).

HAITI (252 specimens: 57M, 2Mgen, 117F, 37P&p, 39L&l; 19 ind rear: 8 l, 9p, 2inc). **Artibonite:** Gonaives, HAR 12. **Nord:** Limbe highway, HAR 42. **Nordouest:** La Pointe, HAT 118. **Ouest:** Arcahaie, HAT 9, 11. Carrefour, HAT 3, 7, 8. Petit Goave, HAR 33, 35. Port au Prince,

HAT 2, 109, 110, 132, 134; same locality, 30 Mar, E. Petersen, 3M, 1F; same locality and collector, Feb 1924, 1M, 1F. Thor, HAT 105. **Sud:** Godet, HAT 12. **Department not specified:** Mar Franc, 9 Jul 1941, Jobbins, 3F. P. Margot Rd., 25 Jun 1941, Jobbins, 7F. Locality not specified, Nov 1928, S. Cook, 1M, 3F; 29 Oct 1929, ?S. Cook, HAR 8; Oct 1929, S. Cook, HAC 2; 1 Jan 1930, ?S. Cook, HAR 11; 27 Jun 1941, Jobbins, 4M; no data, HAR 43.

HONDURAS (111 specimens: 11M, 1Mgen, 74F, 13p, 12L&l; 13 ind rear: 8 l, 4p, 1inc). **Atlantida:** Humazones, HON 59. Ceiba, 28 Jul 1945, 2M, 1F. Lancetilla, HON 29, 36. Las Brisas, HON 60. **Colon:** Puerto Castilla, HON 97, 99, 100; same locality, K. Maxwell, 3M, 3F. Truxillo [Trujillo], 28 Nov 1942, J. Duncan, KO 115A-11, 48F; same data, 5F. **Cortes:** Finca Chasnigua, HON 6. Puerto Cortes, HON 67. **Tegucigalpa:** Locality not specified, Jul 1945, KO 115-3, 1M. **Yoro:** Progreso, 26 Oct 1940, W. Komp, 1F.

JAMAICA (565 specimens: 71M, 10Mgen, 117F, 167P&p, 200L&l; 143 ind rear: 60 l, 65p, 18 inc). **Clarendon:** Milk River Bath, JA 868. **Kingston and St. Andrew:** Ferry, JA 350, 781, 896. Kingston, various dates 1902-1906, M. Grabham, 9M, 5F. Newstead, JA 962. Temple Hall, JA 46, 47, 48. **St. Ann:** Claremont, JA 742. Delight, JA 757. Runaway Bay, JA 766. **St. Catherine:** Caymanas, JA 1, 4, 29, 30, 32, 210, 743, 744, 746, 747. Central Village, JA 759. Congrieve Park, JA 22. Grange Farm, JA 20. Great Salt Pond Farm, JA 26. Gregory Park, JA 16, 17, 18. Naggo Head, JA 8, 10, 11, 23. Passage Fort, JA 12. Port Henderson, JA 9. Rio Cobre Dam, JA 819. Spanish Town, JA 24, 27, 35, 36. **St. Elizabeth:** Luana, JA 357. Black River, 2F. **St. Mary:** Castleton Botanical Gardens, JA 807. Fort Stewart, JA 808. **St. Thomas:** Albion Estate, JA 803, 873. Amity Hall, JA 58; same locality, 5 Dec 1962, T. Aitken, no. 53, 1F, 1L; same locality, 11 Dec 1962, T. Aitken, no. 136, 1P, 2L, 1 l. Chiswick, JA 65. Dalvey, JA 91, 148. Duckenfield Hall, JA 54, 55. Golden Grove, JA 56, 63. Grants Pen, JA 75, 77, 413, 800, 813, 814, 871, 872. Hampton Court, JA 149. Holland Bay, JA 57. White Bay, JA 121, 169. Winchester, 4 Dec 1962, T. Aitken, no. 5, 1F; same locality and collector, 5 Dec 1962, no. 25, 3F; same locality and collector, 6 Dec 1962, no. 44, 1F; same locality and collector, 7 Dec 1962, no. 38, 1F. Winchester House, JA 67, 205. Locality not specified, Mar 1928, M. Boyd, 2M, 9F. **Westmoreland:** Crab Pond Bay, JA 782, 785. Negril, JA 231, 935. **Parish not specified:** Cave Stream, R. Hill, no. 28, 1M, 1F. Locality not specified, 7 Dec 1899, F. Cundall, M. Grabham, 1F [BM]; 8 Feb 1900, M. Grabham, 1M, 1F [BM]; 19 May 1905, N. Y. S., 1M, 1F; 1910, F. Theobald, 1L (396) [BM]; 1932, Washburn, 1F [BM1933-6].

MEXICO (212 specimens: 10M, 7Mgen, 160F, 11p, 24L&l; 10 ind rear: 5 l, 5p). **Baja California Sur:** San Jose del Cabo, 23 Jan 1979, A. Bourge, D. Pletsch, 4F. **Guerrero:** Acapulco Airport, 4 Feb 1975, D. Pletsch, 1F. **Jalisco:** Puerto Vallarta, MEX 457. **Nayarit:** San Blas, 25-29 Jun 1956, W. McDonald, 14F, 2L. **Oaxaca:** Tehuantepec, MEX 106. **Quintana Roo:** Cancun, 22 Aug 1975, D. Pletsch, 1F. **Tabasco:** Tenosique, MEX 575. Villahermosa, 20 Jan 1942, 3F. **Tamaulipas:** Gonzalez, MEX 203, 204. Padilla, MX 13. Tampico, MEX 205, 206, 207, 208. **Veracruz:** El Naranjo, MEX 101. St. Lucrecia, Oct 1911, F. Urich, 1F. Tampico, 3 Sep 1902, Goldberger, 1M, 6F; same locality, 22 Jan 1921, J. Prince, 36F; same locality and collector, 10 Mar 1921, 1F; same locality and collector, 17 Dec 1921, 1F. Veracruz, 3F. **Yucatan:** [Isla de] Cozumel, 9 Dec 1942, D. Hall, 40F. Progreso, 25 Oct 1927, C. Hoffmann, 1F [AMNH]. **State not specified:** "Boleta 408," KO 115A-1, 1M. Intapa, 31 Oct 1973, D. Pletsch, 1F. Locality not specified, MEX 742.

MONTSERRAT (136 specimens: 11M, 6Mgen, 20F, 36P&p, 63L&l; 26 ind rear: 22 l, 1p, 3inc). **St. Anthony:** Delvins Village, MNT 81. Elberton Estate, MNT 2, 3. Foxs Bay, MNT 9, 10, 11, 39, 41, 43, 84, 88, 93. **St. Peter:** Happy Hill Village, MNT 15. Old Road Estate, MNT 50. Olveston Estate, MNT 24, 55. **Parish and locality not specified:** LAR 14.

NEVIS (145 specimens: 14M, 18F, 31P&p, 82L&l; 23 ind rear: 14 l, 4p, 5inc). **St. Paul Charlestown:** Charlestown, LAR 11. **St. Thomas Lowland:** Cades Bay, NVS 13. Cotton Ground, NVS 14. Paris Pond, NVS 1, 2, 46. Pinneys Estate, NVS 17, 47, 18, Vaughans, NVS 16.

NICARAGUA (215 specimens: 35M, 7Mgen, 115F, 15P&p, 43L&l; 14 ind rear: 8 l, 6p). **Chinandega:** Corinto, 13 Sep 1943, H. Crowell, KO 115-9, 16F; same locality and collector, 15 May 1945, KO 115-4, 1F; same locality and collector, 13 Sep 1945, KO 115-11, 11F. **Granada:** Granada, NIR 2, 2F; same locality, 26 Nov 1924, NIR 3, 1F; same locality, NIR 6, 3M, 1Mgen, 6F. **Leon:** Las Penconas, NI 22. Pantano El Esparto, NI 19, 29. Puerto Somoza, NI 16, 20, 25, 28. Simonillo, NI 30. **Managua:** Lago de Managua, NIR 5, 2M, 1Mgen, 4F. Managua, NIR 17, 3M,

10F. Tipitapa, 3 Jan 1925, NIR 16, 1M, 1Mgen, 4F. **Rivas:** Rivas, 21 Nov 1924, NIR 22, 1M, 1F. **Zelaya:** Bluefields, 13 Aug 1943, P. Woke, KO H-18-14, 1M, 2F; same locality, NI 39; same locality, 9F. Rama, 17 Aug 1943, P. Woke, 2M, 5F. **Department not specified:** El Recreo, 20 Aug 1943, P. Woke, KO H-18-13, 1M. "Pila Office," NIR 14, 5M, 1Mgen, 6F; same locality, NIR 15, 7F. Locality not specified, NIR 4, 2M, 1Mgen, 1F; NIR 9, 10M, 1Mgen, 4F; NIR 10, 1M, 2F; NIR 13, 3F; NIR 19, 1F; NIR 20, 1M; 22 Nov 1942, 4M, 1F.

PANAMA AND CANAL ZONE (1770 specimens: 394M, 47Mgen, 1012F, 108P&p, 209L&l; 100 ind rear: 26 l, 46p, 28inc). **Bocas del Toro:** Almirante, PA 669; same locality, Jan 1930, PAX 6, 16M, 19F. Big Creek, PA 652. Milla 2, PA 337. Punta de Pena, PA 238. **Canal Zone:** Ancon, Jul 1941, PAX 181, 2M, 6F; same locality, 7M, 44F [CU]. Chulupi, Rio Chagres, 31 Mar 1944, Pierce, KO 115A-32, 7M, 27F. Corozal, 3 Jul 1922, J. Shropshire, 1F [MCZ]. Cristobal, 13 Jul 1944, Sterns, *et al.*, ASM 68-1, 3M, 2F, 10L [CU]; same data, 49-68-1 [ASM 68-1], 2M, 1Mgen. Culebra, 3 May 1925, D. Baker, 3F [MCZ]; same locality and collector, 1925, 1M. Empire, 27 Oct 1924, J. Zetek, 1F [MCZ]. Escobal, PA 1158, 1159. Fort Clayton, 21 Mar 1925, D. Baker, 1F [MCZ]; same locality, Nov 1939, W. Komp, 1M, 3F; same locality, 1944, ASM 66-1, colony, 4M, 1Fgen, 3L [CU], 1F; same locality, Nov 1939, W. Komp, KO H-18-8, 1M. Fort Kobbe, 27 Oct 1939, PAX 149, 5M; same locality, 6 Feb 1963, F. Padilla, CZ 23, 1L; same locality, 10 Feb 1964, J. Rodriquez, CZ 118, 1 lpF, 1L. Fort Thomas, 3F [MCZ]. France Field, 19 Nov 1924, J. Zetek, 1F [MCZ]; same locality, 1925, Baker, 1M, 2F. Gamboa, Rio Chagres, 4 Oct 1944, Wood, Middlekauff, ASM 195-1, 2L [CU]. Gatun, Jan-Feb 1913, J. Zetek, 4F [AMNH], 92F. Juan Mina, Rio Chagres, 23 May 1939, PAX 112, 3M, 16F; same locality, PA 1122, 1123, 1125, 1160. Madden Dam, PA 1137. Mindi, May 1941, KO 115-10, 1M, 2F; same locality, KO 115-17, 5F. Mojo Pollo, Rio Chagres, 31 Mar 1944, KO 115A-15, 9M, 3F. Pacific side, Feb 1943, KO 115A-25, 1F. Paraiso, A. Jennings, 1M [CU]. Locality not specified, Feb 1933, D. Curry, 1M, 3F [BM1933-504]; Jun 1941, KO 115A-9, 2M, 1F; Jun 1941, KO 115A-30, 3M, 4F; 1941, KO 115-12, 2F; Jan 1943, KO 115-44, 8M, 9F; Jan 1944, KO 112-10, 1F; 6 Jul 1950, 4F; H. Crowell, KO 115-8, 7M, 3F; KO 115A-29, 1F; KO 115-45, 7M, 19F. **Colon:** Portobelo, PA 604. Santa Rosa, 28 Jul 1943, G. Fairchild, KO 115A-26, 3F; same locality, PA 43. **Darien:** Pucro, PA 631. **Los Santos:** Cape [Punta] Mala, 3 Feb 1944, Marucci, Wood, KO 115A-2, 3M, 3F. **Panama:** Chepo, PA 1064. Isla de San Jose, 15 Mar 1944, KO 115-27, 2F; same locality, 25 Jul 1944, KO 115A-7, 2F. Juan Diaz, PA 749, 801, 836. Juan Franco, 6 Jul 1941, PAX 177, 1M, 4F. Juan Mina, 6 Aug 1943, G. Fairchild, KO 115A-28, 23F; same locality and collector, 31 Aug 1943, KO 115A-27, 14F; same locality, date and collector, 5F; same locality and collector, 3 Sep 1943, KO 115A-18, 25F; same locality and collector, 5 Oct 1943, KO 115A-10, 18F; same locality, 17 Jul 1949, 11 [JH]; same locality, 25 Jul 1949, 12 l [JH]; same locality, G. Fairchild, KO 115A-16, 6F. La Chorrera, 4 Jul 1944, 49-36-2 [ASM 36-2], 1M, 1Mgen, 2F; same locality, 6 Nov 1944, ASM 270-1, 6L [CU]; same locality, 2 Dec 1944, Wood, Griffing, ASM 328-1, 3L [CU]; same locality and date, ASM 329-1, 5L [CU]; same locality, 7 Dec 1944, ASM 334-1, 1Fgen, 11L [CU]; same locality, 7 Dec 1944, 1F; same locality, 13 Jan 1945, ASM 378-1, 1M [CU]; same locality, 23 Jan 1945, ASM 382-2, 2M [CU]; same locality, 16 Jul 1945, ASM 655, 1F; same locality and date, 5F; same locality, 27 Nov 1944, Wood, Griffing, ASM 299-2, 1L [CU]. Las Guacas, PA 13. Pacora, PA 1063. Paitilla, PA 755, 780. Panama City, 15 Sep 1935, PAR 25, 4M, 3Mgen. Panama Viejo, 27 Jul 1935, PAR 18, 1M, 1Mgen, 44F; same locality, 17 Nov 1944, R. Arnett, K. Frick, ASM 283-1, 1L [CU]. Tocumen, PA 547, 1147. **Province not specified:** Aguadiente, 31 Jan 1935, PAR 75, 74M, 3Mgen. Lagarto, 26 Jul 1945, Van Doran, ASM 680-2, 2F. Rio Chagres, 12 Feb 1943, KO 115A-8, 17M, 18F; same locality, 25 Jul 1945, Van Doran, ASM 679-1, 1F. Rio Pescado, 7 May 1937, 1M, 2F. Sabanas Rd., 30 Oct 1934, 1M, 1F. Laboratory colonies, PA 1178, PAR 118A, 120, 123, PAX 60, 61, 62, 63, 64, 65; colony, 17 Aug 1937, 3M, 2Mgen, 9F; colony, 31 Jul 1937, 1M, 1Mgen, 20F. Locality not specified, 28 Mar 1935, PAR 78, 1Mgen; 2 Oct 1935, PAR 92, 12M, 3F; 31 Jul 1937, 1M, 14F; no data, 3F.

PERU (10 specimens: 1M, 1Mgen, 2F, 3p, 3L&l; 3 ind rear: 2 l, 1p). **Piura:** Mallares, PER 18.

PUERTO RICO. Culebra Island (2M): Locality not specified, 20 Jan 1954, H. Hurt, 1M (567); same collector, 21 Jan 1954, 1M (569). **Puerto Rico** (Island) (416 specimens: 185M, 4Mgen, 151F, 27P&p, 49L&l; 16 ind rear: 5 l, 9p, 2 inc): Aguirre, 10 May 1920, H. Green, 2M, 2F. Arecibo, Mar 1942, H. Pratt, 2L. Carolina, Mar 1942, W. Hoffman, H. Pratt, 7p. Catano, PRA 31; same locality,

10 Nov 1943, H. Pratt, 1L. Cayey, 2 Dec 1943, J. Maldonado-Capriles, H. Pratt, 5L. Dorado, PR 151. Fort Buchanan, 14 Dec 1942, T. Aitken, 2M, 2F; same locality, 13 Jan 1943, H. Pratt, 1F; same data except 19 Jan, 2M; same data except 26 Jul, 1Mgen; same locality, PRA 69. Gurabo, PR 123; same locality, H. Pratt, 2L. Juan Diaz, Jul 1944, KO 106-17, 2M. Lares, 28 Apr 1944, H. Pratt, 1L. Levittown, PR 160, 166. Loiza, KO 115-1, 53F; same locality, KO 115-7, 6F. Loiza Aldea, 12 Sep 1935, R. Watson, 2F. Losey Field, 18 Nov 1942, A. Pritchard, 7L; same locality, 1944, H. Pratt, KO 115-5, 30M; same locality, KO 115-13, 42M; same locality, KO 115-16, 32M. Mayaguez, 25 Feb 1936, G. Tulloch, 9M, 14F; same locality, PR 116. Puerto Arturo, 30 Oct 1940, KO H-18-10, 3M, 2Mgen, 4F. Punta Salinas, 28 Mar 1942, W. Hoffman, H. Pratt, 3P. San Juan, Jan 1914, 1M, 2F; same locality, 3L. Tortuguero, Camp, 6 Feb 1943, G. Bradley, 3F. Tortuguero, Laguna, 25 Aug 1942, E. Charneco, 2L; same locality, 15 Dec 1944, H. Pratt, 2L. Yauco, 26 Dec 1942, J. Maldonado-Capriles, 5L. Locality not specified, Feb 1914, W. Wippitt, 2M, 6F; KO 115-2, 40M; H. Pratt, PRX 13, 2M, 1F; no data, 1M, 3F. **Vieques Island** (21 specimens: 5M, 1Mgen, 7F, 2p, 6L&l; 2 inc ind rear): Locality not specified, 27 Feb 1942, H. Hurlbut, 1 lp (AA 2-27-42-1); 3 Mar 1942, H. Hurlbut, 1 lp (AA 3-3-42-3); 1942, H. Hurlbut, 5M, 1Mgen, 6F, 4L; 10 Jan 1943, H. Pratt, 1F.

SAINT MARTIN (1L). Old Battery Cistern, 3 Jun 1955, Hummelinck, 1L (529b).

UNITED STATES. FLORIDA (24 specimens: 11F, 1p, 12L&l; 1 inc ind rear). **Monroe Co.**: Big Pine Key, 26 Mar 1948, J. Haeger, 1 lP (274-101) [CU]. Key West, 5 Sep 1946, Fernandez, 1F; same data except 25 Sep, 1F; same data except 26 Sep, 1F; same data except 17 Oct, 1F; same locality, C. Gardner, 2F. Marathon Key, 7 Aug 1946, USPHS, 1F. Stock Island, 31 Oct 1946, Fernandez, 1F; same locality, 15 Oct 1959, W. Warner, 1F; same data except 20 Oct, 1F. Vaca Key, 27 Aug 1947, W. Buren, 1F. Locality not specified, "Sta 338," 7 Dec 1949, J. Haeger, 11L. **TEXAS** (97 specimens: 8M, 4Mgen, 65F, 20L). **Cameron Co.**: Brownsville, 13 Oct 1923, R. Turner, 13F; same data except 24 Oct, 2F; same locality, 29 Nov 1939, 2F; same locality, reared 14 Dec 1939, 2M; same locality, 6 Aug 1942, W. Gordon, 1M, 1Mgen, 13F [CU]; same data except 10 Aug, 1M, 1Mgen, 5F [CU]; same locality, 13 Sep 1942, E. Garbera, 1F; same locality, 26 Sep 1942, E. Ross, 1L [ANS]; same locality, 28 Sep 1942, E. Ross, H. Roberts, 3F; same locality, 12 Oct 1942, T. Burns, 5F; same locality, 19 Nov 1942, E. Gerberg, 1Mgen, 3F [CU]; same locality, 1942, 1M, 1Mgen [CU]; same locality, 5 Jun 1943, W. Gordon, 5F [CU]; same locality, Jan 1944, C. Joyce, 1M; same locality, Oct 1944, R. Usinger, 5L; probably same locality, KO 115-25, 12F. Combes, Oct 1944, R. Usinger, 7L. Harlingen, Jan 1944, Col. Pfrejer, 1L. Locality not specified, 11 Jun 1937, T. McGregor, 1M. **Hidalgo Co.**: Edinburg, Oct 1944, R. Usinger, 3L. McAllen, 4 Nov 1923, R. Turner, 1F. **County not specified**: Rancho Viejes, Resaca, Oct 1944, R. Usinger, 2L. Yturria, Oct 1944, R. Usinger, 1L.

VENEZUELA (111 specimens: 6M, 1Mgen, 85F, 6P&p, 13L&l; 6 ind rear: 4 l, 1p, 1inc). **Anzoategui**: Barcelona, 8-15 Aug 1940, VZK 45, 1M; same locality, 25 Sep 1944, VZK 17, 1M, 2F; same locality, 26 Sep 1944, W. Komp, KO 115A-33, 13F; same data, KO 115-37, 11F; same data, KO 115-40, 10F; same data, KO 115-43, 18F. Puerto La Cruz, 27 Sep 1944, VZK 24A, 3M, 5F; same locality, 26 Sep 1944, KO 111-21, 18F; same locality, 25 Sep 1944, VZK 19, 1F. **Aragua**: Turiamo, 13 Aug 1944, E. Winton, KO 111-12, 2F. **Carabobo**: Boca de Yaracuy, VZ 259. La Cabrera Peninsula, VZ 93, 94, 95. Puerto Cabello, 12 Jul 1927, F. Root, 1M [BM1929-194]. **Zulia**: Independencia, Nov 1949, A. Gabaldon, 3L (1375, 210, Zone I, Lot 98). **State and locality not specified**: 14 May 1940, VZK 44, 1F.

VIRGIN ISLANDS. St. Croix (Island) (5L): Bethlehem, Nov 1939, H. Beatty, 2L. Caledonia, VI 12. **St. John** (Island) (1 lpM): Leinster Bay, VI 6. **St. Thomas** (Island) (1M, 1F): Locality not specified, LAR 1A.

OSWALDOI GROUP

FEMALES. Head: Light to dark. Palpal segments 2 and 3 predominantly dark with a small to medium white band at apices; erect outstanding scales on segments 1, 2 and basal 0.3-0.5 of 3, becoming less outstanding toward apex of 3; segment 3 with or without dorsolateral, golden to white speckled, longitudinal stripe; segment 4 with at least some white or cream on mediolateral surface, base and apex usually with brown band; segment 5 completely white or with small dark basal band. **Thorax:** Pruinose and scale patterns and color same as in section description. Occasionally upper *mep* with few light scales. Anterior *mep* with light scale patch in *triannulatus* only. **Legs:** Foretarsal segments 2 and 3 basally dark at least on dorsal surface and light in about apical 0.2-0.9 of segment; segment 4 usually all dark at least on dorsal surface, occasionally with a few golden to cream, apical scales or with a broader apical light area (*triannulatus*), rarely predominantly light (some *ininii*); segment 5 usually dark in about basal 0.5 and light in apical 0.5, but varying from predominantly dark (*triannulatus*) to predominantly light (some *strodei* and *ininii*). Midtarsal segments 1, 2 and 3 with a small to moderate, apical, light area, basally predominantly dark at least on dorsal surface; segment 4 all dark at least on dorsal surface, except in *ininii*; segment 5 with apical 0.3-0.5 golden to white, rarely completely cream (some *ininii*), usually dark at least on dorsal surface in basal 0.5-0.7. Hindtarsal segment 2 with basal 0.10-0.85 dark, apical remainder white; segment 3 usually all white, rarely dark at least on dorsal surface in basal 0.3 (0.20-0.35) of segment (*rondoni* and mutants); segment 4 light, very rarely basally dark (mutants). Dark basal areas and light apical areas of foretarsal segments 2-5, light apical areas of midtarsal segments 1-5 and dark basal area of midtarsal segment 5 appearing as complete or incomplete, light and dark bands or rings; light bands almost always complete (entirely encircling segment); dark basal bands usually appearing complete or almost complete with light scales usually on ventral surface. Hindtarsal segment 2 with dark basal area appearing as a dark basal band; segment 5 with basal dark and apical light areas appearing as complete bands. **Wing:** Wing spots as in section description, highly variable and important in species diagnoses. **Abdomen:** Caudolateral scale tufts present on tergites and sternites II-VII. Sternite I usually with a few, moderately long to long setae and occasionally some inconspicuous obovate to lanceolate, light scales in basal half.

MALES. Essentially as in females except for sexual characters. **Head:** Palpal segment 4 with a subbasal and a subapical dark band, ventral surface usually with some dark scales, rest of median surface predominantly light. **Antenna:** 0.75-0.85 length of proboscis. **Legs:** Forefemur 0.55-0.70 length of proboscis. Basal plantar surface of foretarsal segment 5 with short to long, spiniform setae.

MALE GENITALIA. Segment IX. Sternite moderately long to long, with a short to long, variously shaped, nonspiculose apodeme along anterior border. **Sidepiece, Clasper:** As in section description. **Claspettes:** Ventral claspette with setae at least on basal lobules in Oswaldoi Subgroup, or without setae and apicolaterally produced into auriculate lobes in the Triannulatus Subgroup. Preapical plate and apex of ventral claspette variously developed. **Phallosome:** Triannulatus Subgroup without leaflets; Oswaldoi Subgroup with or without leaflets.

LARVAE. Moderate to large, rarely small (*triannulatus*). **Head:** Moderately to heavily sclerotized. Median tooth of mental plate narrow to broad. Hairs 2-C widely spaced except in *anomalophyllus* and *strodei*. Hair 3-C equal to or shorter than 2-C. Hair 4-C usually short and branched, except in *nuneztovari* and *trinkae*. Hairs 8,9-C dendritic or weakly plumose, moderately small to large. Hairs 10,12,13-C large in

triannulatus and *ininii*, small to moderate in remaining species. Hair 15-C moderately large to large, single to numerously branched. Collar narrow to wide, heavily sclerotized. **Antenna**: Weakly to heavily pigmented. Spicules on mesal margin short and thin to long and stout. Hair 1-A small to moderately large or occasionally large (*ininii, benarrochi*). **Thorax**: Moderately to heavily pigmented. Submedian prothoracic group (1-3-P) with or without 1,2-P sharing a common tubercle; 1-P palmate. Hairs 9,10,12-P single and long; 12-P longer than 9,10-P; 9-P subequal to 10-P; 11-P double or rarely triple, branched about 0.25 from base, about 0.5 or less length of 12-P. Hair 14-P with a moderately short to long, flattened shaft. Mesothoracic hair 1-M usually ovoid to elliptical in outline, with elongate flattened shaft. Metathoracic hair 2-T moderately long to long. Hair 3-T palmate, transparent to weakly pigmented, brushlike or with spreading lanceolate leaflets. Hairs 9,10-T single and long, 9-T shorter than 10-T. **Abdomen**: Hair 0-II-VII with few to numerous branches, usually more than 3 except in some *trinkae*. Palmate hair 1-I unpigmented to weakly pigmented, leaflets narrow to moderately wide; 1-II-VII usually strongly sclerotized, with long, narrow to broad, lanceolate leaflets. Hair 2-II highly variable, 3-10 branched. Hair 5-I small to large, 2-12 branched. Hair 11-I moderately large to large. Hair 13-I more than 3 branched (4-9), except in *triannulatus* and *benarrochi*. Hair 13-II,III small to moderately large, numerously branched (except 13-II in *triannulatus*); 13-IV small to moderate, never as large as in *albimanus*; 13-V moderately large to very large. **Spiracular Lobe**: Pecten highly variable. Lateral arms of spiracular apparatus varying from very short and directed caudolaterally to long and directed laterally. **Anal Segment**: Covered with spicules. Saddle reddish brown. Hair 1-X short to long, inserted on or not inserted on saddle. Anal gills short to long.

DISCUSSION. The species comprising the Oswaldoi Group are distinguished from that in the Albimanus Group in the females by (1) palpal segment 4 with at least some white or cream on mediolateral surface, (2) presence of dark caudolateral scale tufts on abdominal segment II and (3) foretarsal segment 5 usually with at least an apical light band to occasionally completely light, except in some *strodei* and *triannulatus* where it is all dark; in the **male genitalia** by (1) sternite IX moderately long to long, subtrapezoidal or subtriangular, (2) ventral claspette with setae, *or if* without setae *then* apex of claspette expanded laterally into large auriculate lobes and (3) ventral surface of ventral claspette without bare, inflated, ovoid, bulbous lobes; in the **larvae** by (1) hair 4-C usually short except in *trinkae* and *nuneztovari* where it is longer, (2) hair 1-P palmate, (3) hair 9-P,T single and (4) hair 13-I,III,IV small to moderately large, *or if* large *then* hair 11-I large and 5-7 branched.

I am separating the Oswaldoi Group into 2 distinct subgroups, the monotypic Triannulatus Subgroup and the Oswaldoi Subgroup composed of 12 species (fig. 4). Almost all the characters separating the Oswaldoi Group from the Albimanus Group are derived, with the exception of those mentioned on page 14. *An. triannulatus* is the least derived species in the group, retaining many characters that are intermediate between the Albimanus Group and the Oswaldoi Subgroup. For example, in the female of *triannulatus*, (1) palpal segment 4 is usually darker than in the Oswaldoi Subgroup, but not as dark as in *albimanus* and (2) foretarsal segment 5 is predominantly dark; and in the larva, (1) hair 1-P is not plumose as in *albimanus*, but has numerous and very slender, almost filiform branches and (2) hair 13-I,III,IV is relatively large and few branched, as in *albimanus*.

The Oswaldoi Subgroup is a collection of very closely allied species. Their external morphology is interspecifically very similar and usually highly variable intraspecifically. For these reasons the keys are not always reliable, particularly in some cases for

the adult females and pupae. In *most* instances, the adult females of *aquasalis, rangeli, rondoni, oswaldoi, ininii* and *nuneztovari* are easily identified. *An. aquasalis* can be confused with *benarrochi*; however, since the distributions of the 2 species are so different, this usually is not a problem. *An. trinkae* is difficult to identify because the humeral light spot on the costal vein is not always less than twice the length of the basal dark spot. *An. oswaldoi* may be confused with *strodei, ininii* and occasionally *noroestensis*, so it is necessary to refer to the secondary characters listed in the key. *An. anomalophyllus* is very similar to *strodei*, but it is rare and encountered only in Panama and Costa Rica. Again it is reemphasized that reference should be made to the individual species description, discussion, bionomics and distribution sections when attempting to identify any specimens in this group.

The Oswaldoi Group is more or less restricted to tropical Central and South America, and is predominantly of South American origin. Only the relict species, *anomalophyllus*, appears to have evolved in Central America. The other species occurring in Central America, *aquasalis, oswaldoi, triannulatus* and *strodei*, probably have invaded this area in recent times. *An. strodei* extends the farthest north, having been collected in the state of Veracruz, Mexico (Vargas and Martinez Palacios 1956:142). On the Pacific side of the Andes, northern Peru is the southernmost limit of the group. Only one species, *aquasalis*, has invaded the Lesser Antilles, extending as far north as the island of Antigua. *An. aquasalis* is capable of breeding in brackish water which may explain its success in colonizing these Caribbean islands. East of the Andes the group extends as far south as the northern provinces of Argentina.

OSWALDOI SUBGROUP

FEMALES. Moderately large to large. **Head:** Palpal segment 4 predominantly white, usually with a basal and an apical dark band, and often with dark scales of varying amounts on ventral surface. **Thorax:** Integument light brown to almost black. Median anterior promontory area with long white scales often extending dorsad onto anterior of acrostichal line. Anterior *mep* without scales. **Legs:** Foretarsal segments 1-4 with varying amounts of white; segment 5 usually with apical 0.5 or more golden to white, except in some *strodei*. Midtarsal segment 3 with a small, apical, cream band. **Wing:** Variable. Vein C humeral light spot usually large except in most specimens of *nuneztovari* and *trinkae*.

MALES. Essentially the same as in female except for sexual characters. **Head:** Palpal segment 4 with a basal and an apical light band and with or without a subbasal and a subapical dark band, mediolaterally extensively cream to white, ventral surface dark. **Thorax:** Anterior *mep* without a scale patch.

MALE GENITALIA. Segment IX: Sternite moderately long to long, subtriangular or subtrapezoidal, with short to long, variously shaped, nonspiculose apodeme along anterior border. **Sidepiece, Clasper:** As in group description. **Claspettes:** Dorsal claspette as in species descriptions. Ventral claspette never bare, with short to long setae on basal lobules, or on basal lobules and on lateral and ventral surface of fused portion of lobe, setae extending to or near to apex. Preapical plate variable in shape and pigmentation. **Phallosome:** Aedeagus with or without leaflets; apex less than 1.5 as long as wide.

LARVAE. Moderate to large. **Head:** Hairs 2,3-C single and simple, barbed or plumose with short to long branches in about apical half; hairs 2-C narrowly or widely spaced. **Antenna:** Hair 1-A short to moderately long, except in *benarrochi* and *ininii*. **Thorax:** Submedian prothoracic group (1-3-P) with hair 1-P with fewer than 16 (except in some *strodei* and *ininii*) narrow to broad, lanceolate leaflets; 1,2-P with or

without common tubercle. Hair 14-P with a short to moderately long, flattened shaft. Metathoracic hair 3-T with semitransparent or weakly pigmented leaflets. **Abdomen**: Palmate hairs narrow to broad. Hair 11-I moderately large, 2-4 branched. Hair 13-I small to moderately large, usually more than 3 branched; 13-III usually small and numerously (5-14) branched; 13-IV small to moderate. Sclerotized tergal plate VII equal to or less than about 1.7 size of tergal plate VI. **Spiracular Lobe**: Pecten variable. Lateral arms of spiracular apparatus very short to moderately long, except long in *ininii*. **Anal Segment**: Covered with spicules. Hair 1-X moderately long to long, inserted on or not inserted on saddle. Anal gills short to long.

DISCUSSION. Members of the Oswaldoi Subgroup can be distinguished from the Triannulatus Subgroup in the female by (1) palpal segment 4 more predominantly white, (2) absence of anterior mesepimeral scales, (3) absence of a large apical light band on foretarsal segment 4, except occasionally in *nuneztovari* and *ininii* and (4) foretarsal segment 5 half to completely light, except in some *strodei*; in the male genitalia by the presence of setae at least on the basal lobules of the ventral claspette; and in the larvae by (1) palmate hair 1-P usually with fewer than 16 narrow to broad leaflets, (2) hair 14-P with a short to moderate shaft, (3) hair 11-I moderately large, 2-4 branched, (4) hair 13-I small to moderately large, usually more than 3 branched, (5) hair 13-III usually small and numerously branched and (6) lateral arms of spiracular apparatus short to moderately long, except in *ininii*.

The relationships of the species within the Oswaldoi Subgroup is very difficult to determine because of the tremendous number of overlapping characteristics of the species in each of the different stages. The derived features of the male genitalia serve to link together the taxonomically important characters in the other life stages. Upon examination of the ventral claspette of the male genitalia, 2 distinct phyletic lines become apparent, which I am calling the Oswaldoi Complex and the Strodei Complex (fig. 4). Of these 2 complexes, the Strodei Complex is more closely akin to the Triannulatus Subgroup than is the Oswaldoi Complex. This was also evident to Gabaldon (1940:4), when he placed *strodei* and later (Gabaldon and Cova Garcia 1952: 178) *rondoni* and *benarrochi* in the same group as *triannulatus* in the Subseries Triannulatus, based on the morphology of the male genitalia. Other characters linking *triannulatus* to the Strodei Complex are the slender collar and numerous slender branches of hair 1-P in the larva, and the shape of the trumpet and the caudolateral spines in the pupa. The relationship of *benarrochi* to *triannulatus,* and to *rondoni* and *strodei* is not clear. However, the male genitalia of *benarrochi* are more like *strodei* than any other species in the Oswaldoi Subgroup. The Oswaldoi Complex is the more derived complex in the Oswaldoi Subgroup.

OSWALDOI COMPLEX

FEMALES. No diagnostic characters separating this complex from the Strodei Complex in the adult females are apparent.

MALES. Essentially as in females except for sexual characters.

MALE GENITALIA. Segment IX: Sternite long, about 0.5 length of phallosome, approximating shape of an isosceles trapezoid or a truncated triangle. Apodeme across anterior border short to long. **Sidepiece**: Parabasal spine moderately short to moderately long. **Ventral Claspette**: Nonrugose along apical margin, with setae on basal lobules and on lateral and ventral surface extending to or near to apex, apex not laterally expanded. Preapical plate moderately small to large, usually distinct. **Phallosome**: Aedeagus with or without leaflets, apically rounded or truncate (*noroestensis*).

LARVAE. Moderately large to large. There are no good diagnostic characters in the larvae to separate this complex from Strodei Complex. **Head:** Variable branching of inner and outer clypeal hairs (2,3-C); inner clypeals (2-C) widely spaced, except in *anomalophyllus.* Hair 4-C usually short, except in *nuneztovari* and *trinkae.* Hairs 10,12,13-C large in *ininii*, small to moderately large in remaining species. Collar always moderately wide to wide, heavily sclerotized. **Antenna:** Hair 1-A small to moderately large, except in *ininii.* Hairs 2,3-A relatively large, particularly in *ininii.* **Thorax:** In many but not all species, a large proportion of specimens with hairs 1,2-P of submedian prothoracic group (1-3-P) sharing a common tubercle, or base of 1-P not sclerotized and 1-P apparently arising separately from 2-P. Hair 14-P with short to moderately long, flattened shaft. **Abdomen:** Hair 0-II small to moderately large. Hair 5-I moderately large (except in *rangeli*) and close to lateral margin of abdomen. Hair 13-I-III small, numerously branched; 13-IV larger than 13-I-III, with fewer branches than 13-VI. **Spiracular Lobe:** Lateral arms of spiracular apparatus short, except moderately long in *noroestensis* and *oswaldoi*, and long in *ininii.* **Anal Segment:** Hair 1-X inserted on or not inserted on saddle. Anal gills short to long.

DISCUSSION. In general, the male genitalia and the larvae offer the best characters for separation of the species in the Oswaldoi Complex. The Oswaldoi Complex is distinguished from the Strodei Complex in the **male genitalia** by (1) presence of setae extending to the apex of ventral claspette or to at least as far as level of apical margin of preapical plate, (2) apex of ventral claspette not laterally expanded and (3) parabasal spine slightly shorter, usually extending neither to far margin of aedeagus nor to tubercle of other parabasal spine.

The species in this complex are very closely related. On the basis of the male genitalia, there seem to be 2 primary phyletic lines. *An. oswaldoi, galvaoi, noroestensis, aquasalis, ininii* and possibly *anomalophyllus* form one line, and *trinkae, nuneztovari* and *rangeli* compose the other (fig. 4). I have not designated these phyletic lines as separate taxa due to their close phylogenetic relationship and because it would tend to excessively complicate the presently proposed hierarchy.

The species of the first phyletic line, *aquasalis, noroestensis, galvaoi, oswaldoi, ininii* and *anomalophyllus*, are characterized by the tapering, rounded apex of the ventral claspette, with a distinct crescent shaped or oval preapical plate. *An. aquasalis* and *oswaldoi* are fairly widely distributed in Central and South America, *aquasalis* primarily along the Atlantic Coast and *oswaldoi* in the interior. *An. noroestensis* is widely distributed from the northeast of Brazil south to the northern states of Argentina, but is not found in northwestern South America or Central America. The latter 3 species are often broadly sympatric, but they usually occupy distinct niches. *An. aquasalis* is primarily associated with brackish water, *oswaldoi* with the forest and *noroestensis* with open drier areas. *An. galvaoi* seems to be primarily restricted to the high Amazon basin extending south into Mato Grosso and Sao Paulo and possibly east into Goias and Bahia. It would seem to be sympatric with *oswaldoi* throughout most of its range, although it is not clear if the range of *galvaoi* overlaps with that of *noroestensis*, its closest ally. *An. anomalophyllus* and, to a lesser extent, *ininii* retain many primitive characters which clearly distinguish them from the remaining species. Both species have restricted known distributions. *An. anomalophyllus* is a rare species, to date found only in Costa Rica and northern Panama. *An. ininii* has been collected only in French Guiana and Para, Brazil. The ventral claspettes of *ininii* and *anomalophyllus* look very much alike in outline and are, in general, similar to those of *oswaldoi, aquasalis, galvaoi* and *noroestensis.* The aedeagus of both species has leaf-

lets, very strongly developed in *anomalophyllus* and weakly developed in *ininii*. On the basis of the male genitalia, adult and larva, *ininii* seems to be clearly affiliated with the first phyletic line. In the case of *anomalophyllus*, the male genitalia correspond to the type in the Oswaldoi Complex, but the larva and adult look very much like the *strodei* type. For this reason I am unsure of the phylogenetic relationship between *anomalophyllus* and the rest of the species in the Oswaldoi Subgroup. One possibility is that *anomalophyllus* is an annectent relict form, intermediate between the Oswaldoi Complex and the Strodei Complex.

The other phyletic line in this complex, composed of *rangeli, trinkae* and *nuneztovari*, is again based primarily on the structure of the ventral claspette of the male genitalia, correlated with characters in the other stages. The ventral claspette of these species is broad at the apex and has setae on the ventral and lateral surfaces of the fused portion of the lobe. The adults of *rangeli, trinkae* and *nuneztovari* are exceedingly alike, making species diagnosis difficult. It is possible that the 2 latter species have not differentiated enough to become reproductively isolated, in which case they would be considered subspecies rather than species. As will be discussed later, this is really not so important, since they appear to be allopatric, and differ significantly in the immature stages and male genitalia. For these reasons, I feel justified in treating these 2 as separate species. The species in this second phyletic line are restricted to the Caribbean, Orinoco and Amazon drainage systems, with extensions into Bolivia and Mato Grosso.

2. Anopheles (Nys.) oswaldoi (Peryassu)

Figs. 2, 4, 6, 10, 11

1922. *Cellia oswaldoi* Peryassu 1922:179. TYPE: *Syntypes* males and females, Vale do Rio Doce (Espirito Santo) and Baixada Fluminense (Rio de Janeiro), Brazil, Mar and Apr [Museu Nac Rio de Janeiro] (Belkin, Schick and Heinemann 1971:6).

1932. *Anopheles (Nyssorhynchus) tarsimaculatus* var. *aquacaelestis* Curry 1932:566-571. TYPE: *Syntypes* male with genitalia slide, female and larva, Atlantic side of Canal Zone, Panama, no type locality cited, although Colon Hospital, 20 Jun 1929, C. H. Bath and lower Chagres River mentioned [LU]. Synonymy with *oswaldoi* by Senevet and Abonnenc (1938:487-493).

1942. *Anopheles (Nyssorhynchus) konderi* Galvao and Damasceno 1942:115-118. TYPE: *Syntypes* male(s), larva(e), pupa(e), right margin of Solimoes [Amazon], 300 km from Manaus, Coari (Amazonas), Brazil [LU, no material in FMSP, 651; apparently lost] (Belkin, Schick and Heinemann 1971:6). Synonymy with *oswaldoi* by Lane (1953:262).

Anopheles (Nyssorhynchus) oswaldoi of Senevet (1934:49-52; 1948a:277-279; 1948c:437); Galvao and Lane (1938:175-177; 1941:10); Rozeboom (1938a:101; 1938b:289-290; 1942:239-240); Senevet and Abonnenc (1938:493); Lane (1939:25-26; 1944:262-268; 1949:403; 1953:261-263); Gabaldon (1940:5); Gabaldon and Aguilera (1940:65-66); Gabaldon, Cova Garcia and Lopez (1940:10, 11); Galvao (1940:426-432; 1943:141, 143, 149, 151); Komp (1941a:93, 95, 97; 1942:26, 39, 40, 43, 74-75, 80, 124-125, 132, 160-161); Rozeboom and Gabaldon (1941:92-98); Floch and Abonnenc (1942a:2; 1942b:2; 1946b:3-5; 1947:6; 1951:49-50); Fonseca and Fonseca (1942:93, 94); Galvao and Damasceno (1942:121); Oliveira and Verano (1942:353-358); Simmons and Aitken (1942:39, 46, 54, 62, 95-96); Cerqueira (1943:19); Galvis (1943:93); Ramos (1943:51-52, 56-60); Causey, Deane and Deane (1944:2, 4, 5; 1946:27); Correa and Ramos (1944b:130; 1944c:11-12); Deane, L. M., Causey and Deane (1946:7-9; 1948:874-876); Deane, M. P., Causey and Deane (1946:38, 45); Gabaldon and Cova Garcia (1946b:99-103); Amaral and Penido (1947:164, 168, 173-178); Arnett (1947:197); Vargas (1948:158; 1959:377, 383); van der Kuyp (1949a:67-68); Levi-Castillo (1949:9-11, 13, 15, 28, 67, 72, 76, 82, 86); Bejarano and Duret (1950:150, 153); Downs (1950:29-30); Duret (1950a:371; 1950b:302); Rey and Renjifo (1950:534, 537); Carvalho and Rachou (1951:475, 480); Rachou and Ferraz

(1951:542, 547-553); Rachou and Ricciardi (1951:424-426, 432 437); Senior-White (1951a: 330); Horsfall (1955:184); Senevet and Andarelli (1955:339); Vargas V. (1956:29; 1957; 1958a; 1958b); Bejarano (1957:326-333, 335-336; 1959:305, 315, 325); Castro (1959a:174); Stone, Knight and Starcke (1959:33-34); Cerqueira (1961:126); Fauran (1961:11); Forattini (1962: 421); Garcia and Ronderos (1962:137-139, 158-159); Belkin, Schick and Heinemann (1965:44; 1971:61); Morales-Ayala (1971:139); Consolim and Galvao (1973:177); Cova Garcia and Sutil O. (1976:31; 1977:23, 47, 62, 88); Knight and Stone (1977:63-64).

Anopheles oswaldoi of Kumm (1932:1); Gabaldon, Cova Garcia and Arevalo (1940:26, 28-32); Gabaldon, Ochoa Palacios and Perez Vivas (1940:42-55); Rozeboom (1941:102-103); Vargas (1941:118); Downs, Gillette and Shannon (1943:29, 30, 33); Russell, Rozeboom and Stone (1943:26, 30, 37, 42, 48); Floch and Abonnenc (1946a:2); Vargas V. (1958a; 1958c:1, 3); Foote and Cook (1959:129-130); Cova Garcia (1961:34-35, 69, 86-87, 113, 123-124, 154); Maciel (1962:477); Vincke and Pant (1962:2-7, 10, 12, 14); Mattos and Xavier (1965:273); Stojanovich, Gorham and Scott (1966a:12, 18, 34; 1966b:21, 29, 43); Gorham, Stojanovich and Scott (1967:15, 47, 58; 1973:112, 139, 149); Cova Garcia and Sutil O. (1975a:23; 1975b:211); Panday (1977:732, 734); Cova Garcia, Pulido F. and Amarista M. (1978:157).

Anopheles (Nyssorhynchus) oswaldoi var. *oswaldoi* of Galvao and Lane (1937e:213-216; 1938: 175); Galvao (1938a:51, 52, 53-54, 58; 1938b:101-103); Galvao and Amaral (1938:13); Fonseca and Fonseca (1942:118).

Anopheles oswaldoi oswaldoi of Vargas (1943:59).

Anopheles (Nyssorhynchus) tarsimaculatus var. *oswaldoi* of Christophers (1924:40, 90); Galvao and Lane (1937a:77, 78; 1938:173-174).

Anopheles tarsimaculata var. *oswaldoi* of Root (1926a:51, 89, 107-108).

Nyssorhynchus (Nyssorhynchus) tarsimaculatus var. *oswaldoi* of Lima (1928:96-98).

Nyssorhynchus aff. *oswaldoi* (?) of Townsend (1934:495-497).

Cellia oswaldoi of Boyd (1926:31, 37).

Anopheles (Nyssorhynchus) tarsimaculatus in part of Root (1922a:522; 1926b:684-700, 709-711; 1932:781); Christophers (1924:41, 90); Dyar (1925:187, 188, 195; 1928:439); Davis (1928: 549-553; 1933:278, 280); Shannon and Davis (1930:488); Senevet (1932:251; 1937:358-360); Shannon (1933:124-133, in part?); Komp (1936a:161-162); Galvao, Lane and Correa (1937:40, 41); Lane (1939:29); Pinto (1939:390-398); Leeson and Buxton (1949:251, ?).

Anopheles tarsimaculatus in part (?) of Pinto (1930:154, 156).

Anopheles (Nyssorhynchus) tarsimaculata in part of Root (1924b:461-463).

Anopheles tarsimaculata in part of Dyar (1923:185); Godoy and Pinto (1923:29-33); Senevet (1934:29).

Anopheles (Anopheles) tarsimaculata in part of Bonne (1923:127-128); Bonne-Wepster and Bonne (1923:127); Root (1923:276; 1924b:460-463); Bonne and Bonne-Wepster (1925:511-515).

Cellia tarsimaculata in part of Neiva and Penna (1916:94); Peryassu (1921b:183); Bonne (1924: 133-137).

Anopheles (Nyssorhynchus) aquacoelestis (!) of Senevet and Abonnenc (1938:487-493).

Anopheles (Nyssorhynchus) konderi of Galvao (1943:143, 148, 149, 151); Causey, Deane and Deane (1944:2, 4, 5; 1946:27); Correa and Ramos (1944b:130); Deane, L. M., Causey and Deane (1946:8; 1948:876-877); Deane, M. P., Causey and Deane (1946:38, 42, 45); Vargas (1948:158); Lane (1949:403; 1953:262); Levi-Castillo (1949:11, 15, 28, 67, 72, 76, 81, 86); Castro, Garcia and Bressanello (1959:549).

Anopheles konderi of Cova Garcia (1964:200).

Cellia albimana in part (?) of Neiva (1909:69-77).

FEMALE (fig. 6). Wing: 3.4 mm. Proboscis: 2.3 mm. Palpus: 2.25 mm. Forefemur: 1.5 mm. Abdomen: about 2.8 mm. **Head:** Integument brown to dark brown. Proboscis about 1.5 length of forefemur. Vertex with many long, narrow, erect, cuneate scales, each with a narrow threadlike base. Palpal segment 2 occasionally with dorsal light scales; segment 3 with a fairly extensive, conspicuous, dorsal or dorsolateral, longitudinal light stripe; apex of segment 2 with a small to moderate band of whitish scales; apex of segment 3 with a moderately large band of white scales, 0.18

(0.15-0.25) of segment; segment 4 predominantly white with a moderately large, basal, dark band and a small, apical, dark band, with or without a usually inconspicuous, dark, ventral stripe; segment 5 completely white. **Antenna**: Dorsomesal and mesal surfaces of flagellar segment 1 distally with a large, very prominent patch of long white scales. Flagellar segments 2-13 with 7-9 long, silver setae in basal whorl. **Thorax**: Integument brown to very dark brown. Median anterior promontory with numerous long, white, setiform scales extending dorsad onto anterior of acrostichal line. Silver to cream scales on scutum slightly longer than those of *aquasalis*. Prescutellar space usually horseshoe shaped. *Sp* with 4-9 moderately long, silver setae. *Pra* with about 7-10 long, silver setae and a patch of gray to silver scales. Upper *stp* with 4 (2-6) long, light to dark setae in horizontal to vertical arc and a patch of gray to silver scales in horizontal row. Lower *stp* with 1, 2 long setae and a small patch of gray to silver scales. **Legs**: Coxal light scales usually very light gray to white, usually not cream. Midfemur with anteroapical spot and knee spot conspicuous and moderate in size. Foretarsal segment 2 with apical 0.35 (0.20-0.45) cream to white; segment 3 with a large, 0.65-0.85 (0.50-0.85), apical, cream to white band, usually more extensive than in *aquasalis*; segment 4 all dark to at least 0.3 basally dark; segment 5 golden to light cream in about apical 0.5. Midtarsal segment 2 with a golden to cream band in apical 0.10 (0.05-0.30); segment 3 with a small, golden to cream, apical band; segment 4 all dark; segment 5 golden to white in apical 0.3-0.5. Hindtarsal segment 2 with a small dark band in basal 0.18 (0.12-0.25), remainder white. **Wing**: Light spots on vein C and R cream to very light cream, not white; more posterior veins may be white. Vein C humeral light spot 1.6-3.0 (1.1-3.8) of basal dark spot; subcostal light spot about 0.11-0.35 (0.1-0.5) of subcostal dark spot, almost never greater than 0.5; preapical light spot about 0.3 (0.25-0.40) of preapical dark spot; apical dark spot usually very small and inconspicuous. R sectoral dark spot usually conspicuously smaller than presectoral dark spot. Rs-R_{2+3} variable, more or less predominantly dark, with 3, 4 dark spots and 3, 4 light spots. R_3 with or without small apical dark spot. R_{4+5} subcostal and preapical dark spots usually moderately small. M highly variable, from almost all light, with few dark scales, to predominantly dark; preapical dark spot not extending onto M_{1+2}. Apical light fringe spot usually moderately long, conspicuous, occasionally divided; light fringe spot at apex of R_{4+5} moderately large; additional, inconspicuous, light fringe spots at apices of M_{1+2}, M_{3+4}, Cu_1, Cu_2 and A; a moderate size, light fringe spot at level of 0.5 distance from base of A. **Abdomen**: Sternite I with a few setae and a few inconspicuous, lanceolate scales. Scales of caudolateral tufts on tergites and sternites long, very broad, outstanding, dark and obovate.

MALE. Wing: 3.4 mm. Proboscis: 2.7 mm. Forefemur: 1.5 mm. Abdomen: about 2.7 mm. Essentially as in female except for sexual characteristics. **Head**: Palpal segments 2 and 3 with cream scales along dorsomesal border; segment 4 predominantly cream to white, usually with a basal or a subbasal, and occasionally an apical, small, dark band; dark scales on ventral surface usually visible only when viewed ventrally. **Antenna**: About 0.75 length of proboscis. Flagellar segment 1 with long, conspicuous, oblanceolate scales on dorsomesal margin. **Legs**: Forefemur about 0.65 length of proboscis. Basal plantar surface of foretarsal segment 5 with 6-8 moderately long, thick, spiniform setae. Claw on foreleg long and curved; submedian tooth 0.20-0.25 length of claw, moderately acuminate and recurved at apex; basal tooth moderately short and decurved, slightly less than length of submedian tooth.

MALE GENITALIA (fig. 10). **Segment VIII**: Tergite and sternite with moderately narrow, obovate scales; scales broader on sternite than on tergite. **Segment IX**:

Sternite similar to *aquasalis*, curved, subtrapezoidal and moderately long, about 0.2 length of sidepiece. Anterior apodeme subtrapezoidal or subtriangular, and long (longer than in *aquasalis*), about 0.25-0.33 length of sternite. **Sidepiece**: Moderately narrow, conical. Tergal surface usually with 3-5 long, submedian tergomedial bristles and 1, 2 subapicolateral bristles; with moderately long bristles mesad of tergomedial bristles. Tubercle of parabasal spine large, appearing equal to or greater than 0.5 length of parabasal spine. Basal apodeme about 0.2 length of sidepiece. Longer, more dorsal accessory spine about 0.5 length of sidepiece; more ventral spine 0.70-0.85 of longer spine. Internal spine strongly retrorse apically. **Clasper**: Spiniform attenuate, thin and long, subequal to seta *b*. **Dorsal Claspette**: Pedicel moderately narrow (narrower than in *aquasalis*); base rounded and weakly curved mesad. Leaflets moderately broad; basomesal projection of dorsal leaflet usually reduced. **Ventral Claspette**: About 0.5 length of sidepiece. Lateral margins tapered toward narrow apex, width at apex about 0.33 or less length of claspette and about as wide as or slightly wider than apex of aedeagus. Basal lobule very large, expanded laterally, with long strong setae distributed along basal margin often reflexed and caudally directed; setae along basal margin about 2.0 width of aedeagus; setae not concentrated on basomesal margin. Lateral and ventral surfaces (exclusive of basal lobule) with setae about equal to or slightly less than width of aedeagus; setae extending to or nearly to apex. Apex with rounded lateral margins and a moderately shallow median sulcus; sulcus with moderately sloping sides. Preapical plate large, usually crescent shaped, moderately to heavily sclerotized, located about 0.3-0.4 length of claspette basad of apex. Transparent membranous area immediately basad of preapical plate bordering vertex of mesal cleft. Refringent structure moderately thick, in shape of inverted horseshoe or V, usually without lateral arms and moderately pointed at vertex. **Phallosome**: Aedeagus about 1.0-1.2 length of ventral claspette; apex rounded, about as wide as long or slightly longer than wide; usually without, occasionally with very small, membranous leaflets.

PUPA (fig. 10). Abdomen: 2.5 mm. Trumpet: 0.45 mm. Paddle: 0.75 X 0.55 mm. **Cephalothorax**: Brownish yellow to brownish black. Wing cases occasionally with dark, heavily sclerotized, longitudinal stripes. Hair 2-C slightly shorter than 1, 3-C; 1-C 1,2 branched; 2-C 1-3 branched; 3-C 2,3 branched (2-4). Hairs 4,5-C 1-3 forked. Hair 6-C 1,2 forked (1-3). Hair 7-C with 2-4 subequal branches, moderately long. **Trumpet**: Pinna moderately heavily pigmented, dark amber; short, about 1.6-2.1 (1.5-2.2) length of meatus; in lateral aspect, appearing truncate and flared apically, usually not appearing to taper toward apex. **Metanotum**: Hair 10-C single and moderately short (0.1 mm), slightly shorter than 11-C. Hair 11-C 2-4 branched (1-4) near base. Hair 12-C single, more than 2.0 length of 10-C. **Abdomen**: Hairs in general shorter than those of *aquasalis*. Hair 2-I 3-7 branched, dendritic, moderately long; 3-I about 0.50-0.75 length of 2-I. Hair 4-I variable, 3-5 branched (2-5). Hair 5-I 1-3 forked (1-4), moderately long. Hair 6-I single or double, moderately long. Hair 7-I 2,3 branched (2-4), 0.60-0.75 length of 6-I. Hair 9-I 1,2 branched, longer than 7-I and shorter than 6-I. Hair 0-II-VI 3-6 branched (2-6); 0-II,III usually with 1,2 more branches than 0-IV-VII; 0-VII 3,4 branched (3-5). Hair 1-II 6-9 branched (4-9) and 1-III 7-13 branched (3-13), both strongly developed and with median branches longer than lateral; 1-IV-VII single and long, about 1.5-1.7 length of segment. Hair 3-IV 3-5 branched (2-6); 3-V 2,3 forked (1-4), moderately long. Hair 5-III 5-8 branched (4-8), moderate; 5-IV 3-5 branched (2-5), larger and stronger than 5-III. Hair 6-II single, equal to or slightly longer than 7-II; 6-III single or double, moderately long. Hair 7-II 2,3 branched (2-4); hairs 7-III-V and 8-III-VII short, with 4 or fewer

branches, usually 2,3 branched; 7-VI single or double, moderately long; 7-VII single and long. Hair 9-II small and unpigmented; 9-III about 2.0 length of 9-II, weakly pigmented; 9-IV at least 2.0 of 9-III; 9-IV-VIII heavily pigmented; 9-IV,V shorter than 9-VI,VII; 9-V-VIII weakly curved, stout, short, usually 0.33 or less length of segment. Hair 10-III 1-3 forked (1-4), moderate. Hair 4-VIII 2-4 forked (1-4), moderately long. **Terminal Segments**: Male genital lobe with distinct, apical, mammilliform protuberance. **Paddle**: Very similar to that of *aquasalis* in size and shape. Subapex of paddle weakly to moderately emarginate at insertion of hair 1-P. Midrib distinct basally, indistinct distally. External buttress 0.65 length of paddle. External margin distad of buttress with fine short filamentous spicules extending around apex and terminating 0.5 from base on inner margin. Hair 1-P single, moderately long. Hair 2-P single or forked, subequal to 1-P.

LARVA (fig. 11). Head: 0.55 mm. Antenna: 0.35 mm. Anal Saddle: about 0.30 mm. **Head**: Moderately pigmented, light brown, with brown to dark brown mottling. Median tooth of mental plate moderately broad and pointed. Inner and outer clypeal hairs (2,3-C) plumose, with moderately long to long, usually dendritic branches in apical half; 2,3-C subequal in length; hairs 2-C widely spaced, clypeal index about 1.65. Hair 4-C 2-4 branched, moderately short, inserted moderately close to anterior margin, distance between insertion of 4-C and 2-C subequal to distance between insertion of 2-C and 3-C. Hairs 8,9-C highly variable, 4-7 (3-8) and 4-7 (4-10) branched respectively, moderately large, length about 1.5 distance separating hairs 5-C. Hair 12-C 2-4 branched, subequal to hairs 8,9-C. Hair 15-C 3-5 branched (2-5), moderately long. Collar dark brown, heavily pigmented and broad dorsomedially (about 0.06 mm). **Antenna**: Pigmentation similar to head capsule. Mesal margin with numerous, moderately long spicules becoming shorter and stouter apically; a few short spicules on ventral surface. Hair 1-A 5-8 branched (3-8), short, about as long as width of antenna at point of insertion. **Thorax**: Integument gray to dark yellowish brown or grayish black. Inner submedian prothoracic group (1-3-P) with or without hairs 1,2-P sharing common tubercle; palmate hair 1-P with 10-12 moderately narrow leaflets; 2-P 13-18 branched (12-18), 3.0-4.0 length of 1-P. Hair 14-P 6-8 branched from a short to moderately short, flattened stalk, lateral branches shorter than median. Mesothoracic hair 1-M strongly plumose, 23-29 branched. Metathoracic hair 2-T long, extending beyond caudal margin of thorax. Palmate hair 3-T moderately large, with 9-13 semitransparent, narrow leaflets. **Abdomen**: Integument as in thorax; more pigmented medially. Hair 0-II-VII 5-8 branched (4-8), moderately large to large. Palmate hair 1-I with 10-12 (8-16) moderately narrow, semitransparent leaflets; 1-II-VII with 18-25 moderately broad, spreading leaflets; 1-III-VI larger than 1-II,VII. Hair 2-II 5-8 branched, large; 2-III 4-7 branched, large; 2-IV single, moderately long; 2-V 2,3 branched, large. Hair 5-I 2,3 branched, moderate; 5-II 7-12 branched, moderate. Hair 9-I 3,4 branched (3-6), long. Hair 13-I,II,III 7-10, 6-11 and 8-11 (7-11) branched respectively, small; 13-IV 5-7 branched, moderately large; 13-V 3-5 branched (3-6), very large, with long branches extending beyond caudal margin of segment V; 13-VI 8-10 branched, about equal to 13-IV. **Spiracular Lobe**: Pecten with 13-16 teeth; most of median teeth subequal and of moderate length; serrations on dorsobasal margins of teeth moderately short. Lateral arm of spiracular apparatus moderately long, projecting caudolaterad or laterad, rounded at lateral margins, usually reaching spiracular openings. Hairs 8,9-S 3-5 branched. **Anal Segment**: Almost entire surface except for base covered with fine spicules, more strongly developed at apex. Hair 1-X longer than saddle; not inserted on saddle; inserted immediately ventrad of ventral margin of saddle and usually slightly more than 0.5 distance from base

of segment. Anal gills long (0.5 mm), as long as or longer than anal segment.

DISCUSSION. *An. oswaldoi* can be distinguished from other species in the Oswaldoi Subgroup in the female by the combination of (1) foretarsal segments 2 and 3 cream to white in apical 0.20-0.45 and 0.50-0.85 respectively, (2) foretarsal segment 4 all dark to more than 0.3 dark basally, (3) midtarsal segment 4 all dark, (4) hindtarsal segment 2 less than 0.25 dark basally and (5) vein C with a small, basal, dark spot, and humeral light spot 1.6-3.0 (1.1-3.8) length of basal dark spot; in the male genitalia by the combination of (1) basal lobules of ventral claspette very large, expanded laterally, with long setae along basal margin which are about 2.0 width of aedeagus, (2) lateral and ventral surfaces of ventral claspette (exclusive of basal lobules) with setae equal to or slightly less than width of aedeagus, (3) preapical plate large, usually crescent shaped, moderately to heavily sclerotized and (4) aedeagus usually without leaflets; in the pupa by (1) pinna of trumpet short, about 1.6-2.1 length of meatus, appearing truncate and flared apically, (2) meatal cleft pointed at base, (3) hair 9-V-VIII short, usually 0.33 or less length of segment, (4) hair 6-II equal to or slightly longer than 7-II and (5) hair 2-I 3-7 branched, moderately long; and in the larva by the combination of (1) hairs 2,3-C plumose, with usually dendritic branches, hairs 2-C widely spaced, clypeal index about 1.65, (2) hair 4-C moderately short, distance between insertion of 4-C and 2-C subequal to distance between insertion of 2-C and 3-C, (3) hairs 8,9-C moderately large, length about 1.5 distance separting hairs 5-C, (4) lateral arm of spiracular apparatus moderately long, (5) median teeth of pecten mostly subequal, (6) hair 1-X not inserted on saddle and (7) anal gills long, as long as or longer than anal segment.

The populations of *oswaldoi* examined in this study do not exhibit much interpopulational variation. In the larvae, the clypeals (2,3-C) of the Panamanian populations do not show as extensive branching as the South American populations. Frequently the branching of the clypeals is simple in Panamanian specimens rather than dendritic. In the male genitalia, the Panamanian populations sometimes have very small, membranous, basolaterally directed leaflets similar to those in *ininii, rangeli* and *nuneztovari.* It is possible that these leaflets are occasionally present in other populations, but I have not been able to observe them. However, the diagnostic key characters are constant, permitting identification of all stages.

An. oswaldoi is most closely related to *noroestensis, galvaoi* and *aquasalis.* The male genitalia of these species are very similar in general appearance; this is particularly evident when comparing *oswaldoi* with *galvaoi* and *noroestensis.* The shape of the preapical plate and the length of the setae on the ventral claspette of *galvaoi* and *noroestensis*, and the truncate aedeagus of *noroestensis* are the only characters which differentiate the male genitalia of these species from *oswaldoi.* There is also considerable overlap in the adults of *oswaldoi* and *noroestensis,* which sometimes makes species identification difficult. The larvae of *aquasalis* and *noroestensis* are similar to those of *oswaldoi,* differing mainly in the characters given above. The pupa of *noroestensis* is distinguished from that of *oswaldoi* only by a longer pinna and a slightly longer hair 9 on segments V-VIII.

Although *oswaldoi* may occur sympatrically, in the broad sense, with *aquasalis* and *noroestensis,* it is ecologically isolated from these species, breeding in fresh, usually well shaded water in the interior of forests. The center of origin for *oswaldoi* was probably a forested region in tropical South America. *An. oswaldoi* has extended its range through the isthmus of Panama as far north as Costa Rica.

Peryassu described *oswaldoi* as a species of *Cellia* in 1922. The following year Dyar (1923:185) listed *oswaldoi* as a synonym of *An. tarsimaculata* Goeldi 1905.

Bonne (1923:128; 1924:134, 135), and Bonne and Bonne-Wepster (1925:514) recognized 2 "races" of *tarsimaculatus* existing in Surinam: one that was exophilic in the interior of the country, characterized by a very small dark ring on the hindtarsal segment 2 (=*oswaldoi*), and the other a coastal species (=*aquasalis*). Root (1924b:461, 462), after studying a series of mounts of the male genitalia of *"oswaldoi"* and *tarsimaculata,* found no genitalic differences, and therefore synonymized *oswaldoi* again with *tarsimaculata.* Lima (1928:96-98) described constant differences between *tarsimaculatus* and *oswaldoi* in the adult, pupa and larva, but maintained that *oswaldoi* was only a variety of *tarsimaculatus.* In 1932, Curry described *aquasalis* and *aquacaelestis* as varieties of *tarsimaculatus.* He stated that the variety *aquacaelestis* "is undoubtedly quite similar in appearance to *A. oswaldoi* from Brazil, which Root (1926b:709-711) places in the synonymy of *A. tarsimaculatus.*" Senevet (1934:49-52) revalidated *oswaldoi,* describing the pupa in some detail, and, in 1938, Senevet and Abonnenc synonymized *aquacoelestis* [*sic*] with *oswaldoi.* Galvao and Lane (1937e:218-221) stated that the species, *oswaldoi*, really consists of 3 types: *oswaldoi oswaldoi* Peryassu 1922, *oswaldoi* var. *metcalfi* Galvao and Lane 1937 and *oswaldoi* var. *noroestensis* Galvao and Lane 1937. In 1942, Galvao and Damasceno recognized *noroestensis* as a species separate from *oswaldoi* and considered *metcalfi* to be a *nomen nudum* [*sic, ?nomen dubium*]. In this same paper they described *konderi* as a species very closely related to *oswaldoi,* differing only in the shape of the apex of the aedeagus. I have not had the opportunity to examine any material from the type locality of *konderi.* However, since the proportions of the aedeagus appear to change depending on how the genitalia are mounted, and some variation does occur between different populations, I concur at this time with Lane (1953: 262) in synonymizing *konderi* with *oswaldoi.*

BIONOMICS. The immature stages of *oswaldoi* are found in the interior, usually in or on the margins of tropical forests, frequently along roads, in cultivated fields or grasslands adjacent to forested areas. The breeding sites are in permanent or temporary ground pools, margins of ponds or lakes, swamps and streamside pools; the sites are found most often in deep to partial shade, less often in full sun. The immature stages are commonly collected in the grassy margins of pools with muddy bottoms, and algae and abundant flotage are often present. The water is always fresh and may be turbid or clear. Galvao (1938b) reared *oswaldoi* in the laboratory at a mean temperature of 25.7°C and found that the time necessary for development from egg to adult was 12 days. The immatures are commonly encountered in association with *triannulatus* and less often *rangeli.* Occasionally *oswaldoi* has been collected with *inini* and *nuneztovari* in Para, Brazil. Other species found in association with *oswaldoi* are *Anopheles (Ano.) neomaculipalpus, An. (Ano.) punctimacula, Culex (Cux.) coronator* group, *Uranotaenia (Ura.) geometrica* and *Ur. (Ura.) lowii.*

The adults of *oswaldoi* are largely restricted to the forest. They are exophilic and zoophilic. Of the 6470 adults of *oswaldoi* Deane, Causey and Deane (1948:876) captured in Para, Brazil, 83 or 1.3% were from inside houses. Rey and Renjifo (1950: 537) in 3 months, September through November, captured 2414 anophelines inside houses in northern Colombia of which only 0.75% were *oswaldoi.* Correa and Ramos (1944c:11) reported that from the Ilha de Santo Amaro, in the state of Sao Paulo, Brazil, 5.2% of the anophelines collected in houses were *oswaldoi.* Although primarily zoophilic, *oswaldoi* feeds freely on man inside the forest, such as in the Mojinga Swamp in Panama or in the forest of French Guiana (Rozeboom 1941:102-103; Floch and Abonnenc 1947:6; Curry 1932). Rozeboom (1942a:240), in the interior of the cacao growing districts of Trinidad, collected twice as many females of *oswal-*

doi on animal bait as on human bait and found none inside houses. Deane, Causey and Deane (1948) reported that the peak of biting activity of *oswaldoi* was between 1800 and 1900 h.

MEDICAL IMPORTANCE. *An. oswaldoi* has been experimentally infected with *Plasmodium vivax* and *P. falciparum* by Fonseca and Fonseca (1942:106-111) in the state of Sao Paulo, Brazil and by Rozeboom (1942a:240) in Trinidad. However, it has never been found naturally infected or otherwise implicated in transmitting malaria. Deane, Causey and Deane (1948:876) dissected 540 females from the northeast of Brazil and found none infected with *Plasmodium*. Lucena (1940b) and Correa and Ramos (1942b) reported finding *oswaldoi* var. *metcalfi* naturally infected in Brazil; however, these investigators were probably dealing with *noroestensis* or *aquasalis* and not *oswaldoi*. *An. oswaldoi*, at present, does not seem to be a vector of malaria.

DISTRIBUTION (fig. 2). *An. oswaldoi* is distributed throughout South America east of the Andes as far south as the northern provinces (Formosa, Missiones, Salta, Tucuman) of Argentina. It occurs throughout most of Colombia, Venezuela, the Guianas, Brazil, Paraguay and Bolivia; it also occurs in Ecuador and Peru east of the Andes. Northward, it extends into Panama and Costa Rica. It is also found in Trinidad, but not in Tobago or any other islands of the Antilles. It is not certain how far south *oswaldoi* occurs west of the Andes.

Material Examined: 1376 specimens: 244 males, 117 male genitalia, 561 females, 273 pupae, 181 larvae; 259 individual rearings: 129 larval, 118 pupal, 12 incomplete; 9 progeny rearings.

BOLIVIA (7F). **Beni**: Guayaramerin, 18 Feb 1944, 1F [MCZ]; same locality, 3 Jun 1947, 5F (47-12258). **Pando**: Ingavi, Abuna?, 29 Dec 1943, 3111, [KO] 119A-30, 1F.

BRAZIL. Amazonas (9F): Manaus, Jun 1931, R. Shannon, 4F; same locality, F. Urich, 1F. Rio Amazonas above Manaus, 1914-18, R. Moffat, 1F [BM]. Rio Brancos, Aug 1930, 2F. Tonantins, Mar 1931, 1F. **Bahia** (1M, 2Mgen, 2F): Bonfim, 26 Jan 1930, 2F. Salvador, 1936, R. Shannon, 1M, 1Mgen. Locality not specified, M. Boyd, 1Mgen. **Mato Grosso** (1M, 1Mgen, 43F): Maracaju, Jun 1937, 1M, 1Mgen. Westborder, May 1931, R. Shannon, 1F (151). Locality not specified, May 1931, R. Shannon, 42F. **Para** (60 specimens: 8M, 9Mgen, 34F, 6p, 3 l; 6 ind rear: 2 l, 4p): Altamira, 150 km W of, 5 Nov 1974, J. Reinert *et al.*, coll. 77, 1 pF. Belem, 14 Apr 1941, W. Komp, BRAK 2A, 3F; same locality, 16 Apr 1941, 1 l; same locality, 17 Apr 1941, BRAK 3, 4M, 3Mgen; same locality, Mar 1944, MacCreary, Bricken, 1Mgen; same locality, det. Deane, 1M [CU]; same locality, W. Komp, 3Mgen. Bacuri, 28 Oct 1974, J. Reinert, *et al.*, coll. 62, 1Mgen, 2 lpM, 1 pM, 2 pF. Fordlandia, 31 Jun, R. Shannon, 1M, 1Mgen. Maraba area, 4 May 1976, 1F (M-6); same locality, 2 Jun 1976, 1F (R-3); same locality, 5 Jul 1976, 11F (M-6); same locality, 7 Jul 1976, 1F (M-8); same locality, 19 Oct 1976, 4F (1); same locality, 20 Oct 1976, 1F (1); same locality, 21 Oct 1976, 1F (1); same locality, 11 Nov 1976, 1F (1); same locality, 1976, D. Roberts, 3F. Locality not specified, N. Davis, 4F. **Rio de Janeiro** (1M, 2Mgen, 11F): Bangu, 11 Jun 1924, F. Root, 1 Mgen. Porto das Caixas, 3 Mar 1925, 1F (37); same locality, 29 May 1925, F. Root, 1M and 1Mgen (710210-1, lectotype of *metcalfi*). Rio de Janeiro, L. Saunders, 3F [BM1924-240]; same locality, M. Boyd, 1F [BM 1925-336]; same locality and collector, 6F. **Rondonia** (9F): Porto Velho, May 1931, R. Shannon, 5F. Guajara Mirim, May 1931, R. Shannon, 3F **Sao Paulo** (6M, 2Mgen, 5F, 1 lp): Caraguatatuba, 1M, 1F. Juquia, Nov 1938, [?] J. Lane, 1F (1.116); same locality and collector, 1F [CU]. Santos, Guanuja, 1F. Sao Vincente, 1938, A. Galvao, 4M, 1F; same locality, 1M; same locality, 1Mgen (97-16), 1 lp (15-12) [JH]. Locality not specified, 1938, A. Galvao, 1Mgen.

COLOMBIA (57 specimens: 13M, 9Mgen, 6F, 11p, 18L&l; 2 inc ind rear). **Boyaca:** Puerto Boyaca, COM 651. **Caqueta:** Tres Esquinas, COM 652. **Meta:** Restrepo, Rd. to Cumaral, Jul 1935, KO 120A-4, 1M. Villavicencio, Jun 1947, CV 671, 2 lp, 9p, 15L, 1 l; same locality, 1947, L. Rozeboom, CV-P 38, 1F, E (progeny); same locality, Jun 1947, [CV] 671.1, 1Mgen [JH]. Puerto Lopez, COM 653. Puerto Porfia, COM 649. Locality not specified, 25 Nov 1936, COR 155, 2F. **Department not specified:** Puerto Nino, 21 Feb 1922, F. Miller, 1F. Locality not specified, 1943, [KO] 119A-21, 2F.

COSTA RICA (1Mgen). **Limon**: Puerto Viejo, Apr 1938, H. Kumm, 1Mgen.

GUYANA (8 specimens: 3M, 3F, 2L). **East Demerara-West Coast Berbice**: Mackenzie, Sep 1945, 111A-310, 2F; same locality, 15 May 1945, G. Giglioli, [KO] 119A-41, 3M, 1F; same locality, Sep 1949, 2L.

PANAMA AND CANAL ZONE (878 specimens: 144M, 65Mgen, 281F, 251P&p, 137L&l; 249 ind rear: 127 l, 113p, 9inc; 9 progeny rearings). **Canal Zone**: Atlantic side, May 1939, PAX 114, 3M, 5F. Escondido River, 19 May 1939, PAX 108, 2F. Fort Davis, 13 Mar 1923, D. Baker, 1F; same locality and collector, 30 Mar 1925, 1M; same locality, 12 Feb 1940, PAX 168, 4M, 2F. Fort Sherman, 8 Feb 1945, ASM 410-1, 1F; same locality, May 1945, 1M. France Field, 30 Aug 1924, J. Zetek, 1M, 1F; same locality and collector, 1 Nov 1924, 4M, 5F; same data, 1M, 2F [MCZ]; same locality, 11 Nov 1924, 1M, 8F; same locality, 23 Nov 1924, C. Mopp, 2M, 2F; same locality, 7 Mar 1925, D. Baker, 1F; same locality and collector, 9 May 1925, 1M, 1F; same locality, 6 Feb 1940, 2M, 4F. Gatun, Jan 1913, J. Zetek, 1Mgen; same locality, 7 Jul 1931, D. Curry, PAX 25, 3F. Mojinga Swamp, Oct 1935, PAX 54, 9M, 11F; same locality, 28 Oct 1948, No. 113, 1L; same locality, 2 Jul 1949, 16Mgen [JH]; same locality, 20 Jul 1949, 14Mgen; same locality, PA 729, 1175, 1176 (6 progeny rearings), 1177 (3 progeny rearings); same locality, 12F. [Rio] Chagres, 17, 19 Aug 1953, S. Carpenter, 20F; same locality and collector, 10 Sep 1953, 26F. Locality not specified, D. Curry, 1F [BM1933-504]; 5 Aug 1909, A. Jennings, 1Mgen. **Darien**: Paya, GG 1-126, 1-129, 1-133, 1-137, 1-138, 1-141. Rio Tuira, GG 1-159. **Panama**: Juan Diaz, 21 Mar 1935, PAR 16, 3F. La Chorrera, 29 Jan 1945, ASM 397-1, 1F. **Province not specified**: Rio Trinidad, 9 Jun 1912, A. Busck, 2F; same locality and collector, 3 Jul 1912, 1F. Locality not specified, 5 May 1952, S. Carpenter, 1F (620926-6); 30 Jul 1936, PAR 104, 3F.

PERU (71 specimens: 2Mgen, 67F, 2L). **Huanuco**: Tingo Maria, May 1946, E. Hambleton, 2 Mgen; same locality, [?1946], Emilio-Viale, 2L. **Loreto**: Iquitos, Mar-Apr 1931, R. Shannon, 67F.

SURINAME (23 specimens: 11M, 4Mgen, 8F). **Marowijne**: Moengo, 1944, Guicherit, 3F; same locality and collector, Oct 1945, 1M (46-V-8d), 1M (46-V-8e), 1Mgen. **Paramaribo**: Paramaribo, J. Bonne-Wepster, 4M, 1Mgen. **District not specified**: Billeton, 5 Jul 1943, 1F. "Leidino XIa," 21 Jun 1946, E. van der Kuyp, 5M, 2Mgen. Locality not specified, J. Bonne-Wepster, BB 897, 4F.

TRINIDAD AND TOBAGO. TRINIDAD (158 specimens: 52M, 14Mgen, 71F, 4p, 17L&l; 1 p ind rear). **Caroni**: Tabaquite, 22 Aug 1945, 2M, 5F; same data, [KO] 119A-31, 2F; same data, P. Woke, 3M, 2F; same locality and date, [KO] 119A-40, 1F; same data, [KO] 119A-42, 3M, 3F; same locality, 23 Aug 1945, 1 l; same data, [KO] 119A-33, 1F; same locality, 22 Aug 1945, [KO] 119A-39, 1M, 4F; same locality, 23 Aug 1945, [KO] 119A-29, 1F. **Nariva**: Charuma Forest, 27 Aug 1964, A. Guerra, TR 643, 1L. Nariva Swamp, 16 Nov 1961, T. Aitken, 1p; same locality, 18 Feb 1964, TR 77, 1L. Navet, 20 Aug 1964, A. Guerra, TR 610, 2L. **St. Andrew**: Cumuto, 2 Jun 1941, TRR 1, 2M, 2Mgen, 1F; same locality, 27 Jun 1941, TRR 15B, 1M, 1Mgen, 2F; same locality, 7 Aug 1941, TRR 26, 2F; same locality, TRR 64, 2M, 1Mgen, 3F. Mount Harris, 10-16 Jul 1964, F. Powdhar, 1F. Sangre Grande, 1941, W. Downs, coll. E-43-44, 3Mgen. Valencia, 29 Aug 1945, 1 l. **St. George**: Arima, 21 Aug 1938, E. de Verteuil, 1M [BM]; same locality, 8 Jul 1965, A. Guerra, TR 1247, 1Mgen, 1 pM. Curepe, 21 Jul 1931, E. de Verteuil, 1M [BM1931-562]. Diego Martin River, 8-26 Feb 1941, W. Komp, TRK 35, 17M, 13F. Fort Read, Oct 1944, 1F. Four Roads, 18 Mar 1941, W. Komp, [KO] 119A-6, 3M, 5F; same locality, 5 Jun 1941, TRR 3, 13M, 2 Mgen, 9F. Maraval, 1946, 5F. **County not specified**: St. Helena, 24 Oct 1936, TRK 33, 1M, 1M gen, 8F. Locality not specified, W. Downs, 1Mgen (301-3), 1Mgen (409-1), 1Mgen (413-2) [JH]; Mar 1941, W. Komp, KO 111-7, 1M; 22 Aug 1945, 2p, 1L, 10 l; no data, 1F.

VENEZUELA (16 specimens: 4M, 6Mgen, 5F, 1L). **Aragua**: Maracay, 1F. **Monagas**: Caripito, 10 Jun [1935], 1F. **Portuguesa**: Acarigua, 1Mgen. **State not specified**: Rancho Cachipo, 5 Sep 1936, Quire, [KO] 119A-7, 3M, 2F. Juasipati, May 1929, 2Mgen (52). San Joaquin, 16 Dec 1944, E. Winton, KO 111-16, 1M. Locality not specified, VZ 421; Jul 1937, P. Anduze, 1L; 1938, A. Gabaldon, 2Mgen; 1949, 1Mgen.

3. Anopheles (Nys.) galvaoi Causey, Deane & Deane
Figs. 3, 4, 6, 12

1943. *Anopheles (Nyssorhynchus) galvaoi* Causey, Deane and Deane 1943:293-296. TYPE: *Lectotype* female (R426), marked *capanemai* in register, Rio Branco (Acre), Brazil, O. R. Causey [FMSP, 694; designation by Belkin, Schick and Heinemann 1971:5].

Anopheles (Nyssorhynchus) galvaoi of Galvao (1943:142, 143, 145 146, 148, 149, 151); Causey, Deane and Deane (1944:1, 2, 5, 6; 1945:248; 1946:27, 31); Correa and Ramos (1944b:131); Galvao, Lane and Unti (1944:45, 46); Deane, L. M., Causey and Deane (1946:7, 8, 9, 10, 12; 1948:877); Deane, M. P., Causey and Deane (1946:43, 45); Cohen (1948:88); Senevet (1948a: 279); Lane (1949:403, 410, 413, 414; 1953:269-270); Levi-Castillo (1949:11, 15, 28, 58, 67, 72, 76, 82, 86); Carvalho and Rachou (1951:475, 480); Rachou and Ricciardi (1951:424, 425-426); Bejarano (1957:326, 330, 331); Vargas (1959:370); Cerqueira (1961:124); Forattini (1962:325, 370, 415, 418-419, 476, 484, 491); Garcia and Ronderos (1962:137, 138, 139, 158); Consolim and Galvao (1973:177, ?).

Anopheles galvaoi of Foote and Cook (1959:29); Maciel (1962:477 478); Mattos and Xavier (1965: 272); Gorham, Stojanovich and Scott (1967:18, 47, 54).

FEMALE (fig. 6). Wing: about 3.5 mm. Proboscis: 2.3 mm. Palpus: 2.2 mm. Forefemur: 1.5 mm. Abdomen: about 3.1 mm. Description based on only 4 damaged females (2 paratypes and 2 topotypes). **Head:** Integument dark brown. Proboscis about 1.5 length of forefemur. Vertex with numerous, long, erect, cuneate or weakly forked, white scales. Palpal segments 2 and 3 with an indistinct, dorsolongitudinal, light stripe; apex of segment 2 with a small, light, apical ring; segment 3 with a moderately large, light apical band; segment 4 with a basal and an apical, moderately small, dark band, remainder light without distinct ventral stripe of dark scales; segment 5 light. **Antenna:** Flagellar segment 1 with a patch of long, white, oblanceolate scales distally on dorsomesal surface, shorter scales mesally; with small light scales basally on lateral surface. Flagellar segments 2-13 each with about 6-9 long, silver setae in a basal whorl. **Thorax:** Integument brown. Median anterior promontory area with long, creamish to white, setiform scales extending dorsad onto most anterior part of acrostichal line. Scutum with moderately short (0.7 mm), obovate, creamish scales. Prescutellar space horseshoe shaped. Many of setae and scales missing or not apparent on pleuron. Upper *stp* with 2, 3 long, dark setae and many, small, obovate, cream scales in horizontal arc. Lower *stp* with one long, dark seta and a patch of small, obovate, cream scales. Upper *mep* with about 4 long, cream setae. **Legs:** Light scales on coxae grayish white to white. Midfemur with anteroapical spot and knee spot moderately large, distinct and light cream to white. Foretarsal segment 2 cream to white in apical 0.13-0.24; segment 3 cream to white in apical 0.16-0.40; segment 4 with a few, light, apical scales; segment 5 cream to white in apical 0.30-0.45. Midtarsal segment 2 creamish white to white in apical 0.08-0.11; segment 3 with a few, light, apical scales; segment 4 all dark or apically slightly lighter; segment 5 creamish white to white in about apical 0.5. Hindtarsal segment 2 brown in basal 0.42-0.55; segment 5 cream in about apical 0.5. **Wing:** Light scales on wing white except for creamish white scales on vein C. Vein C humeral light spot large, 2.1-3.6 of basal dark spot; basal dark spot small; presectoral light spot absent or consisting of only a single scale, so that presectoral and sectoral dark spots fuse into a single, large, dark spot; subcostal light spot 0.24-0.45 of subcostal dark spot; preapical light spot 0.35-0.48 of preapical dark spot; apical dark spot small. R presectoral dark spot small; sectoral dark spot very small, in one specimen consisting of only 2 dark scales. R_3 with 3 light spots and 3 occasionally indistinct, dark spots; apical dark spot small. R_{4+5} subcostal dark spot moderately small; preapical dark spot

moderately small to moderately large. M sectoral dark spot moderately small and inconspicuous, to moderately large with a few interspersed light scales. Cu sectoral dark spot moderately small. Cu_1 subcostal dark spot small, in one specimen consisting of only a single scale. Vein A subcostal dark spot small to moderate, about 0.15 of vein. Apical light fringe spot moderately small and divided; additional light fringe spots at apices of R_{4+5}, M_{1+2}, M_{3+4}, Cu_1, Cu_2 and A; a moderate size, light fringe spot at level of 0.5 distance from base of A. **Abdomen**: Sternite I with a few, light, obovate, submedian scales. Dark caudolateral scale tufts large, each scale about 0.1 mm long. Tergites II-VII densely covered with cream to golden, narrow, lanceolate scales in a subtriangular pattern on segments II, III, becoming more extensive and subrectangular on distal segments.

MALE. Wing: about 3.3 mm. Forefemur: 1.5 mm. Description based only on a single paratype male. Essentially as in female except for sexual characters. **Head**: Palpal segments 2 and 3 with a dorsal stripe of cream to white scales, stripe longer on 2 than on 3; segment 4 with a light basal band, and a subbasal and a subapical, dark band, mediolaterally predominantly light, ventral surface inconspicuously dark. **Antenna**: Flagellar segment 1 with long, oblanceolate, white scales on dorsomesal surface. **Legs**: Claw on foreleg weakly curved; submedian tooth recurved at apex, about 0.25 length of claw; basal tooth subequal to submedian, decurved.

MALE GENITALIA (fig. 12). Description based on only 2 specimens (one paratype and one from Sao Paulo). In general very similar to those of *oswaldoi* and *noroestensis*. **Segment VIII**: Tergite and sternite with narrow, long, obovate scales; scales slightly broader on sternite than on tergite, darker medially on tergite. **Segment IX**: Sternite as for those of *oswaldoi* and *noroestensis*; subtrapezoidal, about 0.25 length of sidepiece. Anterior apodeme moderately long, about 0.2 length of sternite. **Sidepiece**: Moderately broad and subconical. Tergal surface with 5 alveoli for submedian tergomedial bristles, 2 long, strong bristles remaining on specimens; 1, 2 long subapicolateral bristles; 5, 6 moderately short to moderately long bristles mesad of tergomedial bristles, subbasal bristles longest. Parabasal spine moderately long and narrow; tubercle of spine moderately long, 0.3-0.4 of spine; combined lengths of tubercle and spine about 0.3 of sidepiece. Basal apodeme moderately short, about 0.2 length of sidepiece. Longer, more dorsal accessory spine slightly longer than 0.5 of sidepiece, curving caudally at apex; more ventral spine about 0.8 of longer spine. Internal spine subequal to shorter accessory spine, strongly retrorse apically. **Clasper**: Spiniform long, slender and apically attenuate; seta *b* 1.5-2.0 length of spiniform. **Dorsal Claspette**: About 0.5 of sidepiece. Pedicel moderately narrow; base curved mesad. Leaflets about 0.40-0.47 length of claspette; dorsal leaflet with prominent basomesal projection. **Ventral Claspette**: About 0.5 length of sidepiece. Lateral margins tapered toward narrow apex, width at apex about 0.35 length of claspette and 1.25-1.50 width of apex of aedeagus. Basal lobule very large, expanded laterally and covered with very long, occasionally caudally reflexed setae distributed uniformly over lobule; setae on basal margin about 3.0 width of aedeagus. Ventral and lateral surfaces (exclusive of basal lobule) covered with short setae about 0.5 width of aedeagus; setae extending to or nearly to apex. Apex with rounded lateral margins separated by a moderately shallow V shaped median sulcus; lateral margins tapering apically. Preapical plate distinct, large, circular to semicircular with small basolateral projections directed basally, heavily sclerotized, located about 0.25 length of claspette basad of apex. Transparent membranous area small, not very distinct, with lateral margins projecting basolaterally. Refringent structure very distinct, in shape of inverted V, lateral arms not visible. **Phallosome**: Aedeagus equal to or slightly longer

than ventral claspette; apex rounded, about as wide as long (possibly shorter than *oswaldoi*); leaflets absent.

PUPA, LARVA. No specimens available.

DISCUSSION. *An. galvaoi* can be distinguished from other species in the Oswaldoi Complex in the male genitalia by the combination of (1) ventral claspette with basal lobule very large, covered with very long, uniformly distributed setae about 3.0 width of aedeagus, and ventral and lateral surfaces (exclusive of basal lobules) with short setae about 0.5 width of aedeagus, (2) preapical plate heavily sclerotized, circular to semicircular with small basolateral projections and (3) apex of aedeagus rounded, about as wide as long (possibly shorter than *oswaldoi*), without leaflets. The female of *galvaoi* is apparently very similar to those of *aquasalis* and *benarrochi*. Since there were only 4 damaged specimens available to me, I was not able to differentiate the female of *galvaoi* from those of the latter 2 species. Consequently, I have not included *galvaoi* in the key to females. Forattini (1962:418-419) states that Correa and Ramalho (1958) can distinguish *galvaoi* from *aquasalis* on the basis of the relative lengths of the dark basal spot and humeral light spot of vein C. Forattini reports that in *aquasalis* the basal dark spot is about 0.5 the length of the humeral (B_2) spot; whereas, in *galvaoi*, the basal dark spot is clearly less than 0.5 the length of the humeral light spot. For *aquasalis* this is not always true. Because *aquasalis* and *galvaoi* are not sympatric, there should be no problem in recognizing *aquasalis*. A problem also arises in that the wing of *benarrochi* has the same characteristics as described above for *galvaoi*, and it is possible that these 2 species occur sympatrically. The male genitalia of *galvaoi* are very similar to those of *oswaldoi* and *noroestensis*, *galvaoi* differing only by (1) longer setae on basal lobule of ventral claspette and shorter setae on ventral and lateral surfaces of the fused portion of ventral claspette when compared to *oswaldoi*, (2) circular or semicircular shape of preapical plate when compared to *oswaldoi* and (3) rounded apex of the aedeagus in contrast to *noroestensis*.

Neither the larva nor the pupa of *galvaoi* was available for this revision. However, the larva has been described by M. P. Deane, Causey and Deane (1946:36). From their description and key (p 43) it seems that *galvaoi* most closely resembles *goeldii (=nuneztovari), noroestensis* and *rangeli*. With regard to the larva, these investigators stated, "... it [*galvaoi*] can usually be separated from *A. goeldii* in which the posterior clypeal hairs are longer and simple or divided far from the base. In *A. goeldii, A. noroestensis* and *A. rangeli* the anterior clypeal hairs have even less numerous and shorter branches, and the leaflets of the abdominal palmate tufts of segments 5 to 7 are pointed at the tips." In their key, *galvaoi* is distinguished from *noroestensis* and *rangeli* by palmate hairs 1-V-VII possessing apically truncate leaflets. The difficulties of correctly identifying *galvaoi* are best summarized by Rachou and Ricciardi (1951: 426): *"Para se julgar dessa dificuldade, basta atentar-se para o fato de que esse mosquito, segundo os autores da especie, se assemelha ao* A. tarsimaculatus (A. aquasalis) *nas marcacoes do alado, ao* A. oswaldoi *na terminalia do macho, ao* A. noroestensis *na fase larvaria e possue ovos do tipo* oswaldoi, *donde se conclue que para se fazer um diagnostico conscientodas dessa especie e indispensavel que se analise todo esse conjunto, isto e todos as suas fases evolutivas."*

Based on the ventral claspette of the male genitalia, *galvaoi* shows the greatest affinity to *oswaldoi* and *noroestensis*. The larva seems to be very similar to that of *noroestensis*. For these reasons I am tentatively placing *galvaoi* between *oswaldoi* and *noroestensis* in this revision. The center of origin for *galvaoi* was probably within its present distribution, possibly in some refugium in the upper Amazon basin or along the eastern slope of the Andes.

BIONOMICS. Very little has been written about the natural history of *galvaoi*. Deane, Causey and Deane (1948:877) found the larvae in puddles containing grass and algae exposed to the sun. Forattini (1962:415) reports that the larvae are found in similar habitats to those of *rondoni*, such as puddles and marshes. The females are said to be crepuscular and have been collected on animal bait but not inside houses (Deane, Causey and Deane 1948).

MEDICAL IMPORTANCE. *An. galvaoi* is of no known medical importance.

DISTRIBUTION (fig. 3). *An. galvaoi* was described from the territory of Acre, Brazil. This species has been reported also to occur in Brazil in the following territories or states: Amazonas, Rondonia, Mato Grosso, Para, Sao Paulo, Rio de Janeiro (?) (Carvalho and Rachou 1951:475, 480); Goias (?) (Mattos and Xavier 1965:272); and Bahia (?) and Parana (?) (Rachou and Ricciardi 1951:425-426). Deane, Causey and Deane (1948:877) state that in the northeast and Amazon basin regions of Brazil, *galvaoi* is restricted to the high Amazon basin. These investigators encountered *galvaoi* in Rio Branco, Rio Zinho and Brasileia (Acre), and in Guajara Mirim (Rondonia). Garcia and Ronderos (1962:158) record *galvaoi* from Paraguay.

Material Examined: 7 specimens: 1 male, 2 male genitalia, 4 females.

BRAZIL. Acre (1M, 1Mgen, 4F): Rio Branco, O. Causey, 1M and 1Mgen (paratype 58037), 1F (paratype 58039), 1F (paratype); same locality, S.E.S.P. 699, 2F (13428-12 and 13428-42) [JH]. **Sao Paulo** [?] (1Mgen): Locality not specified, det. A. Galvao, 1Mgen (1085-28).

4. Anopheles (Nys.) noroestensis Galvao & Lane

Figs. 2, 4, 6, 13, 14

1937. *Anopheles (Nyssorhynchus) oswaldoi* var. *noroestensis* Galvao and Lane 1937e:220-221. TYPE: *Lectotype* male genitalia slide (2177, 10293), adult apparently lost, (possible syntype FMSP, 373), Novo Oriente [Pereira Barreto], near Lussanvira (Sao Paulo), Brazil [FH; designation by Belkin, Schick and Heinemann 1971:6].

1937. *Anopheles (Nyssorhynchus) oswaldoi* var. *metcalfi* Galvao and Lane 1937e:218-220. TYPE: *Lectotype* male (96) with genitalia on slide (710210-1), Porto das Caixas (Rio de Janeiro), Brazil, 29 May 1925, F. M. Root; one of several specimens identified as *tarsimaculatus* by Root (1926b:711), on which Galvao and Lane based their *metcalfi* [USNM; designation by Belkin, Schick and Heinemann 1971:6]. TRANSFERRED SYNONYMY.

1940. *Anofeles (Nyssorynchus) osvaldoi* (!) var. *ayrozai* Unti 1940a:379-383. TYPE. *Syntypes* female(s), larva(e), eggs, Vale do Rio Paraiba, Guaratingueta (Sao Paulo), Brazil, Nov 1939-Aug 1940 [NE; not in FH or SPM, Belkin, Schick and Heinemann 1971:6]. Synonymy with *noroestensis* by Galvao, Lane and Unti (1944:39).

1942. *Anopheles (Nyssorhynchus) clarki* Komp 1943:197-201. TYPE: *Holotype* dissected male genitalia mounted on slide, Monteros (Tucuman), Argentina, Jun 1940, C. A. Alvarado [USNM, 56476; male apparently lost].

Anopheles (Nyssorhynchus) noroestensis of Galvao and Damasceno (1942:125-129, 131); Barretto and Coutinho (1943:321); Correa (1943:128); Fonseca and Unti (1943:47-49); Galvao (1943: 143, 148, 149, 151); Ramos (1943:52); Unti and Ramos (1943:28); Causey, Deane and Deane (1944:2, 4, 5; 1946:26); Correa and Ramos (1944b:130); Galvao, Lane and Unti (1944:37-43); Lane (1944:264, 265; 1949:403; 1953:264-266); Deane, L. M., Causey and Deane (1946:7, 9, 10, 12; 1948:878-880); Deane, M. P., Causey and Deane (1946:38, 43, 45); Amaral and Penido (1947:168, 173-179); Senevet (1948a:278); Levi-Castillo (1949:10, 11, 15, 28, 67, 72, 76, 82, 86); Duret (1950a:371; 1950b:301-302; 1952:347); Carvalho and Rachou (1951:474-477, 480); Pinotti (1951:670); Rachou and Ferraz (1951:542-543, 547-553); Rachou and Ricciardi (1951: 424-426, 432-437); Gabaldon and Cova Garcia (1952:178, 193, 201); Horsfall (1955:170); Bejarano (1956:9, 20; 1957:326-335; 1959:305, 314, 323, 325); Guedes, Amorim and Schreiber (1957:247); de Andrade (1958b:117-125); Rachou (1958:148); Rachou, Moura Lima, Ferreira Neto and Martins (1958:417, 421, 423); Castro (1959a:175); Castro and Garcia (1959:600); Castro, Garcia and Bressanello (1959:549); Schreiber and Guedes (1959b:128-129; 1960:356-

357; 1961:657-658); Stone, Knight and Starcke (1959:33); Vargas (1959:370, 383); Cerqueira (1961:124); Forattini (1962:311, 394-395); Garcia and Rondero: (1962:137-139, 158); Belkin, Schick and Heinemann (1971:6); Consolim and Galvao (1973:17"-179); Knight and Stone (1977:63).

Anopheles noroestensis of Foote and Cook (1959:29, 32); Schreiber and Guedes (1959a:97-98); Maciel (1962:473-775); Cova Garcia (1964:200); Mattos and Xavier (1965:272-273); Gorham, Stojanovich and Scott (1967:17, 47, 58; 1973:113, 138, 147).

Anopheles (Nyssorhynchus) oswaldoi var. *noroestensis* of Galvao (1938a:52, 54-56, 58; 1940:432-437); Galvao and Amaral (1938:14); Galvao and Lane (1938:176-177); Fonseca and Fonseca (1942:99); Oliveira and Verano (1942:355); Rozeboom (1942a:240).

Anofeles (Nyssorynchus) osvaldoi (!) *noroestensis* of Unti (1940a:378).

Anopheles oswaldoi noroestensis of Galvao (1938b:101-103); Russell, Rozeboom and Stone (1943: 51); Vargas (1943:59).

Anopheles (Nyssorhynchus) oswaldoi in part of Oliveira and Verano (1942:353-358).

Anopheles (Nyssorhynchus) oswaldoi var. *metcalfi* of Galvao and Lane (1938:175-176); Galvao (1940:428-433; 1943:142-143); Correa and Ramos (1942a:37, 40-44, 46-47; 1942b:381-386); Galvao and Damasceno (1942:123-125); Rozeboom (1942a:239).

Anopheles (Nyssorhynchus) oswaldoi var. *ayrozai* of Rozeboom (1942a:240); Correa and Ramos (1944b:130).

Anopheles clarki of Russell, Rozeboom and Stone (1943:44); Cova Garcia (1964:200).

Anopheles evansi of Gabaldon (1949:765).

Anopheles (Nyssorhynchus) tarsimaculatus in part of Root (1922a:322, ?; 1926b:684-700, 709-711; 1932:779); Davis (1928:549-553); Shannon and Del Ponte (1928:42, 44-56, 53-54); Shannon and Davis (1930:488); Shannon (1931:10, 22); Lane (1939:27-29); Pinto (1939:390-398); Martinez and Prosen (1951:39, ?); Bejarano (1957:333-335); Castro (1959a:173-174).

Anopheles tarsimaculatus in part of Pinto (1930:154, 156); Kumm (1932:1-6); Unti and Ramos (1942:94, 99-100).

Anopheles (Nyssorhynchus) tarsimaculata in part of Root (1923:271; 1924b:461-463).

Anopheles tarsimaculata in part (?) of Muehlens, Dios, Petrocchi and Zuccarini (1925:262-265).

Cellia tarsimaculata in part (?) of Peryassu (1921b:183); Neiva and Pinto (1922a:321; 1922b:356-357); Godoy and Pinto (1923:29-33).

Cellia albimana in part (?) of Neiva (1909:69-77); Lutz, Souza Araujo and Fonseca Filho (1918: 162).

Cellia albipes in part (?) of Bourroul (1904:35).

FEMALE (fig. 6). Wing: 3.3 mm. Proboscis: 2.1 mm. Palpus: 2.0 mm. Forefemur: 1.4 mm. Abdomen: about 2.7 mm. **Head:** Integument reddish brown to dark brown. Proboscis about 1.5 length of forefemur. Long, erect, white, cuneate scales on vertex. Occiput with predominantly cream to golden scales. Palpal segment 2 with a few lighter scales on dorsal surface; segment 3 usually with a gray to white, dorsolateral stripe; apex of segment 2 usually with a few light scales; apex of segment 3 with a broad, distinct, white band; segment 4 with a dark basal band and a smaller, dark, apical band, often dark scales extending along ventral surface to form a stripe; segment 5 white with dark basal band extending from apex of segment 4. **Antenna:** Flagellar segment 1 with numerous, short, white, obovate scales on basomesal, dorsal and dorsolateral surfaces, and a distinct patch of long setiform scales distally on dorsal and dorsomesal surfaces. Flagellar segments 2-13 each with about 7-9 long, silver setae in a basal whorl. **Thorax:** Integument as on head. Median anterior promontory area with numerous, long, white, setiform scales extending dorsad onto anterior of acrostichal line; lateral promontory area with numerous light scales. Silver to cream scales on scutum large. Prescutellar space small to moderate, subtriangular or horseshoe shaped. Upper *stp* with 4, 5 long, dark setae in a horizontal to vertical arc and a patch of gray to cream scales. Lower *stp* usually with a long dark seta and a patch of gray to cream scales. Upper *mep* with about 4-7 long, brownish setae and

occasionally 1, 2 small scales. **Legs:** Light scales on coxae pale gray or cream, usually not white. Foretarsal segment 2 cream to white in apical 0.26-0.55; segment 3 with a broad, cream to white band in apical 0.55-0.80; segment 4 all dark to 0.5 apically light; segment 5 cream, gray or golden in about apical 0.3-0.5. Midtarsal segment 2 cream in about apical 0.1; segments 3 and 4 predominantly dark, with a few gray or golden apical scales; segment 5 often light in about apical 0.5. Hindtarsal segment 2 with a dark band in basal 0.25-0.35 (0.2-0.4); segment 5 cream to white in about apical 0.5. **Wing:** Light spots on wing yellow to cream, not white, at least on anterior veins. Vein C humeral light spot more than twice, 2.0-4.5 (1.75-4.50), length of basal dark spot; usually subbasal light spot greater than or equal to subbasal dark spot; rarely subbasal light spot absent, or subbasal and presectoral dark spots fused into one large spot; often presectoral light spot absent and the presectoral and sectoral dark spots fused; subcostal light spot moderately large, 0.30-0.45 (0.25-0.46) of subcostal dark spot; preapical light spot moderately large, 0.30-0.43 (0.17-0.43) of preapical dark spot; apical dark spot small, but variable. R presectoral dark spot much larger than sectoral dark spot; sectoral dark spot often absent. Dark preapical spot of R_2 large, conspicuous, 0.45-0.54 (0.40-0.54) of vein. Apical dark spot of R_3 large, occasionally broken by a few light scales. M sectoral and preapical dark spots moderately large to large, conspicuous; preapical dark spot not extending onto M_{1+2}. Cu_1 subcostal dark spot usually smaller than subsequent preapical dark spot. Apical light fringe spot moderately large to large, conspicuous and unbroken to apex of R_{4+5}; additional small light fringe spots at the apices of R_{4+5}, M_{1+2}, M_{3+4}, Cu_1, Cu_2 and A; occasionally a light fringe spot at level of 0.5 distance from base of A. **Abdomen:** Caudolateral scale tufts of segments II-VII with moderately large, obovate scales.

MALE. Wing: about 3.4 mm. Proboscis: 2.55 mm. Forefemur: 1.55 mm. Abdomen: about 2.75 mm. Essentially as in female except for sexual characters. **Head:** Palpal segments 2 and 3 with a dorsal line of cream scales; apex of segment 2 with a small white band; apex of segment 3 with a large white band; segment 4 with a brown basal band, rest of segment golden to white; segment 5 usually with a brown basal band extending along ventral surface to very near apex; dorsally and dorsolaterally remainder of segment 5 cream to white. **Antenna:** About 0.75 length of proboscis. Flagellar segment 1 with numerous, elongate, white setiform scales on dorsomesal margin. **Legs:** Forefemur about 0.6 length of proboscis. Basal plantar surface of foretarsal segment 5 with about 6-8 moderately long, distinct, spiniform setae. Claw on foreleg long, moderately curved; submedian tooth about 0.25-0.30 length of claw, sharp and apically recurved; basal tooth subequal to submedian tooth, heavy and decurved.

MALE GENITALIA (fig. 13). In general very similar to that of *oswaldoi* and *galvaoi*. **Segment VIII:** Tergite and sternite with narrow, long, obovate scales. **Segment IX:** Sternite similar to that of *oswaldoi*, subtrapezoidal, moderately long, about 0.2 length of sidepiece. Anterior apodeme long, about 0.3 length of sternite and subtrapezoidal. **Sidepiece:** Moderately narrow and subconical. Tergal surface usually with 4, 5 long, submedian tergomedial bristles and 1, 2 subapicolateral bristles; with moderately short bristles mesad of tergomedial bristles, often sparse with only 2, 3 short bristles present, more basal and apical bristles occasionally longer than rest. Tubercle of parabasal spine appearing short, less than 0.5 of parabasal spine. Basal apodeme moderately long, usually 0.25 or slightly less length of sidepiece. Longer, more dorsal accessory spine slightly less than 0.5 of sidepiece; more ventral spine about 0.75 of longer spine. Internal spine subequal to shorter accessory spine, moderately to

strongly retrorse apically. **Clasper**: Spiniform long and moderately heavy; seta *b* about 1.5 of spiniform. **Dorsal Claspette**: Pedicel moderately broad, sinuous; base rounded and weakly curved mesad. Leaflets about 0.35-0.45 length of claspette, broad; basomesal projection of dorsal leaflet very reduced. **Ventral Claspette**: About 0.35-0.45 length of sidepiece. Lateral margins tapered toward a narrow apex, width at apex 0.20-0.36 length of claspette and slightly wider than apex of aedeagus. Basal lobules large, expanded laterally, with long, often reflexed setae; setae on basal margin about 1.5-1.8 width of aedeagus; setae not concentrated on basomesal margin. Ventral and lateral surfaces (exclusive of basal lobule) with short setae about 0.5-0.7 width of aedeagus; setae extending to or nearly to apex. Apex with rounded, sclerotized lateral margins, separated by a shallow median sulcus. Preapical plate large, semicircular to oval, occasionally concave basally, heavily sclerotized, located about 0.3 length of claspette basad of apex. Transparent membranous area immediately basad of preapical plate in shape of inverted U. Refringent structure distinct, in shape of an inverted V, with or without lateral arms. **Phallosome**: Aedeagus subequal to length of ventral claspette; apex appearing distinctly truncate; leaflets absent.

PUPA (fig. 13). Abdomen: about 2.6 mm. Trumpet: 0.40 mm. Paddle: 0.75 X 0.55 mm. **Cephalothorax**: Darkly pigmented. Wing cases often with dark, sclerotized, longitudinal stripes. Hair 2-C 1-3 branched, longer than 1,3-C; 1,3-C 2,3 branched. Hairs 4,5-C moderately developed; 4-C 1-3 forked; 5-C 2,3 forked (1-4). Hair 6-C 1,2 forked, long. Hair 7-C 2,3 branched, long, one branch usually about 1.5 length of other branch(es). **Trumpet**: Pinna moderately to heavily pigmented; moderately long, about 3.3-4.1 (3.3-4.3) length of meatus; in lateral aspect, appearing broad medially and tapered toward apex (not as it appears in fig. 13). Meatal cleft usually basally pointed. **Metanotum**: Hair 10-C single and strong. Hair 11-C 3-5 branched, 1.0-1.3 length of 10-C. Hair 12-C single to triple, long, about 1.4-2.0 length of 10-C. **Abdomen**: Chaetotaxy in general very similar to that of *oswaldoi*. Hair 2-I 5-8 branched, moderately long. Hair 3-I single, about 0.5-1.0 length of 2-I. Hair 4-I 4,5 branched. Hair 5-I single or double, long. Hair 6-I single and long. Hair 7-I 2,3 branched, about 0.5 length of 6-I. Hair 9-I single, longer than 7-I and shorter than 6-I. Hair 0-II-VII moderately developed; 0-II,III 4-7 branched (3-7); 0-IV-VII 3-5 branched (2-6). Hair 1-II,III 5-9 (4-9) and 6-10 (5-10) branched respectively, strongly developed; 1-IV-VII strong and very long, 1.75-2.00 length of segment. Hair 2-IV-VII single or double, rarely triple, long, longer than that of *oswaldoi*, 0.5-0.7 length of segment. Hair 3-IV 3,4 branched (3-5), moderately long; 3-V 2,3 forked (1-3), moderately long. Hair 5-III 6-11 branched (5-12), strongly developed; 5-IV 3-5 branched (2-5), median branches longer and stronger than lateral branches; 5-V-VII heavy and long, usually equal to or slightly longer than segment. Hair 6-II-VI single or double, long; 6-II about 1.5 length of 7-II. Hair 7-II 2,3 branched (2-5); 7-III-V and 8-III-VII moderately short; 7-III 2,3 branched (2-4); 7-IV 1-4 branched (1-5); 7-V 1-3 branched; 7-VI,VII single, very long, about 0.7 length of segment; 8-III 2-4 branched (2-5); 8-IV-VI 1-3 branched; 8-VII 3 branched (2-4). Hair 9-II thin, pointed, small, unpigmented; 9-III small, 2.5 or less length of 9-II; 9-IV thick, 2.0-3.0 length of 9-III, heavily sclerotized; 9-V heavy, 1.5-2.0 (1.1-2.0) length of 9-IV; 9-VI strong, thick, weakly curved, 1.0-1.5 length of 9-V; 9-VII thick, curved, acuminate, 1.5-2.0 (1.4-2.0) length of 9-VI; 9-VIII straight, about equal to length of 9-VII; 9-II-VI less than 0.33 length of segment; 9-VII,VIII 0.3-0.5 length of segment. Hair 10-III 2,3 forked, moderately long; 10-IV,V single, very long. Hair 4-VIII 2,3 forked (1-3). **Terminal Segments**: Male genital lobe heavy, thick at base, with sides sloping toward apex; apex with distinct mammilliform protuberance. **Paddle**: Obovate,

slightly emarginate at insertion of hair 1-P. Midrib basally distinct, apically becoming indistinct. External buttress about 0.6 length of paddle. External margin distad of buttress with very fine, filamentous spicules extending around apex and becoming very sparse along caudal 0.5 of inner margin. Hair 1-P moderately short; 2-P single or forked, subequal to 1-P.

LARVA (fig. 14). Head: 0.6 mm. Antenna: 0.28 mm. Anal Saddle: about 0.3 mm. **Head**: Darkly pigmented, reddish brown. Median tooth of mental plate usually wider than combined widths of 2 adjacent teeth from one side. Inner and outer clypeal hairs (2,3-C) single and barbed in about apical half; 3-C about 0.8-0.9 length of 2-C; hairs 2-C widely spaced, clypeal index about 1.7 (1.0-2.0). Hair 4-C 3,4 branched (2-5), moderately short to moderately long, 0.30-0.45 length of 3-C. Hairs 8,9-C often dendritic, moderately large, length about 1.5-2.0 distance separating hairs 5-C; 8-C 4-6 branched (4-7); 9-C 6-8 branched. Hair 10-C 3,4 branched (2-4); 12-C 4, 5 branched, large, subequal to 9-C. Hair 15-C 4-7 branched, moderately large. Collar very dark reddish brown, moderately wide to wide dorsomedially. **Antenna**: Slightly darker than remainder of head. Spicules along mesal margin moderately long and thin; shorter and fewer on ventral surface. Hair 1-A 4-8 branched, short, about as long as width of antenna at point of insertion. **Thorax**: Reddish brown or greenish brown. Inner submedian prothoracic group (1-3-P) usually with hairs 1,2-P not sharing a common tubercle; palmate hair 1-P with 10-14 moderately narrow, pointed, lanceolate leaflets; 2-P 13-18 branched (12-18). Hair 14-P 8,9 branched (7-10), large; branches long (0.3 mm), arising from a moderately short shaft, median branches longer than lateral and extending beyond anterior margin of thorax. Mesothoracic hair 1-M strongly plumose, 26-30 branched (26-32). Metathoracic hair 2-T long, extending beyond caudal margin of thorax. Palmate hair 3-T with 11-15 moderately long, narrow, semitransparent leaflets. **Abdomen**: Integument pigmented as thorax. Hair 0-II-VII moderately large to large; 0-II,III 6-9 branched (5-10); 0-IV-VII 5-7 branched (5-8). Palmate hair 1-I with 15-18 (13-18) semitransparent, narrow, spreading leaflets; 1-II-VII with pigmented, moderately narrow, pointed leaflets; 1-II-V with 21-30 leaflets; 1-VI with 24-25 leaflets; 1-VII with 19-28 leaflets; 1-II,VII slightly smaller than 1-III-VI. Hair 2-II 6-9 branched (4-9), strongly developed, large; 2-III 4-6 branched, large, more than 2.0 length of leaflets of 1-III and stronger than 2-II; 2-IV single, moderately long, about 1.5 length of leaflets of 1-IV; 2-V very long, 3.0-4.0 length of leaflets of 1-V. Hair 5-I 3-5 branched, moderately short, inserted less than 0.75 its length from lateral margin of abdomen; 5-II 8-10 branched, moderately developed. Hair 9-I 4,5 branched, moderately large. Hair 11-I 3,4 branched, large. Hairs 13-I,II,III 5-9, 7-9 (6-9) and 8,9 (8-12) branched respectively, moderately developed; 13-IV 3,4 branched, moderately long, subequal to 2-IV and about 1.5 length of leaflets of 1-IV; 13-V almost always 3 branched (3-5) at least on one side of larva, very large, subequal to 2-V, about 3.0-4.0 length of leaflets of 1-V and extending beyond caudal margin of segment; 13-VI 8-12 branched (6-12), moderately developed. **Spiracular Lobe**: Pecten with 15-20 teeth; arrangement of teeth variable, but similar to that of *oswaldoi*; teeth usually as follows beginning ventrally: (1) 1 long, (2) about 4-6 moderate followed by 2-5 mixed moderate to short, (3) 1 long, (4) 1-5 mixed moderate to short and (5) usually 1 or 2 long occasionally followed by a short tooth; occasionally with another long tooth interspersed in dorsal half of pecten; serrations on teeth moderate in length. Lateral arm of spiracular apparatus short to moderately short, directed caudolaterally. Hairs 8,9-S 4-7 and 5,6 (4-7) branched respectively, moderately large. **Anal Segment**: Most of segment covered with fine spicules more strongly developed apically. Hair 1-X about 1.5-2.0 length of saddle; inserted on sad-

dle near ventral margin, or occasionally on ventral margin of saddle at base of indentation. Anal gills long, usually longer than saddle.

DISCUSSION. *An. noroestensis* can be distinguished from the other species in the Oswaldoi Subgroup in the **female** by the combination of (1) palpal segment 4 often with a dark ventral stripe, (2) hindtarsal segment 2 with a dark band in basal 0.25-0.35 (0.2-0.4), (3) foretarsal segment 3 with a light band in apical 0.55-0.80, (4) light wing spots yellow to cream (at least on anterior veins), and humeral light spot of vein C usually greater than 2.0 of basal dark spot, (5) subcostal light spot of vein C moderately large, about 0.30-0.45 of subcostal dark spot, (6) sectoral and preapical dark spots of vein M moderately large to large and (7) apical light fringe spot moderately large to large and conspicuous; in the **male genitalia** by the (1) apically truncate aedeagus subequal to length of ventral claspette, (2) basal lobule of ventral claspette large, expanded laterally, with setae along basal margin long, about 1.5-1.8 width of aedeagus, (3) apex of ventral claspette narrow, 0.20-0.36 length of claspette and (4) preapical plate large, semicircular to oval and heavily sclerotized; in the **pupa** by the combination of (1) pinna moderately long, about 3.3-4.1 length of meatus, appearing broad medially and tapered toward apex, (2) hair 9-V relatively short, 1.5-2.0 (1.1-2.0) length of 9-IV, (3) hair 9-VII 1.5-2.0 (1.4-2.0) length of 9-VI, (4) hair 9-VII,VIII longer than in *oswaldoi*, 0.3-0.5 length of segment, (5) hairs 2-V and 7-VI long, usually more than 0.5 length of segment, (6) hair 7-C with one branch about 1.5 length of other branch(es), (7) hair 2-I 5-8 branched and moderately long, 3-I about 0.5-1.0 length of 2-I, (8) hair 6-II about 1.5 length of 7-II and (9) hair 1-P moderately short; and in the **larva** by the combination of (1) hairs 2,3-C barbed in about apical half, hairs 2-C widely spaced, clypeal index about 1.7 (1.0-2.0), (2) hair 4-C 3,4 branched (2-5), moderately short to moderately long, 0.30-0.45 length of 3-C, (3) hair 14-P 8, 9 branched (7-10), large, with long branches, (4) hair 13-IV 3,4 branched, moderately long, about 1.5 length of leaflets of 1-IV, (5) hair 2-T long, extending beyond caudal margin of thorax, (6) hair 2-IV moderately long and 2-V very long, 3.0-4.0 length of leaflets of 1-V, (7) hair 5-I moderately short, inserted less than 0.75 its length from lateral margin, (8) hair 13-V very large, about 3.0-4.0 length of leaflets of 1-V, almost always 3 branched (3-5) at least on one side of larva and (9) lateral arm of spiracular apparatus short to moderately short, directed caudolaterally. *An. noroestensis* is difficult to diagnose in all stages, except for the male genitalia. The larva is almost identical with that of *rangeli*, except for the position of hairs 4-C and 5-I,II, and the relative lengths of several of the abdominal hairs. The pupa is very similar to those of *strodei, benarrochi* and *oswaldoi*. The adult is like those of *strodei* and *anomalophyllus*, except for the coloration of the scales of the thorax, coxae and wing, and the banding pattern of the foretarsus.

An. noroestensis is most closely allied to *oswaldoi* and *galvaoi*, and, to a somewhat lesser extent, to *aquasalis*. The male genitalia differ from those of *galvaoi* and *oswaldoi* primarily in the shape of the apex of the aedeagus, and from that of *oswaldoi* in the shape of the preapical plate. The basal band on the second hindtarsal segment of the adult is the main character separating *noroestensis* from *aquasalis, galvaoi* and *oswaldoi*. But because intraspecific variation is so great, individuals at the extremes (with either very small or very large second hindtarsal dark bands) cannot be distinguished from the adults of the latter 3 species. Ecologically, *noroestensis* occupies a different niche than either *aquasalis* or *oswaldoi*; it is found in fresh water in secondary growth areas, usually not in forested areas or coastal brackish water habitats.

The salivary and autosomal chromosomes were examined by Guedes, Amorim and Schreiber (1957) and Schreiber and Guedes (1959b; 1960; 1961). These authors

state that the X chromosomes are metacentric in neuroblasts and acrocentric in the salivary cells, and that some heterozygous inversions and asynaptic zones have been found in the autosomes.

An. noroestensis and *metcalfi* were first described as varieties of *oswaldoi* by Galvao and Lane at a meeting of the Sociedade de Biologia de Sao Paulo, 15 September 1937. The transcripts of this presentation were not published until 1938 in a festschrift for Lauro Travassos. In the interim, Galvao and Lane (1937e) described, in an abbreviated form, these new varieties and included them in keys along with illustrations of the eggs. The description of *metcalfi* was based on a description of an egg by Root (1926b:700) from Brazil. In comparing the surface ornamentation of the eggs, Root stated, "The species of the *Nyssorhynchus* group seem not to show the elongate hexagonal marking, so conspicuous in the eggs of such species as *quadrimaculatus* or *pseudomaculipes*. Instead, one finds the whole ventral and lateral portion of the egg studded with little white stars, each consisting of eight or ten short lines radiating from an imaginary common center." Because of the statement regarding the "little white stars," Galvao and Lane assumed that Root was describing a new and different species, unlike either *noroestensis, oswaldoi* or *tarsimaculatus*. In 1940, Galvao stated that in the state of Sao Paulo *metcalfi* must be rare or must not exist in that region, since no eggs had ever been collected with the characteristics described by Root. Later, Galvao and Damasceno (1942:123-125) reported that the eggs illustrated by Root (1926b) could have been those of *oswaldoi, noroestensis* or *tarsimaculatus*, and that it was impossible to tell what species his description referred to. They wrote, ". . . *julgamos que o* A. oswaldoi metcalfi *nao pode ser caracterizado pelo descricao de Galvao e Lane (1938) e o consideramos como* nomen nudum." By *nomen nudum* the authors, I believe, meant *nomen dubium*, since *nomen nudum* refers to a name not satisfying Articles 12-16 of the International Code of Zoological Nomenclature. As Mayr (1969:347) states, "A *nomen nudum* has no standing in zoological nomenclature and is best never recorded, not even in synonymy." Whereas a *nomen dubium* refers to a name for which there is insufficient evidence for recognition of the species to which the name was applied. In the same publication, Galvao and Damasceno (1942:125-129) raised *noroestensis* to specific rank based on the egg, larva, male genitalia and female. In 1971, Belkin, Schick and Heinemann (p 6) designated a male (96) with its genitalia on a slide (710210-1), collected by Root, 29 May 1925 in Porto das Caixas (Rio de Janeiro), as the lectotype of *metcalfi*. They stated that the lectotype was, "1 of several specimens identified as *tarsimaculatus* by Root (1926:711), on which Galvao and Lane based their *metcalfi* (USNM)." After careful examination of this lectotype, I am synonymizing *metcalfi* with *noroestensis*. The apex of the aedeagus clearly appears truncate, and the shape of the preapical plate corresponds to that of *noroestensis*. The dark basal band of hindtarsal segment 2 is 0.35 the length of the segment, also as in *noroestensis*. All the other characters examined correlate with those found in *noroestensis*. Additional specimens were collected near the type locality of *metcalfi* by J. N. Belkin, H. C. Barnett, G. K. Bryce and myself, December 1975 to February 1976 in the state of Rio de Janeiro. After studying these individually reared specimens and correlating the characters in the immatures and the adults, I have identified these specimens as *noroestensis*.

BIONOMICS. The immatures of *noroestensis* have been collected in both permanent and temporary water in drainage ditches, small ground pools, potholes and along stream margins. The immatures are usually found in fresh water, either exposed to the sun or partially shaded. The water is frequently turbid and brownish. One collection from the state of Rio de Janeiro was from a flooded grassy yard highly contami-

nated with pig and chicken feces. The immatures were all collected in regions of secondary growth or in areas of cultivation, and not in the forest, although they may occur along the edge of forested areas. Species that have been collected in association with *noroestensis* are *Anopheles (Nys.) albitarsis, Culex (Cux.) coronator* group, *Cx. (Cux.)* sp, *Cx. (Mel.)* sp and *Uranotaenia (Ura.) lowii.* Additional larval habitats reported in the literature are muddy puddles, rock holes and wells (Deane, Causey and Deane 1948:878-880), and marshes and swamps (Galvao 1940:433). Deane, Causey and Deane (1948) showed that *noroestensis* was highly sensitive to sodium chloride and would not develop to the third instar even in a dilute solution of 0.5%. They also reported collecting *noroestensis* at altitudes greater than 700 m in the state of Ceara, Brazil. Galvao (1938b:102) reared *noroestensis* in the laboratory at a mean temperature of 25.7°C and showed that the development from egg to adult required about 13 days.

Most reports indicate that *noroestensis* is not very anthropophilic or endophilic. Of the 1342 females collected in northeastern Brazil by Deane, Causey and Deane (1948), only 53 or 3.9% were collected in houses. Forattini (1962:394-395) also reported that *noroestensis* was not domestic or anthropophilic. Contrary to these authors, Correa and Ramos (1942a:37-47) indicated that *noroestensis* (as *metcalfi*) was largely anthropophilic and endophilic. Deane, Causey and Deane (1948) stated that *noroestensis* was most abundant during the rainy season (June 1941) in Ceara. In 2 days in June, they collected 447 females on animal bait, representing 96.9% of the anophelines captured. During the dry season in December over a 2 day period, they collected only 12 adults representing 35.3% of the anophelines caught. In host preference studies made between 1730 and 1930 hours in June, Deane, Causey and Deane (1948) collected 38 females on a horse and only one on a man. Biting peaked around sundown, and there was another small peak of activity at dawn, although some individuals could be captured throughout the night.

MEDICAL IMPORTANCE. *An. noroestensis* does not seem to be important as a primary vector of malaria. Correa and Ramos (1942a:37; 1942b:385-386) dissected 24 females of "*metcalfi*" which were collected inside houses in Ribeira, Sao Paulo, Brazil and found 2 (8.3%) with an oocyst infection of *Plasmodium* sp; however, I am not certain that the species these authors reported as *metcalfi* was actually *noroestensis*. Nevertheless, a photograph of the head capsule of the supposed *metcalfi* in Correa and Ramos (1942b:383) corresponds to that of *noroestensis*, as does the habitat in which these mosquitoes were collected. Deane, Causey and Deane (1948), after studying *noroestensis* in many different localities in the northeast of Brazil, stated that all indications are that this species is not important in the transmission of malaria. Forattini (1962:311) reported that it is possibly a secondary vector. *An. noroestensis* from Guaratingueta and Guaruja, Sao Paulo, Brazil has been experimentally infected with *Plasmodium vivax* by Fonseca and Unti (1943:47-52).

DISTRIBUTION (fig. 2). *An. noroestensis* is distributed throughout central and southeastern South America. Its northernmost limits are the southern margins of the Amazon basin and the northeastern states of Brazil (Maranhao, Ceara). In the west, *noroestensis* extends to the eastern versant of the Andes. *An. noroestensis* is reported to occur as far south as the provinces of Chaco, Corrientes, Formosa, Misiones, Salta, Santa Fe and Tucuman in Argentina (Garcia and Ronderos 1962:161).

Material Examined: 178 specimens: 22 males, 18 male genitalia, 57 females, 19 pupae, 62 larvae; 19 individual rearings: 9 larval, 7 pupal, 3 incomplete.

ARGENTINA (7 specimens: 2M, 3Mgen, 2F). **Tucuman:** Concepcion, N. Davis, 3Mgen (*clarki*) [JH]. Monteros, Jun 1940, 2M, 2F.

BOLIVIA (17 specimens: 6M, 4Mgen, 7F). **Santa Cruz:** Charagua, 16 May 1944, 3153, 4F. La Guardia, nr Santa Cruz, 27 Sep 1943, Torres Munoz, 3083, BOL 21, 4M, 3Mgen. **Department and locality not specified:** Carr, No. 2919, 2M, 1Mgen, 2F; same collector, 1F.

BRAZIL. Bahia (47 specimens: 1M, 9F, 37L): C. de Maria, 1F [JH]. Escondido, 1F [JH]. Itapebi, 3L [JH]. Itapira, Mar 1931, 1F. Jequie, 4F [JH]. Jitauna, 1F [JH]. Pindobacu, 2L [JH]. Poiri, 1L [JH]. Salvador da Bahia, 1972, J. Fowler, BRS 82, 3L; same data except Mar 1972, BRS 101, 1L; same data, BRS 110, 1L; same locality and collector, 1972, BRS 116, 3L; same data, BRS 127, 4L; same data, BRS 147, 1L; same data, BRS 149, 1L; same data, BRS 164, 3L; same data, BRS 171, 2L. Rio Ipitanga, 16 Mar 1972, J. Fowler, BRS 92, 3L. Santo Amaro, 1L [JH]. Santo Antonio, 1F [JH]. Locality not specified, thru M. Boyd, 1M; 8L [JH]. **Ceara** (1F): Guaramiranga, det. Deane, 1F [CU]. **Maranhao** (1Mgen): Locality not specified, 1Mgen (10.190) [JH]. **Pernambuco** (3M): Locality not specified, D. Lucen, 3M. **Rio de Janeiro** (86 specimens: 9M, 9Mgen, 27F, 19p, 22L&l; 19 ind rear: 9 l, 7p, 3inc): Bangu, F. Root, 1Mgen (105) [JH]; same locality, 3Mgen (109) [JH]. Itaquai, 19F [JH]; same locality, BRA 282. Mage, 1F [JH]. Seropedica, BRA 230, 231. Varzea das Mocas, BRA 253, 291. **Rio Grande do Norte** (2L): Rio Cajupiranga, on road to San Jose, 6 Jan 1945, H. Dalmat, 1L [CU]. Rio Pirangi, Cajupiranguinha, 1 Nov 1944, H. Dalmat, 1L [CU]. **Sao Paulo** (1M, 11F): Novo Oriente, 1938, A. Galvao, J. Lane, 1M, 11F. **State not specified** (1Mgen, 1L): Manibu, Rio Araray, 18 Oct 1944, H. Dalmat, 1L (21) [CU]. Locality not specified, F. Root, 1Mgen (109-25) [JH].

5. Anopheles (Nys.) aquasalis Curry

Figs. 2, 4, 6, 15, 16

1932. *Anopheles (Nyssorhynchus) tarsimaculatus* var. *aquasalis* Curry 1932:566-572. TYPE: *Syntypes* male with genitalia slide, female and larva, Atlantic side of Canal Zone (no type locality cited although Colon and Cristobal mentioned), D. P. Curry *et al.* [LU] (Belkin, Schick and Heinemann 1965:44).

1941. *Anopheles (Nyssorhynchus) emilianus* Komp 1941:794-800. TYPE: *Holotype* male with genitalia slide, northern outskirts of Belem (Para), Brazil, reared from larva collected in grassy pool, 14 Apr 1941, W. H. W. Komp [USNM]. Synonymy with *aquasalis* by Causey, Deane and Deane (1945:247-248).

1942. *Anopheles (Nyssorhynchus) oswaldoi* var. *guarujaensis* Ramos 1942:61-63. TYPE: *Syntypes* adults, larvae, eggs, Ilha do Guaruja (Sao Paulo), Brazil, Mar 1939, collected in part by Seccao de Ecologia (A. Carvalho Franco) [LU]. Synonymy with *tarsimaculatus* by Galvao and Damasceno (1942:131). Synonymy with *aquasalis* by Lane (1949:402).

1948. *Anopheles aquasalis* var. *guarauno* Anduze 1948:18. TYPE: *Syntypes* adults, reared from eggs of the normal *aquasalis "typicus,"* Pedernales (Delta Amacuro), Venezuela [NE]. Considered as subspecies by Lane (1953:260).

1948. *Anopheles aquasalis* var. *delta* Anduze 1948:18. TYPE: *Syntypes* adults, reared from eggs of the normal *aquasalis "typicus,"* Pedernales (Delta Amacuro), Venezuela [NE]. Considered as subspecies by Lane (1953:260).

1978. *Anopheles (Nyssorhynchus) deltaorinoquensis* Cova Garcia, Pulido F. and Amarista M. 1978:150-161. TYPE: *Syntypes* adults, eggs, larvae and pupae, holotype not specified according to Article 73(b), La Brea, Punta Gorda and Las Parcelas (Sucre), Caribe, Zona de Maturin and Boca de Guanipa (Monagas), and Capure, Punta de Tolete, Pedennales, Isla de Guanoco and Boca de Capurito (Delta Amacuro), Venezuela [DERM]. NEW SYNONYMY.

Anopheles (Nyssorhynchus) aquasalis of Senevet and Abonnenc (1938:487-493); Gabaldon (1940: 4-5); Gabaldon and Aguilera (1940:66-68, 72-80); Gabaldon, Cova Garcia and Arevalo (1940: 25-28); Gabaldon, Cova Garcia and Lopez (1940:10, 11, 13-16); Gabaldon, Lopez and Ochoa Palacios (1940:37-38); Galvao (1941:94; 1943:142-143); Rozeboom (1941:102; 1942a:242); Rozeboom and Gabaldon (1941:92-98); Galvao and Damasceno (1942:130-131); Komp (1942: 39, 40, 73-74, 81, 122-124, 132, 159-160); Simmons and Aitken (1942:38, 46, 54, 62, 87-90); Floch and Abonnenc (1943a:1-9; 1943b:1-8; 1945:2, 4-8, 11, 13-16; 1946b:3-5; 1947:1-5; 1951:44-48); Causey, Deane and Deane (1944:2, 4, 5, 6; 1945:243-250; 1946:27); Lane (1944: 263-266; 1949:402; 1953:259-261); Levi-Castillo (1945:105-116; 1949:10, 11, 15, 27, 32, 58,

67, 72, 76, 81, 85); Deane, L. M., Causey and Deane (1946:2-3, 7-10; 1948:881-894); Deane, M. P., Causey and Deane (1946:38, 42, 45); Arnett (1947:198); Comer (1948:87-88); Vargas (1948: 158; 1959:377); van der Kuyp (1949a:67-68); Downs (1950:29-30); Pinotti (1951:667-668, 673, 681-682); Senior-White (1951a:293-403; 1951b:465-512); Gabaldon and Cova Garcia (1952:179, 182, 189); Frizzi and Ricciardi (1955:399-407); Horsfall (1955:178-181); Vargas V. (1956:29; 1957:1; 1958a; 1958b); Bejarano (1957:326, 327, 329, 333); Rozeboom and Kitzmiller (1958:244); Schreiber and Guedes (1959b:128-129; 1960:356-357); Stone, Knight and Starcke (1959:31); Cerqueira (1961:121-122); Fauran (1961:8-9); Forattini (1962:311, 382-388); Belkin, Schick and Heinemann (1965:44); Kitzmiller and Chow (1971:65-85); Kreutzer, Kitzmiller and Rabbani (1975:363-364); Cova Garcia and Sutil O. (1976:31; 1977:18, 47, 63, 88); Cova Garcia, Pulido F. and Amarista M. (1978:155, 157).

Anopheles aquasalis of Rozeboom (1941:102); Kumm and Zuniga (1942:399); Downs, Gillette and Shannon (1943:33-42); Ross and Roberts (1943:33-34); Russell, Rozeboom and Stone (1943:26, 29, 30, 31, 42); Eyles (1944:12-13); Deane and Damasceno (1948:501-508); Deane, Vernin and Damasceno (1948:793-795, 804-807); Senior-White (1950:5-6; 1954); Floch (1954: 3-5; 1956:45-46); Vargas V. (1958c:1, 3); Foote and Cook (1959:114); Gabaldon and Guerrero (1959:433-434); Giglioli (1959:280; 1963:131-145); Cova Garcia (1961:35-36, 69, 87-88, 113, 124-125, 154; 1964:199-214); Fauran (1962:73-76; 1963:44-45; 1964:51-52); Sellers, Bergold, Suarez and Morales (1965:466-469); Fauran and Courmes (1966:104-105; 1967:70); Stojanovich, Gorham and Scott (1966a:12, 19, 30; 1966b:21, 31, 39); Gorham, Stojanovich and Scott (1967:18, 48, 50; 1973:114, 139, 141); Serie, Kramer and Chatenay (1968:198-200, 202-203, 208, 209); Hamon, Brenques and Chauvet (1970:33); Elliott (1972:757); Panday (1975a:297-301; 1975b:305-308; 1977:732, 734); Cova Garcia and Sutil O. (1975a:23; 1975b:212).

Anopheles (Nyssorhynchus) emilianus of Bruce, Knigin, Yolles and Graham (1943:441); Galvao (1943:142); Causey, Deane and Deane (1945:243-250); Cova Garcia and Sutil O. (1976:31; 1977:18, 47, 63, 88); Cova Garcia, Pulido F. and Amarista M. (1978:155, 157).

Anopheles (Nyssorhinchus) (!) *emilianus* of Cova Garcia (1964:199-217).

Anopheles emilianus of Russell, Rozeboom and Stone (1943:37, 42, 45); Cova Garcia and Sutil O. (1975a:23; 1975b:212).

Anopheles (Nyssorhynchus) tarsimaculatus of Root (1922a:322, in part?; 1926b:684-700, 709-711, in part; 1932:781, in part); Christophers (1924:39-40, 89, in part); Dyar (1925:187-188, 195, in part?; 1928:439-440); Kumm (1929:101-103, in part); Hill (1930:712); Shannon and Davis (1930:488, in part?); Shannon (1931:10, 22); Edwards (1932:45, in part?); Senevet (1932:252, in part?; 1937:358-360; 1938:179-181; 1948c:434-439); Antunes and Lane (1933: 97, in part); Davis (1933:278, 280, in part?); Earle (1936:459-469); Komp (1936a:161-162, in part); Galvao and Lane (1937a:77-78; 1937e:213-216; 1938:169, 170, 172-173, in part); Galvao, Lane and Correa (1937:40-41); Galvao and Amaral (1938:13); Root and Andrews (1938: 566-578); Rozeboom (1938a:96, 100-101, 104; 1938b:289, 293); Lane (1939:27-29, in part); Pinto (1939:398, in part?); Galvao (1940:421-425; 1941:92, in part?; 1943:141-143, 149, 151); Komp (1941a:93, 95, 97); Senevet and Quievreux (1941:248); Floch and Abonnenc (1942b:2); Galvao and Damasceno (1942:129-130); Galvao, Damasceno and Marques (1942:51-111); Barretto and Coutinho (1943:321); Correa (1943:124, 126, 127); Coutinho (1943:65-77); Ramos (1943:51-62); Correa and Ramos (1944a:105-108; 1944b:131; 1944c:10-11); Galvao, Correa and Grieco (1944:85-102); Galvao, Lane and Unti (1944:45); Amaral and Penido (1947:164-165, 168, 173-180); Vargas (1948:157-158); Carvalho and Rachou (1951:474-477, 480); de Andrade (1953a:95-107; 1953b:145-156; 1958a:17-30); Senevet and Andarelli (1955:339, 342); Bejarano (1957:333-335, in part); Rachou (1958:161-168).

Anopheles tarsimaculatus of Edwards (1922:75); Root (1922b:392); Cleare (1926:404-406); Hoffman (1930:366); Benarrochi (1931:691-693); Davis (1931:45-47, 49-50, in part); Shannon (1931:10, 22, in part); Beattie (1932:477-496, in part); Kumm (1932:1-6, in part); Buxton (1934:491-494); Hill (1934:425-428); Earle (1936:460-465, 467-468); de Verteuil and Spence (1937:450, 454-455); Kumm and Novis (1938:503); Kumm and Ruiz (1939:438, 441); Kumm, Komp and Ruiz (1940:388, 389, 391, 412, 419); Kumm (1941a:359); Vargas (1941:118); Unti and Ramos (1942:93, in part?); Oliveira, de Andrade and Nascimento (1951:151-247).

Nyssorhynchus tarsimaculatus in part (?) of Lima (1928:95-98); Townsend (1933b:7-12).
Anopheles (Nyssorhynchus) tarsimaculata in part of Root (1923:276; 1924b:461, 462).
Anopheles tarsimaculata of Dyar and Knab (1906b:160-161, in part); Busck (1908:58); Knab (1913:36, 37, in part); Zetek (1915:221-271); LePrince and Orenstein (1916:43-114); Howard, Dyar and Knab (1917:975-979, in part?); Bonne (1923:127-128, in part); Dyar (1923:185, in part); Muehlens, Dios, Petrocchi and Zuccarini (1925:252-254, 257, 264-265); Senevet (1931: 79-82, in part?).
Anopheles (Anopheles) tarsimaculata in part of Bonne-Wepster and Bonne (1923:127); Bonne and Bonne-Wepster (1925:511-515).
Anopheles (Cellia) tarsimaculata in part (?) of Dyar (1918:151).
Cellia tarsimaculata in part (?) of Neiva and Penna (1916:94); Peryassu (1921a:70; 1921b:181-183); Neiva and Pinto (1922b:356-357); Godoy and Pinto (1923:29-33); Bonne (1924:133-137); Boyd (1926:31, 36, 48).
Anopheles albimanus var. *tarsimaculata* of Evans (1921:460; 1922:213).
Cellia albimana in part (?) of Peryassu (1908:120-121); Neiva (1909:69-77); Theobald (1910:69-70); Godoy and Pinto (1923:29-33).
Anopheles albimanus in part of Nicholls (1912:251-268).
Anopheles albipes of Gray and Low (1902:194).
Cellia albipes in part (?) of Theobald (1903:110-113; 1905b:11); Bourroul (1904:33, 63, 75); Peryassu (1908:61).
Anopheles (Nyssorhynchus) oswaldoi var. *metcalfi* (?) of Lucena (1940a:107-112; 1940b:176-177).

FEMALE (fig. 6). Wing: 3.3 mm. Proboscis: 2.1 mm. Palpus: 2.0 mm. Forefemur: 1.4 mm. Abdomen: 2.85 mm. **Head:** Integument brown to dark brown. Proboscis about 1.5 length of forefemur. Palpal segment 2 with a few, light, erect scales on dorsal or dorsolateral surface; segment 3 with a gray to white, dorsal or dorsolateral, longitudinal stripe beginning 0.3-0.5 from base and usually ending near apex, with a white apical band larger than light apical band of segment 2; base and apex of segment 4 with dark scales occasionally extending onto base of 5; remainder of segments 4 and 5 white; ventral surface of 4 usually without a distinct stripe of dark scales. **Antenna:** Flagellar segment 1 with elongate, oblanceolate, white scales distally on dorsomesal surface, and often with shorter scales on dorsolateral surface; basally with short, obovate, white scales on dorsal or dorsolateral surface. Flagellar segments 2-13 each with basal whorl of 8-10 long, curved, silver setae. **Thorax:** Integument dark brown to almost black. Prescutellar space generally horseshoe shaped, occasionally triangular. *Ppl* with 2 (1-3) long, dark setae. *Sp* with 3-9 moderately long, light setae. *Pra* with 5-10 long setae, and a patch of about 7 long, broad, whitish scales. Upper *stp* with about 4 dark setae, and about 8 (6-11) gray to white, broad, obovate scales distributed in horizontal arc. Lower *stp* with 1, 2 long setae and a patch of about 6 gray to white, obovate scales. Upper *mep* with 3-6 long, dark setae; scales absent. **Legs:** Light scales on coxae light cream to grayish, not white. Foretarsal segment 2 cream to white in about apical 0.25 (0.15-0.36); segment 3 highly variable, light in apical 0.40-0.65 (0.40-0.70) in Central and South America, and light in apical 0.15-0.40 in the Lesser Antilles; segment 4 all dark or with a few, golden, apical scales; segment 5 with apical 0.3-0.7 golden to cream or gray. Midtarsal segment 2 with a cream band in apical 0.1-0.3; segment 3 with a small, apical, golden band; segment 4 all dark; segment 5 golden in apical 0.3-0.5. Hindtarsal segment 2 with brown band in basal 0.40-0.55 (0.3-0.6). **Wing:** Highly variable, characters listed below represent the usual conditon and some of the common variations. Dark spots on posterior veins distinct. Light spots at least on veins C and R light cream to yellowish, occasionally white on posterior veins. Vein C with humeral light spot 1.8-3.5 (1.5-3.5) of basal dark spot; basal dark spot usually 0.5 its length from humeral cross vein; occasionally presectoral light spot absent; very rarely both subbasal and

presectoral light spots absent, so that subbasal, presectoral and sectoral dark spots fused into one large, dark spot; subcostal light spot about 0.35 (0.3-0.5) of subcostal dark spot, occasionally longer in specimens from the Lesser Antilles; preapical light spot about 0.45 (0.3-0.6) of preapical dark spot; apical dark spot moderately small. Rs-R_{2+3} usually with an extra subcostal light and dark spot. R_3 variable, with 2 or 3 light and dark spots, occasionally apical dark spot absent. R_{4+5} subcostal and preapical dark spots moderately small. M sectoral dark spot distinct, usually moderately long although variable; preapical dark spot not extending onto M_{1+2}. Vein A subcostal dark spot moderately long, about 0.1-0.2 length of A. Apical light fringe spot small to moderate; additional small light fringe spots at apices of R_{4+5}, M_{1+2}, M_{3+4}, Cu_1, Cu_2 and A; a moderately small, inconspicuous, light fringe spot at level of 0.5 distance from base of A. **Abdomen:** Sternite I with a few, moderately long setae. Dark caudolateral scale tufts on tergites and sternites II-VII with scales long, broad and very conspicuous. Tergite densely covered with narrow, moderately large, light gray to golden scales in subtriangular pattern on segments II, III and rectangular pattern on IV-VIII.

MALE. Wing: 3.11 mm. Proboscis: 2.55 mm. Forefemur: 1.5 mm. Abdomen: about 2.8 mm. Essentially as in female except for sexual characters. **Head:** Palpal segment 2 and almost always segment 3 with a light dorsal stripe; segment 4 with pale golden, cream or white scales mediodorsally and laterally, usually with a basal and an apical, dark band, and scattered, inconspicuous, dark scales ventrally. **Antenna:** About 0.75 length of proboscis. Flagellar segment 1 with numerous, long, curving, white, lanceolate scales on dorsomesal surface. **Legs:** Forefemur about 0.7 length of proboscis. Claw on foreleg curved and pointed; submedian tooth recurved at apex, about 0.2 length of claw; basal tooth subequal to submedian tooth, strongly decurved and blunt.

MALE GENITALIA (fig. 15). **Segment VIII:** Scales on tergite and sternite narrow, lanceolate to oblanceolate and predominantly light; scales somewhat narrower on sternite than on tergite. **Segment IX:** Sternite long, about 0.2 length of sidepiece, subtrapezoidal. Anterior apodeme subtrapezoidal and moderately long, about 0.15 length of sternite. **Sidepiece:** Moderately narrow, conical. Tergal surface usually with 3, 4 long, submedian tergomedial bristles and one subapicolateral bristle; with moderately short bristles mesad of basal tergomedial bristles and longer bristles laterad of more apical tergomedial bristles. Parabasal spine usually at least 2.0 length of its tubercle. Basal apodeme about 0.2 length of sidepiece. Longer, more dorsal accessory spine about 0.5 length of sidepiece; more ventral spine about 0.70-0.75 of longer spine. Internal spine subequal to shorter accessory spine, moderately to strongly retrorse apically. **Clasper:** Spiniform blunt, moderately long, slightly less than or equal to length of seta *b*. **Dorsal Claspette:** Pedicel moderately broad; base broad and rounded, weakly curved mesad. Leaflets broad; dorsal leaflet with large, prominent basomesal projection. **Ventral Claspette:** Lateral margins tapered toward a moderately narrow apex, width at apex about 0.3 length of claspette. Basal lobule broad and semispherical, covered basally and laterally with radiating, moderately short setae; setae along basal margin about equal to or slightly longer than width of aedeagus; setae shorter on mesal margin and more or less uniformly distributed on lobule. Lateral and ventral surfaces (exclusive of basal lobule) with short setae; setae 0.5 or less width of aedeagus; setae extending to or nearly to apex. Apex with rounded lateral margins and a shallow median sulcus; sulcus with gently sloping sides. Preapical plate moderately small, circular to oval, weakly to heavily sclerotized, located about 0.3 length of claspette basad of apex. Region immediately basad of preapical

plate with a moderately broad, transparent, horseshoe shaped membranous area. Refringent structure in shape of inverted V. **Phallosome**: Aedeagus about 1.20-1.35 length of ventral claspette; apex rounded, slightly wider than long; leaflets absent.

PUPA (fig. 15). Abdomen: about 2.8 mm. Trumpet: 0.5 mm. Paddle: 0.75 X 0.55 mm. **Cephalothorax**: Dark brown to brownish black. Wing cases often with longitudinal sclerotized stripes. Hairs 1-3-C 2,3 branched (1-3); 1-C longest. Hairs 4, 5-C 2-4 forked (1-4). Hair 6-C 1-3 forked (1-4). Hair 7-C 2,3 branched, often caudal branch about 1.5-2.0 length of other branch(es). Hairs 8,9-C subequal in length; 8-C single; 9-C 1-3 forked (1-4). **Trumpet**: Pinna pale yellow, with margin moderately pigmented; moderately long, about 3.5-4.3 (3.5-4.7) length of meatus; in lateral aspect, appearing broad medially and tapered toward apex. Meatal cleft long and basally rounded. **Metanotum**: Hair 10-C single or occasionally double, short, about 0.50-0.75 length of 12-C. Hair 11-C 1-5 forked (2-6), equal to or slightly longer than 10-C. Hair 12-C 1-3 forked about 0.3 from base, long. **Abdomen**: Pigmented as on cephalothorax. Hair 2-I 4-8 branched (2-10) near or at base, moderately short, most branches subequal. Hair 3-I single or double, about 0.5 length of 2-I. Hair 4-I 4-6 branched (3-8), moderately long. Hair 5-I 1-3 branched, moderately long, slightly shorter than 6-I. Hair 6-I single and long. Hair 7-I 3-7 branched, 0.50-0.65 length of 6-I. Hair 9-I single, 0.65-0.85 length of 6-I. Hair 0-II-VI 2-6 branched (2-8); 0-VII 1-3 branched (1-5). Hair 1-II,III 4-9 branched (3-11), moderately long, median branches longer than lateral; 1-IV-VII very long, 1.50-1.75 length of segment. Hair 3-IV 3-8 branched (2-8), moderately developed; 3-V 2-4 forked (1-5), moderately long. Hair 5-III 3-6 branched (3-9) and 5-IV 2,3 branched (1-4), median branches longer than lateral; 5-V-VII single, subequal to length of segment. Hair 6-II single or double, about 2.0 length of 7-II; 6-III 1-3 forked, moderately long; 7-II 3-7 branched (2-7). Hairs 7,8-III-V 2-5 branched; 8-III-VII and 7-III,IV small; 7-V-VII 1-4 forked, moderately long. Hair 9-II minute, unpigmented; 9-III small, less than 2.0 length of 9-II; 9-IV usually blunt, always 2.0 or more length of 9-III; 9-V-VII moderately slender, curved, acuminate, long; 9-V 2.4-4.0 (2.3-5.0) length of 9-IV, slightly less than or equal to 0.5 length of segment; 9-VI 1.0-1.3 length of 9-V; 9-VII 1.1-1.5 length of 9-VI, usually greater than 0.5 length of segment; 9-VIII subequal to and straighter than 9-VII. Hair 10-III 2-4 forked (1-4). Hair 4-VIII 1-3 branched (1-4). **Terminal Segments**: Apex of male genital lobe with large, distinct, mammilliform protuberance. **Paddle**: Light brownish yellow. Large, obovate, moderately broad, emarginate subapically at insertion of hair 1-P. Midrib not reaching apex. External buttress about 0.6 length of paddle, serrated apically with very small teeth. External margin distad of buttress with fine, short, filamentous spicules extending around apex and becoming shorter along caudal 0.7 of inner margin. Hair 1-P strong and moderately long; 2-P 1-3 forked (1-4), weak, subequal to 1-P.

LARVA (fig. 16). Head: 0.6 mm. Antenna: 0.27 mm. Anal Saddle: 0.3 mm. **Head**: Heavily pigmented, mottled over much of ventral and dorsal surfaces, reddish brown to dark brown, lighter in ocular region. Inner and outer clypeal hairs (2,3-C) plumose in apical 0.3-0.7, with 7-12 simple, rarely dendritic, moderately short to long branches; 3-C occasionally with slightly longer branches than 2-C; hairs 2-C widely spaced, clypeal index 1.67. Hair 4-C 1-3 branched, short to moderately short, length usually less than or equal to distance between insertion of hairs 2-C and 3-C; inserted moderately close to moderately far from anterior margin of head. Hair 8-C 3-5 branched (2-6) near base, slightly longer than distance separating insertion of hairs 5-C. Hair 9-C dendritic, 3-6 branched (3-8), about 1.3 length of 8-C. Hair 12-C 3-5 branched (3-6), subequal to 9-C. Collar wide dorsomedially, moderately sclero-

tized, yellowish brown to reddish brown. **Antenna:** More heavily sclerotized than remainder of head. Mesal margin with numerous, strongly developed spicules thicker than in *oswaldoi*. Hair 1-A 4-7 branched (3-10), moderately short, always less than 2.0 width of antenna at point of insertion. **Thorax:** Reddish brown to dark reddish brown or dark greenish brown, often darker medially. Submedian prothoracic group (1-3-P) with or without hairs 1,2-P sharing a common tubercle; often hair 1-P arising from very weakly pigmented tubercle; palmate hair 1-P with 10-15 (10-18) moderately narrow leaflets; 2-P 16-20 branched (13-23), about 4.0 length of leaflets of 1-P. Hair 14-P 6-10 branched from a short, flattened stalk; lateral branches equal to or slightly shorter than median. Mesothoracic hair 1-M 25-40 branched, lanceolate in outline, lateral branches longer than basal and apical. Metathoracic hair 2-T long, usually extending to about caudal margin of thorax. Palmate hair 3-T with 10-15 (9-19) semitransparent, moderately long, spreading leaflets. Pro-, meso- and metathoracic pleural group spines long, strongly developed. **Abdomen:** Pigmented as on thorax, sternum lighter than tergum. Hair 0-II-VI 3-7 branched (2-8), moderately developed. Palmate hair 1-I with 11-15 (10-17) semitransparent, moderately narrow leaflets; 1-II,VII with 18-26 broad, pointed leaflets, smaller than 1-III-VI; 1-III-VI with with 20-30 (20-32) leaflets. Hair 2-II 3-6 branched, strongly developed; 2-III 2-5 branched, large; 2-IV single, moderately long; 2-V 1-3 branched, very long. Hair 5-I 3,4 branched (3-5), branches subequal and moderately long; 5-II 5-9 branched (4-9). Hair 9-I 4-7 branched (3-8). Hairs 13-I,II,III 4-7 (3-7), 5-9 (5-11) and 5-9 (5-13) branched respectively, small; 13-IV 4-6 branched (3-8), moderately large; 13-V 4-7 branched (3-7), large; 13-VI 8-13 branched (7-13), moderately small. **Spiracular Lobe:** Pecten with 12-19 teeth; median teeth mixed moderate and short. Lateral arm of spiracular apparatus very short. Hairs 8,9-S 3-5 branched (2-6). **Anal Segment:** Covered, except for base, with very fine, short spicules becoming stronger toward apex. Saddle rusty brown, with irregular ventral margin. Hair 1-X longer than saddle; inserted on ventral margin of saddle at base of indentation, or on saddle near ventral margin; inserted about 0.3 cephalad of caudal margin. Anal gills usually short, about 0.5 length of anal segment, very rarely equal to length of saddle.

DISCUSSION. *An. aquasalis* can be distinguished from the other species in the Oswaldoi Subgroup in the **female** by the combination of (1) palpal segment 4 usually without a distinct ventral stripe of dark scales, (2) light scales on coxae light cream to grayish, not white, (3) foretarsal segment 3 highly variable, light in apical 0.40-0.70 in Central and South America and light in apical 0.15-0.40 in the Lesser Antilles, (4) hindtarsal segment 2 brown in basal 0.40-0.55 (0.3-0.6), (5) vein C with humeral light spot large, 1.5-3.5 length of basal dark spot, and with basal dark spot usually about 0.5 its length from humeral cross vein, (6) subcostal light spot on vein C usually less than 0.5 subcostal dark spot, (7) apical light fringe spot small to moderate, (8) dark spots on posterior veins distinct and (9) light wing spots at least on veins C and R light cream to yellowish, not white; in the **male genitalia** by the combination of (1) apex of ventral claspette moderately narrow, width at apex about 0.3 length of claspette, (2) basal lobule broad with uniformly distributed setae, setae along basal margin equal to or slightly longer than width of aedeagus, (3) lateral and ventral surfaces of ventral claspette (exclusive of basal lobules) with short setae 0.5 or less width of aedeagus and (4) preapical plate moderately small, oval to circular; in the **pupa** by the combination of (1) hair 7-C with one branch about 1.5-2.0 length of other branch(es), (2) pinna of trumpet moderately long, about 3.5-4.3 (3.5-4.7) length of meatus, with margin moderately pigmented, and with a long, basally rounded meatal cleft, (3) hair 10-C single, about 0.50-0.75 length of 12-C, (4) hair 12-C 1-3 forked, long, (5) hair

2-I 4-8 branched (2-10) near or at base, moderately short, (6) hair 3-I about 0.5 length of 2-I, (7) hair 7-I 3-7 branched, 0.50-0.65 length of 6-I, (8) hair 9-III small, less than 2.0 length of 9-II, and 9-IV always 2.0 or more length of 9-III, (9) hair 9-V 2.4-4.0 (2.3-5.0) length of 9-IV and (10) hair 9-V-VIII usually about 0.5 length of segment; and in the larva by the combination of (1) hairs 2,3-C plumose, with 7-12 simple, rarely dendritic branches, and hairs 2-C widely spaced, clypeal index about 1.67, (2) hair 4-C 1-3 branched, short to moderately short, (3) hair 8-C slightly longer than distance separating insertion of hairs 5-C, (4) pecten with median teeth mixed medium and short, (5) lateral arm of spiracular apparatus very short, (6) saddle with ventral margin irregular, hair 1-X inserted on ventral margin at base of indentation, or on saddle near ventral margin and (7) anal gills usually short, about 0.5 length of anal segment, rarely longer. The adults of *aquasalis* are easily distinguished in most cases from all other species in the Oswaldoi Subgroup except for *benarrochi*. Even so, *aquasalis* can usually be distinguished from *benarrochi* by the characters given in the above discussion and by its geographical distribution. Because of the paucity of material available for study of *benarrochi*, an attempt has not been made to separate *aquasalis* from the former in the key to the adult females. I believe that separation of these 2 species in the key would lead to unnecessary misidentification.

There does not seem to be any consistent geographical differentiation in *aquasalis* except when the females from Central and South America are compared with those from the Lesser Antilles, and then only in the banding pattern of the third foretarsal segment. The apical light band of foretarsal segment 3 on the mainland specimens varies from 0.40-0.70 the length of the segment, whereas the apical light band of the island specimens is in general much less than half (0.15-0.40) the length of the third foretarsal segment.

The amount of interpopulational and intrapopulational variation is very great in *aquasalis* from the Lesser Antilles. On first examination of the material from this region, I believed, as did Senior-White (1951a:306-307), that possibly I was looking at a different subspecies or even species. On further examination, I found that in almost every population from which I had a fair number of specimens, there occurred individuals that were almost identical with those examined from mainland and other island localities, suggesting a single, although highly polymorphic species. The greatest diversity was found among the specimens from the island of St. Lucia. In the adults from the Lesser Antilles, there are considerable differences in size and occasionally in color. Many of the adult males from St. Lucia show a reduction in the amount of white on palpal segments 4 and 5. In the females, the light banding on the midtarsi and the length of the wing spots also varies. Vein C occasionally has large subcostal and preapical dark spots, and vein M may be almost entirely dark. Some specimens from St. Lucia exhibit a fusion of the subbasal, presectoral and sectoral dark spots on vein C to form one large spot. In contrast, several specimens from Dominica exhibit a large subcostal light spot on the costal vein, often longer than 0.5 the length of the subcostal dark spot. In the male genitalia from the Lesser Antilles, the preapical plate varies from dark to light, and from a small rounded plate to a larger, lighter, more oval, diffuse plate; the refringent structure may be in the shape of an inverted U or V; the setae on the ventral claspette vary from short to moderately long; and the parameres may be short and thick at their bases, or long and slender. In the larvae and pupae from the Lesser Antilles, most of the variation occurs in the branching of the hairs; this is included in the data on chaetotaxy in the descriptions. In general, the pupae demonstrate considerably more variation than do the other stages; some of the variation includes the length and thickness of hair 9-IV-

VIII, the extent of branching of hair 1-I and the general pigmentation. In the larvae, the frontal ecdysial suture may be rounded or pointed. Usually the branches of hairs 2,3-C are long and simple, although occasionally they are dendritic; this is particularly evident in the St. Lucia specimens, while on the other hand, one specimen from Costa Rica had short clypeal branches. Also in the larvae, hair 4-C is often single and long in specimens from northern Brazil, Trinidad, Tobago and the Lesser Antilles. The pecten can vary in the number and the length of the teeth, with the St. Lucia specimens again demonstrating the greatest variability. The length of the anal gills varies apparently depending on the type of aquatic habitat: occasionally larvae have moderately large anal gills, usually when collected in fresh water.

The great amount of diversity within and sometimes among populations of *aquasalis* on the islands in the Lesser Antilles may possibly be attributed to 3 factors. First, under island conditions there may be decreased interspecific competition (fewer species present) that may result in a shifting and/or expansion of a species' niche, which may in turn be reflected in some external morphological character. Second, the founder effect is possibly an important factor; when only a few individuals colonize an island, genetic drift can result. And third, species may be subjected to quite different selection pressures on islands than they are on the mainland; the different selection pressures may then result in a phenotype different from that on the mainland. Although the immatures of *aquasalis* are found only occasionally in fresh water in Central and South America, many of the specimens examined from the Lesser Antilles have been collected in fresh water, even in rain barrels. This indicates that at least some niche expansion has occurred on certain of the islands.

The closest allies of *aquasalis* are *oswaldoi, galvaoi* and *noroestensis*. As previously mentioned (p 72), the male genitalia of these 4 species are very similar, differing primarily in the shape and sclerotization of the preapical plate, the length of setae on the ventral claspette and, in the case of *noroestensis*, the shape of the aedeagus. *An. aquasalis* does not share as many characters with *galvaoi, oswaldoi* and *noroestensis* as these share with each other; however, the larvae and, to some degree, the pupae of all 4 are similar.

The first cytogenetic studies of the salivary gland chromosomes of *aquasalis* were performed by Frizzi and Ricciardi (1955:403-407) on specimens from Sao Bento and Duque de Caxias, Rio de Janeiro, Brazil. These workers reported no chromosome abnormalities. Later, Kitzmiller and Chow (1971) examined the salivary gland chromosomes of *aquasalis* from 2 populations in Brazil, one collected near Belem and another collected near Rio de Janeiro. They found no inversions and stated, "*aquasalis, albimanus* and *oswaldoi* show a close morphological relationship." Further, when comparing the extent of regions of homologous banding, the chromosomes of *aquasalis* were more similar to those of *oswaldoi* than to those of *albimanus*. In comparing the chromosomes of *nuneztovari* with *albimanus, aquasalis* and *darlingi,* Kitzmiller, Kreutzer and Tallaferro (1973:443) found the "strongest" autosomal homologies between *nuneztovari* and *aquasalis*.

An. aquasalis, for many years prior to its description by Curry in 1932, was referred to as *tarsimaculata* (or *tarsimaculatus*) as is evident in the references listed in the synonymy (p 76-77). As early as 1915, Zetek recognized this brackish water mosquito in Panama and considered it a racial variety. Much of the information regarding *tarsimaculatus* has been summarized earlier in the Taxonomic History chapter (p 5-7). In 1941, Komp (1941b) described *emilianus* from Belem, Brazil, and stated that it could be separated from *aquasalis* by the shape of the aedeagus, the slightly longer setae covering the ventral claspette (both of which he states are sub-

ject to variation and are rather indefinite) and, most easily, by the egg. Causey, Deane and Deane (1945:247-248) studied 7000 ovipostions from isolated females of *aquasalis* and found considerable variation among the eggs even within a single oviposition. In addition, they noted, "Variations in the male genitalia as great as the differences described by Komp between *emilianus* and *aquasalis* may also be found among mosquitoes from the same oviposition." After examining the holotype adult male and its genitalia, and several other specimens from the type locality of *emilianus*, I agree with Causey, Deane and Deane (1945:247-248) and Floch and Abonnenc (1945:7) in the synonymy of *emilianus* with *aquasalis*. In 1942, Ramos described a variety of *oswaldoi, guarujaensis,* from the island of Guaruja in the state of Sao Paulo, Brazil. Galvao and Damasceno (1942:131) synonymized *guarujaensis* with *tarsimaculatus* which was later synonymized with *aquasalis* by Lane (1949:402). As with many species in the Albimanus Section, mutants have been described as varieties. Anduze (1948) described 2 varieties of *aquasalis* from Venezuela based on adults, *guarauno* and *delta*. *An. guarauno* supposedly has a black apical ring on the fourth hindtarsal segment, and *delta* supposedly has 2 additional apical dark rings on hindtarsal segments 3 and 4 (the ring on segment 4 being more pronounced than on 3).

Recently, Cova Garcia, Pulido F. and Amarista M. (1978) described *deltaorinoquensis* from Sucre, Monagas and Delta Amacuro, Venezuela. I have examined one specimen each of the male, male genitalia, female, pupa and larva labelled "*A. deltaorinoquensis,* 2697," which I received from Dr. P. Cova Garcia through Dr. J. N. Belkin. With the exception of the hindtarsal segments and the wing of the adults, and a few other characters in the immatures summarized below, all stages closely resemble those of *aquasalis*. The observed differences which distinguish these specimens are in the female (1) hindtarsal segment 2 dark in basal 0.66, (2) hindtarsal segment 3 with a small dark band in basal 0.1, (3) hindtarsal segment 4 with a small dark band in basal 0.16 and (4) vein C subcostal light spot small, 0.15 length of C subcostal dark spot; in the pupa (1) hair 2-I long (0.16 mm) and (2) hair 5-III,IV 7,9 and 4-6 branched respectively; and in the larva (1) clypeal hair 3-C with distinctly longer branches than 2-C, some branches dendritic, (2) hair 14-P 4,5 branched and (3) hair 13-I 8,9 branched. Cova Garcia, Pulido F. and Amarista M. also state that in the larva, the lateral arms of the spiracular apparatus are long, reaching the spiracular openings, and that in the male genitalia, the preapical plate is oval, similar in shape to a "grano de cafe." I did not see any significant differences from *aquasalis* in these latter characters in the available specimens. These authors report that the immatures of *deltaorinoquensis* were collected along the coast or along waterways, in brackish and fresh water, at elevations of 0-20 m above sea level. The preferred habitat was brackish mangrove swamps of *Rhizophora mangle, Laguncularia racemose* and/or *Avicennia nitida*. Additional immatures were encountered in puddles of rainwater and ground pools bordering rivers, streams and lakes. Most of the collections were from amber colored water with a high organic content. The immatures were associated with the following additional aquatic plants: *Pistia stratiotes, Eichhornia* sp, *Lemna* sp, *Azolla* sp, *Sagittaria guianensis, Salvinia* sp, *Utricularia* sp. The pH of the water tested varied from 6.6 to 8.4 and the salinity (gm/lit NaCl) from 7.5 to 17.4. In the laboratory at 26-29°C, *deltaorinoquensis* required 18 days for development from egg to adult (egg 2 days, larva 14 days, pupa 2 days). They report that of the 1681 adults captured, 1376 were *deltaorinoquensis* and 305 were *emilianus (=aquasalis).* Further, they state that both the immatures and adults of *emilianus* are commonly encountered in association with *deltaorinoquensis*. Nevertheless, they state that the adults reared from eggs of *emilianus* never had spotted [hind] tarsi, and, in contrast,

the legs of the adults reared from eggs of *deltaorinoquensis* were never white.

For the present, even though the differences enumerated above exist in the single specimen of each stage I examined, I do not recognize *deltaorinoquensis* as a distinct species. Geographically *aquasalis* and *deltaorinoquensis* are sympatric. Also, both "species" occupy a similar ecological niche, occurring primarily in brackish water habitats in relatively close proximity to the coast. In addition, as shown by Rozeboom's experiments (1963) with the mutant forms of *albimanus* (*bisignatus* with an extra dark band on hindtarsal segment 3 and *trisignatus* with extra dark bands on hindtarsal segments 3 and 4), a character or characters that "breeds true" in the laboratory from eggs isolated from a particular phenotype does not prove that this phenotype represents a separate species (see Discussion section for *rondoni*, p 134). Because of the great overall morphological, distributional and ecological similarity between these nominal taxa, I believe that, until more conclusive evidence becomes available, *deltaorinoquensis* should be considered a synonym of *aquasalis*.

BIONOMICS. As with *albimanus*, the literature on the bionomics and medical importance of *aquasalis* is voluminous. I will present only a brief summary.

An. aquasalis is considered to be primarily a brackish water mosquito; however, it has been collected from a wide variety of habitats in both fresh and brackish water. It is more or less restricted to the coast and areas that are influenced by the tides, although on certain occasions it has been collected considerable distances inland. Deane, Causey and Deane (1948:882) collected *aquasalis* 60 km from the coast in the state of Pernambuco, Brazil in a brackish water lake, Lagoa Salgada [Salty Lake]. In the Amazon basin, the same authors collected *aquasalis* 140 km from the coast on the right and left banks of Rio Para. Recently, adults that resemble *aquasalis* have been collected at numerous localities in the Maraba area, Para, Brazil (D. R. Roberts, personal communication). Since these collections were made about 500 km from the coast in fresh water, and the immatures have not been studied, I am reluctant to state that these adults are definitely *aquasalis*. Interestingly, in this region these adults are endophilic with an outdoor to indoor ratio of 3.9. Lucena (1946) collected *aquasalis* 252 km from the coast at Jupi in northeastern Brazil, at an altitude of 750 m and in an area in which the soil had a high salt concentration. In all these instances, except possibly in the Maraba area, salt seemed to be essential for the presence of *aquasalis* inland from the coast.

The immatures have been collected in mangrove swamps, brackish marshes, flooded meadows, rice fields, sugar cane plantations, ditches, fresh water ponds, pools along stream margins, temporary and semipermanent ground pools, large artificial containers and crab holes. Although there seems to be a preference for brackish water, many of the specimens examined came from fresh water but usually no farther than 5-8 km from the coast at altitudes of 200-300 m; its occurrence in fresh water is particularly common in the Lesser Antilles. Most of the collections were from aquatic habitats in full sun or partial shade, but some were in deep shade, such as in mangrove swamps and in crab holes. Deane, Causey and Deane (1948:885-886) stated that most of their collections came from water with a sodium chloride concentration of 0.2-1.0%, although some came from water with a concentration as high as 1.5%. They also found that the number of pupae and adults from larvae reared in 0.5-1.5% sodium chloride solutions was greater than the number produced when larvae were reared in fresh water. De Verteuil and Spence (1937:454) collected *aquasalis* in Trinidad in 70% sea water. Senior-White (1951a:310) reported that in the wet season in Trinidad, breeding is in water not exceeding 0.35% sodium chloride, but that during the dry season breeding occurs in water with a salt concentration of

2.38%. Causey, Deane and Deane (1945:247) showed that under laboratory conditions, *aquasalis* can complete development in pure sea water, and, if the water is allowed to evaporate, larvae continue to grow and pupate in water with a concentration as high as 7.4% sodium chloride. Floch and Abonnenc (1943a:7) collected larvae in fresh water about 3 km from the beach in French Guiana; these survived when placed in a 19 gm/lit solution of sodium chloride. They also placed larvae collected in brackish water into fresh water without any apparent ill effects. De Andrade (1958a:29) stated that *aquasalis* is an acidophilic species, and that larval density decreased as pH increased from 3 to 7. Buxton (1934:491) reported that larvae are rarely found in water containing more than 0.3 ppm ammonia. Senior-White (1951a: 312), however, stated that saline or ammonia concentration "plays no part in regulating either the oviposition or the larval life of *A. aquasalis.*" The larvae seem to be able to tolerate moderate amounts of pollution.

In Brazil (Deane, Causey and Deane 1948:884) and in Suriname (Panday 1975b: 305), the maximum density of *aquasalis* occurs during the rainy season. *An. aquasalis* during this season is found in a greater number of habitats than in the dry season when this species is more restricted to the coastal flats. Notwithstanding, in some areas *aquasalis* may be more abundant locally during the dry season. Downs, Gillette and Shannon (1943:39) found a higher density of *aquasalis* in Tobago and Trinidad in the dry season, because at that time the mouths of streams are blocked by sand bars which dam the streams and provide protected breeding habitats. Giglioli (1963: 132-133) discovered *aquasalis* to be particularly abundant during a drought in Guyana and noted, "During dry periods, tidal salt water invasion of the estuaries and lower reaches of the rivers extends far beyond the average level; thus, not only the prevalence of *A. aquasalis*, but its range as well, is increased."

The most common species collected in association with *aquasalis* in both fresh and brackish habitats are *An. albimanus, Culex (Cux.) nigripalpus, Cx. (Mel.) atratus* and *Aedes (Och.) taeniorhynchus*. In mangrove swamps and flooded meadows, *Ae. (Och.) tortilis* and *Cx. (Mel.) madininensis* are occasionally associated. *Psorophora (Gra.) cingulata* group and *Cx. (Cux.) coronator* group are commonly associated with *aquasalis* in fresh semipermanent ground pools and ditches, and *Cx. (Mel.) idottus* group and *Uranotaenia (Ura.) lowii* breed with *aquasalis* in permanent fresh water ponds. Occasionally *aquasalis* has been collected along stream margins in association with *Cx. (Cux.) declarator* group, and occasionally in crab holes with *Deinocerites magnus*. Other species that have been reported in association with *aquasalis* are *triannulatus* (rarely), *An. (Ano.) punctimacula, An. (Ano.) pseudopunctipennis, An. (Ano.) apicimacula* and *Chagasia bathana*. Common plant associates are *Typha angustifolia, Cyperus articulatus, Rhizophora* sp and *Avicennia* sp (mangroves), *Eleocharis mutata, Ipomoea reptans, Chara* sp, *Naias* sp and *Utricularia* sp. Frequently *aquasalis* is associated with mats of algae.

The adults of *aquasalis* are crepuscular, usually being active from dusk to a few hours after sundown. The adult females feed readily on man and on domestic animals such as cattle, horses, donkeys, dogs, sheep and pigs. They rest inside houses on the walls normally lower than one meter (Deane and Damasceno 1948:508). Throughout vast stretches of northeastern Brazil and in some areas of the Guianas and Lesser Antilles, it is the only anopheline that occurs in large numbers in houses; however, it is reported that less than 10% stay in the house for 24 hours (Deane, Causey and Deane 1948:891). Feeding preference studies indicate that *aquasalis* is more zoophilic than anthropophilic, except in the Lesser Antilles where it may be more anthropophilic. Nevertheless, when domestic animals are removed

from an area, which has happened in many places because of mechanization, man usually becomes the primary host; under these conditions *aquasalis* becomes a major health threat (Downs, Gillette and Shannon 1943; Giglioli 1959, 1963; Hamon, Mouchet *et al.* 1970:33). The adults of *aquasalis* are considered to be strong fliers capable of migrating considerable distances. In marked release and recapture studies conducted in Panama by LePrince and Orenstein (1916:114), individuals of *tarsimaculata (=aquasalis)* marked with aniline dye traveled from 366 to 1905 meters from the release station. De Verteuil and Spence (1937:454-455) reported that *aquasalis* was able to fly at least 4.8 km in Trinidad; however, this was not experimentally verified.

MEDICAL IMPORTANCE. *An. aquasalis* has been a major vector of malaria along the coast of Brazil south to the state of Parana, and in the Lesser Antilles. It is believed not to be a vector in Panama, probably because of its zoophilic behavior there. In Venezuela and the Guianas, *aquasalis* has played a role in residual malaria transmission (Gabaldon and Guerrero 1959; Floch 1956:45-46; Giglioli 1959:280; Hamon, Mouchet *et al.* 1970:33). *An. aquasalis* has been extremely important as a malarial vector in Trinidad, Tobago and in northeastern Brazil. De Verteuil and Spence (1937:454) reported that 70% of the mortality due to malaria from 1931 to 1933 in Trinidad was a result of the presence of *An. tarsimaculatus (=aquasalis)* within 4 miles of brackish water. *An. aquasalis* has been incriminated as the major vector of malaria in Grenada (Earle 1936; Root and Andrews 1938:577), St. Lucia (Earle 1936) and Guadeloupe (Fauran 1962:76). It has been found to be naturally infected with *Plasmodium* sp in Brazil (Deane, L. M., Causey and Deane 1946; Correa and Ramos 1944c; Coutinho 1943:69; Fonseca and Fonseca 1942:102-106, 110, 117), Trinidad and Tobago (Downs, Gillett and Shannon 1943:35-37), Grenada and St. Lucia (Earle 1936:463-465). In all the other areas where it is important as a potential vector, it is considered to be dangerous only when it occurs in large numbers. Thus, its vector effectiveness is dependent on adult density (Deane, L. M., Causey and Deane 1946; Forattini 1962:385; Senior-White 1951b) and to some extent on the presence of alternate hosts which serve to decrease the number of females feeding on man.

An. aquasalis does not seem to be important in the transmission of filariasis, although Deane, Causey and Deane (1948:893-894) found a filarial worm, *Wuchereria bancrofti*, in the thorax of a female in Belem, Para, Brazil. Venezuelan Encephalitis virus was isolated from one of 40 lots of *aquasalis* representing a total of 1537 specimens tested in Venezuela during the VE outbreak in 1962-1964 (Sellers, Bergold *et al.* 1965). *Aedes taeniorhynchus* appeared to be the major carrier during the above outbreak. *An. aquasalis* may or may not be capable of transmitting the virus.

DISTRIBUTION (fig. 2). *An. aquasalis* is primarily restricted to the coast, coastal lowlands and coastal waterways influenced by tides, except in the islands of the Lesser Antilles and possibly in Para, Brazil. It occurs in the state of Parana, Brazil, north along the coast, west through the Guianas, Venezuela and Colombia, and into Central America predominantly along the Atlantic side of Panama and Costa Rica to Nicaragua. On the Pacific side of South America, *aquasalis* is reported to occur as far south as the province of El Oro, Ecuador on the shores of the Gulf of Guayaquil. *An. aquasalis* is present in Trinidad, Tobago and the Lesser Antilles as far north as the Leeward Islands of Antigua and St. Kitts, but it does not occur in the Greater Antilles, Virgin Islands or the Bahama Islands.

Material Examined: 2159 specimens: 432 males, 132 male genitalia, 839 females, 189 pupae, 567 larvae; 150 individual rearings: 77 larval, 52 pupal, 21 incomplete.

ANTIGUA (62 specimens: 55F, 3p, 4L&l; 3 ind rear: 1 l, 2p). **St. George:** Fitches Creek, ANT 66, 67. **St. John:** Five Islands, 8 Oct 1948, H. Box, 1F [BM1939-219]; same locality, ANT 101. **Parish and locality not specified:** 1 Dec 1899, 1F on slide [BM]; 27 Sep 1950, 50F.

BRAZIL. Bahia (35 specimens: 1M, 25F, 9L): Bonfim, 26 Jan 1930, N. Davis, R. Shannon, 1 M, 25F. Salvador da Bahia, Mar 1972, J. Fowler, BRS 89, 3L; same locality and collector, 1972, BRS 117, 1L; same data, BRS 144, 2L; same data, BRS 180, 1L; same locality and collector, 1972-73, BRS 499, 2L. **Ceara** (1M, 2F): Aracati, Beirada, 1M, 2F [CU]. **Maranhao** (3M): [Sao Luis], 3M [JH]. **Para** (97 specimens: 20M, 8Mgen, 69F): Belem, Goeldi, KO H-20-28, 4F; same locality, Apr 1930, N. Davis, 15F; same locality, 13 Apr 1941, W. Komp, BRAK 2, 9M, 6Mgen, 25F; same locality and collector, 14 Apr 1941, 1M and 1Mgen (holotype of *emilianus*), 2F (paratypes of *emilianus*); same locality and collector, Apr 1941, 3M, 3F (paratypes and allotypes of *emilianus*); same data, 1M, 2F (paratypes of *emilianus*) [JH]; same data, 3M, 15F; same locality, 1944, Causey, 1M; same locality, Malinha, 1Mgen [JH]; same locality, 1M (689-4), 1M (889-2) [JH]; same locality, S. E.S.P. No. 592, 1F (11.082-4) [JH]; same locality, S.E.S.P. No. 597, 1F (11.352-1) [JH]; same locality, S.E.S.P. No. 626, 1F (11.934-2) [JH]. **Pernambuco** (10 specimens: 1M, 3F, 6L): Boa Viagem, nr Recife, 24 Aug 1944, R. Wenzel, 3L; same data except 4 Sep, 1L; same data except 5 Sep, 1L; same data except 7 Sep, 1L. Recife, Pontazinha, May 1945, E. Coner, 1F [CU]. Recife, Ibura Field, det H. Dalmat 1944, 1F (27-3-H-3) [CU]. Locality not specified, 1M (1269), 1F (1615). **Rio de Janeiro** (26 specimens: 6M, 3Mgen, 2F, 7p, 8L&l; 7 ind rear: 4 l, 3p): Duque de Caxias, BRA 227, 228. Itaguai, BRA 289. Itaipu, BRA 248. Rio de Janeiro, 1M (3551) [JH]. **Sao Paulo** (3M, 3F): Sao Vincente, 3M [JH]. Locality not specified, A. Lutz (3F). **State and locality not specified** (2Mgen): O. Causey, 1Mgen (689-2), 1Mgen (1269) [JH].

COSTA RICA (8 specimens: 2F, 1p, 5L&l; 1 l ind rear). **Limon:** Puerto Viejo, H. Kumm, No. 179, 1F [BM1938-696]. Westfalia, CR 473.

DOMINICA (105 specimens: 8M, 2Mgen, 31F, 10P&p, 54L&l; 6 ind rear: 4 l, 2inc). **St. Andrew:** Portsmouth, 2 Mar 1964, D. Bray, 2F; same locality, 19-21 Oct 1966, A. Gurney, 1F; same locality, L. Charles, 15L. **St. David:** Bataka, DOM 173. **St. John:** Cabrit Swamp, 23 Feb 1965, W. Wirth, 4M, 20F. Cotton Hill Estate, DOM 97. Picard Estate, DOM 158. Prince Rupert Bay, DOM 213. **St. Joseph:** Mero, DOM 77, 78, 79. **Parish not specified:** Canefield Estate, 25 Apr 1944, L. Charles, 10L. Clarke Hall, 21-31 Mar 1965, W. Wirth, 3F. Locality not specified, 1927, A. Carment, 1M [BM1928-132].

FRENCH GUIANA (109 specimens: 14M, 10Mgen, 51F, 15p, 19L&l; 15 ind rear: 4 l, 10p, 1 inc). **Guyane:** Cabassou (foret de), FGC 3278. Cabassou (Mont), FG 46. Cayenne, 14 Jul 1942, FGA 72-596, 1F; same locality, Dec 1942, FGA 83, 5M, 4F; same locality, 13 Aug 1947, 1M (852), 1Mgen; same locality, 20 Aug 1947, 1 lp; same locality, 5 Apr 1948, 1 lpF; same locality, FGC 3417; same locality, 1Mgen. Cayenne, road to Baduel, 11 Jul 1942, FGA 71-10, 1M. Couachi, FGC 4024. Fort Diamant, FGC 3293. Gallion (foret du), FGC 3381. Iracoubo, 12 Mar 1952, FGA 184, 1F. La Chaumiere, 2 Jul 1942, FGA 67, 3F. Montjoly, FG 69, FGC 3438. Raban, FG 43. Rorota (Lac du), FG 67.

GRENADA (47 specimens: 16M, 8Mgen, 11F, 5p, 7L&l; 5 ind rear: 3 l, 2p). **St. Andrew:** Grenville, GRR 12. Pearls Airport, GR 37. Pearls Bay, LAR 43, 44. Pearls Estate, LAR 46. **St. George:** Caliviny, GR 18. Point Saline, GR 8. **St. Patrick:** Mount Rodney Estate, GR 46. **Parish not specified:** Pevis Port, LAR 51. Locality not specified, GRR 126; 28 Jun 1929, No. 1, 1L, 2 lp [JH].

GUADELOUPE. BASSE TERRE (1F, 65L). **Baie Mahault:** Belcourt, FWI 816. La Jaille, FWI 871, 955. Jarry, FWI 1027. **Capesterre:** Roseau, FWI 1014. **Lamentin:** Blachon, FWI 1005. **Petit Bourg:** Ste. Claire, FWI 1012. Viard, FWI 944, 988, 989. **GRANDE TERRE** (120 specimens: 4M, 3Mgen, 4F, 12P&p, 97L&l; 9 ind rear: 4 l, 1p, 4inc). **Abymes:** Besson, FWI 202. Raizet, FWI 704, 851, 855, 927, 951, 959, 1022. **Anse Bertrand:** Port Louis, FWI 200, 929. **Gosier:** Anse Vinaigri, FWI 967. Blanchas, FWI 818. Grande Ravine, FWI 876. Labrousse, FWI 958, 960. Poucet, FWI 203. St. Feliz, FWI 931. **Morne-a-l'Eau:** Berville, FWI 865. Blain, FWI 973. **Ste. Anne:** Anse du Belley, FWI 1004. **MARIE GALANTE** (119 specimens: 8M, 7Mgen, 12F, 32P&p, 60L&l; 20 ind rear: 10 l, 10p). **Grand Bourg:** Route de Folle Anse, FWI 236. **St. Louis:** St. Louis, FWI 264.

GUYANA (155 specimens: 11M, 7Mgen, 137F). **East Berbice-Corentyne:** New Amsterdam, 10 Mar 1900, E. Rowland, 1F [BM]; same locality, GUY 1, 17, 20A; same locality, Aiken, 1F. Locality not specified, 12 Feb 1908, Aiken, 3F; 1936, W. Komp, 22F. **East Demerara-West Coast Berbice:** Georgetown, 1931, W. Beveridge, 1M, 1F [BM1931-210]; same locality, E. Rowland, 6F. Hyde Park, 29 Jul 1941, BGR 2, 1M, 1Mgen, 3F; same data, 1F (1D) [JH]. **North West:** Locality not specified, Sep 1949, BGR 7, 15F. **District and locality not specified:** 6 Mar 1941, GUYK 10, 1F; 10 Jul 1941, Fox, 2M [JH]; Giglioli, GUYK 34, 1M, 1F; no data, 1F [JH].

MARTINIQUE (46 specimens: 8M, 6Mgen, 6F, 13P&p, 13L&l; 13 ind rear: 5 l, 6p, 2 inc). **Anse d'Arlets:** Anses d'Arlets, FWIM 1. **Ste. Marie:** Riviere Charpentier, MAR 116. **La Trinite:** Galion Sugar Refinery, MAR 7. **Locality not specified:** July, A. Busck, 1F.

MONTSERRAT (1 lpF). **St. Anthony:** Foxs Bay, MNT 39.

PANAMA AND CANAL ZONE (327 specimens: 137M, 7Mgen, 166F, 8P&p, 9L). **Bocas del Toro:** Punta de Pena, PA 219, 253. **Canal Zone:** Ancon, 1912, J. Zetek, 1F; same locality, Jul 1941, PAX 181, 1F. Cocolis [Cocoli], 26 Feb 1943, 1M. Cristobal 13 Jul 1944, Sterns *et al.*, ASM 68-1, 2M, 2Mgen, 1F; same data, 3M, 2F, 10L [CU]. France Field, Mar 1941, 1M, 5F. Galeta Is., 3 Sep 1930, PAX 17, 5F. Gatun, 28 Feb 1930, D. Curry, PAX 7, 3M, 2F; same locality and collector, 29 Feb 1930, PAX 8, 6M, 6F; same locality and collector, Jan 1931, PAX 21, 9M, 17F; same locality, 25 Mar 1933, PAX 31, 8M, 22F; same locality, 10 Mar 1937, 2F; same locality, PAR 46, 10M, 2Mgen, 32F; same locality, KO H-19-18, 48M. Gatun Lake, 20 Feb 1934, PAX 36, 1M, 3F. Largo Reme [Remo], 1926, D. Curry, 1F. Mindi, 10 May 1941, C. Brown, PAX 176, 31M, 28F. Mojinga Swamp, PA 1165. Mt. Hope, 29 Jan 1944, 5M, 2F. Pedro Miguel Locks, 22 May 1939, PAX 110, 1F. Locality not specified, Feb 1944, 1F. **Colon:** Colon, 11 May 1930, D. Curry, PAX 9, 1M, 1F; same locality and collector, 27 May 1930, PAX 10, 1F; same locality and collector, 7 Jun 1930, PAX 12, 1M; same locality and collector, 10 Jun 1930, PAX 13, 4M, 4F. Pina, 27 Jun 1945, 1F. Portobelo, PA 603, 604, 606. **Panama:** Chepo Road, 19 Nov 1939, PAX 157, 1M. **Province and locality not specified:** PAR 136, 1F; from D. Curry, 5L [JH]; no data, 2Mgen [JH].

SAINT KITTS (5F). Conaree Swamp, 22 Nov 1949, 5F.

SAINT LUCIA (192 specimens: 19M, 9Mgen, 23F, 38P&p, 103L&l; 30 ind rear: 24 l, 3p, 3inc). **Anse La Raye:** Anse La Raye, LU 71, 72, 127. Roseau Sugar Estate, LU 23. Roseau Sugar Factory, LU 20, 86. **Castries:** La Toc, LU 6. **Gros Islet:** Bois D'Orange, LU 37. Choc Swamp, LU 153, 154. Gros Islet, 24 Feb 1941, 1F; same locality, 29 Jul 1941, 4F; same locality, 2 Aug 1945, Ingle, 2F. Marisule, LU 39, 40. Union Agricultural Station, LU 150. 151, 157. **Laborie:** Sapphire Estate, LU 121. **Micoud:** Troumassee Estate, LU 118, 119. **Praslin:** Volet Estate, LU 98, 102. **Soufriere:** Soufriere, LU 84, 85. **Quarter and locality not specified:** No data, 1L.

SAINT VINCENT (1M). Locality not specified, 1M [BM].

SURINAME (59 specimens: 11M, 8Mgen, 33F, 2p, 5L&l; 2 inc ind rear). **Coronie:** Friendship, 15 Jun 1946, E. Kuyp, 1Mgen (46-x-17a). Sarahmeer, 17 Jun 1946, E. Kuyp, 1Mgen (46-x-16b). Zoetwater Kanaal, 14 Jun 1946, E. Kuyp, 1M. Locality not specified, 15 Jun 1946, E. Kuyp, 3M, 1F. **Marowijne:** Moengo, Sep 1944, Guicherit, 2F. **Nickerie:** Nieuw Nickerie, 14 Jun 1946, E. Kuyp, 1Mgen (46-x-21a). **Paramaribo:** Charlesburg, 9 Jun 1946, E. Kuyp, 1M, 1Mgen (46-x-22a), 1F, 2L; same locality, 11 Aug 1949, D. Geijskes, 4F [BM1949-475]; same locality, SUR 49. **Suriname:** Domburg, SUR 39. Ma Retraite, SUR 70, 72. Morgenstand, 22 Jun 1946, E. Kuyp, 4M, 1 Mgen (46-ix-16b-82), 1Mgen (46-ix-16c-83), 3F, 1 lp (87), 1 l (88). Meerzorg II, 10 Jun 1946, E. Kuyp, 1M, 1Mgen (46-x-22b). Ornamibo, 23 Jun 1946, E. Kuyp, 1F, 1 lp. Tweekinderem, 22 Jun 1946, E. Kuyp, 1M, 1Mgen (46-x-22d). **District and locality not specified:** SUR 117; H. Polah, 1F.

TRINIDAD AND TOBAGO. TOBAGO (28 specimens: 3M, 2Mgen, 7F, 6P&p, 10L&l; 6 ind rear: 2 l, 3p, 1inc). **St. Patrick:** Bon Accord Estate, 16 Nov 1965, T. Aitken, R. Martinez, A. Guerra, TOB 22, 1 pF; same data, TOB 24, 1 lpM, 1 lpF, 1 lP, 6L. Golden Grove, 19 Nov 1965, T. Aitken, R. Martinez, A. Guerra, TOB 58, 1Mgen, 1 pM; same data, TOB 59, 5F. Orange Hill, 30 Nov 1965, R. Martinez, A. Guerra, TOB 142, 1Mgen, 1 pM, 1L. **TRINIDAD** (463 specimens: 143M, 47 Mgen, 171F, 24p, 78L&l; 20 ind rear: 14 l, 5p, 1inc). **Caroni:** Caroni Swamp, 15 Oct 1964, A. Guerra, TR 762, 1Mgen, 1 pM, 1 pF, 1 lpM, 1 lpF; same data, TR 763, 1 lpF, 2L. Locality not specified, Jan 1946, 2F. **Mayaro:** Guayaguayare Rd., 27 Oct 1964, A. Guerra, TR 797, 4L. **St. Andrew:** Cumuto, 11 Jul 1941, TRR 21B, 1M, 1Mgen. Turure Rd. nr Guaico, 9 Apr 1966, A. Guerra, TR 1492, 1Mgen, 1 lpM, 1 lpF, 1P, 3L. **St. David:** Redhead, 28 Feb 1964, A. Guerra, TR 122,

1 lpF, 3L; same data, TR 124, 1L; same data, TR 125, 1 lpM, 2 lpF. Sans Souci, 5 Mar 1964, A. Guerra, TR 147, 1Mgen, 2 pF, 3 lpM, 1 lpF, 2L; same data, TR 148, 1 pF, 2L. Toco, 6 Mar 1964, A. Guerra, TR 162, 1L; same data, TR 166, 2L; same data, TR 167, 4L; same data, TR 168, 2L; same locality, TRK 9, 26M, 1Mgen, 21F. **St. George:** Blanchisseuse, 27 Mar 1941, W. Komp, KO 111-9, 9M; same locality, 10 Apr 1964, A. Guerra, TR 306, 1 l. Chaguaramas, 29 Jun 1961, T. Aitken, 1 lp. Diego Martin River, 8-26 Feb 1941, W. Komp, TRK 35, 24M, 2Mgen, 40F. El Socorro, Nov 1945, 4M, 2F. Long Stretch, 5 Feb 1941, TRK 4, 1Mgen. Piarco, Golden Grove, 14 Sep 1954, 1F [BM]; same locality, Sep 1954, 1F [BM]. Port of Spain, 10 Jun 1941, 6Mgen [JH]; same locality, 14 Jun 1941, TRR 7, 14M, 5Mgen, 7F; same locality, 16 Jun 1941, L. Rozeboom, 4L; same data, 24L [JH]; same locality, 23 Jun 1941, TRR 56, 1M, 1Mgen; same locality, 26 Jun 1941, TRR 57, 28M, 7Mgen, 1F; same locality, 9 Jul 1941, TRR 59, 16M, 4Mgen, 27F. **St. Patrick:** La Brea, 29 Jul 1966, A. Guerra, TR 1563, 2F, 1 lpF. Lillette Swamp, 9 Jul 1966, T. Aitken, R. Martinez, TR 1552, 2M, 1Mgen, 1F, 3p, 5L. **County not specified:** S. Joseph, 2 Aug 1899, F. Urich, 2F. Locality not specified, 1915-1928, J. Dickson, 11(191) [BM]; 22 Jul 1931, E. de Verteuil, 1F [BM1931-562]; 25 Jul 1931, E. de Verteuil, 1M, 1F [BM1931-562]; Mar 1941, W. Komp, KO 111-7, 2M, 3F; Jul 1941, 1Mgen [JH]; May 1963, T. Aitken, 2M, 9F; Jun, A. Busck, 36F; W. Downs, 9Mgen [JH]; F. Urich, 1M, 3F; no data, 5M, 5Mgen (750915-23, 24, 25, 26, 27).

VENEZUELA (62 specimens: 14M, 3Mgen, 19F, 12p, 14L&l; 12 ind rear: 9p, 3inc). **Anzoategui:** Barcelona, 16 Sep 1944, VZK 20, 2M. **Aragua:** Turiamo, 11 Sep 1944, VZK 3, 2M, 5F; same locality, Sep 1944, VZK 30, 4M, 1F. **Carabobo:** Boca de Yaracuy, VZ 259. Puerto Cabello, 1M gen [JH]. **Guarico:** El Sombrero, 14 Jul 1945, 1F. San Juan de los Morros, 17 Jan 1945, 1M, 1F. **Monagas:** Punta Tigre, Rio Guanaco, 3 Jan 1929, F. Urich, 1F [BM1929-453]. Jusepin, 30 Apr 1945, 2M. **Province not specified:** Higuerote, Nov 1949, 1L (616-Zone I, Cot. 185).

6. Anopheles (Nys.) ininii Senevet & Abonnenc

Figs. 2, 4, 6, 17, 18

1938. *Anopheles (Nyssorhynchus) ininii* Senevet and Abonnenc 1938:494-500. TYPE: *Syntypes* 2 females with associated larval and pupal skins and genitalia slides, St. Elie mines, Sinnamary River (Inini), French Guiana, artificial reservoir, 7 Feb 1938 [NE; Belkin (1968b:53) reported that type was lost or destroyed during Algerian conflict].

Anopheles (Nyssorhynchus) ininii of Rozeboom and Gabaldon (1941:97-98); Floch and Abonnenc (1942b:2; 1943a:1-3; 1946a:1-4; 1946b:3-5; 1947:6; 1951:17, 50-51); Senevet (1948a:277-279; 1948b:431-432; 1948c:436-437); Levi-Castillo (1949:10, 15, 28, 58, 67, 77, 82, 86); Gabaldon and Cova Garcia (1952:178, 191); Senevet and Andarelli (1955:339); Stone, Knight and Starcke (1959:33); Vargas (1959:370); Fauran (1961:10-11); Belkin, Schick and Heinemann (1965:23); Belkin (1968b:53).

Anopheles ininii of Russell, Rozeboom and Stone (1943:51); Foote and Cook (1959:28, 29).

FEMALE (fig. 6). Wing: 3.7 mm. Proboscis: 2.3 mm. Palpus: 2.35 mm. Forefemur: 1.6 mm. Abdomen: about 3.1 mm. Dark, very similar to that of *oswaldoi*. Head: Integument dark brown with silver pruinose areas. Interocular space moderately wide, about 3-6 ommatidial diameters. Proboscis about 1.4 length of forefemur. High contrast between the integument and white erect scales on vertex, and decumbent scales on interorbital line and upper orbitals. Erect scales of vertex as those of *oswaldoi*. Dark scales of palpus dark brown to black; apex of palpal segment 2 with a small white band; apex of segment 3 with a moderately large, white band; dorsal surface of 2 and 3 with tan scales, not always conspicuous on 2, but as a longitudinal stripe on 3; segment 4 with a moderately large, dark, basal band and usually a much smaller, dark, apical ring; dark scales on ventral surface of segment 4 extending distad from basal band to form a distinct, dark, ventral stripe, usually not reaching the dark apical ring; mediolateral surface of segment 4 and 5 white. Antenna: Flagellar segment 1 with long, numerous, very prominent, white scales on dorsomesal surface. Flagellar segments 2-13 each with 7-9 setae in basal whorl. Thorax: Integu-

ment dark brown to brownish black. Short light scales on scutum ivory to silver. Anterior promontory area with long, white, setiform scales extending dorsad onto acrostichal line; humeral scale tuft very prominent, with white scales above and numerous, cuneate, brownish black scales below. Prescutellar space large, horseshoe shaped and very dark. Upper *stp* with about 3 long setae and 10 gray to white, obovate scales. Lower *stp* with one long seta and about 8 scales; scales similar to those of upper *stp*, occasionally lighter, in a large, conspicuous, diagonal patch. Upper *mep* with 5,6 setae; scales absent. **Legs**: Coxal scales white. Foretarsal segments 3-5 predominantly cream to white; light apical bands on segments 2 and 3 0.45 (0.35-0.55) and 0.75 (0.70-0.86) respectively; segment 4 often all light cream to golden brown or with a small, dark, basal area rarely longer than 0.3 of segment; often dark basal scales on segments 1-3 and occasionally 4,5 primarily restricted to dorsal, or dorsal and part of anterior and posterior surfaces so that basal bands appear incomplete ventrally; segment 5 all cream to about 0.5 basally dark. Midtarsal segments 2 and 3 with a small cream band in apical 0.08-0.17 and 0.12-0.24 respectively; segment 4 with a cream band in apical 0.15-0.25; segment 5 from completely cream to dark in about basal 0.5. Hindtarsal segment 2 with a dark band in basal 0.17-0.26; segment 5 cream to white in apical 0.5-0.6. **Wing**: Light wing spots white to very light cream. Dark spots dark brown to brownish black. Vein C humeral light spot 2.0-3.3 (1.5-3.3) of basal dark spot; subcostal light spot 0.35-0.70 of subcostal dark spot; preapical light spot 0.25-0.50 of preapical dark spot; apical dark spot small. R presectoral dark spot moderately small; sectoral dark spot small. Rs-R_{2+3} usually with an extra, small to moderately large, subcostal dark spot. M highly variable, with a moderately long to very long, sectoral dark spot; preapical dark spot not extending onto M_{1+2}. Cu_1 subcostal and preapical dark spots small to moderate. Apical light fringe spot moderately small to large, undivided or divided by a few dark scales between R_2 and R_3, and/or R_3 and R_{4+5}; additional light fringe spots as in remaining species. **Abdomen**: Tergite I with a few light scales along caudomedian border. Sternite I with a few setae. Caudolateral scale tufts large and prominent on segments II-VII. Light scales of tergites II-VII often overlapping bases of dark caudolateral tufts. Scales on sternite II-VII as in section description except very distinct and numerous.

MALE. Wing: 3.6 mm. Proboscis: 2.9 mm. Forefemur: 1.6 mm. Abdomen: about 3.2 mm. Large, essentially as in female except for sexual characters. **Head**: Palpal segments 2 and 3 with a dorsal cream stripe; segment 4 with a white band at base and apex, a small, brown, subbasal band usually present; segment 4 cream to white mediolaterally and brown ventrally. **Antenna**: About 0.75 length of proboscis. Flagellar segment 1 with numerous, long, thin, conspicuous, white, lanceolate scales. **Legs**: Forefemur about 0.55 length of proboscis. Basal plantar surface of foretarsal segment 5 with 7,8 moderately long, spiniform setae; setae longest toward apex. Claw on foreleg large, curved, acuminate; submedian tooth long, about 0.25 length of claw, tapering to blunt recurved point; basal tooth long, subequal to submedian tooth, strongly decurved.

MALE GENITALIA (fig. 17). **Segment VIII**: Tergite and sternite with moderately large, obovate scales. Sternite with a few, median, dark scales, and laterally with cream to white scales. Tergite with dark scales along posterior margin. **Segment IX**: Sternite long, about 0.2 length of sidepiece, subtrapezoidal. Anterior apodeme a sclerotized band across anterior border of sternite, about 0.15 length of sternite, occasionally appearing weakly bilobed. **Sidepiece**: Subconical. Tergal surface with 4, 5 long, submedian, tergomedial bristles; bristles mesad of tergomedial bristles moderately long. Parabasal spine moderately long, at least 2.0 length of its tubercle. Basal

apodeme thick, moderately long, about 0.2 length of sidepiece. Longer, more dorsal accessory spine slightly longer than 0.5 length of sidepiece; more ventral spine 0.65-0.70 of longer spine. Internal spine subequal to shorter accessory spine, apically retrorse. **Clasper**: Spiniform long and narrow, subequal to seta *b*. **Dorsal Claspette**: Long, 0.55-0.70 length of sidepiece. Pedicel moderately thick; base rounded, occasionally curved mesad. Leaflets long, about 0.5 length of claspette, sharply curved mesad about 0.5 from base; dorsal leaflet with small basomesal projection. **Ventral Claspette**: Strongly conoid; long, about 0.5 length of sidepiece; narrow at apex, width at apex about 0.3 length of claspette. Basal lobule very large, extending laterad, and usually bent at base ventrally so that setae on basal margin projecting caudad; setae along basal margin very strong and long, about 2.0-3.0 width of aedeagus; setae distributed uniformly over surface of lobule. Lateral and ventral surfaces (exclusive of basal lobule) with short setae about 0.5 width of aedeagus; setae extending toward apex only as far as level of apical margin of preapical plate. Apex without setae, produced into rounded cone with a very small, median sulcus. Preapical plate distinct, very large, crescent shaped, heavily sclerotized. Refringent structure rooflike, in shape of an inverted V with a rounded vertex. **Phallosome**: Aedeagus about 0.5-0.6 length of sidepiece; apex about as long as wide, moderately rounded, with or without very small, membranous leaflets as in *nuneztovari*.

PUPA (fig. 17). Abdomen: about 2.9 mm. Trumpet: 0.5 mm. Paddle: 0.8 X 0.6 mm. In general, setae long and numerously branched. **Cephalothorax**: Heavily sclerotized. Wing cases with or without longitudinal stripes. Hair 2-C 2,3 forked (1-3), longer than 1,3-C; 1-C 2 branched (1-3), shorter than 3-C; 3-C 2,3 branched near base. Hairs 4,5-C subequal; 4-C 2-4 forked; 5-C 2-5 forked. Hair 6-C 1-3 branched. Hair 7-C 2,3 branched (1-4) near base, shorter branches subequal to 6-C, with one branch about 1.25-1.50 length of shorter branch(es). **Trumpet**: Similar to that of *strodei* and *aquasalis*. Pinna amber; about 3.7-4.4 (3.6-4.6) length of meatus; in lateral aspect, appearing broad medially and tapered toward apex. Meatal cleft long, moderately pointed at base. **Metanotum**: Hair 10-C single or double, strong, moderately long, slightly less than or equal to 11-C. Hair 11-C 3-5 branched near base. Hair 12-C 1-3 forked, about 2.0 length of 10-C. **Abdomen**: Heavily sclerotized. Hair 2-I 5-8 branched near base, moderately long; 3-I single or double, slightly more than 0.5 length of 2-I. Hair 4-I 5-8 branched. Hair 5-I 2,3 forked (1-3), long. Hair 6-I single and very long. Hair 7-I 3-6 branched, 0.5 length of 6-I. Hair 9-I single, longer than 7-I and shorter than 6-I. Hair 0-II,III,VI,VII moderately large; 0-IV,V large; 0-II 4-7 branched (4-10); 0-III 5-7 branched (4-7); 0-IV,V 4-6 branched (3-8); 0-VI 4-7 branched; 0-VII 4-6 branched. Hair 1-II,III 8-12 (8-13) and 7-13 (6-14) branched respectively, large; 1-IV-VII very long, 1.75 to more than 2.00 length of segment. Hair 3-IV 4-6 branched (4-7); 3-V 3-5 forked (2-5). Hair 5-II 4-7 branched (4-8) near base, moderately small; 5-III numerously, 9-13 (5-13) branched, moderately developed; 5-IV 2-6 branched (2-8), large, subequal to length of segment; 5-V-VII single, long. Hair 6-II single or double, long, at least 2.0 length of 7-II. Hair 7-II 4-6 branched; 7-III,IV about 3-7 branched, moderately developed; 7-V 3,4 branched, longer than 7-III,IV; 7-VI usually double (1-4 branched), moderately long, about 0.5 or less length of segment. Hair 8-III-VII moderately developed; 8-III-VI about 2-5 branched; 8-VII 4-6 branched. Hair 9-II very small, unpigmented; 9-III blunt, stout, short, subequal to or slightly longer than 9-II, pigmented; 9-IV stout, about 2.0 of 9-III; 9-V acuminate, stout, curved, 1.75-2.00 (1.4-2.4) length of 9-IV; 9-VI strong, relatively short, about 0.25-0.33 length of segment; 9-VII 1.4-1.8 (1.3-1.8) length of 9-VI; 9-VII,VIII tapering to a fine point, long, about 0.5 or more length of segment; 9-VII curved;

9-VIII almost straight. Hair 10-III 2-4 forked, moderately long. Hair 4-VIII 2-4 forked. Sum of branches of hairs 1-III, 5-III and 0-VI 22-27 (22-31). **Terminal Segments:** Male genital lobe heavy, thick, with mammilliform protuberance moderately prominent. **Paddle:** Large, obovate, weakly emarginate at insertion of hair 1-P. External buttress 0.55 length of paddle. External margin distad of buttress with moderately long, filamentous spicules extending around apex and becoming minute along caudal 0.5 of inner margin. Hair 1-P moderately long (0.1 mm); 2-P 1-3 forked, subequal to 1-P.

LARVA (fig. 18). Head: 0.6 mm. Antenna: 0.3 mm. Anal Saddle: 0.3 mm. **Head:** Moderately large. Very darkly pigmented, often almost black. Setae strongly developed and long. Inner and outer clypeal hairs (2,3-C) single and barbed in about apical half, often appearing simple; hairs 2-C widely spaced, clypeal index about 1.25; 3-C about 0.8-0.9 length of 2-C. Hair 4-C 4,5 branched (3-6), short, not extending to base of 2-C. Hairs 8,9-C 6-8 branched (5-10), strongly developed; 9-C weakly plumose with moderately long shaft, longer than 8-C, subequal to 2.0 distance separating insertion of 5-C and 6-C. Hair 10-C 3,4 branched, subequal to 8-C. Hair 12-C 4-6 branched, subequal to 8-C. Hair 15-C about 5 branched, strongly developed, long. Collar heavily pigmented and wide dorsomedially. **Antenna:** Very heavily pigmented. Mesal margin with strongly developed, stout spicules; ventral surface with numerous, shorter, heavy spicules; dorsal surface with a few small spicules. Hair 1-A dendritic, 7-9 branched (6-10), long, about 2.0 width of antenna at point of insertion, inserted about 0.25-0.33 from base of antenna. Hairs 2,3-A long and narrow. **Thorax:** Dark, greenish brown, heavily pigmented. Submedian prothorax group (1-3-P) often with 1,2-P sharing common tubercle, occasionally tubercle appearing more sclerotized at insertion of 2-P than at insertion of 1-P; palmate hair 1-P with 11-16 (10-18) long, moderately narrow leaflets; 2-P 14-17 branched (10-17), long, almost 4.0 length of 1-P. Hair 14-P 7-10 branched (7-13) from moderately long shaft. Mesothoracic hair 1-M 28-33 branched, apical branches shorter than lateral. Metathoracic hair 2-T long, extending to or beyond caudal margin of thorax. Palmate hair 3-T with 12-18 (10-18) large, weakly pigmented leaflets. Prothoracic pleural group spine larger than mesothoracic spine; metathoracic pleural spine smallest. **Abdomen:** Hair 0-II-VI large; 0-II,III,V,VI about 6-10 branched (5-10); 0-IV 5-8 branched. Palmate hair 1-I with 14-17 (11-20) weakly pigmented, moderately long, narrow, spreading leaflets; 1-III-VI with 23-30 (20-31) long, narrow, lanceolate leaflets; 1-I,II,VII shorter than 1-III-VI. Hair 2-II 4-6 branched (3-6), moderately large; 2-III 3-4 branched, large; 2-IV single, slightly longer than length of leaflets of 1-IV; 2-V single, very long (0.3 mm). Hair 3-I single, moderately long. Hair 5-I 4,5 branched (3-6), moderately developed; 5-II 8-10 branched, medium. Hair 9-I about 4-7 branched. Hair 13-I,II, III 4-6 (4-9), 7-11 (6-11) and 8-10 (6-14) branched respectively, small; 13-IV 3,4 branched, larger than 13-I-III; 13-V large, extending beyond caudal margin of segment; 13-VI 7-12 branched. **Spiracular Lobe:** Pecten with 15-22 teeth; many (8-11) of median teeth subequal. Lateral arm of spiracular apparatus long, directed laterally, appearing truncate on lateral margin at point of contact with spiracular opening. **Anal Segment:** Covered with very fine spicules becoming very short and inconspicuous basally. Saddle reddish brown. Hair 1-X longer than saddle; inserted on saddle near ventral margin, never on lateral margin at base of indentation; inserted about 0.3 cephalad of caudal margin. Anal gills very long, usually 2.0 or more length of saddle.

DISCUSSION. *An. ininii* can be distinguished from the other species in the Oswaldoi Subgroup in the female by the combination of (1) palpal segment 4 with a dark basal band extending distad on the ventral surface to form a distinct, dark, ventral

stripe usually not reaching apical dark ring, (2) foretarsal segments 3-5 predominantly cream to white with dark scales often present only on dorsobasal surface of segment, segments 2 and 3 light in apical 0.45 (0.35-0.55) and 0.75 (0.70-0.86) respectively, segment 4 often all light cream to golden brown or with a small, dark, basal area rarely longer than 0.3 length of segment, segment 5 from about 0.5 basally dark to all cream, (3) midtarsal segment 4 with a cream band in apical 0.15-0.25, and segment 5 from completely cream to 0.5 basally dark, (4) hindtarsal segment 2 with a dark band in basal 0.17-0.26, (5) wing spots white to very light cream, (6) humeral light spot on vein C about 2.0-3.3 (1.5-3.3) of basal dark spot and (7) subcostal light spot on vein C 0.35-0.70 of subcostal dark spot; in the **male genitalia** by the combination of (1) ventral claspette strongly conoid, narrow and rounded at apex, width at apex about 0.3 length of claspette, (2) basal lobule very large, extending laterad and usually bent at base ventrally so that setae on basal margin projecting caudad, (3) setae along basal margin of basal lobule very strong and long, 2.0-3.0 width of aedeagus, setae distributed uniformly over surface of lobule, (4) setae on lateral and ventral surfaces of ventral claspette (exclusive of basal lobule) short, about 0.5 width of aedeagus, extending toward apex only as far as level of apical margin of preapical plate, (5) preapical plate heavily sclerotized, very large, crescent shaped and (6) apex of aedeagus with or without very small, membranous leaflets; in the **pupa** by the combination of (1) setae in general long and numerously branched, (2) hair 7-C 2,3 branched (1-4), shorter branches subequal to 6-C, with one branch about 1.25-1.50 length of shorter branch(es), (3) hair 5-II 4-7 branched (4-8) near base, moderately small, (4) hair 9-V 1.75-2.00 (1.4-2.4) length of 9-IV, (5) hair 9-VII 1.4-1.8 (1.3-1.8) length of 9-VI and about 0.5 or more length of segment, tapering to a fine point, (6) hair 2-I 5-8 branched near base, moderately long, hair 3-I slightly more than 0.5 length of 2-I, (7) hair 6-II single or double, at least 2.0 length of 7-II and (8) sum of branches of hairs 1-III, 5-III and 0-VI 22-27 (22-31); and in the **larva** by the combination of (1) hairs 2,3-C single and barbed in about apical half, hairs 2-C widely spaced, clypeal index about 1.25, hair 3-C about 0.8-0.9 length of 2-C, (2) hair 4-C short, not extending to base of 2-C, (3) hairs 8,9-C 6-8 branched (5-10), strongly developed, 9-C weakly plumose with moderately long shaft, subequal to 2.0 distance separating insertion of hairs 5-C and 6-C, (4) hair 1-A dendritic, 7-9 branched (6-10), long, about 2.0 width of antenna at point of insertion, (5) hair 14-P 7-10 branched (7-13) from moderately long shaft, (6) hair 13-IV 3,4 branched, larger than 13-I-III, (7) lateral arm of spiracular apparatus long, directed laterally, appearing truncate on lateral margin, (8) hair 1-X inserted on saddle near ventral margin, never on ventral margin at base of indentation and (9) anal gills very long, usually 2.0 or more length of saddle.

An. ininii is a highly derived species, but it still retains a few ancestral characters which it shares with other species in the Oswaldoi Group and with some species in the Argyritarsis Section. These ancestral characters are in the larva (1) hair 13-IV large, with few branches and (2) hair 1-X inserted on saddle near but not on ventral margin; and in the male genitalia (1) the frequent presence of very small leaflets on the apex of the aedeagus and (2) possibly the shape of the ventral claspette. Although *ininii* often has very small leaflets on the aedeagus as do *nuneztovari* and *rangeli*, it is probably more closely related to *oswaldoi, galvaoi, noroestensis* and *aquasalis*. *An. oswaldoi* occasionally has leaflets on the aedeagus, and in general its ventral claspette is similar to that of *ininii*. The preapical plates are almost identical in *oswaldoi* and *ininii*, and the setae are distributed similarly on the basal lobules of the ventral claspette. The females of *oswaldoi* and *ininii* also are very much alike in all characters except for the fourth palpal segment and the banding patterns of the foretarsus.

It is impossible to differentiate these 2 species on the basis of the wing or the second hindtarsal segment. Likewise, the larvae of *oswaldoi* and *ininii* share many similar characters, such as the length of the lateral arm of the spiracular apparatus, the development of hairs 8,9-C and the arrangement of teeth on the pecten; these characters are usually more strongly developed (*i.e.* longer, larger) in *ininii*, except for the branching of hairs 2,3-C which has been strongly reduced in *ininii* as compared to *oswaldoi*. Ecologically, *ininii* occurs sympatrically with *oswaldoi*, the immatures being found in many of the same habitats, although it usually occurs in more open areas than *oswaldoi*. Speciation of *ininii* may have occurred in a geographically isolated area (refugium) in northern central South America.

BIONOMICS. Very little is known about the bionomics of *ininii*, particularly regarding the adults. Almost all the information relating to the larval habitats discussed below came from data recorded on collection forms by John F. Reinert while in Para, Brazil in 1974. The immatures of *ininii* are found along grassy margins of ponds, lakes, reservoirs, temporary or permanent ground pools, and animal or wheel tracks, in full sun or occasionally in partial shade. The water is fresh, clear, and with algae and emergent vegetation, although vegetation is usually scanty in the larval habitat. The general habitat in Para was characterized as secondary scrub. The 3 species in the Albimanus Section collected in association with *ininii* were *oswaldoi, nuneztovari* and *triannulatus*; the last 2 species were by far more common. The following 11 species have also been found in association with *ininii*: *Anopheles (Ano.)* sp, *Culex (Cux.) coronator* group, *Cx. (Cux.) mollis, Cx. (Mel.) bastagarius, Cx. (Mel.) dunni* group, *Cx. (Mel.) ?rachoui, Cx. (Mel.) zeteki* group, *Cx. (Mel.)* sp, *Cx. (Ads.) amazonensis, Uranotaenia (Ura.) geometrica* and *Ur. (Ura.) pulcherrima*. The type material of *ininii* was collected in an artificial reservoir in St. Elie, French Guiana (Senevet and Abonnenc 1938:501-511). Floch and Abonnenc (1947:6; 1951:50-51) reported that *ininii* occurs in dense vegetation with *An. (Nys.) braziliensis, darlingi, nuneztovari, oswaldoi* and *triannulatus*. Floch and Abonnenc (1951:17) reported that in 9 years a total of 6 specimens were collected.

MEDICAL IMPORTANCE. Nothing is known about the adult behavior or the medical importance of *ininii*.

DISTRIBUTION (fig. 2). *An. ininii* has been collected only in French Guiana and in the state of Para, Brazil.

Material Examined: 192 specimens: 32 males, 14 male genitalia, 57 females, 66 pupae, 23 larvae; 66 individual rearings: 18 larval, 48 pupal.

BRAZIL. Para (192 specimens: 32M, 14Mgen, 57F, 66p, 23L&l; 66 ind rear: 18 l, 48p). Altamira, 150 km W of, 5 Nov 1974, J. Reinert *et al.*, coll. 77, 1 pF; same data, coll. 79, 3Mgen, 7 pM, 7 pF; same data, coll. 80, 2 pM, 1 pF; same data except 163 km W of Altamira and 6 Nov, coll. 85, 5Mgen, 4 lpM, 5 lpF, 4 pM, 1 pF, 5L; same data except 158 km W of Altamira and 9 Nov, coll. 111, 1 pM. Bacuri, Gleba 29, Lote 03, 20 Oct 1974, J. Reinert *et al.*, coll. 5, 1M, 1Mgen; same data except Gleba 36, Lote 02 and 23 Oct, coll. 33, 3 lpF; same data except Gleba 29, Lote 03 and 25 Oct, coll. 44, 2Mgen, 2 lpM, 2 lpF, 1 pM; same data except Gleba 36, Lote 02 and 26 Oct, coll. 50, 1M gen, 2 pM, 1 pF; same data except Gleba 34, Lote 02 and 28 Oct, coll. 62, 2Mgen, 2 pM, 1 pF; same data except Gleba 38, Lote 02 and 29 Oct, coll. 64, 2 lpM, 2 pM, 2 pF. Belem, APEG Forest, 22 Nov 1974, J. Reinert *et al.*, coll. 140, 1 pF. Jatobal, 18 Feb 1976, Moramay, 1102, 3 pF; same data except 19 Feb, 1104, 2 pM, 7 pF. Maraba area, 3 Jun 1976, 1F (R-5); same locality, 15 Jun 1976, D. Roberts, 1F (A-1); same locality, 23 Jun 1976, 5F (A-2); same locality, 24 Jun 1976, D. Roberts, 11F (A-1); same locality, 21 Oct 1976, 2F (1); same locality, 8 Nov 1976, 1F (1); same locality, 9 Nov 1976, 1F (2).

7. *Anopheles (Nys.) anomalophyllus* Komp

Figs. 2, 4, 6, 19, 20

1936. *Anopheles (Nyssorhynchus) anomalophyllus* Komp 1936:163-164. TYPE: *Holotype* male with genitalia slide, Wenham's Farm, near Almirante (Bocas del Toro), Panama, bred from pupa, Feb 1929, W. H. W. Komp [USNM, 52018].

Anopheles (Nyssorhynchus) anomalophyllus of Lane (1939:21; 1944:262; 1949:402; 1953:263-264); Komp (1941a:90, 93, 96; 1942:39, 43, 75, 80, 125-127, 132, 161-162); Rozeboom and Gabaldon (1941:92-98); Galvao and Damasceno (1942:132); Simmons and Aitken (1942:39, 46, 52, 62, 87); Levi-Castillo (1949:9, 15, 27, 58, 67, 72, 76, 85); Gabaldon and Cova Garcia (1952:182); Vargas V. (1956:29; 1957; 1958a; 1958b); Bejarano (1957:326, 328, 330, 331); Stone, Knight and Starcke (1959:31); Vargas (1959:376); Belkin, Schick and Heinemann (1965: 43); Cova Garcia, Pulido F. and Amarista M. (1978:157).

Anopheles anomalophyllus of Kumm and Ruiz (1939:438); Kumm, Komp and Ruiz (1940:389, 408); Kumm (1941b:95-97); Rozeboom (1941:103); Russell, Rozeboom and Stone (1943:26, 29, 31); Vargas V. (1958c:1, 3); Cova Garcia (1964:200); Stojanovich, Gorham and Scott (1966a:10, 19, 30).

FEMALE (fig. 6). Description based primarily on 4 specimens from Costa Rica. Wing: 3.1 mm. Proboscis: 1.9 mm. Palpus: about 1.9 mm. Forefemur: 1.2 mm. Abdomen: about 2.7 mm. Generally very similar to *strodei*. **Head:** Integument dark brown. Proboscis about 1.6 length of forefemur. Vertex with very elongate, cuneate or slightly forked, cream to white scales. Dorsal surface of palpal segment 2 with a very few, light, erect scales; dorsal surface of segment 3 with light scales forming a longitudinal stripe; segments 2 and 3 with light apical band, apical band of 2 much smaller than apical band of 3; segment 4 with a basal and an apical dark band, light scales on ventral surface darker than on lateral surface, apparently with light brown to brown scales forming an indistinct ventral stripe; segments 4 and 5 predominantly white; base of 5 with a few dark scales extending from apex of 4. **Antenna:** Flagellar segment 1 with moderately long to long, white, oblanceolate scales distally on dorsomesal surface; base of 1 with small, gray to white, obovate scales. **Thorax:** Integument light brown to reddish brown. Elongate, white anterior promontory scales extending onto acrostichal line. Prescutellar space horseshoe shaped. Upper *stp* with 3,4 long, light brown to dark brown setae and a horizontal row of light scales. Lower *stp* with one long brown seta and a patch of light scales. Upper *mep* with about 4, 5 long, cream to light brown setae; scales not visible in specimens examined. **Legs:** Integument predominantly reddish brown. Light scales on coxae white. Midfemur with long, narrow, cream anteroapical spot and a small knee spot. Foretarsal segments 2 and 3 with a white band in apical 0.35 (0.29-0.42) and 0.51 (0.23-0.78) respectively; segment 4 all brown; segment 5 cream in about apical 0.5. Midtarsal segments 1 and 2 with a small, inconspicuous, white apical band; segment 3 with a cream apical ring (inconspicuous in one specimen); segment 4 all dark; segment 5 with a cream band in about apical 0.5. Hindtarsal segment 2 with brown band in basal 0.4 (0.30-0.45); segment 5 cream in apical 0.5-0.7. **Wing:** Slightly narrower and more pointed at apex than that of *aquasalis*. Light spots of wing white except for vein C and possibly R. Vein C humeral light spot about 2.5 (2.3-4.0) of basal dark spot; subcostal light spot 0.23-0.60 of subcostal dark spot; preapical light spot about 0.5 of preapical dark spot; 2 specimens with presectoral and sectoral dark spots fused. R presectoral dark spot moderately short to long; sectoral dark spot very small in 2 specimens and absent in the other 2. R_{4+5} subcostal and apical dark spots small to moderately small. M sectoral dark spot small to moderate, in 2 specimens absent or indistinct. Apical light fringe spot moderately large, distinctly broken by dark scales

between R_3 and R_{4+5}; additional, small, inconspicuous, light fringe spots at apices of all veins posterior of, and including, R_{4+5}; a moderately large, inconspicuous, light fringe spot at level of 0.5 distance from base of A. **Abdomen**: Dark scales of caudolateral tuft on tergites and sternites relatively small, about 0.07 mm. Remainder of abdomen as for that of *aquasalis*.

MALE. Wing: 2.8 mm. Proboscis: 2.1 mm. Forefemur: 1.45 mm. Abdomen: about 2.6 mm. Head: Palpal segments 2 and 3 with cream dorsal stripe; segment 4 predominantly cream, with a basal and an apical white band, and with or without a subbasal and a subapical dark ring. **Antenna**: About 0.7-0.8 length of proboscis. Flagellar segment 1 with moderately long, white, lanceolate scales. **Legs**: Forefemur 0.7 length of proboscis. Basal plantar surface of foretarsal segment 5 with about 7 moderately long, spiniform setae. Claw on foreleg large, curved, acuminate; submedian tooth long, tapering to a blunt, slightly recurved apex; basal tooth strongly decurved.

MALE GENITALIA (fig. 19). Description based on 5 damaged specimens, including holotype and 2 paratypes. **Segment IX**: Sternite long, about 0.2 length of sidepiece, curved, subtrapezoidal. Anterior apodeme on anterior border moderately developed, subtrapezoidal. **Sidepiece**: Tergal surface with 4,5 long, submedian, tergomedial bristles, basal 3 approximated; bristles mesad of tergomedial bristles moderate in length. Parabasal spine tapering, slender, moderately long, about 2.0 length of its tubercle. Basal apodeme moderately thick, 0.18 length of sidepiece. Longer, more dorsal accessory spine slightly less than 0.5 length of sidepiece; more ventral spine about 0.8 of longer spine. Internal spine subequal to shorter accessory spine, apically retrorse. **Clasper**: Spiniform acuminate and moderately long, slightly less than length of seta *b* (one specimen). **Dorsal Claspette**: About 0.6 length of sidepiece. Pedicel moderately broad; internal apodeme distinct. Leaflets broad, as in section description. **Ventral Claspette**: On holotype slide, about 0.87 length of aedeagus; width at apex about 0.2 length of claspette. Basal lobule large, expanded at base; setae along basal margin long, 1.5-2.0 width of aedeagus. Lateral and ventral surfaces (exclusive of basal lobule) with short setae extending to or nearly to apex. Apex striated, rounded and appearing domelike. Preapical plate moderately large, oval to semicircular, moderately sclerotized, located about 0.3 length of claspette basad of apex. Refringent structure not apparent. **Phallosome**: Aedeagus with apex rounded, longer than wide; with a pair of long, pointed, sclerotized leaflets about 0.4 length of aedeagus, leaflets directed basolaterally and serrated with 4,5 small teeth apically; subtriangular median sclerotizations at base of apex directed caudomesad instead of mesad as in remaining species.

PUPA (fig. 19). Abdomen: about 2.8 mm. Trumpet: 0.48 mm. Paddle: 0.8 mm. Description based on 2 laterally oriented specimens; outline of drawing based on *strodei*, many of setal lengths approximate. **Cephalothorax**: Very dark brown. Hairs 4, 5-C 3 and 2 branched respectively near base. Hair 6-C 3 forked. Hair 7-C 2 branched. **Trumpet**: Pinna long, about 4.5 length of meatus. Meatal cleft long, basally rounded. **Metanotum**: Hair 10-C single, short (0.1 mm). Hair 11-C slightly shorter than 12-C, 4 branched near base, median branch longer than lateral. Hair 12-C single, about 2.0 length of 10-C. **Abdomen**: Very darkly pigmented brownish black. Hair 2-I 6 branched 0.25 from base, long (0.16 mm), about 2.0 length of 3-I. Hair 4-I 4 branched, short. Hair 5-I single and moderately long. Hair 6-I single and long. Hair 7-I 3 branched near base, slightly longer than 0.5 length of 6-I. Hair 9-I single, slightly shorter than 6-I. Hair 0-II,III 3 and 4 branched respectively, moderately long; 0-IV-VII 3-5 branched. Hair 1-II 9 branched, strongly developed; 1-III 7,9 branched,

strong; 1-II,III with median branches longer than lateral; 1-IV-VII single, very long, 1.5-1.8 length of segment, longer on anterior segments than on posterior. Hair 3-IV 5 branched, moderately long; 3-V 2 forked 0.5 from base, long. Hair 5-III 9 branched, subequal to 1-III; 5-IV 5 branched, lateral branches shorter than median; 5-V-VII single, long, subequal to length of segment. Hair 6-II single, probably slightly longer than 7-II; 6-III single, long. Hair 7-II 3 branched; 7-III 2 forked, moderately developed; 7-V double, longer than 7-IV; 7-VI,VII single, long. Hair 8-III 2 forked, moderately long; 8-IV 1,2 forked, moderately long; 8-V single, moderately long; 8-VI,VII 2 and 3 branched respectively. Hair 9-II very small; 9-III strongly developed, more than 2.0 length of 9-II, heavily pigmented; 9-IV stout, 2.0 of 9-III; 9-IV-VII thick, acuminate, slightly curved, progressively longer from IV to VII, relatively short, less than 0.33 length of segment; 9-VIII subequal to 9-VII. Hair 10-III 3 forked, moderately long. Hair 4-VIII 2,3 forked, moderately long. **Terminal Segments** and **Paddle** not clearly discerned because of lateral orientation of specimens. Buttress about 0.7 length of paddle, serrated distally with small teeth. Hair 1-P moderately short (0.05 mm).

LARVA (fig. 20). Head: 0.6 mm. Antenna: 0.25 mm. Anal Saddle: 0.3 mm. **Head**: Moderately pigmented. Median tooth of mental plate moderately wide, less than combined width of 2 adjacent teeth from one side. Inner and outer clypeal hairs (2,3-C) single and barbed, with 8-10 and 4-9 barbs respectively; barbs of 3-C longer than those of 2-C; 3-C about 0.6-0.7 length of 2-C; hairs 2-C closely approximated, clypeal index about 2.5. Hair 4-C 2,3 branched, short, not reaching base of 2-C; distance between insertion of 4-C and 2-C about 1.5 distance between insertion of 2-C and 3-C. Hairs 8,9-C 3-5 branched (2-6), large; 8-C slightly shorter than 9-C. Hair 12-C 4-7 branched, large, subequal to 9-C. Hair 15-C single or forked, long. Collar wide dorsomedially, dark, heavily pigmented. **Antenna**: Darkly pigmented. Mesal margin with numerous, strong, long spicules; ventral surface with few, moderately strong, short spicules. Hair 1-A 5,6 branched (3-6), short, slightly longer than width of antenna at point of insertion, inserted about 0.3 from base of antenna. **Thorax**: Darkly pigmented. Submedian prothoracic group (1-3-P) with 1,2-P sharing a common sclerotized tubercle; palmate hair 1-P with 9-12 long, moderately broad to broad, pointed, lanceolate leaflets; 2-P 12-14 branched (12-17), about 3.0 length of 1-P. Hair 14-P 7-10 branched from a short, flattened stalk, lateral branches shorter than median. Mesothoracic hair 1-M 20-30 branched (20-32). Metathoracic hair 2-T moderately short. Palmate hair 3-T with 10-14 (10-16) moderately short, semitransparent, lanceolate leaflets. **Abdomen**: Hair 0-II-VII moderately large to large; 0-II, III,V-VII 4-7 branched; 0-IV 6,7 branched. Palmate hair 1-I with 12-16 narrow, moderately long, semitransparent leaflets; 1-II-VII with long, moderately narrow, pigmented leaflets; 1-II,VII smaller than 1-III-VI; 1-III,VI slightly smaller than 1-IV,V. Hair 2-II 4-7 branched, large; 2-III 3-6 branched (3-7), moderately long; 2-IV single, medium, about 2.0 length of leaflets of 1-IV; 2-V single, long. Hair 5-I 3-5 branched (3-8); 5-II 8-11 branched, moderately developed. Hair 9-I 5-9 branched, moderately large. Hair 11-I 2-4 branched, moderately large. Hair 13-I,II,III 5-7, 7-10 (5-12) and 6-10 branched respectively, moderately small; 13-IV 4,5 branched, moderately large; 13-V 3,4 branched (3-7), moderately large to large. **Spiracular Lobe**: Pecten with 13-17 teeth; many of median teeth subequal, with a few mixed long and short. Lateral arm of spiracular apparatus short, similar to that of *aquasalis* but narrower. Hairs 8, 9-S 3-5 branched, medium. **Anal Segment**: Hair 1-X longer than saddle; inserted on ventral margin of saddle at base of indentation, or less often on saddle near ventral margin. Anal gills slightly shorter than or about equal to length of saddle.

DISCUSSION. The female of *anomalophyllus* is very similar in appearance to those of *noroestensis* and *strodei*. It is not possible to separate *anomalophyllus* from the 2 latter species, particularly *strodei*, except by careful correlation of the characters given below and by comparing them with the descriptions of *noroestensis* and *strodei*. Locality data are also extremely useful in identifying *anomalophyllus* because of its limited distribution in Panama and Costa Rica. Due to insufficient material, *anomalophyllus* is not included in either the key to females or the key to pupae. *An. anomalophyllus* can be distinguished from the other species in the Oswaldoi Sub-Group, except for *strodei*, in the female by the combination of (1) palpal segment 4 apparently with an indistinct brown ventral stripe, (2) prescutellar space horseshoe shaped, (3) foretarsal segment 2 0.35 (0.29-0.42) apically white and segment 3 0.51 (0.23-0.78) apically white, (4) foretarsal segment 5 with a cream band in about apical 0.5, (5) midtarsal segment 5 cream in about apical 0.5, (6) hindtarsal segment 2 with brown band in basal 0.4 (0.30-0.45), (7) light spots of wing white except for vein C and possibly R, (8) humeral light spot of vein C about 2.5 (2.3-4.0) length of basal dark spot and subcostal light spot 0.23-0.60 length of subcostal dark spot and (9) caudolateral dark scale tufts of tergites and sternites of abdomen relatively small, about 0.07 mm; in the male genitalia by (1) aedeagus with long serrated leaflets about 0.4 length of aedeagus, (2) basal lobule large, expanded at base, with long setae along basal margin 1.5-2.0 width of aedeagus and (3) preapical plate moderately large, oval to semicircular, moderately sclerotized; and in the larva by the combination of (1) hairs 2,3-C single and barbed, hairs 2-C closely approximated, clypeal index about 2.5, (2) collar wide dorsomedially, dark, heavily pigmented, (3) hairs 1,2-P sharing a common tubercle, (4) palmate hair 1-P with 9-12 long, moderately broad to broad, pointed, lanceolate leaflets, and 2-P 12-14 branched (12-17), (5) hair 1-M 20-30 branched (20-32), (6) hair 13-V moderately large to large and (7) hair 1-X inserted on ventral margin of saddle at base of indentation, or less often on saddle near ventral margin.

It is unclear exactly what species are the closest allies of *anomalophyllus*. I am placing *anomalophyllus* in the Oswaldoi Complex on the basis of the similarities in the male genitalia. In general appearance, the ventral claspette is similar to those of the other species in the Oswaldoi Complex, including the presence of setae on the ventral and lateral surfaces of the fused portion of the claspette. *An. anomalophyllus* retains long serrated leaflets on the aedeagus, an ancestral character it shares with no other species in the Albimanus Section. Since phylogeny cannot be demonstrated on the basis of ancestral characters, the presence of the leaflets does not aid in establishing phylogenetic relationships. However, the female and particularly the larva of *anomalophyllus* are very similar to those of *strodei*. The larva is so much like that of *strodei*, that identification is possible only when all diagnostic characters given in the key are correlated. It is probable that very early in the divergence of the species in the Oswaldoi Subgroup, a population of an ancestral species became isolated in the Panamanian Isthmus and speciated into what is now recognized as *anomalophyllus*. Therefore, *anomalophyllus*, sharing characters with both the Oswaldoi Complex and Strodei Complex, represents a separate intermediate phylogenetic line. However, at this time I do not feel that enough information and material are available to justify the establishment of a separate monotypic taxon of higher category for *anomalophyllus*.

BIONOMICS. *An. anomalophyllus* is a rare mosquito of limited distribution known from very few collections. All collections of *anomalophyllus* have been from running streams at elevations from less than 100 m to about 600 m. Komp (1936a:

160-161) stated that the stream at the type locality was shaded. Kumm, Komp and Ruiz (1940:391, 408) took one larva from a sunlit pooled stream at Finca Canada, near Turrialba, Costa Rica. In 1971, D. A. Schroeder collected one fourth instar larva along a slow moving, clear, fresh, semipermanent, grassy stream in a cacao plantation outside of Zent, Costa Rica.

MEDICAL IMPORTANCE. *An. anomalophyllus* is of no medical importance.

DISTRIBUTION (fig. 2). *An. anomalophyllus* is a rare species found only in southern and central Costa Rica and on the Atlantic coast of western Panama.

Material Examined: 36 specimens: 4 males, 5 male genitalia, 8 females, 2 pupae, 17 larvae; 2 individual rearings: 1 larval, 1 incomplete.

COSTA RICA (27 specimens: 3M, 2Mgen, 8F, 2P&p, 12L&l; 2 ind rear: 1 l, 1inc). **Cartago:** Turrialba, Finca Canada, [H. Kumm], No. 33, 1M. **Limon:** Amubre [Amubri], [H. Kumm], No. 1496, 1 lpF [JH], 4F, 4 l; same locality, 2F. Chase, Jan 1930, W. Komp, 1M, 1Mgen; same data except Feb 1932, 1L, 1 l. Suerre, [H. Kumm], No. 1426, 1Mgen; same data except No. 1427, 1L [JH], 1 lP, 1L. Zent, CR 456, 1L. **Province not specified:** Margarita, 1 l [JH]. Volcan, [H. Kumm], No. 1071, 1M, 1F.

PANAMA (9 specimens: 1M, 3Mgen, 5L&l). **Bocas del Toro:** Almirante, 19 Dec 1928, W. Komp, 1 l; same data except 1 Jan 1929, 3 l; same data except Feb 1929, 1M and 1Mgen (holotype), 2Mgen (paratypes); same data except date not specified, 1L.

8. Anopheles (Nys.) rangeli Gabaldon, Cova Garcia & Lopez

Figs. 3, 4, 6, 21, 22

1940. *Anopheles (Nyssorhynchus) rangeli* Gabaldon, Cova Garcia and Lopez 1940:13-20. TYPE: *Holotype* male (309.5), Puerto Cabello (Carabobo), Venezuela [MDM].

Anopheles (Nyssorhynchus) rangeli of Gabaldon and Aquilera (1940:69-73, 76); Galvao (1941:93; 1943:149, 150, 151); Rozeboom and Gabaldon (1941:91-98); Galvao and Damasceno (1942: 121-122); Simmons and Aitken (1942:39, 46, 52, 61, 96); Cerqueira (1943:19; 1961:126); Galvis (1943:91-92); Causey, Deane and Deane (1944:2; 1946:27); Lane (1944:263; 1949:403; 1953:266-268); Deane, L. M., Causey and Deane (1946:7, 9, 12; 1948:897-899); Deane, M. P., Causey and Deane (1946:38, 43, 45); Gabaldon and Cova Garcia (1946b:114-118; 1952:178, 195-196); Senevet (1948a:278); Bates and de Zulueta (1949:134-139); Levi-Castillo (1949:10, 15, 28, 72, 76, 86); Rey and Renjifo (1950:534, 537); Bejarano (1957:326, 329, 331); Stone, Knight and Starcke (1959:34); Vargas (1959:377, 383); Forattini (1962:395-396); Belkin, Schick and Heinemann (1965:72); Morales-Ayala (1971:139); Cova Garcia and Sutil O. (1976: 28; 1977:23, 46, 64, 85); Cova Garcia, Pulido F. and Amarista M. (1978:157).

Anopheles rangeli of Gabaldon, Cova Garcia and Arevalo (1940:28-29); Cova Garcia and Marcano (1941:57-58); Rozeboom (1941:103); Russell, Rozeboom and Stone (1943:26, 30, 41, 49); Renjifo and de Zulueta (1952:600-601); Komp (1956:39-40); Foote and Cook (1959:12, 13, 23, 26, 29, 32); Cova Garcia (1961:37-38, 68, 90-91, 114, 125-126, 153); Vincke and Pant (1962:2-4, 6, 7, 10, 12, 13); Mattos and Xavier (1965:273); Stojanovich, Gorham and Scott (1966b:22, 30, 44); Gorham, Stojanovich and Scott (1967:60; 1973:112, 138, 150); Elliott (1972:757); Cova Garcia and Sutil O. (1975a:22; 1975b:213).

FEMALE (fig. 6). Wing: 3.3 mm. Proboscis: 2.0 mm. Palpus: 2.0 mm. Forefemur: 1.2 mm. Abdomen: about 2.6 mm. **Head:** Integument light brown to dark brown with light pruinose areas. Interocular distance 3,4 ommatidial diameters. Proboscis about 1.7 length of forefemur. Erect scales on vertex as those of *oswaldoi*, long, narrow, tapering at base into threadlike stalk. Palpal segment 2 occasionally with many, light, dorsal scales; segment 3 with an indistinct to conspicuous, creamish, dorsolongitudinal stripe, apex with a moderately large, white band; segments 4 and 5 predominantly white; base of 4 with a moderately small, dark band and apex with a small to indistinct, dark band; segment 5 occasionally with a few, dark, basal scales; segment 4 usually without brown scales forming a distinct ventral stripe.

Antenna: Dorsomesal and mesal surfaces of flagellar segment 1 with numerous, elongate, white scales. Flagellar segments 2-13 each with 8-10 silver setae in basal whorl. Thorax: Integument extremely variable, tan to very dark brown. Scutum largely reddish cream, tan or silver, particularly in pruinose areas. Pleuron often with integument very light so that pruinose light regions hard to distinguish from nonpruinose areas. Anterior promontory scales extending dorsad onto acrostichal line. Prescutellar space usually large and subtriangular. *Sp* with 4-8 setae and a few, elongate, light scales. *Pra* with 6-10 elongate, light, setiform scales, and a patch of elongate lanceolate scales, with some shorter obovate scales interspersed. Upper *stp* with 4 (3-5) long setae and a patch of about 10 cream to white, small, obovate to lanceolate scales in a horizontal arc. Lower *stp* with one long, usually light seta, and 4-8 cream to white scales in diagonal patch. Upper *mep* with about 6 long, dark setae; anteriorly often with a setiform scale shorter than setae; often with 1-4 light, moderately small, obovate scales, either dorsal or anterior to setae; often scales rubbed off or difficult to see. Legs: Light scales on coxae white, grayish white or very light cream. Foretarsal segments 2 and 3 with a cream to white band in apical 0.30-0.45 and 0.7 (0.60-0.85) respectively; segment 4 predominantly dark, with or without apical cream ring; segment 5 light in about apical 0.5. Midtarsal segment 2 with light band in apical 0.10-0.35; segment 3 with small light apical band; segment 4 with or without light apical scales; segment 5 light in about apical 0.5. Hindtarsal segment 2 with a brown band in basal 0.28 (0.24-0.35); segment 5 cream to white in about apical 0.5. Wing: Light spots of vein C very light cream, remaining veins with light spots white. Wing characterized by several large light spots. Vein C humeral light spot about 1.8-3.5 (1.0-3.7) of basal dark spot; subcostal light spot usually greater than 0.5 (0.45-1.00) of subcostal dark spot; preapical light spot large, 0.40-0.65 of preapical dark spot. R presectoral and sectoral dark spots usually small, occasionally sectoral dark spot absent. Rs-R_{2+3} highly variable. R_{2+3} and R_2 preapical light spots usually large. M predominantly light, sectoral dark spot often indistinct; preapical dark spot not extending onto M_{1+2}. Cu_1 subcostal and preapical light spots small to moderately long; occasionally subcostal spot absent. Apical light fringe spot large, conspicuous and undivided, or with a few dark scales anterior to apex of R_{4+5}; additional, moderate size, light fringe spots at apices of R_{4+5}, M_{1+2}, M_{3+4}, Cu_1, Cu_2 and A; occasionally a conspicuous, fairly large, light spot between base of wing and A. Abdomen: Sternite I with a few, moderately long to long, dark setae, and usually a few, small, inconspicuous, obovate to moderately lanceolate, light scales in basal 0.5. Caudolateral scale tufts of segments II-VII with scales large, dark brown, obovate and conspicuous.

MALE. Wing: 3.2 mm. Proboscis: 2.45 mm. Forefemur: 1.4 mm. Abdomen: about 3.0 mm. Essentially as in female except for sexual characters. Head: Palpal segments 2 and 3 with a light, dorsal stripe; lateral surface of segment 3 speckled with cream and dark scales; segment 4 extensively light, occasionally with a subbasal and a subapical, small, brown band; base and apex of 4 usually white, medially cream with a few, scattered, dark scales. Antenna: About 0.8 length of proboscis. Flagellar segment 1 with numerous, conspicuous, long, white, lanceolate scales on dorsomesal surface. Legs: Forefemur about 0.6 length of proboscis. Basal plantar surface of foretarsal segment 5 with about 6 moderately short, heavy, spiniform setae; 2 apical spiniform setae longer than others. Claw on foreleg similar to that of *aquasalis*, except submedian tooth slightly more attenuate toward apex.

MALE GENITALIA (fig. 21). Segment VIII: Tergite and sternite with narrow lanceolate scales; scales broader on sternite than tergite. Segment IX: Sternite long, about 0.25 length of sidepiece, subtrapezoidal. Anterior apodeme long, subtriangular,

may not extend entire width of sternite. **Sidepiece**: Moderately narrow, conical. Tergal surface usually with 3,4 long, submedian, tergomedial bristles and one or 2 subapicolateral bristles; with moderately short bristles mesad of tergomedial bristles, except for occasionally a stronger, longer, basomesal bristle. Parabasal spine slender, about 2.0 length of its tubercle. Basal apodeme long and narrow, about 0.25 length of sidepiece. Longer, more dorsal accessory spine about 0.5 length of sidepiece; more ventral spine about 0.7-0.8 of longer spine. Internal spine subequal to shorter accessory spine, strongly retrorse apically. **Clasper**: Spiniform moderately developed, acuminate, subequal to seta *b*. **Dorsal Claspette**: Pedicel moderately broad; base rounded and usually curved mesad. Dorsal leaflet with a moderately developed basomesal projection. **Ventral Claspette**: Large, about 0.5 length of sidepiece; width at apex 0.4-0.5 length of claspette. The nonfused dorsal lobe may appear to project beyond apex of fused ventral lobe, depending on angle of observation. Basal lobule very large, expanded laterally at base and usually curved ventrally; setae along basal margin strong, reflexed caudally and long, about 1.5 length of aedeagus; basomesal margin with a concentration of long setae directed caudally into mesal cleft. Ventral and lateral surfaces (exclusive of basal lobule) with short setae about as long as width of aedeagus; setae extending to or nearly to apex. Apex truncate; lateral margins abruptly angled, rounded, sclerotized; apex medially membranous and weakly emarginate. Preapical plate small, oval, heavily sclerotized; located about 0.15 length of claspette basad of apex; convex apically, flat or slightly concave basally, occasionally with small basomesal projection, often produced basolaterally into short, caudolaterally directed, sharp points. Membranous area transparent, horseshoe shaped, immediately basad of preapical plate, extending basad bordering mesal cleft. Refringent structure in shape of an inverted horseshoe, often indistinct, without lateral arms. **Phallosome**: Aedeagus about 1.0-1.2 length of ventral claspette; apex rounded with tapering sides, slightly longer than wide; with or without very small membranous or weakly sclerotized leaflets.

PUPA (fig. 21). Abdomen: 2.5 mm. Trumpet: 0.45 mm. Paddle: 0.7 X 0.5 mm. **Cephalothorax**: Hairs 1-3-C subequal; 1,2-C 2,3 branched; 3-C 1-3 branched. Hairs 4,5-C 2-4 forked (1-4); 4-C slightly shorter than 5-C. Hair 6-C single or 2,3 forked in apical 0.5, subequal to 7-C. Hair 7-C 2,3 branched, branches subequal or one branch slightly longer than other(s). **Trumpet**: Very similar to that of *aquasalis*. Pinna weakly pigmented; moderately long, 3.8-5.4 (3.6-5.4) length of meatus; in lateral aspect, appearing broad medially and tapered toward apex. Meatal cleft long, open, basally rounded. **Metanotum**: Hair 10-C single, heavy, moderately short. Hair 11-C 4-6 branched (2-6), subequal to or slightly longer than 10-C. Hair 12-C single or double, about 2.0 length of 10-C. **Abdomen**: Hair 2-I 5-8 forked (2-8) 0.20-0.33 from base, occasionally dendritic, long; 3-I single or double, subequal to 2-I. Hair 4-I 4-6 branched (3-6), moderately long. Hair 5-I 1-3 branched, moderately long. Hair 6-I single or occasionally double, long, about 2.0 length of 7-I. Hair 7-I 3,4 branched (2-5) near base. Hair 9-I single, slightly shorter than 6-I. Hair 0-II-IV 4-7 branched (3-7), moderate; sum of branches of 0-II and 0-III ranging from 8 to 14; 0-V,VI 3-5 branched, smaller than 0-II-IV; 0-VII 2-4 branched. Hair 1-II,III strongly developed; 1-II 5-9 branched (3-9); 1-III 4-7 branched (2-10); 1-IV-VII strong, very long, 1.7-2.0 length of segment. Hair 3-IV,V 3-6 (2-6) and 2-4 forked respectively, moderately long. Hair 5-III 4-8 branched (3-8), strong; 5-IV 1-4 branched, median branch much longer than lateral; 5-V-VII single, long, about length of segment. Hair 6-II single or occasionally double, about 2.0 length of 7-II; 6-III single, long. Hair 7-II 3,4 branched (2-5); 7-III,IV 2-4 branched (1-4), small; 7-V single to triple; 7-VI,VII single

or rarely double, long. Hair 8-III 3-5 branched (2-5); 8-IV,VII 2-4 branched (1-4); 8-V, VI 1-3 branched (1-4). Hair 9-II minute, unpigmented; 9-III about 2.0 length of 9-II, unpigmented or occasionally pigmented; 9-IV-VII strongly pigmented; 9-IV moderately pointed, at least 2.0 of 9-III; 9-V moderately thin, curved, acuminate, usually 2.3 (2.0-4.5) length of 9-IV; 9-VI-VIII thin, acuminate, subequal to 0.5 length of segment; 9-VI,VII more curved than 9-VIII; 9-VI slightly shorter than 9-VII,VIII; 9-VII 1.1-1.5 (1.1-1.7) length of 9-VI. Hair 10-III 2-4 forked (1-4) in basal 0.3-0.5, moderately developed. Hair 4-VIII 2,3 forked (2-4) about 0.5 from base, subequal to 9-VIII. **Terminal Segments:** Male genital lobe as that of *aquasalis* only broader at base, and sides tapering more medially toward apex. **Paddle:** Broad distally, obovate, very weakly emarginate at insertion of hair 1-P. External buttress 0.7 length of paddle, serrated apically. Spicules on external and internal margin as in *aquasalis*. Hair 1-P moderately long; 2-P single or double, subequal to 1-P.

LARVA (fig. 22). Head: 0.6 mm. Antenna: 0.25 mm. Anal Saddle: 0.25 mm. **Head:** Moderately pigmented. Median tooth of mental plate as broad as combined widths of 2 adjacent teeth from one side, tapering abruptly to a point. Inner and outer clypeal hairs (2,3-C) single, and simple or barbed; hairs 2-C widely spaced, clypeal index about 1.67; 3-C slightly shorter than 2-C. Hair 4-C 2-3 branched (1-4), short, not extending to base of 2-C. Hairs 8,9-C 4-6 (2-6) and 5-7 branched respectively, dendritic, moderately large. Hair 12-C 3-5 branched, moderately large, subequal to 9-C. Hair 15-C 2-4 branched. Collar wide dorsomedially, dark, strongly pigmented. **Antenna:** Moderately pigmented. Mesal margin with long, moderately thin spicules extending almost to base. Hair 1-A 4-6 branched, short, slightly longer than width of antenna at point of insertion, inserted in basal 0.25 or less of antenna. **Thorax:** Moderately pigmented. Submedian prothoracic group (1-3-P) with or without 1,2-P sharing a common tubercle; palmate hair 1-P with 9-13 (8-14) long, broad, lanceolate leaflets; 2-P 13-17 branched (10-19), about 4.0 length of leaflets of 1-P. Hair 14-P 6-9 branched (5-9) from a short to moderately short, flattened stalk; branches long, lateral branches slightly shorter than median. Mesothoracic hair 1-M 28-37 branched, lateral branches equal to or slightly longer than apical branches. Metathoracic hair 2-T moderately long, reaching or not reaching posterior margin of thorax. Palmate hair 3-T with 12-18 semitransparent, moderately long, moderately broad to broad, spreading leaflets. **Abdomen:** In general, tergal hairs shorter in length and inserted closer to midline than in other species in Oswaldoi Complex. Hair 0-II-VI moderately developed; 0-II,III 6-9 branched; 0-IV,V 4-8 branched (3-10); 0-VI 4-6 branched (4-7). Palmate hair 1-I-VII with moderately narrow to broad, acuminate, lanceolate leaflets; 1-I-VII longer than those of other species in Oswaldoi Complex; 1-I with 13-16 (13-17) weakly pigmented leaflets; leaflets of 1-I,II,VII slightly shorter than those of 1-III-VI. Hair 2-II 5-8 branched (5-10); 2-III 3-5 branched (3-6), relatively short, 1.5-2.0 length of leaflets of 1-III; 2-IV single, moderately short, slightly longer than leaflets of 1-IV; 2-V single, about 3.0-4.0 length of leaflets of 1-V. Hair 5-I 3-5 branched, short, inserted 0.75-1.00 its length from lateral margin of abdomen; 5-II 5-9 branched (5-12), short, inserted as 5-I. Hair 9-I 4-6 branched (3-6), moderately small. Hair 11-I 2 branched (2-4), moderately large. Hair 13-I,II,III 4-7 (3-7), 6-10 (5-10) and 7-9 (6-10) branched respectively, small; 13-IV 3 branched (3-5), moderately short, slightly longer than leaflets of 1-IV; 13-V 3-5 branched, moderately long, subequal to 2-V; 13-VI 6-11 branched, small. **Spiracular Lobe:** Pecten with 15-19 teeth; many of median teeth subequal in length. Lateral arm of spiracular apparatus short as in *aquasalis*, directed caudolaterally. Hairs 8,9-S 3-5 forked (3-8). **Anal Segment:** Covered with very fine spicules over about apical

0.7 of segment; fewer spicules in basal 0.5 of membranous portion of segment. Saddle tan to brown. Hair 1-X longer than saddle; inserted on saddle near ventral margin of saddle or on ventral margin at base of indentation, rarely inserted just ventrad of ventral margin; inserted about 0.3 cephalad of caudal margin. Anal gills about 0.35-0.40 mm long, much longer than saddle.

DISCUSSION. *An. rangeli* can be distinguished from the other species in the Oswaldoi Subgroup in the **female** by the combination of (1) upper *mep* often with 1-4 light obovate scales, (2) foretarsal segment 2 with a light band in apical 0.30-0.45 and segment 3 with light band in apical 0.7 (0.60-0.85), (3) hindtarsal segment 2 with a brown band in basal 0.28 (0.24-0.35), (4) wing with several large light spots, humeral light spot of vein C about 1.8-3.5 (1.0-3.7) length of basal dark spot, (5) subcostal light spot of vein C usually greater than 0.5 (0.45-1.00) length of subcostal dark spot, (6) preapical light spot of vein C 0.40-0.65 of preapical dark spot, (7) presectoral and sectoral dark spots of vein R usually small, (8) vein M predominantly light with sectoral dark spot often indistinct and (9) apical light fringe spot large, conspicuous and usually undivided; in the **male genitalia** by (1) ventral claspette large, apex truncate and wide, width at apex 0.4-0.5 length of claspette, apex with abruptly angled, rounded lateral margins, (2) basal lobule very large, usually curved ventrally, with long setae along basal margin about 1.5 width of aedeagus, (3) long setae along basomesal margin of basal lobule concentrated and directed caudally into mesal cleft, (4) preapical plate small, oval, heavily sclerotized, convex apically, flat or slightly concave basally, occasionally with small basomesal projection and (5) apex of aedeagus with or without very small, membranous or weakly sclerotized leaflets, apex slightly longer than wide; in the **pupa** by the combination of (1) hair 7-C with branches subequal or one branch slightly longer than other(s), (2) pinna moderately long, about 3.8-5.4 length of meatus, in lateral aspect appearing broad medially and tapered toward apex, (3) hair 11-C subequal to or slightly longer than 10-C, (4) hair 2-I 5-8 forked (2-8) 0.20-0.33 from base, occasionally dendritic, long, subequal to 3-I, (5) hair 0-II moderate, 5-7 (4-7) branched, (6) sum of branches of hairs 0-II and 0-III ranging from 8 to 14 and (7) hair 9-III about 2.0 length of 9-II, unpigmented or occasionally pigmented, 9-V usually 2.3 (2.0-4.5) length of 9-IV, 9-VII thin, acuminate, about 0.5 length of segment, 1.1-1.5 (1.1-1.7) length of 9-VI; and in the **larva** by the combination of (1) hairs 2,3-C single, and simple or barbed, hairs 2-C widely spaced, clypeal index about 1.67, (2) hair 4-C short, not extending to base of 2-C, (3) hairs 8,9-C 4-6 (2-6) and 5-7 branched respectively, dendritic, moderately large, (4) palmate hair 1-P with 9-13 (8-14) long, broad leaflets, (5) hair 2-IV single, moderately short, (6) hair 5-I,II short, inserted 0.75-1.00 its length from lateral margin of abdomen, (7) hair 13-IV 3 branched (3-5), moderately short, (8) lateral arm of spiracular apparatus short and (9) hair 1-X inserted on saddle near ventral margin of saddle or on ventral margin at base of indentation, rarely inserted just ventrad of ventral margin.

An. rangeli forms the sister group of *nuneztovari* and *trinkae*. It differs from these 2 species in the female usually by (1) the absence of ventral dark line on palpal segment 4, (2) presence of a few light upper *mep* scales and (3) presence of a small basal dark spot and a large subcostal light spot on vein C. The male genitalia of these 3 species are very similar, *rangeli* differing only in the (1) presence of a concentration of long setae along the basomesal margin of the basal lobule, (2) development of the preapical plate and (3) structure of the apex of the ventral claspette to some degree. The pupa of *trinkae* and the larva of *noroestensis* are very much like those of *rangeli* and can be distinguished only by the characters given in the keys. Locality data are

extremely useful in distinguishing the larva of *rangeli* from *noroestensis,* since the distributions of the 2 species do not overlap, except possibly in Bolivia and southwestern Brazil.

There seems to be no significant variation between the populations I have studied. Intrapopulational variation seems as great as or greater than interpopulational variation. Gabaldon and Aguilera (1940:69-72, 76) examined material from Maracay, Dividive, Pampanito and Pampan, Venezuela, and could find no significant differences, although the specimens from Trujillo had a tendency to be darker and smaller. They also studied progeny rearings and found considerable variation between siblings; in one family they studied (LV4), the dark band on hindtarsal segment 2 varied from 28.3 to 42.0%. Also, as in all the species in this section, there is considerable variation in the relative lengths of the wing spots and in the tarsal banding.

BIONOMICS. The immatures of *rangeli* occur in marshy depressions, temporary ground pools, animal and wheel tracks, semipermanent ditches, stream margins, and lakes. They are usually found in full sun or partial shade, and usually not in the forest proper but in open glades, meadows, and scrub or grassland areas. There is usually abundant vegetation in the breeding site, and occasionally the aquatic habitat has decaying vegetation or is contaminated with feces. The immatures are always found in fresh water. Gabaldon, Cova Garcia and Arevalo (1940:28-31) reported that the larvae of *rangeli* cannot tolerate sodium chloride in concentrations as low as 0.05%. The time of development from egg to adult averaged 24 days for specimens from La Victoria (Aragua), Villa de Cura (Aragua) and Puerto Cabello (Carabobo), Venezuela; however, the temperature at which the immatures developed was not reported. The average number of eggs deposited at one oviposition varied from 23 to 217 with a mean of 80.3. In Colombia, the seasonal peak in the populations of *rangeli* occurs in June at the beginning of the rainy season, and *rangeli* continues to be very abundant until December or January (Bates and de Zulueta 1949:136, 137). The larvae and pupae are commonly associated with 3 species in the Albimanus Section, *trinkae, triannulatus* and, in some areas, *strodei*. They have also been collected with *oswaldoi* (Gabaldon 1940). Other species found in association with *rangeli* are *An. (Nys.) argyritarsis, An. (Ano.) punctimacula, Culex (Cux.) corniger, Cx. (Cux.) coronator* group, *Cx. (Cux.) declarator* group, *Psorophora (Gra.) confinnis* group and *Uranotaenia (Ura.) lowii. An. rangeli* occurs in lowlands and at higher elevations; our highest collection was made at 950 m above sea level.

The adults are predominantly exophilic. Rey and Renjifo (1950:537) collected 2414 anophelines inside houses from September to November near Cucuta, Colombia, of which only 0.62% were *rangeli.* Of the 3722 adults collected by Deane, Causey and Deane (1948:899), only 25 or 0.7% were from inside houses. In 131 hours of collecting inside houses, they found only 5 specimens of *rangeli*; however, in less than 41 hours collecting outside, they captured 1391 individuals. The majority of the specimens were collected on horses or bulls, although many were biting man. In Boca de Acre, in a collection made at sundown simultaneously from a cow and a man, 5 females of *rangeli* were collected from the cow and 8 from the man. Elliott (1972:757) reported that in Peru the peak hours of biting by *rangeli* were 1800-2000 h and 0400-0600 h.

MEDICAL IMPORTANCE. Very little is known about the vector capacity of *rangeli.* It does not seem to be a vector of malaria, although Forattini (1962:396) stated that it has been suspected of transmitting malaria in Ecuador. Deane, Causey and Deane (1948:899) dissected 363 females from Rio Branco (Acre), Brazil, and found none infected with *Plasmodium* sp. Rey and Renjifo (1950:537) did not find

rangeli naturally infected in the Cucuta area of Colombia during a malaria epidemic in which *Plasmodium falciparum* (18%), *P. vivax* (55%) and *P. malariae* (27%) were present in the human population.

DISTRIBUTION (fig. 3). *An. rangeli* occurs in the upper Amazon and Orinoco basins, Colombia, Venezuela, Ecuador (Morona Santiago, Napo, Pastaza), and south through eastern Peru and into northern Bolivia (Beni, Santa Cruz).

Material Examined: 1181 specimens: 196 males, 113 male genitalia, 437 females, 267 pupae, 168 larvae; 126 individual rearings: 53 larval, 44 pupal, 29 incomplete; 11 progeny rearings.

BOLIVIA (7 specimens: 2M, 2Mgen, 3F). **Beni**: San Ignacio, 18 Sep 1943, Carr, 3F. Todos Santos, Jun 1946, E. Soracho, BOL 36, 2M, 2Mgen.

BRAZIL (1Mgen, 1F). **Acre**: Rio Branco, 1949, A. Galvao, 1Mgen [JH]. **Amazonas**: Boca do Acre, det. Deane, 1F [CU].

COLOMBIA (780 specimens: 130M, 26Mgen, 317F, 186p, 119L&l; 43 ind rear: 17 l, 26 inc; 11 progeny rearings). **Boyaca**: Puerto Boyaca, COM 650. **Caldas**: La Dorada, 22 Jun 1943, KO 120A-2, 1M; same locality, 23 Jun 1942 [1943], 1M, 1F; same locality, 25 Jun 1943, W. Komp, KO 120A-11, 3M; same locality, 26 Jun 1943, KO 120A-5, 1M, 1F. **Caqueta**: Tres Esquinas, COM 490, 491, 493. Florencia, H. Kumm, 1F [BM]. **Meta**: Restrepo, Jul 1935, KO 120A-4, 1M, 1F; same locality, Sep 1935, W. Komp, KO H-19-8, 1M, 1F; same locality, 13 Jun 1937, 1M, 4F; same locality, COB 50; same locality, 1Mgen. Vega Grande, 24 Nov 1936, COR 147, 11F. Villavicencio, 26 May 1941, M. Bates, CV 265, 2M, 1Mgen; same locality and collector, 30 May 1941, CV 267, 3M, 1Mgen, 1F; same locality and collector, 26 Jun 1941, 1Mgen; same locality, 1 Jun 1942, 1F; same locality, 3 Jun 1942, W. Komp, 1M; same locality and collector, Jun 1942, KO 120A-3, 1M; same data, KO 120A-21, 6M, 2F; same locality and collector, ?1942, KO 120A-23, 14M, 2F; same locality, 15 Jul 1943, KO 120A-8, 20F; same locality, 15 Aug 1943, KO 120A-6, 7F; same locality, 22 May 1944, KO 120A-13, 28F; same locality and date, KO 120A-16, 1M; same locality, 23 May 1944, W. Komp, KO 120A-14, 27F; same locality and collector, 8 Jun 1944, 40F; same data, KO 120A-17, 18F; same locality, 20 Jun 1944, COK 47, 37F; same locality, 1944, M. Bates, 2 l; same data, CV 90, 1F; same data, CV 91, 1F; same data, CV 93, 1M; same locality, 3 May 1947, 3Mgen [JH]; same locality, 3 May 1947, L. Rozeboom, CV-P 1 (progeny rearing), 18p, 7L, 4 l; same data, CV-P 2 (progeny rearing), 17p, 3L, E; same data, CV-P 3 (progeny rearing), 5M, 5Mgen, 3F, 14p, 3L; same data, CV-P 4 (progeny rearing), 15p, 5L; same data, CV-P 5 (progeny rearing), 8 lp, 14p, 1 l; same data, CV-P 6 (progeny rearing), 16p, 3L, 1 l; same data, CV-P 7 (progeny rearing), 15p, 8 L, 1 l; same data, CV-P 8 (progeny rearing), 12p, 5L, 3 l; same data, CV-P 9 (progeny rearing), 13p, 6 l; same data, CV-P 10 (progeny rearing), 5p, 3 l; same data, CV-P 11 (progeny rearing), 10 lp; same locality and collector, 6 May 1947, CV-P 17, 1F; same data, CV-P 18, 1F; same data, CV-P 27, 1F; same locality, 9 May 1947, 1Mgen [JH], 3L; same data, [CV] 370.10, 3L, 1 l [JH]; same locality, 14 May 1947, CV 379, 1F; same locality, 23 May 1947, M. Bates, Cabo, L. Rozeboom, CV 389, 1M; same data, CV 391, 3M, 1F; same locality and date, 4p, 4L [JH]; same locality, 27 May 1947, M. Bates, Cabo, L. Rozeboom, CV 394, 2F; same data, CV 395, 3M, 3F; same locality, May 1947, CV 396A, 1F; same locality, 10 Jun 1943 [1947], L. Rozeboom, Cabo, [CV] 423.2, 1 lp [JH]; same locality, 28 Jul 1948, [CV] C595.104, 1Mgen [JH]; same locality, CV 732, 7 lp, 5L; same locality, COB 39, 42, 53, 60, 61, 63, 70, COM 607; same locality, 27 Jul 1974, J. Kitzmiller, COZ 41, 62M, 77F; same locality, 4M, 2F. Locality not specified, 24 Nov 1936, COR 147 A, 8F. **Santander**: Barranca[bermeja], 8 Sep 1943, D. Fierro, COT 68, 2M, 1Mgen.

ECUADOR (182 specimens: 35M, 14Mgen, 33F, 65p, 35L&l; 67 ind rear: 33 l, 34p). **Morona Santiago**: Sucua, 6Mgen. Locality not specified, Zamosa, 2Mgen. **Napo**: Limoncocha, 3 Jun 1977, Y. Huang, coll. 45, 1 pM, 1 pF, 1 lpF; same data except 8 Jun, coll. 57, 4 pM, 4 pF, 7 lpM. Tena, 1.5 km S of, 13 May 1977, Y.Huang, coll. 26, 5 pF, 2 lpF; same data except 32 km S of Tena, coll. 27, 3 lpF; same data except 12.5 km SE of Tena and 24 May, coll. 38, 1Mgen, 1 pM, 3 pF, 2 lpM, 4 lpF; same data except 11.7 km SW of Tena and 25 May, coll. 40, 1Mgen, 3 pM, 6 lpM, 3 lpF; same data, coll. 41, 1 lpF; same data except 1.5 km S of Tena and 27 May, coll. 44, 1F, 1 pM, 1 lpF. **Pastaza**: Puyo, 39 km N of, 6 May 1977, Y. Huang, coll. 9, 1Mgen, 1 pM, 1 lpF; same data except 4 km NE of Puyo and 7 May, coll. 10, 2 pF; same data except 5.3 km NE of Puyo,

coll. 14, 1Mgen, 1 pM, 1 lpF, 1 l; same data except 16 km NE of Puyo, coll. 15, 1 lpF; same data except 1.5 km S of Puyo and 19 May, coll. 32, 1 pF, 1L; same data, coll. 34, 1Mgen, 2 pM, 1 pF; same data except 23 km SE of Puyo, coll. 35, 1Mgen, 3 pM.

PERU (35 specimens: 10M, 23F, 2L). **Huanuco:** Cochicote, 12, 13 Oct 1965, J. Hitchcock, 14 F. Tingo Maria, Apr 1946, A. Valde Rerma [?], 1M, 2F; same locality, E. Viale, 2L; same locality, E. Hambleton, 6M, 7F. **Province not specified:** Rio Perene, 1939, Kuczunski, Godard, 3M.

VENEZUELA (177 specimens: 19M, 70Mgen, 60F, 16p, 12L&l; 16 ind rear: 3 l, 10p, 3inc). **Aragua:** Cagua, VZ 99. Maracay, 3 Sep 1926, M. Nunez Tovar, 28F; same locality and collector, 11 Sep 1926, 1F; same locality and collector, 9 Oct 1926, 2F; same locality, 9 May 1927, 1Mgen (H36a), 1 lp [JH]; same locality, 11 May 1927, 1F (H38a); same locality, 27 May 1927, 1Mgen (40a) [JH]; same locality, 10 Jun 1927, 2Mgen (63b+c), 2 lp [JH]; same locality, 20 Aug 1928, R. Hill, 1Mgen [JH]; same locality and collector, Aug 1928, 1Mgen (20), 1Mgen (23) [JH]; same locality and collector, 25 Sep 1928, 3Mgen (38) [JH]; same locality and collector, 1928, 13Mgen [JH]; same locality, 2 May 1929, 3Mgen [JH]; same locality, Jun 1929, 1Mgen (57) [JH]; same locality, 22 Jul 1929, 2Mgen (49) [JH]; same locality, 1929, [R. Hill], 22Mgen [JH]; same locality, 20 Aug 1942, VZK 50, 1F; same locality, VZ 130, 131. Turmero, VZ 45, 336. **Carabobo:** Puerto Cabello, 26 Dec 1938, 1L; same locality, 28 Feb 1941, 1M; same locality, 2 Aug 1941, 1M, 1F; same locality, 1Mgen [JH]. **Cojedes:** San Carlos, 8-15 Jun 1941, 2M, 5F; same locality, 16-22 Jun 1941, 2M, 3F; same locality, VZ 115. Tinaquillo, VZ 119. **Distrito Federal:** Caracas, 2Mgen [JH]. **Monagas:** Caripito, 11 Jun 1935, 1M. **Portuguesa:** Acarigua, 13 Jan 1941, 1Mgen (23) [JH]; same data, VZK 49, 1M, 1F. **Trujillo:** Pampanito, 1-7 Aug 1938, 2M, 7F. **State not specified:** Trinidad, 1Mgen (130-8), 1Mgen (49-11) [JH]. Locality not specified, 15 Jul 1929, [R. Hill], 2Mgen (40) [JH]; 1929, 5Mgen (13) [JH]; 1949, 1Mgen, 2L; no data, 3M, 2F.

9. Anopheles (Nys.) trinkae Faran

Figs. 3, 4, 7, 23, 24

1979. *Anopheles (Nyssorhynchus) trinkae* Faran 1979:26-39. TYPE: *Holotype* male (MEP Acc. 638, coll. 29-9) with associated genitalia and larval and pupal exuviae on slides, 1.5 km S of Puyo (Pastaza), Ecuador, large temporary ground pool, 15 May 1977, Yiau-Min Huang [USNM, 76123].

Anopheles (Nyssorhynchus) nuneztovari in part of Simmons and Aitken (1942:39, 46, 53, 95); Galvao (1943:146); Galvis (1943:88-89); Gabaldon and Cova Garcia (1952:193); Lane (1949: 403; 1953:268-269); Stone, Knight and Starcke (1959:33); Vargas (1959:376, 382); Forattini (1962:396-400); Morales-Ayala (1971:139); Kitzmiller, Kreutzer and Tallaferro (1973:435-455, ?in part); Kreutzer, Kitzmiller and Rabbani (1975:363-364, ?in part); Knight and Stone (1977: 63).

Anopheles nuneztovari in part of Russell, Rozeboom and Stone (1943:37, 47); Foote and Cook (1959:24, 26, 29, 32); Stojanovich, Gorham and Scott (1966b:22, 30, 43); Gorham, Stojanovich and Scott (1967:15, 47, 58; 1973:111, 138, 147-148); Elliott (1968:248-252; 1972:756-763, ?in part).

Anopheles (Nyssorhynchus) goeldii (?) of Cerqueira (1943:19).

FEMALE (fig. 7). Wing: 3.4 mm. Proboscis: 2.2 mm. Palpus: 2.1 mm. Forefemur: 1.5 mm. Abdomen: about 3.0 mm. **Head:** Integument reddish brown to dark brown. Proboscis about 1.4 length of forefemur. Vertex with long, white, spatulate or setiform scales becoming shorter, darker and more cuneate caudolaterally on occiput; occipital scales golden; postoccipital scales reddish brown to brownish black. Apex of palpal segment 2 with a small white band; apex of segment 3 with a large white band; segment 2 with a few, erect, cream to white scales; segment 3 with a cream to white, dorsal or dorsolateral stripe; segment 4 with a moderately large, dark, basal band and a smaller, dark, apical band, usually with a single row of dark scales on ventral surface, not always visible; segment 5 white, occasionally with a few, dark, basal scales extending from apex of 4. **Antenna:** Flagellar segment 1 with numerous, long, oblanceolate scales on dorsomesal and mesal surfaces in apical 0.5; with shorter scales on dorsolateral surface and small obovate scales at base. Flagellar segments 2-

13 each with a basal whorl of about 8,9 long, silver setae. **Thorax:** Integument of scutum reddish tan to dark brown, and extensively pruinose. Anterior promontory area with setiform scales extending a short distance dorsad onto acrostichal line. Prescutellar space moderately large, horseshoe shaped. Pleuron light brown to brown. *Sp* with 7 (3-9) light setae. Upper *stp* with 4 (2-4) long, dark setae in horizontal arc, and about 6-15 cream, obovate scales. Lower *stp* with 1-3 long setae, and a diagonal patch of 5-11 cream, obovate scales. Upper *mep* with 7-9 long, cream setae, and occasionally one or 2 cream, obovate scales. **Legs:** Dark scales reddish brown. Light scales on coxae white. Midfemur with both anteroapical spot and knee spot distinct. Foretarsal segments 2 and 3 with a white band in apical 0.31-0.46 and 0.6-0.9 respectively, usually longer than in *nuneztovari*; segment 4 golden to white in apical 0.3 (0.1-0.5); segment 5 cream to white in about apical 0.5. Dorsal surface of midtibia and midtarsal segments 1,2 and usually 3 with a cream stripe. Midtarsal segments 1-3 with a small, cream, apical band, band largest and most distinct on 2; segment 4 all dark; segment 5 cream in apical 0.3-0.7. Hindtarsal segment 2 with a dark band in basal 0.3-0.4 (0.30-0.43); segment 5 light cream to white in about apical 0.5. **Wing:** Light wing spots white or very light cream. Dark wing spots not usually as extensive as in *nuneztovari*. Vein C humeral light spot about 1.3-2.5 (1.3-4.0) of basal dark spot, usually 2.0 or less of basal dark spot; basal dark spot usually not reaching humeral crossvein; subbasal dark spot equal to or longer than subbasal light spot, often 2.0 of subbasal light spot; subcostal light spot 0.25-0.43 (0.25-0.65) of subcostal dark spot; preapical light spot about 0.31-0.46 of preapical dark spot; apical dark spot moderate and distinct. R presectoral dark spot moderately large; sectoral dark spot relatively small, rarely absent. R_2 preapical dark spot about 0.5 of vein. R_{4+5} subcostal and apical dark spots moderately small. M sectoral dark spot variable, small to large, lighter than dark spots on C, often with interspersed light scales; preapical dark spot not extending onto M_{1+2}. Cu sectoral dark spot moderately large and distinct. Cu_1 subcostal spot usually as large as or larger than preapical dark spot. Vein A subcostal dark spot moderately short to moderately long. Apical light fringe spot moderately small and divided by small dark spots between R_2 and R_3, and R_3 and R_{4+5}; additional light fringe spots as those of *nuneztovari*. **Abdomen:** As that of *nuneztovari*, except caudolateral and sternomedian scale tufts on segments II-VII small.

MALE. Wing: 3.2 mm. Proboscis: 2.5 mm. Forefemur: 1.45 mm. Abdomen: 2.45 mm. Essentially as in female except for sexual characters. **Head:** Palpal segments 2 and 3 with a conspicuous, cream, dorsal stripe; apex of segment 2 and base of segment 3 with a small white band; apex of segment 3 with a moderately broad, white band; segment 4 with a basal and an apical brown band, occasionally with white scales interspersed in small basal band, and usually with a few, white, subapical scales; segment 4 with mediolateral surface predominantly light cream, ventral surface usually with inconspicuous dark scales. **Antenna:** About 0.70-0.75 length of proboscis. Flagellar segment 1 with numerous, long, white, oblanceolate scales on dorsomesal margin. **Legs:** Forefemur about 0.6 length of proboscis. Basal plantar surface of foretarsal segment 5 with about 8 moderately long to long, spiniform setae; longest setae about 0.3 length of segment. Claw on foreleg moderately large, weakly curved, acuminate; submedian tooth 0.25-0.33 length of claw, moderately thin and apically recurved; basal tooth moderately long, heavy and decurved.

MALE GENITALIA (fig. 23). **Segment VIII, Segment IX, Sidepiece, Clasper** and **Dorsal Claspette** essentially the same as those of *nuneztovari*. **Ventral Claspette:** Very similar to that of *nuneztovari* except for the following. Moderately long, 0.40-

0.50 length of sidepiece; apex moderately broad, width at apex 0.43-0.50 (0.38-0.54) length of claspette. Preapical plate moderately small, semicircular to oval, weakly to moderately sclerotized. **Phallosome:** Aedeagus about 0.5 length of sidepiece and 1.00-1.20 (1.00-1.33) length of ventral claspette; apex rounded, about as wide as or slightly wider than long; leaflets not visible on any specimen examined.

PUPA (fig. 23). Abdomen: about 2.5 mm. Trumpet: 0.5 mm. Paddle: 0.75 X 0.55 mm. Only exuviae examined. **Cephalothorax:** Wing cases with moderately pigmented longitudinal stripes. Hair 1-C 2-4 branched; 2,3-C 2,3 branched. Hairs 4,5-C 2-5 forked; 4-C slightly shorter than 5-C. Hair 6-C 2,3 forked (1-3), usually as long as or slightly longer than short branch(es) of 7-C; 7-C 2-4 branched, with one branch about 1.5 length of other branch(es). **Trumpet:** Pinna moderately pigmented; long, about 3.6-4.0 (3.5-4.1) length of meatus; in lateral aspect, not appearing to taper toward apex. Meatal cleft basally rounded. **Metanotum:** Hair 10-C single or double, subequal to 11-C. Hair 11-C 2,3 branched. Hair 12-C 1-3 branched (1-4), about 1.5-2.0 length of 10-C. **Abdomen:** Hair 2-I 4-6 forked (2-6), moderately long to long, branches arising at least 0.20 distad of base. Hair 3-I single, about 0.5-0.9 length of 2-I. Hair 4-I 4-6 branched (3-6), moderately long. Hair 5-I 1-3 branched. Hair 6-I single, long, about 2.0 length of 7-I. Hair 7-I 4-7 branched (3-7). Hair 9-I single, about 0.7 length of 6-I. Hair 0-II 1-3 branched (1-4), small; 0-III-VII moderately developed; 0-III 3-6 branched (2-6); sum of branches of 0-II and 0-III 4-7 (3-9); 0-IV 4, 5 branched (2-5); 0-V 2-5 branched; 0-VI 2,3 branched (2-4); 0-VII 1-3 branched. Hair 1-II,III strongly developed; 1-II 6-10 branched (4-13); 1-III 3-9 branched (1-10); 1-IV-VII single, long, 1.75-2.00 length of segment. Hair 3-IV dendritic, 3-6 branched (1-6), moderately developed; 3-V 3-5 forked (1-5). Hair 5-III 5-7 branched (5-9), strongly developed; 5-IV 2-5 branched (1-5), moderately long, median branch often longer than lateral; 5-V-VII single (1-3 branched), long, subequal to length of segment. Hair 6-II single or double, long, about 2.0 length of 7-II. Hair 7-II 3-7 branched (3-8); 7-III,IV 3-5 branched, short; 7-V 2-4 forked, longer than 7-III,IV; 7-VI,VII single or double, long. Hair 8-III,IV 2-6 branched (2-7); 8-V,VI 2-4 branched (1-4); 8-VII 2-4 branched, moderately short, slightly longer than 8-III-VI. Hair 9-II small, unpigmented, thinner and more pointed than 9-III; 9-III small, less than or occasionally equal to 2.0 length of 9-II; 9-IV heavy, 1.6-3.6 length of 9-III, strongly pigmented; 9-V moderately thin, acuminate, long, 2.5-4.5 (2.5-4.9) length of 9-IV; 9-VI equal to or slightly longer (1.0-1.3) than 9-V; 9-VII 1.05-1.25 (1.05-1.30) length of 9-VI; 9-VIII usually straighter than 9-V-VII, subequal to 9-VII; 9-V-VIII about 0.5 length of segment. Hair 10-III 3,4 forked (2-6), long. Hair 4-VIII 3-5 forked (2-5), about 0.65-0.70 length of 9-VIII. **Terminal Segments:** Male genital lobe large, heavy, with a very prominent mammilliform protuberance. **Paddle:** Large, obovate, emarginate at insertion of hair 1-P. External buttress 0.6 (0.53-0.68) length of paddle, serrated apically. External margin distad of buttress with fine, short, filamentous spicules extending around apex and becoming shorter and fewer along caudal 0.3-0.5 of inner margin. Hair 1-P moderately long; 2-P subequal to 1-P.

LARVA (fig. 24). Head: 0.6 mm. Antenna: 0.25 mm. Anal Saddle: 0.3 mm. **Head:** Heavily pigmented, dull reddish brown. Median tooth of mental plate moderately broad, less than combined width of 2 adjacent teeth from one side, tapering to blunt point. Inner and outer clypeal hairs (2,3-C) single, and simple or with very small barbs; hairs 2-C widely spaced, clypeal index about 1.25; 3-C 0.5-0.8 length of 2-C. Hair 4-C single or 2 forked, long, 0.7-1.0 length of 3-C and usually extending to beyond base of 2-C. Hair 8-C 2 branched (2,3) near base, occasionally forked, length about 2.0 distance separating insertion of 2-C and 3-C. Hair 9-C weakly dendritic, 4-

6 branched (4-7), equal to or slightly longer than 8-C. Hair 12-C 2-5 branched, moderately long. Hair 15-C 2-4 forked. Collar wide dorsomedially, heavily pigmented. **Antenna**: Pigmented as remainder of head. Mesal margin with stout, moderately long spicules; ventral surface with fewer and shorter spicules. Hair 1-A 4-6 branched, short, inserted in basal 0.25 of antenna. **Thorax**: Darkly pigmented, reddish brown. Submedian prothoracic group (1-3-P) with or without hairs 1,2-P sharing a common tubercle; 3-P occasionally arising from the same tubercle as 2-P; palmate hair 1-P with 11-15 (10-18) moderately narrow to narrow, pointed, pigmented, lanceolate leaflets; 2-P 15-19 branched (12-20), 3.0-4.0 length of 1-P. Hair 14-P 7-10 branched (6-11) from a moderately short shaft. Mesothoracic hair 1-M 28-37 branched (26-37). Metathoracic hair 2-T single, moderately long but not reaching posterior margin of thorax. Palmate hair 3-T with 9-13 (9-17) semitransparent, moderately narrow, pointed, lanceolate leaflets. Pleural group spines as those of *nuneztovari*. **Abdomen**: Hair 0-II 1-3 branched, very short, about 0.5 or less length of leaflets of 1-II, inconspicuous; 0-III-VII 1-3 branched (1-4), small to moderately small. Palmate hair 1-I moderately small, with 12-16 (10-17) narrow, semitransparent, spreading, lanceolate leaflets; 1-II-VII with strongly pigmented, moderately narrow, pointed, lanceolate leaflets; 1-II 23-27 branched (19-30); 1-III 24-32 branched; 1-IV 22-29 branched; 1-V 23-30 branched (22-30); 1-VI 21-27 branched (20-30); 1-VII 20-26 branched; 1-II,III,VII slightly shorter than 1-IV-VI. Hair 2-I 2 branched (1-3), very small; 2-II 6,7 branched (4-9), moderately large; 2-III 3-5 branched (2-6), large; 2-IV single or rarely double, about 1.5 length of leaflets of 1-IV; 2-V single, very long. Hair 3-I single (1,2 branched), moderately long. Hair 5-I 3,4 branched (3-5), small; 5-II 6-11 branched (5-11), small. Hair 9-I 5,6 branched (4-6). Hair 13-I,II,III 4-6 (3-7), 7-9 (7-10) and 6-8 (6-9) branched respectively, small; 13-IV 3,4 branched, moderately large, 1.5-2.0 length of leaflets of 1-IV; 13-V 3-5 branched (2-6), very large; 13-VI 8-10 branched (6-10), moderately small. **Spiracular Lobe**: Pecten with about 15-17 teeth; median teeth subequal, occasionally mixed short to moderate, with 2-4 long interspersed; serrations on teeth moderately long. Hair 8-S 3-4 branched (3-5), moderately long, subequal to 9-S; 9-S 3-5 branched. Lateral arm of spiracular apparatus short. **Anal Segment**: Apically with short thin spicules. Saddle reddish brown. Hair 1-X longer than saddle; inserted on saddle near ventral margin of saddle, or rarely on ventral margin at base of indentation. Anal gills longer than saddle.

DISCUSSION. *An. trinkae* can be distinguished from the other species in the Oswaldoi Subgroup in the **female** (except occasionally *nuneztovari* and *rangeli*) by the combination of (1) palpal segment 4 usually with a single ventral row of dark scales, (2) prescutellar space moderately large and horseshoe shaped, (3) foretarsal segment 2 with a large white band in apical 0.31-0.46 and segment 3 with a very large white band in apical 0.6-0.9, (4) foretarsal segment 4 golden to white in apical 0.3 (0.1-0.5), (5) hindtarsal segment 2 with a dark band in basal 0.3-0.4 (0.30-0.43), (6) light wing spots white or very light cream, (7) humeral light spot of vein C 1.3-2.5 (1.3-4.0) length of basal dark spot and (8) subcostal light spot of vein C 0.25-0.43 (0.25-0.65) length of subcostal dark spot; in the **male genitalia** by the same characters as in *nuneztovari* except that (1) ventral claspette long, 0.40-0.50 length of sidepiece and length of aedeagus 1.00-1.20 (1.00-1.33) length of claspette, (2) width of apex of ventral claspette 0.43-0.50 (0.38-0.54) length of claspette and (3) apex of aedeagus rounded, about as wide as or slightly wider than long and without apparent leaflets; in the **pupa** by the combination of (1) hair 7-C with one branch about 1.5 length of shorter branch(es), (2) pinna long, about 3.6-4.0 (3.5-4.1) length of meatus, not appearing to taper toward apex in lateral aspect, (3) hair 11-C 2,3 branched, subequal

to 10-C, and hair 12-C 1-3 branched (1-4), about 1.5-2.0 length of 10-C, (4) hair 2-I 4-6 forked (2-6), moderately long to long, and 3-I about 0.5-0.9 length of 2-I, (5) hair 0-II 1-3 branched (1-4), small, (6) sum of branches of hairs 0-II and 0-III usually less than 8 (3-9) and (7) hair 9-III less than or equal to 2.0 length of 9-II, 9-V 2.5-4.5 (2.5-4.9) length of 9-IV, 9-VII 1.05-1.25 (1.05-1.30) length of 9-VI and 0.5 or more length of segment; and in the larva by the combination of (1) hairs 2,3-C single, and simple or with very small barbs, hairs 2-C widely spaced, clypeal index about 1.25, and 3-C 0.5-0.8 length of 2-C, (2) hair 4-C single or 2 forked, long, 0.7-1.0 length of 3-C, usually extending to beyond base of 2-C, (3) hairs 1,2-P sharing or not sharing a common tubercle, 3-P occasionally arising from same tubercle as 2-P, palmate hair 1-P with 11-15 (10-18) moderately narrow to narrow, pointed, lanceolate leaflets, (4) hair 0-II 1-3 branched, very short, about 0.5 or less length of leaflets of 1-II, inconspicuous, and 0-III-VII 1-4 branched, small to moderately small, (5) hair 13-IV moderately large, 1.5-2.0 length of leaflets of 1-IV and (6) hair 1-X inserted on saddle near ventral margin, or rarely on ventral margin at base of indentation.

Superficially, the larva and male genitalia of *trinkae* appear similar to those of *nuneztovari*, and the pupa is much like that of *rangeli*; however, these stages can readily be distinguished by the characters above. Unfortunately, the key features of the adult female can easily be confused with those of either *nuneztovari* or *rangeli*, and occasionally (when the humeral light spot of the costal vein is greater than 2.0 the length of the basal dark spot) the adults can be mistaken for those of *strodei*. To alleviate this problem, *trinkae* keys out twice in the key to adult females. Because the adult female is the most unreliable stage for identification, careful attention should be given to the male genitalia, larva and pupa for positive species determination.

In the adult female, the wings of specimens from Ecuador differ from those of specimens from Colombia by possession of a proportionally smaller basal dark spot and a larger subcostal light spot on the costal vein. The immatures from Ecuador have 1-5 fewer branches on several of the abdominal hairs than those examined from Colombia, and palmate hair 1-P of the larva from Ecuador has more numerous (14-18) and narrower branches.

Since *rangeli* and *trinkae* occur sympatrically (the immatures have been collected from the same aquatic habitats), it is reasonable to assume that they are genetically isolated. With respect to *nuneztovari* with which *trinkae* shows the greater affinity, it is unknown if *trinkae* and *nuneztovari* are sympatric over any part of their ranges. Therefore, it is impossible to state with absolute certainty that these latter 2 species have evolved sufficiently to maintain separate gene pools if they were to associate in nature. However, after having examined numerous individual rearings and one large progeny rearing of *trinkae* from several different localities, I feel confident that *trinkae* represents a species distinct from both *rangeli* and *nuneztovari*.

BIONOMICS. The data on the bionomics of *trinkae* were extracted from the collection records compiled by Yiau-Min Huang while she was in Ecuador. Additional information came from field notes on one collection from Colombia (COB 42).

The immatures of *trinkae* have been collected in temporary and permanent, small to large ground pools (43%), wheel tracks (19%), ponds and lakes (19%), streamside pools (14%), and ditches (5%). All collections were from either clear or slightly colored fresh water exposed to the sun. Several collections came from the sides of roads and one was from a sugar cane plantation. Many of the ground pools were in grassy areas so that emergent and submerged vegetation was abundant. Green algae frequently occurred in the aquatic habitats. Most of the collections were made near human habitations, usually within 1 km of the nearest house. The collections came

from localities ranging in elevation from 82 to 950 m above sea level, and all were from the eastern slope of the Andes. Huang characterized the general habitat in Ecuador as "scrub with scattered trees." Hueck and Seibert (1972) recognize these regions of Colombia and Ecuador where *trinkae* occurs as the "*Andes septentrionales y Cordilleras*," the "*bosques tropicales y subtropicales, deciduos y mesofiticos de Colombia y Venezuela*" and the "*laderas orientales de los Andes medios.*" The immatures of *trinkae* occurred with 2 other species in the Albimanus Section, *rangeli* and rarely *triannulatus*. Other species that have been found associated with *trinkae* are *Culex (Mel.) bastagarius, Cx. (Mel.) chrysonotum* and *Cx. (Mel.) pilosus*.

Because of the uncertainty of the geographical range of *trinkae* and its morphological similarities with *rangeli* and *nuneztovari*, there is some confusion as to which of these 3 species is referred to in much of the literature on bionomics and distribution. For example, Elliott (1968, 1972) studied the adult behavior of *"nuneztovari"* in 5 localities in Colombia and contrasted this with the behavior of *nuneztovari* in Brazil. There is a possibility, although an unlikely one, that at some of the localities Elliott worked not on the behavior of *nuneztovari* but on the behavior of *trinkae*. Nevertheless, without voucher specimens it is impossible to be certain. Similarly, the distribution records for *nuneztovari* and *rangeli* from Ecuador and parts of Colombia may really refer to *trinkae*. For these reasons many of the references listed in the synonymy of *trinkae* should be considered tentative.

MEDICAL IMPORTANCE. Nothing is known about the vector potential of *trinkae*. As with the literature on bionomics and distribution, many of the references to either *rangeli* or *nuneztovari* concerning transmission of malaria could refer to *trinkae*. Huang (personal communication) states that in the Ecuadorian provinces of Pastaza and Napo, *rangeli* was thought to be the vector of malaria. Likewise, Forattini (1962:393) reports that *rangeli* has been suspected as a carrier of malaria in Ecuador; but in no other country has *rangeli* ever been thought to be important as a vector. Since *trinkae* is often easily confused with *rangeli* in the adult female, it is *possible* that *trinkae* is transmitting malaria in Ecuador.

DISTRIBUTION (fig. 3). *An. trinkae* is known to occur along the eastern slope of the Andes from Villavicencio, Colombia south to Puyo, Ecuador. It is not known how much farther north or south the range of this species extends. Cerqueira (1943: 19) reports *goeldii* from several localities in Bolivia based on examination of adult females and 2 male genitalia. I do not know if this represents *nuneztovari* or *trinkae*.

The following corrections in the "Material Examined" section of the original description of *trinkae* (Faran 1979:33-34) should be noted: (1) collections CV 737, 738 and 739 are *not* progeny rearings, (2) on page 34, line 4, "Acarias, 3 Jun 1949" should be changed to "Acacias, 3 Jun 1947" and listed under the department of Meta in Colombia, (3) Ecuador coll. 26 (page 34, line 5-6) is *not trinkae*, but *rangeli* and (4) Ecuador colls. 32 and 33 (page 34, line 19-21) were made 1.5 km S of Puyo, *not* 4.3 km E Puyo as stated.

Material Examined: 385 specimens: 73 males, 18 male genitalia, 60 females, 127 pupae, 107 larvae; 127 individual rearings: 56 larval, 48 pupal, 23 incomplete; 1 progeny rearing.

COLOMBIA (102 specimens: 12M, 6Mgen, 17F, 24p, 43L&l; 24 ind rear: 3 l, 21 inc; 1 progeny rearing). **Meta:** Acacias, 3 Jun 1947, [CV] 408.1, 1 lp [JH]. Villavicencio, 26 May 1947, L. Rozeboom, CV-P 28 (progeny rearing), 12M, 6Mgen, 15F, 8 lp, 12L; same locality, 14 Feb 1948, [CV] 537.1, 1 lp [JH]; same locality, CV 737, 3 lp, 4L; same locality, CV 738, 4 lp, 3L; same locality, CV 739, 5 lp, 4L; same locality, COB 42.

ECUADOR (283 specimens: 61M, 12Mgen, 43F, 103P&p, 64L&l; 103 ind rear: 53 l, 48p, 2inc). **Napo:** Tena, 11.7 km SW of, 25 May 1977, Y. Huang, coll. 40, 4 pM, 1 pF, 2 lpM, 2 lpF; same

data except 13 km SW of Tena, coll. 43, 1 lpM. Pastaza: Puyo, 5 May 1977, Y. Huang, coll. 4, 1 Mgen, 2 pM, 2 pF, 1L; same data, coll. 5, 2L; same data, coll. 6, 1 pM; same data except 20 km N of Puyo and 6 May, coll. 8, 1Mgen, 1 pM, 1 pF, 1 lpM, 1 lpF; same data except 39 km N of Puyo, coll. 9, 2 pM, 1 pF, 1 lpF, 1 lP; same data except 4 km NE of Puyo and 7 May, coll. 11, 1 pF, 1 lpM, 1 lpF, 1 lP, 2L; same data except 16 km NE of Puyo, coll. 15 1Mgen, 1 lpM, 1 lpF; same data, coll. 16, 1Mgen, 1 pF, 2 lpM, 1 lpF; same data except at Puyo and 8 May, coll. 17, 1Mgen, 5 pM, 3 pF, 3 lpF; same data, coll. 18, 1Mgen, 3 pM, 1 pF, 1 lpF; same data except 31 km W of Puyo and 9 May, coll. 20, 3L; same data except 12 km W of Puyo, coll. 23, 1Mgen, 1M; same data except 1.5 km S of Puyo and 15 May, coll. 29, 1Mgen, 2 pM, 1 pF, 4 lpM, 5 lpF; same data, coll. 30, 1Mgen, 4 pM, 3 pF, 6 lpM, 2 lpF, 1F, 1 l; same data except 4.3 km E of Puyo and 17 May, coll. 31, 1Mgen, 2 pM, 2 lpM, 4 lpF; same data except 1.5 km S of Puyo and 19 May, coll. 32, 1Mgen, 5 pM, 7 lpM, 3 lpF; same data, coll. 33, 1Mgen, 2 pM, 1 pF, 1F.

10. Anopheles (Nys.) nuneztovari Gabaldon

Figs. 3, 4, 7, 25, 26

1940. *Anopheles (Nyssorhynchus) nuneztovari* Gabaldon 1940:5-6. TYPE: *Holotype* male, San Carlos (Cojedes), Venezuela [MDM].

1941. *Anopheles (Nyssorhynchus) goeldii* Rozeboom and Gabaldon 1941:89-91. TYPE: *Holotype* male with associated genitalia slide, labelled "N. gorgasi no. 6," Boa Vista, Rio Tapajos (Para), Brazil, C. H. T. Townsend [USNM].

1945. *Anopheles (Nyssorhynchus) dunhami* Causey 1945:231-234. TYPE: *Holotype* male with associated genitalia slide, Tefe (Amazonas), Brazil, captured on animal bait [USNM, 58036].

Anopheles (Nyssorhynchus) nuneztovari of Gabaldon and Aguilera 1940:68, 69); Gabaldon, Cova Garcia and Lopez (1940:9); Rozeboom and Gabaldon (1941:91-98); Komp (1942:5, 26, 34); Simmons and Aitken (1942:39, 46, 53, 95); Galvao (1943:146); Floch and Abonnenc (1946b: 1, 3-5; 1947:6; 1951:57-58); Gabaldon and Cova Garcia (1946b:98-99; 1952:178, 193, in part); Deane, Causey and Deane (1948:894-897); Senevet (1948a:278; 1948c; 434-438); Vargas (1948: 158; 1959:376, 382, in part); vander Kuyp (1949a:67, 68); Lane (1949:403; 1953:268-269, in part); Rey and Renjifo (1950:534-538); Bejarano (1957:326, 329, 330, 331); Giglioli (1959: 280); Stone, Knight and Starcke (1959:33, in part); Cerqueira (1961:125-126); Fauran (1961: 11); Forattini (1962:396-400, in part); Hamon, Mouchet *et al.* (1970:32-33); Belkin, Schick and Heinemann (1971:6); Morales-Ayala (1971:139); Gabaldon (1972:634-639); Kitzmiller, Kreutzer and Tallaferro (1973:435-455); Kreutzer, Kitzmiller and Rabbani (1975:363-364); Cova Garcia and Sutil O. (1976:27; 1977:23, 48, 64, 84); Cova Garcia, Pulido F. and Amarista M. (1978:157); Kitzmiller (1979:26-31); Faran (1979:26, 27, 30, 31, 32, 33).

Anopheles nuneztovari of Russell, Rozeboom and Stone (1943:37, 47); Floch and Abonnenc (1946a:2); Foote and Cook (1959:24, 26, 29, 32, in part); Gabaldon and Guerrero (1959:433-434); Cova Garcia (1961:37-69, 89-90, 114, 127-128, 152); Vincke and Pant (1962:2-18, 28, 31, 35-42); Stojanovich, Gorham and Scott (1966b:22, 30, 43, in part); Gorham, Stojanovich and Scott (1967:15, 47, 58; 1973:111, 138, 147-148, in part); Elliott (1968:248-252; 1972:756-763, ?in part); Cova Garcia and Sutil O. (1975a:24; 1975b:213); Perez de Valderrama and Scorza (1976:212-220); Scorza, Tallaferro and Rubiano (1976:129-130); Panday (1977:728-737; 1979b:57); Panday and Panday-Verheuvel (1979:36).

Anopheles nunes-tovari (!) of Mattos and Xavier (1965:273).

Anopheles (Nyssorhynchus) dunhami of Deane, Causey and Deane (1948:897); Senevet (1948a: 278); Lane (1953:268); Elliott (1972:758, 762).

Anopheles (Nyssorhynchus) goeldii of Gabaldon and Aguilera (1940:72); Gabaldon, Aguilera and Arevalo (1941:60); Galvao and Damasceno (1942:122-123); Simmons and Aitken (1942:39, 46, 53, 61, 94-95); Cerqueira (1943:19, ?); Galvao (1943:149, 151); Causey, Deane and Deane (1944:2, 5, 6; 1946:27); Floch and Abonnenc (1944b:2); Lane (1944:263; 1949:403); Deane, L. M., Causey and Deane (1946:6, 7, 9, 10, 12); Deane, M. P., Causey and Deane (1946:42, 45); Senevet (1948a:278); Levi-Castillo (1949:11, 15, 28, 67).

Anopheles goeldii of Russell, Rozeboom and Stone (1943:37, 42, 46).

Anopheles (Nyssorhynchus) tarsimaculatus in part of Shannon (1933:124-132).
Nyssorhynchus tarsimaculatus in part of Townsend (1933b:7-12).
Nyssorhynchus albimanus in part (?) of Townsend (1934:493-494).
Anopheles (Nyssorhynchus) gorgasi in part of Townsend (1933a:101-102).
Anopheles (Nyssorhynchus) sp, *goeldii* series of Bruce, Knigin, Yolles and Graham (1943:442).
Cellia albimana in part (?) of Neiva (1909:69-77).

FEMALE (fig. 7). Wing: 3.2 mm. Proboscis: 2.1 mm. Palpus: about 2.1 mm. Forefemur: 1.5 mm. Abdomen: about 2.9 mm. Moderate size. Integument dark brown to very dark brown, with considerable contrast between light and dark regions. **Head:** Proboscis about 1.4 length of forefemur. Palpal segments 1 and 2 and base of 3 with predominantly dark, outstanding scales; segments 2 and 3 with a small, white, apical band and a small to moderate, white, apical band respectively; segments 2 and 3 with or without a dorsal or lateral speckling of light scales; segment 4 with base and usually apex dark scaled, usually ventral surface with row of dark scales; segment 5 usually completely white, occasionally with a few, dark, basal scales. **Antenna:** Flagellar segment 1 with numerous, white, oblanceolate setae distally on dorsomesal and mesal surfaces; basally with shorter obovate scales. Flagellar segments 2-13 each with a basal whorl of about 8-10 tan to silver setae. **Thorax:** Anterior promontory area with long, white, setiform scales usually not extending far dorsad onto acrostichal line. Prescutellar space subtriangular or horseshoe shaped. *Sp* with 4-8 moderately long, light setae and a few obovate scales. Upper *stp* with 3-5 long, dark setae above a patch of light scales in horizontal arc. Lower *stp* with 1,2 long setae and a diagonal patch of light scales. Upper *mep* with 7 (5-9) long, cream to brown setae; scales absent. **Legs:** Light scales on coxae white to pale cream. Midfemur with both anteroapical spot and knee spot distinct. Foretarsal segments 2 and 3 cream to white in apical 0.2-0.4 (0.15-0.44) and 0.55 (0.40-0.75) respectively; segment 4 with a small, cream, apical band; segment 5 golden to cream in about apical 0.5. Midtarsal segments 1 and 2 with a small, golden, apical band; segments 3 and 4 all dark, occasionally with a few, lighter, apical scales; segment 5 with apical 0.25-0.50 lighter than base. Hindtarsal segment 2 brown to dark brown in basal 0.25-0.32 (0.20-0.32); segment 5 dark in about basal 0.5, apical 0.5 cream to white. **Wing:** Light wing spots usually cream, not white, at least on anterior veins. Large dark wing spots distinct. Vein C humeral light spot about 0.7-1.3 (0.7-1.7) of basal dark spot; basal dark spot often extending to humeral crossvein; subbasal dark spot usually longer than subbasal light spot; sectoral dark spot occasionally absent; subcostal light spot 0.20-0.55 of subcostal dark spot, usually less than 0.5; preapical light spot about 0.36 (0.2-0.5) of preapical dark spot; apical dark spot moderately long and distinct. R presectoral dark spot moderately large, usually much larger than sectoral dark spot. R_2 preapical dark spot large, about 0.3-0.5 of R_2. R_{4+5} subcostal and apical dark spots moderate, very dark and conspicuous. M sectoral dark spot variable, moderately long to long, 0.25-0.70 of M; preapical dark spot not extending onto M_{1+2}. Dark spots of M_{1+2} and M_{3+4} very dark and conspicuous. Cu_1 subcostal, preapical and apical, and Cu_2 preapical dark spots moderately long and distinct. Vein A subcostal dark spot moderately long, about 0.2 (0.15-0.30) of A. Apical light fringe spot moderately small (to large in Venezuelan specimens) and divided or undivided by a few dark scales between R_2 and R_3, and R_3 and R_{4+5}; additional, and in most cases conspicuous, small, light fringe spots at apices of R_{4+5}, M_{1+2}, Cu_1, Cu_2 and A; a moderately conspicuous to inconspicuous, light fringe spot between base of wing and A. **Abdomen:** Sternite I with a few, moderately long to long setae, longer setae sternomedially and shorter setae laterally; with occasionally a few, scattered, inconspicuous, light,

lanceolate to obovate scales, usually only visible on slide preparations. Caudolateral and sternomedian dark scale tufts on segments II-VII with scales conspicuous, large and broad.

MALE. Wing: 3.4 mm. Proboscis: 2.75 mm. Forefemur: 1.6 mm. Abdomen: about 3.2 mm. Essentially as in female except for sexual characters. **Head**: Palpal segments 2 and 3 with a stripe of light scales along dorsal surface; segment 4 with a basal and an apical, white band, and a subbasal and a subapical, smaller, dark band; mediolateral surface of segment 4 largely speckled with cream scales with a few intermingled dark scales; ventral surface of 4 inconspicuously dark scaled. **Antenna**: About 0.75 length of proboscis. Flagellar segment 1 with conspicuous, long, white, lanceolate, dorsomesal scales. **Legs**: Forefemur about 0.6 length of proboscis. Basal plantar surface of foretarsal segment 5 with about 7 long, stout, spiniform setae. Claw on foreleg long, weakly curved; submedian tooth long, about 0.5 length of claw, and moderately thick at base, tapering to a blunt, very slightly recurved tip; basal tooth thick, strongly decurved and blunt, subequal to submedian tooth.

MALE GENITALIA (fig. 25). **Segment VIII**: Tergite and sternite with narrow to moderately broad, obovate scales. Tergite usually with darker scales on caudal and caudolateral margins. Sternite with median dark scales and lateral, cream to white scales. **Segment IX**: Sternite long, about 0.25 length of sidepiece, subtrapezoidal. Anterior apodeme moderately short, subrectangular to subtriangular, extending across anterior border of sternite. **Sidepiece**: Tergal surface with 4,5 long, submedian tergomedial bristles and one subapicolateral bristle; bristles mesad of tergomedial bristles moderately long. Parabasal spine long, at least 2.0 length of its tubercle. Basal apodeme moderately thick, pointed, long, about 0.20-0.25 length of sidepiece. Longer, more dorsal accessory spine slightly less than 0.5 length of sidepiece; more ventral spine about 0.75 of longer spine. Internal spine subequal to shorter accessory spine, apically retrorse. **Clasper**: Spiniform moderately developed, acuminate, subequal to seta *b*. **Dorsal Claspette**: Pedicel long, moderately narrow to moderately broad; base rounded, curved mesad; internal apodeme conspicuous. Leaflets broad and less than 0.5 (0.37-0.47) length of claspette; dorsal leaflet with prominent, fairly large basomesal projection. **Ventral Claspette**: Moderately short, 0.25-0.40 length of sidepiece; lateral margins not tapering appreciably medially toward apex; apex broad, width at apex about 0.50-0.60 (0.50-0.64) length of claspette. Basal lobule moderately expanded laterally, not appreciably wider than apex of claspette; setae along basal margin moderately long, slightly longer than to 1.5 width of aedeagus but never 2.0 width; setae distributed evenly over basal surface and radiating in different directions; no concentration of long setae on basomesal margin directed caudad toward vertex of mesal cleft. Ventral and lateral surfaces (exclusive of basal lobule) with short setae about 0.5 width of aedeagus, setae extending to or nearly to apex. Depending on angle of observation, apex of ventral claspette appearing either truncate or with a variously developed median sulcus with gradual to steeply sloping sides; apex with abruptly angled, rounded, sclerotized, lateral margins. Preapical plate moderately small, semicircular to oval, weakly to moderately heavily sclerotized, located about 0.2 length of claspette basad of apex. Transparent membranous area basad of preapical plate as in *rangeli* except slightly more pointed at vertex. Refringent structure inconspicuous to moderately conspicuous, in shape of inverted V, with rounded vertex; lateral arms occasionally apparent. **Phallosome**: Aedeagus about 0.5 length of sidepiece and 1.33-1.60 (1.31-1.89) length of ventral claspette; apex moderately rounded, usually wider than long; with or without very small, membranous, nonserrated, pointed, basolaterally directed leaflets.

PUPA (fig. 25). Abdomen: about 2.8 mm. Trumpet: 0.45 mm. Paddle: 0.75 X 0.55 mm. Only exuviae examined. **Cephalothorax**: Moderately to heavily pigmented. Wing cases with heavily sclerotized stripes. Hairs 1-3-C 2,3 branched (2-4); 2-C shorter than 1,3-C. Hair 4-C 2-4 branched, about 0.7 length of 5-C. Hair 5-C 2,3 branched (2-4). Hair 6-C 2 forked (2,3) 0.25-0.70 from base, moderately short, slightly longer than 5-C. Hair 7-C 2,3 branched (1-3) near base, long, subequal to 6-C, one branch about 1.25 length of shorter branch(es). **Trumpet**: Pinna moderately pigmented; moderately long, about 3.5-4.5 (3.0-4.8) length of meatus; in lateral aspect, appearing broad medially and tapered toward apex. Meatal cleft long and basally rounded. **Metanotum**: Hair 10-C 1-3 branched, less than 0.5 length of 12-C and about 0.8 length of 11-C. Hair 11-C 3-5 branched (2-7) usually near base. Hair 12-C 1-3 branched, very long. **Abdomen**: Hair 2-I dendritic, 5-8 branched (3-9) near base, large, with long branches; 3-I single or double, long, 0.7-1.0 length of 2-I. Hair 4-I 4-6 branched (4-7), moderately short. Hair 5-I 1-3 branched, long. Hair 6-I single or occasionally double, very long, usually more than 2.0 length of 7-I. Hair 7-I 3-5 branched (2-5) near base. Hair 9-I single or rarely double, about 0.7 length of 6-I. Hair 0-II-V 4-7 branched (3-8), moderately large; 0-VI,VII 2-5 branched, moderately short. Hair 1-II,III 6-8 (6-13) and 5-9 (4-11) branched respectively, strongly developed, median branches longer than lateral; 1-IV-VII very long, 1.6-2.0 length of segment. Hair 3-IV 4-6 branched (3-9) near base, moderately large; 3-V 2-4 forked (1-4). Hair 5-III,IV 4-11 and 3-5 (2-5) branched respectively, strongly developed; 5-V-VII single, as long as or slightly longer than segment. Hair 6-II 1-3 branched, 1.4-1.8 length of 7-II or occasionally longer; 6-III 1-3 branched, long. Hair 7-II 3-5 branched (2-6); 7-III 3-5 branched (1-6); 7-IV 4-6 branched (2-6); 7-V 2-4 branched, longer than 7-III,IV; 7-VI,VII single or rarely double, long. Hair 8-III,VII 3-5 branched (2-5); 8-IV 3 branched (2-6); 8-V,VI 2-3 branched (2-4). Hair 9-II small, unpigmented; 9-III pointed, almost always less than 2.0 length of 9-II, pigmented; 9-IV thick, pointed, usually 2.0 or more of 9-III; 9-V-VIII thick, curved, acuminate, short, about 0.33 length of segment; 9-V,VI slightly shorter than 9-VII,VIII; 9-VIII straighter than 9-V-VII. Hair 10-III 3-5 branched (2-5), moderately long. Hair 4-VIII 3,4 branched (3-5), subequal to 9-VIII. **Terminal Segments**: Male genital lobe as in *aquasalis*, with a very prominent mammilliform protuberance. **Paddle**: Obovate with moderately broad, rounded apex, weakly emarginate at insertion of hair 1-P. External buttress 0.65-0.75 length of paddle, with distinct spiculiform serrations near apex. Spicules on external margin conspicuous, continuing around apex and along inner margin to about 0.3 from base. Hair 1-P single, moderately long; 2-P 2,3 branched (1-3), about 0.5 length of 1-P.

LARVA (fig. 26). Head: 0.6 mm. Antenna: 0.3 mm. Anal Saddle: 0.3 mm. **Head**: Moderately to very heavily pigmented. Median tooth of mental plate blunt, as broad as combined widths of 2 adjacent teeth from one side. Inner and outer clypeal hairs (2,3-C) single and barbed in apical 0.5-0.7, barbs usually longer on 3-C; hairs 2-C widely spaced, clypeal index 1.0-1.3; 3-C slightly shorter (0.75-0.90) than 2-C. Hair 4-C single or 2-4 forked, moderately long, 0.30-0.60 length of 3-C and usually extending to near or beyond base of 2-C. Hair 8-C 3-5 branched (2-7) near base, moderately large, length greater than 2.0 distance separating insertion of hairs 2-C and 3-C. Hair 9-C dendritic, 5-8 branched (4-8), slightly longer than 8-C. Hair 12-C 3,4 branched (2-5), moderately long. Hair 15-C 2-6 branched, moderately long. Collar wide dorsomedially, heavily pigmented. **Antenna**: Usually lighter than remainder of head. Mesal margin with moderately short, thin spicules; fewer and shorter spicules on ventral surface. Hair 1-A 5-7 branched (5-8), short, about as long as width of

antenna at point of insertion, inserted about 0.25 from base of antenna. **Thorax:** Darkly pigmented. Submedian prothoracic group (1-3-P) with or without 1,2-P sharing a common sclerotized tubercle, often base of 1-P not sclerotized; palmate hair 1-P with 9-12 (9-15) pigmented, moderately broad leaflets; 2-P 12-18 branched (11-20); 3-P not sharing tubercle with 2-P. Hair 14-P 6-9 branched (5-11) from a moderately short, flattened shaft. Mesothoracic hair 1-M 27-31 branched (25-35). Metathoracic hair 2-T 1-3 forked, moderately long. Palmate hair 3-T with 11-15 (9-18) semitransparent, moderately long, narrow leaflets. Mesothoracic pleural group spine large, subequal to prothoracic spine; metathoracic spine smallest. **Abdomen:** Hair 0-II-VII 5-8 branched (4-10), large, very conspicuous; 0-II subequal to or longer than length of leaflets of 1-II. Palmate hair 1-I with 13-16 semitransparent, spreading, narrow, pointed leaflets; 1-III-VI with 23-31 long, pointed, moderately narrow to moderately broad leaflets; 1-II,VII with 20-27 leaflets, slightly shorter than 1-III-VI. Hair 2-I 3-5 branched (2-6), small; 2-II 6-9 branched (4-10), large; 2-III 4,5 branched (3-6), large; 2-IV single or occasionally double, moderately long; 2-V single, very long. Hair 3-I single or occasionally double, moderately long. Hair 5-I 4,5 branched (3-5), moderately small; 5-II 8-11 branched (6-13), small. Hair 9-I 5-7 branched (4-7). Hair 13-I 5-7 branched (4-8), small; 13-II,III 8-10 branched (7-11), small; 13-IV 4-6 branched (3-6), moderate, equal to or slightly longer than leaflets of 1-IV; 13-V 4-6 branched (4-7), large; 13-VI 7-10 branched (6-10), moderately small. **Spiracular Lobe:** Pecten with 15-19 (14-19) teeth; length of teeth highly variable, usually median teeth mixed moderate and short, except for one long tooth in middle; dorsally pecten usually terminating with 2,3 long teeth; serrations on teeth moderately long, conspicuous. Hairs 8,9-S 3-6 branched; 8-S subequal to 9-S. Lateral arm of spiracular apparatus short, directed caudolaterally. **Anal Segment:** Covered with short thin spicules. Saddle dark reddish brown, with irregular ventral margin. Hair 1-X longer than saddle; inserted on saddle near ventral margin, on ventral margin at base of indentation, or just ventrad of ventral margin. Anal gills subequal to length of saddle.

DISCUSSION. *An. nuneztovari* can be distinguished from the other species in the Oswaldoi Group in the **female** (except occasionally *rangeli* and often *trinkae*) by the combination of (1) integument dark brown to very dark brown with considerable contrast between light and dark regions, and light wing spots usually cream at least on anterior veins, (2) usually ventral surface of palpal segment 4 with row of dark scales, (3) foretarsal segment 2 with a light band in apical 0.2-0.4 (0.15-0.44) and segment 3 with a light band in apical 0.55 (0.40-0.75), (4) foretarsal segment 4 with a small, apical, cream band, (5) hindtarsal segment 2 with a dark band in basal 0.25-0.32 (0.20-0.32), (6) large dark wing spots distinct, humeral light spot of vein C usually smaller than in *trinkae,* 0.7-1.3 (0.7-1.7) of basal dark spot, (7) subbasal dark spot of vein C usually longer than subbasal light spot, (8) subcostal light spot of vein C 0.20-0.55 of subcostal dark spot, usually less than 0.5 and (9) subcostal and apical dark spots of vein R_{4+5} and dark spots of M_{1+2} and M_{3+4} all very dark and conspicuous; in the **male genitalia** by the combination of (1) ventral claspette moderately short, 0.25-0.40 length of sidepiece, width at apex about 0.50-0.60 (0.50-0.64) length of claspette, and apex appearing either truncate or with median sulcus, (2) basal lobule moderately expanded laterally, setae along basal margin moderately long, slightly longer than to 1.5 width of aedeagus but never 2.0 width, setae distributed evenly over basal surface and radiating in different directions, not concentrated along basomesal margin as in *rangeli*, (3) ventral and lateral surfaces of ventral claspette (exclusive of basal lobule) with short setae about 0.5 width of aedeagus, (4) preapical plate semicircular to oval, and weakly to moderately heavily sclerotized and (5) length of aedeagus

1.33-1.60 (1.31-1.89) length of ventral claspette, apex of aedeagus usually wider than long, moderately rounded and with or without very small, membranous leaflets; in the **pupa** by the combination of (1) hair 7-C subequal to 6-C, one branch about 1.25 length of other branch(es), (2) pinna moderately long, about 3.5-4.5 (3.0-4.8) length of meatus, appearing broad medially and tapered toward apex in lateral aspect, (3) hair 10-C less than 0.5 length of 12-C and about 0.8 length of 11-C, (4) hair 2-I dendritic, 5-8 branched (3-9), large, 3-I 0.7-1.0 length of 2-I, (5) hair 6-I usually more than 2.0 length of 7-I and (6) hair 9-II small, unpigmented, 9-III pointed, almost always less than 2.0 length of 9-II, pigmented, 9-IV usually 2.0 or more length of 9-III, and 9-V-VIII thick, curved, acuminate, short, about 0.33 length of segment; and in the **larva** by the combination of (1) hairs 2,3-C single and barbed, hairs 2-C widely spaced, clypeal index 1.0-1.3, (2) hair 3-C 0.75-0.90 length of 2-C, (3) hair 4-C single or 2-4 forked, moderately long, 0.30-0.60 length of 3-C, usually extending to near or beyond base of 2-C, (4) palmate hair 1-P with 9-12 (9-15) pigmented, moderately broad leaflets, (5) hair 0-II-VII 5-8 branched (4-10), large, very conspicuous, 0-II subequal to or longer than leaflets of 1-II, (6) hair 13-IV 4-6 branched (3-6), moderate, equal to or slightly longer than leaflets of 1-IV, 13-V 4-6 branched (4-7) and (7) hair 1-X inserted on saddle near ventral margin, on ventral margin at base of indentation, or just ventrad of ventral margin.

In the specimens from Venezuela as compared to elsewhere, the immatures usually have hairs with somewhat fewer branches, while the adults have the light apical band on foretarsal segment 2 usually wider, the apical light fringe spot and subcostal light spot on vein C usually larger, and the sectoral dark spot on vein C often absent.

An. nuneztovari and *trinkae* are sister species based on shared derived (synapomorphic) characters in the larvae and male genitalia, and together these species form the sister group of *rangeli*. The male genitalia of the 2 former species are so similar that it is possible to distinguish them only when comparing the lengths of the aedeagi relative to the lengths of their corresponding ventral claspettes. The larvae of *nuneztovari* and *trinkae* share the derived feature of the long hair 4-C and are easily separated by the characters enumerated in the key. Unfortunately, the adult females of all 3 of the above species can sometimes be confused due to intraspecific variability and the paucity of reliable differentiating characters. It is very important when there is some doubt, to examine as many specimens as possible, and to correlate all the characters given in the key.

Based on the male genitalia, Gabaldon described *nuneztovari* from San Carlos, Cojedes, Venezuela in 1940. Rozeboom and Gabaldon (1941) described a similar form of *Nyssorhynchus* from the Amazon basin which they called *goeldii* and stated that *goeldii* and *nuneztovari* were distinguished by differences in the "mesosome" (phallosome) and the "fused dorsal lobes" (ventral claspettes) of the male genitalia. Again based on the apex of the mesosome of the male genitalia, which was said to be without leaflets and broader than in *goeldii*, Causey (1945) described *dunhami* from Tefe in the upper Amazon basin. Floch and Abonnenc (1946b:1) synonymized *goeldii* with *nuneztovari* after comparison of the male genitalia of *goeldii* with several specimens of *nuneztovari*. Lane in his "Neotropical Culicidae" (1953:268) listed *dunhami* as a synonym of *nuneztovari*, so *nuneztovari* became the valid name for the above 3 nominal species.

Elliott (1968:248-252) studied the relationship of the indoor biting activity of *nuneztovari* with regard to human activity in 5 Colombian localities. In 1972 (p 758), Elliott stated that 2 species were confused under the name *nuneztovari*: "In Brazil and Surinam, in Ecuador, and almost certainly in Bolivia and Peru, there is a species

that bites at sunset, and therefore mainly outside houses and preferentially on animals. In northern Colombia and western Venezuela, a closely similar but slightly smaller species bites later in the night, and therefore mainly inside houses." According to Elliott, the possible sympatry of the 2 types in Venezuela and Colombia could have lead to confusion, such that the behavior of the nonvector has been attributed to the vector of malaria in this region. Whether or not Elliott was dealing only with *nuneztovari*, or with *nuneztovari* and *trinkae*, is not known to me.

Although I have not examined the holotype of *nuneztovari*, I have studied the holotype and several paratypes of *goeldii*, the holotype of *dunhami*, and numerous other specimens from Brazil (Amazonas, Para, Rondonia), the Guianas and Venezuela (Aragua, Zulia, Barinas and Cojedes, including 3 male genitalia from the type locality of *nuneztovari*). I have been unable to find any apparently significant differences among any of these specimens and therefore am considering them to be all *nuneztovari*. However, when more information and material becomes available which can be correlated with the morphological differences I have observed and with those behavioral and chromosomal differences reported by others, it is possible that *goeldii* will be resurrected to specific status.

Kitzmiller, Kreutzer and Tallaferro (1973) studied the salivary chromosomes of *nuneztovari* from 3 populations in Brazil, 2 in western Venezuela and one in northern Colombia. They reported that the Colombian and Venezuelan populations consistently differ from the Brazilian populations by a homozygous inversion in the X-chromosome. They stated that the 2 "types" could be easily distinguished by this fixed homozygous inversion. Also, they compared the chromosomal banding patterns of *nuneztovari* with those of *An. (Nys.) darlingi, aquasalis, albimanus* and later (Kreutzer, Kitzmiller and Rabbani 1975:363-364) *An. (Nys.) argyritarsis*. The similarities between *nuneztovari* and *albimanus* were not as great as between *darlingi* and *aquasalis*. The autosomal homologies were strongest between *aquasalis* and *nuneztovari*, and *aquasalis* shared more homologous regions with *argyritarsis* than did *nuneztovari*.

BIONOMICS. The immatures of *nuneztovari* are found in open marshy areas, ponds and lakes often in the grassy margins, small or large permanent or temporary ground pools, animal or wheel tracks, and along stream margins; they are found in fresh water that is in full sun or partial shade. Aquatic vegetation may be abundant and algae are often present. *An. nuneztovari* is collected in the interior or in clearings within the forest, and in areas of secondary growth (scrub) such as around villages. In the laboratory, the larvae cannot tolerate a sodium chloride concentration of even 0.5%. *An. triannulatus* and especially *ininii* are frequently associated with this species in ponds and lakes; occasionally *oswaldoi* is also collected with *nuneztovari*. Other species associated with *nuneztovari* are *Culex (Mel.) bastagarius, Cx. (Mel.) dunni* group, *Cx. (Mel.) ensiformis, Cx. (Mel.) rachoui* (?), *Cx. (Mel.) zeteki* group, *Cx. (Cux.) coronator* group and *Uranotaenia (Ura.) geometrica*.

Considerable work has been done on the adult behavior of *nuneztovari* from Colombia by Elliott (1968:248-252; 1972) which I will briefly summarize. Elliott studied the relationship between the biting activity indoors and outdoors with regard to human activity in 5 localities in Colombia: El Pescado, Rio Fuego, Puerto Reyes, Turbo and Las Aranas. At Rio Fuego he found the months *nuneztovari* was most abundant were April and May; biting occurred the first 2 hours of the evening outdoors, the next 2 hours indoors and over the entire night with an outdoor to indoor ratio of 1:1. At all the other stations he reported the same pattern. In the months of highest density, biting reached a peak shortly before midnight, indoor biting being

equal to or slightly greater than outdoor. In the months of low density, biting peaked an hour or so earlier than during the high density season, biting being slightly greater outdoors than indoors. He states, "there are indications of a negative correlation between the seasonal density and the proportion of outdoor biting . . ." *An. nuneztovari* in Colombia also showed earlier peaks of activity during the light phases of the moon (Elliott 1972:756). Biting activity was unimodal, not showing early evening or morning peaks. *An. nuneztovari* collected outside in resting places equidistant between animals and houses had a human blood index (HBI) of less than 10%. This species usually rests one meter high or less on the walls inside houses, although occasionally (15%) above this height. Because it feeds inside while most people sleep, it is effectively endophilic.

In 3 months (September to November), Rey and Renjifo (1950) collected 3301 anophelines inside houses and in stables in northern Colombia of which 14.4% were identified with certainty as *nuneztovari* and 67.2% as a mixture of *nuneztovari* and *rangeli.* Of the total of 2722 *nuneztovari* and *rangeli* collected, a study of the eggs from 501 of these females revealed that 476, or 95%, were *nuneztovari.* These authors therefore concluded that the majority of females collected inside were actually *nuneztovari.* The principal time *nuneztovari* entered houses was 2200-2400 h.

Gabaldon (1972:635) stated that before spraying the inside walls of houses with DDT in Venezuela, *nuneztovari* was very endophilic, remaining in the houses and resting on the walls and ceiling after taking a blood meal. Spraying of insecticides, however, selected for "intense exophilism." *An. nuneztovari* is still anthropophilic, but, immediately after taking a blood meal, the females leave the house, thereby avoiding a lethal dose of insecticide by not resting on the walls. Gabaldon stated that, even though strongly exophilic, "*A. nuneztovari* in Venezuela, for example, maintains a human blood preference of around 80%, and a man-biting rate of more than 100 during a night indoors." Gabaldon believes that this intense exophilism has been largely responsible for refractory malaria in Venezuela.

Panday (1977:728-737) reported a unimodal distribution of biting activity of *nuneztovari* in Suriname occurring 1800-1900 h, the peak beginning at the termination of twilight (1830 h, sunset was fixed at 1800 h). His recent surveys showed a tremendous increase in the numbers of *nuneztovari* in the "hilly and mountainous forest region" in the interior of Suriname. He believes that to a large extent this increase is due to the construction of Afobaka dam, which has been responsible for the formation of Brokopondo storage lake. From daily collections 15 m inside the forest near the lake, 1800-1900 h, on human bait, July-December 1976, 13,824 females were captured. He stated that "*An. nuneztovari* seems to be the dominant anthropophilic *Anopheles* species" in this region and implicated it as the primary vector of *Plasmodium falciparum.* In laboratory studies on the life cycle of this species, Panday found the egg stage lasts one day, larval stages 7 days and pupal stage one day. The first gonadotrophic cycle requires 5 days, whereas all subsequent cycles require 4 days. The maximum parous rate during the above period was 0.69 with a minimum of 0.14 and a mean of 0.34. He also reported that grassy vegetation seems essential for oviposition. Contrary to what is observed in Venezuela, the adults are susceptible to DDT, dieldrin and malathion.

In Para, Brazil, the females seem to be primarily exophagous, unlike *nuneztovari* in Colombia and Venezuela. Deane, Causey and Deane (1948:895-896) reported that of the 21,967 females of *nuneztovari* collected, only 411 or 1.9% were captured inside houses. In 29 hours collecting inside houses in Maraba, Para, one specimen of *nuneztovari* was found; however, in 31 hours outside on animal bait, 978 females

were captured. Feeding preference studies, comparing a horse and a man as bait, indicate that *nuneztovari* feeds freely on man outdoors. Recent studies, conducted from March 1975 to April 1976 by the U. S. Army Medical Research Unit-Belem (USAMRU) in Palestina (100 km SW of Maraba, Para), also indicate that *nuneztovari* is exophilic and most active at sunset. In this region, *nuneztovari* was the dominant anopheline captured in landing and resting collections.

Scorza, Tallaferro and Rubiano (1976:130-131) conducted precipitin tests to determine what hosts females of *nuneztovari* were feeding on in Santa Barbara, Barinas, Venezuela. Of those blood fed, 75% tested positive for the immune sera used in this study and 25% did not react; 74.2% (289) had fed on cattle, 13% (50) on dogs, 7.4% (29) on humans, 4.5% (19) on chickens, 0.7% (3) on horses, 0.2% (1) on cats and none on pigs.

MEDICAL IMPORTANCE. *An. nuneztovari* is a major vector of malaria in western Venezuela and northern Colombia. It was first discovered naturally infected with *Plasmodium* sp by Rey and Renjifo (1950). Gabaldon and Guerrero (1959:434) stated that in some areas where *nuneztovari* was transmitting malaria the spleen indices were close to 100%. They also found that in areas not close to the jungle, malaria disappeared when the local inhabitants took chloroquine; however, in districts near forests chloroquine failed to stop transmission. Hamon, Mouchet *et al.* (1970:32-33) also indicated that the importance of *nuneztovari* depends on the amount and density of vegetation around houses. Vector density is reduced in areas where vegetation has been cleared around houses.

In Suriname, Panday (1977:728-737) reported that *nuneztovari* may have been the principal vector of *Plasmodium falciparum* in recent epidemics. He stated that *An. (Nys.) darlingi,* thought to be the primary vector of malignant malaria, has not been captured in the epidemic regions. In these same areas *nuneztovari* has been collected in great numbers. Since *nuneztovari* is the dominant anthropophilic mosquito and has a fairly high parous rate (mean 0.34), Panday states that this species in the Brownsweg area, "may well act as a good vector of pathogens."

An. nuneztovari has not been reported to be an important vector of malaria in the Amazon basin. Deane, Causey and Deane (1948) dissected 405 adults and found all to be negative for *Plasmodium* sp. Recently, in the Maraba area of Para, Brazil, Dixon and Roberts (personal communication) found both *P. falciparum* and *P. vivax* in the local human population in the absence of recognized primary or secondary vectors. Dixon and Roberts stated, "In August 1975, 4 teenage members of a colonist family in Gleba 36 [a small village] became ill with malaria (3 with falciparum and 1 vivax; all denied recent travel from their lote)." Furthermore, a high percentage of the transient workers who are initially negative for *Plasmodium* sp, contract malaria after working a short time in this region. As in Suriname, *darlingi*, thought to be the vector of malaria along waterways, is not collected in the Maraba area. Although *nuneztovari* occurs in high densities in this region, the entomological and/or epidemiological data are insufficient to implicate this species as a vector. Several other anophelines have been collected in this general locality, such as *ininii, oswaldoi, strodei, triannulatus, ?aquasalis, An. (Nys.) allopha, An. (Nys.) braziliensis, An. (Ano.) ?mattogrossensis* and *An. (Ano.)* sp. None of these species has been considered a primary vector with the exception of *?aquasalis* which occurs in relatively low numbers. For these reasons, *nuneztovari*, a known or suspected vector in other countries of northern South America, should be carefully investigated as a potential vector in Para, Brazil.

Scorza, Tallaferro and Rubiano (1976:129-136) attempted to infect *nuneztovari*

experimentally with *P. falciparum* and *P. vivax* and found that this species is highly susceptible to the former. The results for *P. vivax* were unexpected. Mosquitoes that had shown a high rate of early infection with *P. vivax* (55.9% with young oocysts) when dissected after 20 days had neither mature oocysts nor sporozoites. They explained this by the fact that the patient used to infect the mosquitoes had ingested the sporocide pyrimethamine which resulted in suppression of the development of *P. vivax*. The strain of *P. falciparum* used in the experiment was resistant to chloroquine and pyrimethamine.

DISTRIBUTION (fig. 3). *An. nuneztovari* occurs throughout much of the Amazon basin; it is also found in the Guianas, northern Colombia and Venezuela, and eastern Panama. It is not known how far south it occurs in Colombia and Venezuela, nor how far west in the Amazon basin. Cerqueira's report (1943:19) of *goeldii* from Bolivia may refer to *trinkae* or *nuneztovari*.

Material Examined: 529 specimens: 106 males, 61 male genitalia, 153 females, 115 pupae, 94 larvae; 114 individual rearings: 70 larval, 42 pupal, 2 incomplete.

BRAZIL. Amazonas (30 specimens: 9M, 4Mgen, 15F, 1 lp): Manaus, May 1901, Durham, 2F; same locality, Jun 1931, R. Shannon, 7M, 2Mgen; same data, 1F [BM]; same locality and date, 1M, 11F; same locality, 1942, A. Galvao, M.286-2A, 1 lp, 1Mgen. Tefe, 1945, O. Causey, 1M and 1M gen (holotype of *dunhami*), 1F. **Mato Grosso** (6F): Westborder, May 1931, R. Shannon, 6F. **Para** (324 specimens: 63M, 21Mgen, 101F, 89p, 50 l; 89 ind rear: 50 l, 39p): Altamira, 163 km W of, 6 Nov 1974, J. Reinert *et al.*, coll. 85, 1 lpM, 1Mgen. Bacuri, Gleba 36, Lote 05, 23 Oct 1974, J. Reinert *et al.*, coll. 31, 1 pM, 1Mgen; same data except Lote 02, coll. 33, 3Mgen, 11 lpM, 6 lpF, 5 pM, 2 pF; same data except 26 Oct, coll. 50, 1Mgen, 4 lpM, 7 lpF, 2 pF; same data except Gleba 34, Lote 05, coll. 51, 1Mgen, 1 lpM; same data except Gleba 29, Lote 09 and 28 Oct, coll. 60, 1 pM; same data except Gleba 34, Lote 02, coll. 62, 5Mgen, 1 lpM, 6 lpF, 13 pM, 6 pF; same data except Gleba 38, Lote 02 and 29 Oct, coll. 64, 2Mgen, 6 lpM, 7 lpF, 3 pM, 6 pF. Belem, 1944, O. Causey, 3M, ?2F; same locality, 6 Nov 1968, T. Aitken, 4M, 4Mgen; same locality, 29-30 Sep 1970, T. Aitken, A. Toda, 2M, 2Mgen, 2F; same locality, BRB 43. Boa Vista, C. Townsend, 6M, 6Mgen, 11F (including holotype and paratypes of *goeldii*). Curralinho, 1935, H. Kumm, 2F (K.91) [BM 1936-319]; same data, Rio Aracaca, 1F (K.256) [BM1936-319]. Fordlandia, Jun 1931, R. Shannon, 2M, 1Mgen, 8F; same data, 2F [BM]; same locality, 2M, 1F. Itupiranga, 17 Feb 1976, Moramay, 3F (1050). Maraba area, 4 May 1976, 5F (M-6); same locality, 6 May 1976, 1F (M-8); same locality, 2 Jun 1976, 6F (R-3); same locality, 3 Jun 1976, 1F (R-5); same locality, 4 Jun 1976, 2F (M-6); same locality, 6 Jun 1976, 1F (M-8); same locality, 9 Jun 1976, 1F (M-3); same locality, 17 Jun 1976, 3F (A-3); same locality, 23 Jun 1976, 1F (M-11); same locality, 7 Oct 1976, 1M (1261); same locality, 8 Oct 1976, 1M (1262); same locality, 1976, D. Roberts, 10F. Palestina, 100 km SW of Maraba, 21 Sep 1976, Moramay, 1F (N-1252). **Rondonia** (1Mgen, 4F): Guajara Mirim, May 1931, [R. Shannon], 1F. Porto Velho, May 1931, R. Shannon, 1Mgen (43.11.17a), 3F.

COLOMBIA (1F). **Atlantico**: Barranquilla, L. Dunn, 1F.

FRENCH GUIANA (2Mgen). **Inini**: Oyapock, 1Mgen [JH]. Saut Tigre, 30 Oct 1945, 1Mgen (No 778 23A).

GUYANA (2M, 6F). **East Berbice-Corentyne**: Kwakwani, 18 Jan 1942, G. Giglioli, KO 111-18, 1F; same locality and collector, 13 Jan 1943, KO 111-20, 4F. **West Demerara-Essequibo Coast**: MacKenzie, Sep 1945, KO 111-29, 1M. **District not specified**: 1942, G. Bevier, KO 111-8, 1M, 1F.

PANAMA (22 specimens: 5M, 4Mgen, 4F, 5p, 4L&l; 5 ind rear: 1 l, 3p, 1inc). **Darien**: Pucro, PA 630. Rio Tuira, GG 1-159, 43.

SURINAME (35 specimens: 19M, 11Mgen, 5F). **Brokopondo**: Brownsweg, Prof. Dr. Ir. W. J. van Blommestein Meer, 21 Oct 1975, R. Panday, 4F; same locality and collector, 31 Jul 1976, 3M, 1Mgen; same locality and collector, 9 Aug 1976, 6M, 3Mgen; same locality and collector, 7M, 5M gen. **Marowijne**: Moengo, 6 Jun 1945, Guicherit, 1M. **Paramaribo**: Paramaribo, 5-9 Jul 1945, Tillema, 2M, 1Mgen (46-v-8a), 1Mgen (46-v-8b), 1F.

VENEZUELA (96 specimens: 8M, 18Mgen, 11F, 20p, 39L&l; 19 larval ind rear). **Aragua**: Maracay, 1 Aug 1929, R. Hill, 1Mgen (56) [JH]; same locality, 3 Sep 1926, M. Nunez Tovar, 6F.

Barinas: Andres Eloy Blanco, Aug 1977, [P. Cova Garcia], 8 lpM, 1 lpF, 15 L. Locality not specified, Jan 1943, Iriarle [?], 1F. **Cojedes:** San Carlos, 2Mgen; same locality, 1Mgen [JH]. **Zulia:** Mene Grande, 2Mgen (no 3) [JH]; same locality, 6Mgen [JH]. **State and locality not specified:** 27 Dec 1939, A. Gabaldon, 1Mgen [JH]; same collector, [1977], 1 p, 3L, 3Mgen; same collector, 1Mgen [JH]; no data, 1L (1949), 1L (1950), 1Mgen.

STRODEI COMPLEX

FEMALES. No diagnostic characters distinguishing the adult females of this complex from the species in the Oswaldoi Complex are apparent.

MALES. Essentially as in females except for sexual characters.

MALE GENITALIA. Segment IX: Sternite moderately long to long. Anterior apodeme short to moderately long. **Sidepiece:** Parabasal spine moderately long to long, often reaching lateral margin of aedeagus on other side. **Ventral Claspette:** Setae on lateral and ventral margins extending only a short distance toward apex, not as far as level of apical margin of preapical plate, absent from apex. Apex truncate, rugose or deeply striated, expanded laterally into rounded or pointed lobes. Preapical plate oval to circular, distinct. **Phallosome:** Aedeagus rounded apically, without leaflets.

LARVAE. Moderately large to large. **Head:** Inner and outer clypeal hairs (2,3-C) plumose with moderately long branches, or single and barbed; inner clypeals (2-C) widely spaced in *benarrochi* and closely approximated in *strodei*. Hair 4-C short and branched. Collar moderately narrow to narrow dorsomedially, heavily pigmented. **Antenna:** Hair 1-A large in *benarrochi*, small in *strodei*. Hairs 2,3-A moderately developed. **Thorax:** Submedian prothoracic group (1-3-P) usually without 1,2-P sharing a common tubercle. Hair 14-P with a short to moderately short, flattened shaft. **Abdomen:** Hair 0-II moderately small. Hair 5-I moderately large and close to lateral margin of abdomen. Hair 13-I small, numerously branched; 13-IV moderately large in *strodei*, small in *benarrochi*. **Spiracular Lobe:** Lateral arm of spiracular apparatus short in *strodei*, moderately long and heavy in *benarrochi*. **Anal Segment:** Hair 1-X short in *benarrochi*, long in *strodei*; inserted on saddle. Anal gills moderately long to long.

DISCUSSION. The Strodei Complex is characterized in the **male genitalia** by the apex of the ventral claspette being laterally expanded, rugose and without setae. This complex is composed of 3 species. Two of these, *strodei* and *rondoni*, are extremely similar and represent a clearly defined phyletic line. These 2 species share several derived characters. The male genitalia are almost identical, and the larvae reportedly differ only in the number of branches of a few setae. *An. strodei* is widely distributed throughout Central and South America, often being found at relatively high altitudes. *An. rondoni* is limited to the interior of southern South America on the eastern side of the Andes extending south to the northern provinces of Argentina. *An. rondoni* is highly derived in the adult female, possessing a dark basal band on hindtarsal segment 3, and unique and extensive dark spots on the wing.

An. benarrochi is the most derived species in the complex. Partly because it has so many unique characters, its phylogenetic relationship to the rest of the species in the Oswaldoi Subgroup is not clearly understood. On the basis of the male genitalia, I am placing *benarrochi* in this complex, but it may be shown later to be more closely allied with the Oswaldoi Complex. The distribution of *benarrochi* is similar to that of *rangeli*, these species occurring principally in the Orinoco basin and extending south into Brazil and Peru. The adult of *benarrochi* is very similar to that of *aquasalis*, making species identification based on external morphology very difficult. The

larva of *benarrochi* is very different from that of *strodei,* having unique characters such as a large hair 1-A of the antenna and a small, numerously branched hair 13-IV.

11. Anopheles (Nys.) strodei Root

Figs. 1, 4, 7, 27, 28

1926. *Anopheles (Nyssorhynchus) strodei* Root 1926b:711-714. TYPE: *Lectotype* male (64) with associated genitalia on slide (750923-29), a few miles from Agua Limpa, near Juiz de Fora (Minas Gerais), Brazil, 27 Mar 1925 [USNM; designation by Stone and Knight 1956: 280]. RESURRECTED FROM SYNONYMY with *evansi* (Brethes 1926).

1940. *Anopheles (Nyssorhynchus) strodei* var. *ramosi* Unti 1940b:489-491. TYPE: *Syntypes* larvae, Lorena (Sao Paulo), Brazil, Mar 1940 [NE]. NEW SYNONYMY.

1941. *Anopheles (Nyssorhynchus) strodei* var. *arthuri* Unti 1941:9. TYPE: *Syntypes* eggs, Vale do Rio Paraiba [do Sul] (Sao Paulo), Brazil, elev. ca 500 m [NE]. NEW SYNONYMY.

1941. *Anopheles (Nyssorhynchus) strodei* var. *artigasi* Unti 1941:9. TYPE: *Syntypes* eggs, Vale do Rio Paraiba [do Sul] (Sao Paulo), Brazil, elev. ca 500 m [NE]. TRANSFERRED SYNONYMY.

1941. *Anopheles (Nyssorhynchus) strodei* var. *albertoi* Unti 1941:9-10. TYPE: *Syntypes* eggs, Vale do Rio Paraiba [do Sul] (Sao Paulo), Brazil, elev. ca 500 m [NE]. NEW SYNONYMY.

1941. *Anopheles (Nyssorhynchus) strodei* var. *lloydi* Unti 1941:10. TYPE: *Holotype* egg, Panama, locality not specified [NE]. NEW SYNONYMY.

Anopheles (Nyssorhynchus) strodei of Davis (1928:549-550); Shannon and Del Ponte (1928:45, 46, 54-55); Hill (1930:711-713); Shannon (1931:10; 1933:120); Curry (1932:566-568; 1934: 647); Edwards (1932:45); Root (1932:779); Senevet (1934:52-54; 1948a:278; 1948c:437); Komp (1936a:161; 1941a:88, 93, 96, 97; 1942:39, 40, 43, 71-73, 80, 120-122, 132, 158-159); Galvao, Lane and Correa (1937:41-42); Galvao and Lane (1937a:77, 78; 1937b:275-282; 1937c: 26; 1937d:65-69; 1937e:214, 221-223); Correa (1938:104-109; 1943:126); Galvao (1938a:52, 56-57; 1940:443-447; 1943:143-144, 149, 150; 1950:38-48); Galvao and Amaral (1938:13); Rozeboom (1938a:102-103; 1938b:290; 1941:102; 1942a:240-241); Senevet and Abonnenc (1938:489-494); Galvao and Barretto (1939a:113-114); Barretto (1940:159-164); Lane (1939: 27; 1944:263-266; 1953:271-273); Gabaldon, Lopez and Ochoa Palacios (1940:34-35); Unti (1941:3-18); Correa and Ramos (1942a:37-46; 1943:35, 36; 1944b:131; 1944c:11); Fonseca and Fonseca (1942:94); Komp (1942:43, 71-72, 81, 120-122, 132, 158-159); Simmons and Aitken (1942:39, 46, 53, 62, 96-97); Fonseca and Unti (1943:43, 45, 47-49); Kumm, Bustamante and Herrera (1943:373-375); Unti and Ramos (1943:27-28); Causey, Deane and Deane (1944:2, 5, 6; 1946:26); Deane, L. P., Causey and Deane (1946:6, 8, 9, 12; 1948:904-906); Deane, M. P., Causey and Deane (1946:42, 45); Floch and Abonnenc (1946b:3-5; 1947:7; 1951:55-57); Gabaldon and Cova Garcia (1946b:118-120; 1952:184, 196, 201); Amaral and Penido (1947:168); Arnett (1947:198; 1950:103, 106, 110, 113); Bates and de Zulueta (1949:132); Levi-Castillo (1949:9-11, 16, 28, 58, 67, 72-73, 77, 82, 86); Duret (1950a:372; 1950b:302; 1952:347-348); Vargas and Martinez Palacios (1950:130-133; 1956:129-132); Carvalho and Rachou (1951:474-477, 480); Martinez and Prosen (1951:38); Pinotti (1951:670); Rachou and Ferraz (1951:542-543, 547-553); Rachou and Ricciardi (1951:425-426, 432-437); Horsfall (1955:185); Bejarano (1956:9, 20; 1957:326, 327, 331-333, 337-339; 1959:317, 325); Schreiber and Pompeu Memoria (1956:1-3); Vargas V. (1956:29; 1957; 1958a; 1958b); Guedes, Amorim and Schreiber (1957: 247-248); Rachou, Moura Lima, Ferreira Neto and Martins (1958:417, 421, 423); Rachou (1958:148); Castro (1959a:175); Castro, Garcia and Bressanello (1959:549, 550); Stone, Knight and Starcke (1959:32); Schreiber and Guedes (1959b:128-129; 1960:356-357; 1961:658); Vargas (1959:377, 382); Cerqueira (1961:127); Forattini (1962:388-394); Aragao, Ferreira Neto and Martins (1973:291); Consolim and Galvao (1973:177-179, 181); Cova Garcia and Sutil O. (1975a:19; 1975b:213; 1977:19, 43, 64, 84); Cova Garcia, Pulido F. and Amarista M. (1978: 157).

Anofeles (!) *(Nyssorhynchus) strodei strodei* of Unti (1940b:493-505).

Anopheles strodei of Benarrochi (1931:691); Kumm (1932:4; 194 :b:93-97); Galvao (1938c:133-134); Gabaldon, Ochoa Palacios and Perez Vivas (1940:42-55); Kumm, Komp and Ruiz (1940: 388, 389, 391, 412, 419); Vargas (1941:110, 118, 120; 1950:106, 121); Unti and Ramos (1942:94-105); Russell, Rozeboom and Stone (1943:49-50); Castellanos, Murrieta, Lassman and Ortiz (1949:34); Senior-White (1951a:294); Renjifo and de Zulueta (1952:600-601, 610); Vargas and Martinez Palacios (1955:82-83, 106, 114, 121); Vargas V. (1958c:1, 3); Foote and Cook (1959:22, 23); Schreiber and Guedes (1959a:97-98); Cova Garcia (1961:40-41, 67, 92-93, 114, 129-130, 155); Maciel (1962:471-473); Vincke and Pant (1962:2, 4, 6, 7, 10); Mattos and Xavier (1965:273-274); Cova Garcia and Sutil O. (1975a:19; 1975b:213).

Nyssorhynchus (Nyssorhynchus) strodei of Lima (1928:100-102).

Anopheles (N.) strodei ramosi of Unti (1941:10).

Anopheles (Nyssorhynchus) evansi of Root (1927:477); Dyar (1928:438); Pinto (1930:153-154, 156-157; 1932:287, 293; 1939:425-427); Senevet (1931:108; 1932:252); Komp (1941b:801-802); Martinez, Prosen and Carcavallo (1959:111-112).

Anopheles (Nyssorhynchus) evansae of Stone, Knight and Starcke (1959:32); Fauran (1961:10); Stojanovich, Gorham and Scott (1966a:10, 19, 32; 1966b:18, 29, 41); Gorham, Stojanovich and Scott (1967:17, 43, 54; 1973:114, 135, 144); Belkin, Schick and Heinemann (1968:10; 1971: 5); Vargas (1976:87, 88, 89).

Anopheles tarsimaculata in part (?) of Howard, Dyar and Knab (1917:978); Petrocchi (1923:139).

Cellia tarsimaculatus in part (?) of Neiva and Penna (1916:94); Peryassu (1921a:70); Neiva and Pinto (1922a:321; 1922b:355-357).

Cellia albimana in part (?) of Neiva (1909:69-77).

FEMALE (fig. 7). Wing: 3.3 mm. Proboscis: 2.0 mm. Palpus: 2.0 mm. Forefemur: 1.4 mm. Abdomen: 2.8 mm. Highly variable in size and diagnostic characters. **Head:** Integument light brown to very dark brown. Proboscis about 1.4 length of forefemur. Scales on vertex and occiput predominantly white; occiput with white to cream, cuneate scales extending caudolaterally onto medium occiput; erect scales on vertex very conspicuous, long, white, lanceolate to cuneate, and tapering into thread-like stalk at base. Dorsal surface of palpal segments 2 and 3 with a few light scales more extensive on segment 3; apices of 2 and 3 with a white band; segment 4 with a basal and an apical brown band, and often with a narrow brown stripe on ventral surface; segment 4 white on mediolateral surface; segment 5 completely white. **Antenna:** Flagellar segment 1 with elongate white scales on dorsomesal surface, and with an incomplete ring of small scales at base. Flagellar segments 2-13 each with a basal whorl of 8-10 setae. **Thorax:** Integument reddish brown to dark brown. Light scales of scutum and scutellum silver to white. Anterior promontory area with elongate scales extending dorsad onto acrostichal line. Humeral tuft scales numerous and prominent. Prescutellar space moderately small and usually horseshoe shaped. *Sp* with numerous (6-9), moderately long, light setae. Upper *stp* with 3-6 long setae and a horizontal patch of about 10 obovate to lanceolate, gray to white scales. Lower *stp* with 1,2 long setae and a small patch of scales similar to those on upper *stp*. Upper *mep* with 6-8 long, cream setae; scales absent. **Legs:** Light scales on coxae usually white or very light cream. Midfemur with both anteroapical spot and knee spot fairly large and conspicuous. Foretarsal segments 2 and 3 with a cream to white band in apical 0.25 (0.18-0.35) and 0.5 (0.25-0.80) respectively; segment 4 all brown, occasionally with a few, lighter, apical scales; segment 5 usually one color, golden to brown or with a few lighter apical scales, rarely with apical 0.5 lighter than basal 0.5. Midtarsal segments 1 and 2 with a small, golden to white, apical band in about 0.1 and 0.1-0.4 respectively; segment 3 either all dark or with a small, golden to cream, apical band; segment 4 all dark; segment 5 usually with a small cream band in less than apical 0.3. Hindtarsal segment 2 with a brown band in basal 0.35-0.45 (0.30-0.50). **Wing:** Lengths of wing spots variable. Light wing spots usually white, occasionally very light cream on vein C; in general, light spots relatively large. Vein C

humeral light spot 2.0-4.0 (1.2-4.1) of basal dark spot; often sectoral light spot absent; subcostal light spot moderately large, 0.35 (0.25-0.50) of subcostal dark spot; preapical light spot variable, 0.2-0.5 of preapical dark spot; apical dark spot small. R presectoral and sectoral dark spots small, occasionally sectoral spot absent. Vein M with preapical dark spot not extending onto M_{1+2}. Remainder of light spots on wing usually small but variable. Apical light fringe spot small to moderately large, usually divided; additional light fringe spots at apices of R_{4+5}, M_{1+2}, M_{3+4}, Cu_1, Cu_2 and A; a light fringe spot at level of 0.5 distance from base of A. **Abdomen**: Sternite I with a few, moderately short, lateral setae, and long median setae in basal 0.5, occasionally with a few, inconspicuous, lanceolate, light scales. Dark caudolateral scale tufts on segments II-VII with large cuneate scales.

MALE. Wing: 3.4 mm. Proboscis: 2.6 mm. Forefemur: 1.55 mm. Abdomen: about 3.15 mm. Essentially as in female except for sexual characters. Size extremely variable. **Head**: Palpal segments 2 and 3 with a conspicuous, cream to white, dorsal stripe; segment 4 extensively light, white basally and apically with a dark subbasal band; medially 4 predominantly cream to white, occasionally with a speckling of dark scales. **Antenna**: About 0.75 length of proboscis. Flagellar segment 1 with numerous, long, white, oblanceolate scales on dorsomesal surface; long mesal setae of flagellar whorl 1 distinctly white; occasionally setae white on mesal margins of flagellar whorls 2-5. **Legs**: Forefemur about 0.6 length of proboscis. Basal plantar surface of foretarsal segment 5 with 6,7 long, spiniform setae; longest setae about 0.3 length of segment. Claw on foreleg moderately large, curved and acuminate; submedian tooth moderately thick, tapering to slightly recurved tip; basal tooth large, decurved and blunt.

MALE GENITALIA (fig. 27). **Segment VIII**: Tergite and sternite with moderately narrow, light, obovate scales. **Segment IX**: Sternite long, about 0.2 length of sidepiece, subtrapezoidal. Anterior apodeme subtriangular to subtrapezoidal, moderately long, about 0.15-0.25 length of sternite. **Sidepiece**: Tergal surface with 4-6 long, submedian tergomedial bristles and 1,2 long, subapicolateral bristles; bristles mesad of tergomedial bristles moderately long. Parabasal spine moderately slender and tapering, long, usually at least 2.0 length of its tubercle; apex of parabasal spine almost reaching lateral margin of aedeagus on other side. Basal apodeme moderately long and thick. Longer, more dorsal accessory spine about 0.5 length of sidepiece; more ventral spine about 0.8 of longer spine. Internal spine subequal to shorter accessory spine. **Clasper**: Spiniform heavy, fusiform, moderately short, shorter than seta *b*. **Dorsal Claspette**: Long, equal to or slightly greater than 0.5 length of sidepiece. Pedicel moderately broad; base usually not curved mesad. Leaflets slightly less than 0.5 length of claspette, strongly concave mesally; dorsal leaflet with a small basomesal projection. **Ventral Claspette**: Large, 0.45-0.52 length of sidepiece; apex very wide, width at apex 0.5-0.6 length of claspette. Basal lobule large, expanded laterally and occasionally bending ventrad at base so that setae distributed over basal margin project caudad; setae along basal margin long, 2.0-3.5 width of aedeagus. Apex without setae, more or less truncate and rugose or deeply striated, with a small, V shaped median sulcus. Apex strongly expanded laterally into large rounded lobe; apicolateral lobe with convex basal and lateral margins, and usually weakly concave apical margin; depending on angle of observation, apex occasionally medially produced into small, hemispherical cap with median sulcus at its vertex. Setae on lateral margins extending toward apex to base of apicolateral lobes. Preapical plate moderate, oval to circular, weakly to moderately sclerotized and moderately well-defined, located about 0.25 length of claspette basad of apex. Refringent structure in shape of

inverted horseshoe. **Phallosome:** Aedeagus about 0.5 length of sidepiece; apex rounded, slightly longer than wide; without leaflets.

PUPA (fig. 27). Abdomen: 2.75 mm. Trumpet: 0.5 mm. Paddle: 0.8 X 0.5 mm. Pupa very similar to that of *triannulatus*. **Cephalothorax:** Dark brown. Hairs 1-3-C moderately long; 2-C 3 branched, subequal to 1,3-C; 1,3-C 2,3 branched. Hairs 4,5-C 3,4 branched or forked, subequal in length. Hair 6-C 2,3 forked distally, long. Hair 7-C 1-3 branched near base, long, one branch conspicuously longer, 1.5-2.0 length of other branch(es). **Trumpet:** In general, similar to that of *aquasalis*. Pinna amber; long, about 3.8-4.6 (3.7-4.8) length of meatus; in lateral aspect, appearing broad medially and tapered toward apex. Meatal cleft moderately open, basally pointed. **Metanotum:** Hair 10-C single, moderately long, equal to or slightly shorter than 11-C. Hair 11-C 3-6 branched usually near base. Hair 12-C 1-4 forked, about 1.75 length of 10-C. **Abdomen:** Pigmented as cephalothorax. Hair 2-I 5-7 branched near base, moderately long; hair 3-I about 0.75 length of 2-I. Hair 4-I about 5-7 branched. Hair 5-I single or double, long. Hair 6-I single or double, very long (0.35 mm). Hair 7-I 3 branched, 0.5 or less length of 6-I. Hair 9-I single, subequal to 6-I. Hair 0-II-VII moderately large; 0-II 4-6 branched; 0-III-V 3-6 branched; 0-VI 2-4 branched; 0-VII 1-4 branched. Hair 1-II,III 5-8 (3-8) and 4-7 (3-7) branched respectively, strongly developed; 1-IV-VII strong, very long, about 1.6-2.0 length of segment. Hair 3-IV 4-6 branched, large; 3-V 2-4 forked (2-5), long. Hair 5-II 3-5 branched, moderately long; 5-III,IV 5-8 and 3-5 (2-5) branched respectively, large; 5-V-VII single or often 5-V double, long, all equal to or longer than length of segment. Hair 6-II 1-3 forked, very long, at least 2.0 length of 7-II. Hair 7-II 3-5 branched near base. Hairs 7-III-V, 8-III-VII branched near base, moderately developed; 7,8-III 3-5 branched; 7,8-IV 2-4 branched; 7-V 3,4 branched; 7-VI long, equal to or slightly longer than 0.5 length of segment; 8-V-VII 2-4 branched. Hair 9-II thin, small, unpigmented; 9-III stout, short, less than 2.0 length of 9-II, unpigmented to strongly pigmented; 9-IV about 2.0 of 9-III; 9-V stout, slightly curved, 1.8-2.3 (1.7-2.3) of 9-IV; 9-VI curved, moderately long, 1.1-1.5 (1.1-1.8) of 9-V, much shorter than 9-VII,VIII; 9-VII 1.5-2.0 of 9-VI; 9-VII,VIII thin, tapering to fine point, very long, usually equal to or longer than 0.5 length of segment. Hair 10-III 3-5 branched near base, moderately long. Hair 4-VIII 2-4 forked, subequal to 9-VIII. Sum of branches of hairs 1-III, 5-III and 0-VI less than 18. **Terminal Segments:** Male genital lobe broad, heavy, lateral margin tapering at slight angle from base toward apex, appearing thicker than those of other species, with distinct mammilliform protuberance. **Paddle:** Large, obovate, very weakly emarginate at insertion of hair 1-P. External buttress 0.6 length of paddle. External margin distad of buttress with moderately short, filamentous spicules extending around apex and along inner margin to 0.5 from base. Hair 2-P 1, 2 forked, subequal to 1-P.

LARVA (fig. 28). Head: 0.6 mm. Antenna: about 0.3 mm. Anal Saddle: about 0.3 mm. Highly variable, several differences between Panamanian populations and southeastern Brazilian populations. **Head:** Dark reddish brown, heavily pigmented. Inner and outer clypeal hairs (2,3-C) single and barbed in about apical 0.5; hairs 2-C closely approximated, clypeal index about 3.0-4.0; 3-C about 0.6 length of 2-C. Hair 4-C 1-4 branched, small to moderately small, usually not reaching base of 2-C. Hairs 8,9-C 2-7 branched near base, 2.0 length of distance separating insertion of 2-C and 3-C. Hairs 10,12-C 2-4 and 3-5 branched respectively, subequal to 8,9-C. Hair 15-C 1-3 branched, long. Collar moderately thin dorsomedially, heavily pigmented. **Antenna:** Moderately to heavily pigmented. Mesal margin with moderately thin, very sharp spicules. Hair 1-A 4-6 branched, short. **Thorax:** Submedian pro-

thoracic group (1-3-P) not sharing a common tubercle; rarely 1,2-P sharing common tubercle; palmate hair 1-P with 13-17 narrow, lanceolate leaflets; 2-P with a small sclerotized tubercle, 16-23 (16-24) branched, apical branches subequal to lateral. Hair 14-P 7-13 branched from a short to moderately long stalk. Mesothoracic hair 1-M 31-35 branched, ovate in outline, apical branches much shorter than lateral. Metathoracic palmate hair 3-T with 10-16 narrow, semitransparent leaflets, moderately small. Hair 4-T 3-5 branched (2-5), small. Pro-, meso- and metathoracic pleural group spines moderately developed, prothoracic spine slightly longer than meso- and metathoracic spines. **Abdomen**: Hair 0-II-VI 5-8 branched (4-9), moderately long to long. Palmate hair 1-I with 12-16 (11-16) semitransparent, spreading, narrow, pointed leaflets; 1-II-VII with pigmented, long, moderately narrow to moderately broad, pointed leaflets. Hair 2-II 4-6 branched; 2-V single, long. Hair 5-I 3-5 branched, moderately small; 5-III 8-11 branched. Hair 9-I 5-7 branched; 9-IV,V 10-13 (6-13) and 7-13 branched respectively. Hair 11-I 3,4 branched, medium. Hairs 13-I,II,III 5-8, 7-10 and 7-11 branched respectively, small; 13-IV 4-6 branched (4-7), moderately large; 13-V 4-6 branched, very large, extending beyond caudal margin of segment. **Spiracular Lobe**: Pecten with 14-17 teeth; median teeth mostly subequal; number and placement of long teeth variable; serrations on basal half of teeth from short to moderately long. Lateral arm of spiracular apparatus short to moderately short. Hairs 8,9-S 4-7 and 5-7 (4-9) branched respectively, moderately developed. **Anal Segment**: Covered with very thin, moderately long spicules becoming longer at apex. Saddle reddish brown with irregular lateral and apical margins. Hair 1-X long; inserted on saddle near ventral margin, or rarely on ventral margin at base of indentation; inserted about 0.3 cephalad of caudal margin. Hair 2-X relatively short, about 0.7 length of 3-X. Anal gills longer than saddle.

DISCUSSION. *An. strodei* can be distinguished from the other species in the Oswaldoi Group in the **female** (except for *anomalophyllus*, and occasionally *noroestensis* and *trinkae*) by the combination of (1) palpal segment 4 often with a narrow brown stripe on ventral surface, (2) light scales on coxae usually white or very light cream, (3) foretarsal segments 2 and 3 cream to white in apical 0.25 (0.18-0.35) and 0.5 (0.25-0.80) respectively, (4) foretarsal segment 5 usually entirely golden to brown or with a few light apical scales, rarely with apical 0.5 lighter than basal 0.5, (5) midtarsal segment 5 usually with a small cream band in less than apical 0.3, (6) hindtarsal segment 2 brown in basal 0.35-0.45 (0.30-0.50), (7) light wing spots usually white, occasionally very light cream on vein C, (8) basal dark spot of vein C small, humeral light spot 2.0-4.0 (1.2-4.1) of basal dark spot, (9) subcostal light spot of vein C 0.25-0.50 of subcostal dark spot and (10) abdomen with dark caudolateral tuft scales large and cuneate; in the **male genitalia** by (1) apex of ventral claspette very wide, width at apex 0.5-0.6 length of claspette, without setae, more or less truncate, rugose or deeply striated, strongly expanded laterally into large rounded lobe which is convex on basal and lateral margins and weakly concave on apical margin, (2) setae along basal margin of basal lobule long, 2.0-3.5 width of aedeagus, (3) setae on lateral margins of ventral claspette extending toward apex only to base of apicolateral lobes, (4) preapical plate moderate, oval to circular, weakly to moderately sclerotized, moderately well-defined and (5) apex of aedeagus without leaflets, slightly longer than wide; in the **pupa** by the combination of (1) hair 7-C with one branch conspicuously longer, 1.5-2.0 length of other branch(es), (2) pinna long, 3.8-4.6 (3.7-4.8) length of meatus, with basally pointed meatal cleft, (3) hair 10-C single, moderately long, equal to or slightly shorter than 11-C, (4) hair 12-C 1-4 forked, about 1.75 length of 10-C, (5) hair 5-II 3-5 branched, moderately long, (6) sum of branches of hairs 1-III,

5-III and 0-VI less than 18, (7) hair 6-II 1-3 forked, very long, at least 2.0 length of 7-II and (8) hair 9-III stout, short, less than 2.0 length of 9-II, 9-V 1.8-2.3 (1.7-2.3) of 9-IV, 9-VII thin, tapering to fine point, very long, 1.5-2.0 of 9-VI and about 0.5 length of segment; and in the larva by the combination of (1) hairs 2,3-C single and barbed, hairs 2-C closely approximated, clypeal index about 3.0-4.0, (2) collar moderately thin dorsomedially, heavily pigmented, (3) hairs 1,2-P rarely sharing common tubercle, palmate hair 1-P with 13-17 narrow leaflets, 2-P 16-23 branched (16-24), (4) hair 1-M 31-35 branched, ovate in outline, apical branches much shorter than lateral, (5) hair 13-V very large, extending beyond caudal margin of segment and (6) hair 1-X inserted on saddle near ventral margin, or rarely on ventral margin at base of indentation.

An. strodei varies throughout its geographic range. Unfortunately with regard to the immatures, only material from Colombia, Venezuela, Panama and Brazil was available for this study. The only individually reared specimens examined came from Brazil, Colombia and Panama. In general, the immatures from Brazil are much larger and darker than those from Colombia, Venezuela and Panama. In larvae from Sao Paulo, Brazil, hair 8-C is 4 or 5 branched, whereas in the Panamanian specimens it is 1-3 branched. Also, hair 9-III-V in the Brazilian specimens has fewer branches (1-6) than it does in the Panamanian specimens. As in the immatures, the adult females from the states of Mato Grosso and Sao Paulo, Brazil are much larger and darker than those from Central America. Although not showing any geographical variation, foretarsal segment 5 in the adults is usually of uniform color, which is unique in the Oswaldoi Subgroup; only rarely is it 0.5 apically light, 0.5 basally dark. As evident in the description of the adult female, the relative sizes of the wing spots are highly variable; in one specimen from Panama the subcostal light spot of vein C is longer than the subcostal dark spot, similar to that of *rangeli.*

Although it was not possible to examine the eggs of *strodei* for this study, it should be mentioned that the eggs are extremely diverse. Five different varieties (*typicus, artigasi, arthuri, albertoi, lloydi*) were described by Unti (1940b; 1941) based on variations in the morphology of the egg. Rozeboom (1938a:102-103, 106) recognized 3 different types of eggs designated Types A, B and C from Panama, about which he stated, "it seems unlikely that the different types of *strodei* eggs were deposited by separate races, as they were all collected from the same breeding place at the same times, and there were all kinds of gradations between the extremes." Galvao (1943:143-144) recognized 3 major types of eggs representing different forms, including Rozeboom's types. The great variation in the eggs and in the other stages has lead to *strodei* being considered a complex of species similar to the *Anopheles (Ano.) maculipennis* Meigen 1818 complex of Europe or the *An. (Cel.) gambiae* Giles 1902 complex of Africa. Other important papers written on the eggs of *strodei* are those of Galvao and Lane 1937b:272-275; Galvao 1938a:56-57, 1940:445; Galvao and Barretto 1938:113-114; Kumm 1941b:94-97; and Rozeboom 1942a:240-241.

Besides the diversity in the external morphology, there is considerable variation in the banding patterns of the salivary chromosomes of *strodei.* Several workers (Schreiber and Pompeu Memoria 1956:1-3; Guedes, Amorim and Schreiber 1957: 247-248; Schreiber and Guedes 1959b, 1960, 1961) have studied the salivary glands of *strodei* and have found many heterozygous inversions, asynaptic zones and (rarely) translocations in the chromosomes. These authors stated they were able to locate 3-11 "anomalous zones" per nucleus. This is in contrast with the cytogenetics of some of the other species in the section which have been studied. *An. aquasalis* and *albi-*

manus show no chromosomal variation in the populations that have been examined, and *nuneztovari* has only one homozygous inversion. Schreiber and Guedes (1961) hypothesized that the high degree of polymorphism in the chromosomes of *strodei* is correlated with the great variation in the morphology of the eggs.

Whether or not *strodei* represents a complex of species cannot be ascertained with any confidence with the information presently available to me. Until more material and more data concerning the bionomics and genetics are available, I am treating *strodei* as a single species.

The closest ally to *strodei* is *rondoni.* The male genitalia of *strodei* and *rondoni* are almost identical except that in *rondoni* the setae on the ventral claspette do not extend toward the apex to base of apicolateral lobes. Differences reported to distinguish *rondoni* from *strodei* are listed in the discussion of *rondoni.*

I no longer consider *evansi* as the valid name of the presently discussed species. Brethes (1926a) described, in French, *evansi* from material that was sent to him from Tucuman, Argentina by N. C. Davis. In another description (1926b) in Spanish, Brethes included a mislabelled diagram of the male genitalia of *evansi* which is impossible to identify as any particular species in the Albimanus Section. Later the same year, Root (1926b) described *strodei* from the state of Minas Gerais, Brazil, and clearly illustrated the diagnostic characters of this species in all the life stages except the egg. The following year, for some reason that is unclear to me, Root (1927:477) included *strodei* as a synonym of *evansi* in a paper on *Chagasia fajardi* (Lutz 1904). Davis (1928:549-550), who furnished Brethes with the type material of *evansi,* referring to Brethes' description stated, "It is true that some Anophelines showing the genitalic characteristics of *strodei* have been taken in northern Argentina . . . but by far the greater number are of the type which Root accepts as *tarsimaculatus.*" Davis then pointed out the errors Brethes made in labelling his diagram, and said that it is "barely possible" that Brethes was working with both *tarsimaculatus* and *strodei,* and that drawings of the male genitalia represent a composite. In either case I agree with Davis that Fig. 2C of Brethes (1926b), which appears to be the spiculose apex of a ventral claspette, does not look like anything seen in *strodei.* Also, the ninth sternite in fig. 2A appears to be too broad to be *strodei.* Lima (1928:100-102) wrote that Davis had told him that what Brethes described was not *strodei,* but that since he (Davis) had not seen the type he was not sure of the validity of *evansi*; also Davis again stated that possibly *evansi* was the same as *tarsimaculatus.* Shannon and Del Ponte (1928:54) synonymized *evansi* with *tarsimaculatus,* giving as evidence the figure of the ventral claspette. According to Bejarano (1957:336), Del Ponte, in his unpublished 1941 thesis on the revision of the Argentine species of *Anopheles,* stated that possibly specimens classified by Brethes as *evansi* could be *oswaldoi.* Casal (in Belkin, Schick and Heinemann 1968:10) designated the lectotype male genitalia slide of *evansi* which had the following Brethes label, "*Cellia evansi* Brethes=tarsimaculata auct. (nec Goeld), Tucuman, N. C. Davis ded., III.1926, Pr. micr. An. M.," in Del Ponte's hand "384," "DP14," "DP14=?noroestensis G. y L., 1938 [signature in ink], Tipo de evansi." From this label it is apparent that Del Ponte looked at the male genitalia of *evansi* some time after 1937 and tentatively synonymized *noroestensis* with *evansi,* in which case *evansi* would become the valid name for *noroestensis.* Gabaldon (1949:765), writing about the vector status of West Indian and South American anophelines, also considered *noroestensis* and *clarki* as synonyms of *evansi.* However, not having examined the type specimen of *evansi,* I am not proposing at this time any nomenclatorial changes regarding the biological species *noroestensis.* I am only considering *strodei* as the valid name of the species described here, since it has

been extensively used in the past in referring to this taxon, and because there is substantial evidence that the lectotype of *evansi* does not represent this species. For the present, I am considering *evansi* as a *nomen dubium.*

As in the adult females of some of the other species in the Albimanus Section, mutants or anomalous specimens of *strodei* have been described with extra black rings on hindtarsal segments 3, 4 and 5, segments 3 and 4, and segments 4 and 5 (Rachou and Ferraz 1951:542-543).

BIONOMICS. The immatures of *strodei* occur predominantly in ground pools. In addition, it has been collected from animal tracks, ponds, lakes, swamps, stream margins, potholes, marshy depressions, ditches, seepage areas and rock holes. It is found only in fresh water, usually in the full sun or partial shade but occasionally in deep shade. It occurs over a wide range of elevations, from near but usually not on the coast to altitudes of 1600 m (Unti 1941). It is commonly found in mountainous areas, plains and plateaus in the interior. The immatures usually are associated with abundant vegetation such as grasses, algae and *Utricularia* sp. Galvao (1940:443-447) stated that the immatures can tolerate large fluctuations in temperature (17.5-33.0° C), pH (5.9-7.2) and amounts of organic material. Unti (1941) has reported collecting the larvae in water as cold as 2°C. He also found *strodei* in water poor or rich in organic material, varying in nitrate concentration from 0.008% to 0.064%, and in water with sometimes high concentrations of bicarbonates or sulfates. On one occasion, he discovered immatures in water with a pH of 4.0 and a high sulfate residue from a nearby paper plant. The larvae have been collected with 3 other species of *Nyssorhynchus, allopha, argyritarsis* and *rangeli.* They have been collected with 32 other species of mosquitoes: *Aedes (Och.) crinifer, Ae. (Och.) dupreei* group sp B of Heinemann and Belkin 1979:79, *Ae. (Och.)* sp, *Anopheles (Ano.) ?apicimacula, An. (Ano.) eiseni, An. (Ano.) neomaculipalpis, An. (Ano.)* sp, *Culex (Cux.) coronator* group, *Cx. (Cux.) declarator* group, *Cx. (Cux.) mollis, Cx. (Cux.) nigripalpus, Cx. (Cux.) thriambus, Cx. (Cux.)* spp 72 and 85 of Heinemann and Belkin 1978a:184, *Cx. (Mel.) bahiense, Cx. (Mel.) bastagarius, Cx. (Mel.) chrysonotum, Cx. (Mel.) conspirator, Cx. (Mel.) dunni, Cx. (Mel.) dureti, Cx. (Mel.) educator, Cx. (Mel.) ?egcymon, Cx. (Mel.) erraticus, Cx. (Mel.) ?inadmirabilis, Cx. (Mel.) ?iolambdis, Cx. (Mel.) pilosus, Cx. (Mel.)* sp, *Psorophora (Gra.) cingulata* group, *Uranotaenia (Ura.) coatzacoalcos, Ur. (Ura.) lowii, Ur. (Ura.) pulcherrima, Ur. (Ura.)* sp.

The adult females of *strodei* are exophilic, feeding predominantly on mammals other than humans. They only rarely enter houses to feed; in Brazil, Deane, Causey and Deane (1948:905) collected 1895 adults of *strodei* of which only one was from inside a house. In host preference studies using a human and a horse as bait in Alagadico in 1942, Deane, Causey and Deane (1948:906) collected 17 females on the human and 23 on the horse during the crepuscular hours. Kumm, Komp and Ruiz (1940:388) in Costa Rica and Rozeboom (1938b:290, 293) in Panama occasionally found *strodei* inside houses, but usually *strodei* showed a preference for animals and fed outside. The only exception was reported by Correa (1938), who found a very high density of *strodei* at the Fazenda Santa Alice in the state of Sao Paulo, Brazil, and collected 165 females from inside a house which represented 95.3% of all anophelines captured. In Panama (Curry 1932:566; Rozeboom 1938b:290) and Colombia (Renjifo and de Zulueta 1952:601; Bates and de Zulueta 1949:135-137), the peak abundance of *strodei* is during the early part of the dry season. In Santa Catarina, Brazil, *strodei* occurs in the lowest numbers during the cold months. The adults are usually most active around dusk, although they are reported to feed throughout the night (Deane, Causey and Deane 1948:904-906; Barretto 1940:160).

MEDICAL IMPORTANCE. *An. strodei* does not seem to be an important vector of malaria. As mentioned earlier (p 18), it has been incriminated only once as a vector of malaria, and that was by Correa (1938) at the Fazenda Santa Alice, Sao Paulo, Brazil. In that study Correa dissected 163 females collected inside houses and found 2 of them (1.2%) naturally infected with oocysts. Galvao and Lane (1937d), Galvao (1938c), and Fonseca and Unti (1943) have easily and successfully experimentally infected *strodei* with *Plasmodium vivax.* Because of its predominantly exophilic and zoophilic habits, *strodei* can be considered a possible health problem only when it occurs at very high densities.

DISTRIBUTION (fig. 1). *An. strodei* is widely distributed throughout Central America and much of South America east of the Andes. Its northernmost limit is reported to be the state of Veracruz, Mexico on the Gulf of Mexico; on the Pacific side it is reported from as far north as the Costa Rica-Nicaragua border. In South America, it is found in northern and eastern Colombia, Venezuela, the Guianas, Brazil, Bolivia, Paraguay and northern Argentina. *An. strodei* is found on the eastern slope of the Andes in Colombia, Bolivia and northern Argentina; it is presumably also found in eastern Ecuador and Peru, although there are no records. It is not known if it occurs on the Pacific slope of the Andes, although it is reported to occur in the Magdalena River drainage in northern Colombia. The southernmost limit east of the Andes is in the province of Buenos Aires, Argentina. *An. strodei* does not occur on any of the Caribbean islands, including Trinidad and Tobago.

Material Examined: 566 specimens: 63 males, 25 male genitalia, 146 females, 41 pupae, 291 larvae; 41 individual rearings: 21 larval, 12 pupal, 8 incomplete.

ARGENTINA (1M, 1F). **Tucuman:** Locality not specified, 23 Aug [?1941], Alvarado, 1F; 28 Aug 1941, 1M.

BOLIVIA (6F). **Santa Cruz:** Loma Alta, 19 May 1944, 3092, KO 111-22, 4F. San Antonio del Parapeti, 9 May 1944, 3151, KO 111-26, 2F.

BRAZIL. Amazonas (6F): Manaus, Jun 1931, R. Shannon, 6F. **Bahia** (3F, 7L): Bonfim, 26 Jan 1930, N. Davis, R. Shannon, 3F. Prado, 1F [JH]. Salvador da Bahia, 1972, J. Fowler, BRS 277, 3L; same data, BRS 278, 4L. **Minas Gerais** (6 specimens: 2M, 1Mgen, 2F, 1L): Agua Limpa, near Juiz de Fora, 27 Mar 1925, [F. Root], 1M (64) and 1Mgen (750923-29, lectotype of *strodei*), 1F (64, paratype of *strodei*); same data, 1M (64), 1L (paratypes) [JH]. Lassance, 12 May 1925, [F. Root], 1F (81) [JH]. **Para** (14 specimens: 1M, 7F, 3p, 3 l; 3 larval ind rear): Maraba area, 7 Jun 1976, 2F (M-1); same locality, 18 Jun 1976, 1F (M-4); same locality, 21 Jun 1976, 1F (M-9); same locality, 25 Jun 1976, 1F (M-13). Palestina, 100 km SW of Maraba, 12 Feb 1976, Moramay, 1 lpM (1001); same data except 14 Feb, 2 lpF (1002). **Rondonia** (1F): Guajara Mirim, May 1931, R. Shannon, 1F. **Sao Paulo** (80 specimens: 14M, 10Mgen, 14F, 15P&p, 27L&l; 15 ind rear: 12 l, 2p, 1inc): Boraceia Field Station, BRA 114, 150, 151, 157. Itapetininga, 28 km W of, BRA 166, 167. Itapira, 1Mgen (No. 3, SPM-88, 89). Juquia, J. Lane, 1F (1.113). Porto Ferreira, 1M, 1Mgen. Santos, 1F. Sao Paulo, Butantan, 1939, [Worontzow], 1M (191-3), 1M (191-9) [JH]; same locality, 707, 3M, 3F [JH]. Sao Paulo de Piracicaba, A. Ayroza, 1Mgen (No. 4, SPM 88). Sao Paulo, Pinheiros, 1937, A. Galvao, 5M; same locality and collector, 1940, 2M. Sao Pedro, 1F (No. 4). Locality not specified, 1Mgen (No. 5, SPM 88, 89); 1943, 1Mgen (819-27); Galvao, 1 l (14-18) [JH]. **State and locality not specified** (2M, 1Mgen): J. Lane, 1M (851), 1M (854), 1Mgen (740515-33).

COLOMBIA (10 specimens: 2F, 1p, 7L&l; 1 inc ind rear). **Meta:** Villavicencio, Mar 1946, 2L (425) [JH]; same locality, 6 May 1947, L. Rozeboom, CV-P 26, 1F; same locality, 9 May 1947, 1 lp, 4L [JH]; same locality, 1947, L. Rozeboom, CV-P 32, 1F.

COSTA RICA (3F). **Province not specified:** Barranca, H. Kumm, 1F (84) [BM1938-696]. No data, 2F.

PANAMA AND CANAL ZONE (402 specimens: 43M, 8Mgen, 93F, 19P&p, 239L&l; 19 ind rear: 5 l, 10p, 4inc). **Bocas del Toro:** Punta de Pena, PA 238. **Canal Zone:** Chiva Chiva, 15 Aug 1944, Wood, ASM 102, 1L; same locality, 18, 20 Mar 1947, 2M, 1F; same locality, 20 Mar 1947, 2 F. [Ft.] Clayton and Corozal Army Reservations, Feb 1943, 1M, 2F. Ft. Clayton, 24 Apr 1944,

P. Adams, 2L. Stilsons Lake [Pond], 21 Oct 1924, D. Curry, 1Mgen. Locality not specified, Feb 1933, D. Curry, 3M [BM1933-504]. **Chiriqui:** El Hato del Volcan, PA 636, 637. Palo Santo, PA 646. **Panama:** Arraijan, 6 Feb 1940, PAX 166, 7M, 11F. Bejuco, PA 542. Juan Diaz, 4 Jan 1935, 3F; same locality and date, L. Rozeboom, 1L [JH]; same locality, 2 Dec 1936, 1F; same locality and date, L. Rozeboom, 2L [JH]; same locality, 7 Dec 1936, 6M, 12F; same locality and date, L. Rozeboom, 12L [JH]; same locality, 16 Dec 1936, 6M, 17F, 8L; same locality, 16 Dec 1936, L. Rozeboom, 3M, 11F; same data, 1L [JH]; same locality and collector, 29 Dec 1936, 2L [JH]; same locality, 1936, L. Rozeboom, 2M, 5F; same locality, PA 750, 838. La Chorrera, 31 May 1944, ASM 29, 7L; same locality, 4 Jul 1944, ASM 36, 1F; same locality, 26 Sep 1944, ASM 180, 2L; same locality, 6 Nov 1944, ASM 263, 1F, 1L; same locality, 6 Nov 1944, ASM 266, 4L; same locality, 27 Nov 1944, Wood, Griffing, ASM 297, 1L; same locality and collectors, 14 Dec 1944, ASM 337, 1F; same locality, 7 Dec 1944, K. Frick, R. Arnett, ASM 333, 1L; same locality, 13 Feb 1945, Van Doran, Turney, ASM 409, 1F; same locality, 12 Mar 1945, ASM 437, 1M, 1Mgen; same locality, 12 Mar 1945, ASM 445, 1F. Pacora, PA 761. Tocumen and Tapia, 5M, 15F. Tocumen, PA 548. **Province not specified** (1Mgen, 18 l): 6 Nov 1935, L. Rozeboom, 1Mgen; 1936, L. Rozeboom, 18 l [JH].

PARAGUAY (3F). **Alto Parana:** Locality not specified, "Calle 12," 22 Aug 1975, 3F.

VENEZUELA (20 specimens: 5Mgen, 5F, 3p, 7L&l; 3 ind rear: 1 l, 2inc). **Aragua:** Maracay, 10 May 1927, F. Root, 1F [BM1929-194]; same locality, 13 May 1927. 1 lp (10a) [JH]; same locality, 26 May 1927, 1L [JH]; same locality, 10 Jun 1927, 1 lp, 1Mgen (63e) [JH]; same locality, 1M gen (H36) [JH]; same locality, Jun 1929, 2Mgen. Turmero, VZ 337. **State not specified:** Guanoco River, L. Wehekind, 1F [BM1930-69]. Locality not specified, 1929, 1Mgen (6) [JH]; no data, 2F.

12. Anopheles (Nys.) rondoni (Neiva & Pinto)

Figs. 1, 4, 7, 12

1922. *Cellia rondoni* Neiva and Pinto 1922a:322. TYPE: *Lectotype* large wing mounted on slide (403) together with wing of type of *cuyabensis*, marked Matto Grosso, C. Pinto, remainder of adult apparently lost, type locality restricted to Ladario, on Rio Paraguai (Mato Grosso), Brazil [IOC; designation of lectotype and restriction of type locality by Belkin, Schick and Heinemann 1971:6].

Anopheles (Nyssorhynchus) rondoni of Davis (1928:539, 541, 543, 545, 546, 554-561; 1933:278-279); Dyar (1928:436); Shannon and Del Ponte (1928:42, 46, 57, 60); Edwards (1932:45); Root (1932:779); Galvao and Lane (1937e:214); Galvao and Amaral (1938:13); Lane (1939: 26-27; 1944:264, 265; 1949:403-404; 1953:273); Pinto (1939:345); Galvao (1940:447-448; 1943:143, 149, 150); Vargas (1940a:199); Fonseca and Fonseca (1942:95); Cerqueira (1943: 19); Correa and Ramos (1943:135-137; 1944b:132); Deane, L. M., Causey and Deane (1946:7, 9, 12; 1948:906); Deane, M. P., Causey and Deane (1946:42, 45); Senevet (1948a:278); Leeson and Buxton (1949:251-253); Levi-Castillo (1949:9, 10, 11, 16, 28, 58, 67, 76, 82, 86); Duret (1950a:372; 1950b:302; 1952:347); Galvao (1950:44); Rachou and Ferraz (1951:542, 547-553); Rachou and Ricciardi (1951:424-426, 432-437); Gabaldon and Cova Garcia (1952:178, 196, 201); Horsfall (1955:124, 170, 171, 182); Bejarano (1956:9, 10; 1957:326, 328, 331, 336-337; 1959:316, 325); Rozeboom and Kitzmiller (1958:244); Castro, Garcia and Bressanello (1959:549); Stone, Knight and Starcke (1959:34); Vargas (1959:370); Cerqueira (1961:127); Forattini (1962:421, 427); Rozeboom (1963:112); Belkin, Schick and Heinemann (1971:6); Consolim and Galvao (1973:177, 178, 181); Cova Garcia, Pulido F., Amarista M. (1978:157).

Anopheles rondoni of Muehlens, Petrocchi and Zuccarini (1925:251, 253, 254, 257, 264, 265); Davis and Shannon (1928:448-456); Pinto (1930:154); Russell, Rozeboom and Stone (1943:37, 41, 49); Foote and Cook (1959:16, 26, 29, 32); Maciel (1962:477); Mattos and Xavier (1965:273); Gorham, Stojanovich and Scott (1967:19, 43, 60; 1973:115, 136, 138, 150).

Cellia rondoni of Neiva and Pinto (1922b:356-357); Bonne (1924:133, 134); Brethes (1926b:313).

Nyssorhynchus (Nyssorhynchus) rondoni of Lima (1928:102).

Anopheles (Anopheles) rondoni of Bonne and Bonne-Wepster (1925:522).

Anopheles (Nyssorhynchus) tarsimaculatus var. *rondoni* of Christophers (1924:40, 90).

Cellia tarsimaculata in part of Bonne (1924:133-137).
Cellia albimana in part (?) of Neiva (1909:69-77).

FEMALE (fig. 7). Wing: 3.6 mm. Proboscis: 2.05 mm. Palpus: 2.1 mm. Forefemur: 1.6 mm. Abdomen: about 3.0 mm. **Head**: Integument dark brown. Interocular space 3,4 ommatidial diameters. Proboscis about 1.3 length of forefemur. Scales light on vertex extending caudally onto median occiput, slightly darker on occiput, dark brown laterad on postgenae. Erect scales on vertex similar to those of *oswaldoi.* Palpal segments 1, 2, 3 and 5 as in group description; segment 4 with a basal and an apical brown band, ventral surface with a row of brown scales, mediolateral scales white usually with dark scales interspersed. **Antenna**: Flagellar segment 1 with numerous, unusually long (longer than segment 2), narrow, white, oblanceolate to setiform scales along dorsomesal surface and a few, moderately long, white, lanceolate scales on apicolateral surface. Flagellar segments 2-13 each with basal whorl of 8-10 long, silver setae. **Thorax**: Integument dark brown to black, extensively pruinose. Anterior promontory scales extending a short distance dorsad onto acrostichal line. Prescutellar space large, subtriangular, very dark brown to black. Bare space at caudal end of posterior fossa small, distinct and rectangular. Upper *stp* with 2-4 long setae, and a large patch of about 15 cream, obovate scales. Lower *stp* with 1-3 setae, and 8-10 scales similar to those on upper *stp,* scales more numerous and extensive than those of other species in group. Upper *mep* with about 5 long setae; scales apparently absent. **Legs**: Light scales on coxae white to pale cream. Foretarsal segments 2 and 3 with a white band in apical 0.2-0.3 and 0.3-0.5 respectively; segment 4 all dark. Fore- and midtarsal segment 5 golden in apical 0.33-0.50. Midtarsal segments 2 and 3 with a small, cream to white, apical band. Hindtarsal segment 1 with a distinct, white, apical ring; segment 2 with a brown band in basal 0.65-0.85; segment 3 with brown band in basal 0.20-0.35; segment 5 white in about apical 0.5. **Wing**: Light wing spots cream. Vein C predominantly dark; basal dark spot small, less than 0.3-0.5 of humeral light spot; subbasal, presectoral and sectoral dark spots fused into a very long, dark spot, occasionally with a few, interspersed, light scales; preapical light spot moderately small, 0.2-0.3 of preapical dark spot; apical dark spot relatively large. R presectoral dark spot moderately long, longer than sectoral dark spot. Rs-R_{2+3} subcostal dark spot moderately large, divided or not divided by a small light spot. R_2 preapical dark spot large, about 0.5 length of vein. M sectoral dark spot distinct, small to moderately long; preapical dark spot of vein M extending unbroken onto M_{1+2}, rarely with a few light scales; base of M_{1+2} dark at furcation. Remainder of dark spots small to moderate. Apical light fringe spot small, with or without dividing dark scales; remainder of light fringe spots as in section description but small and usually inconspicuous. **Abdomen**: Tergite I with a few, long, lanceolate to setiform, cream scales along caudal border. Sternite I with a few setae. Light scales on tergites II-VII extensive, long and narrow. Caudolateral and ventral scale tufts with moderately long, broad scales.

MALE. Wing: 3.3 mm. Proboscis: 2.9 mm. Forefemur: 1.85 mm. Abdomen: about 2.8 mm. Essentially as in female except for sexual characters. Description based primarily on 2 specimens from Jujuy, Argentina. **Head**: Palpal segments 2 and 3 with a light dorsal stripe; segment 4 predominantly white, occasionally with a small, dark, apical band, ventrally dark scaled. **Antenna**: About 0.75 length of proboscis. Flagellar segment 1 with long oblanceolate scales on dorsomesal margin. **Legs**: Forefemur about 0.55 length of proboscis. Spiniform setae of basal plantar surface of foretarsal segment 5 moderately long. Claw on foreleg long, acuminate; submedian tooth tapered to a slightly recurved point; basal tooth not visible on any

specimens examined.

MALE GENITALIA (fig. 12). **Segment VIII:** As that of *strodei.* **Segment IX:** Sternite moderately long, subtrapezoidal. Anterior apodeme a moderately short band. **Sidepiece:** Tergal surface with 4,5 long, submedian tergomedial bristles; bristles mesad of tergomedial bristles moderately long. Parabasal spine and its tubercle long, apex of spine extending to or beyond lateral margin of aedeagus on other side; tubercle about 0.5 length of spine. Basal apodeme moderately long, about 0.15-0.20 length of sidepiece. Longer, more dorsal accessory spine at least 0.5 length of sidepiece; more ventral spine about 0.75 of longer spine. Internal spine subequal to shorter accessory spine, apically retrorse. **Clasper:** As that of *strodei.* **Dorsal Claspette:** About 0.5 length of sidepiece. Pedicel moderately narrow; base curved mesad. Leaflets broad, subequal in length to pedicel; dorsal leaflet with moderately developed basomesal projection. **Ventral Claspette:** Similar to that of *strodei.* Large, slightly less than 0.5 length of sidepiece; apex broad, width at apex about 0.7 length of claspette. Basal lobule as that of *strodei*, with setae along basal margin long, about 2.0 width of aedeagus. Apex more or less truncate and rugose, with a small, U shaped median sulcus. Apex strongly expanded laterally, as that of *strodei,* into large, rounded lobe; apicolateral lobe appears slightly heavier than that of *strodei.* Setae usually on basal lobule only, not extending toward apex to base of apicolateral lobe. Preapical plate moderate, circular to oval, very weakly sclerotized and ill-defined, located about 0.25 length of claspette basad of apex. Refringent structure inconspicuous, in shape of inverted horseshoe. **Phallosome:** As that of *strodei.*

PUPA, LARVA. No specimens available.

DISCUSSION. This species can be distinguished from other species in the Oswaldoi Subgroup in the **female** by (1) palpal segment 4 with a ventral row of brown scales, (2) prescutellar space large, subtriangular, very dark brown to black, (3) foretarsal sement 3 light in apical 0.3-0.5, (4) hindtarsal segment 2 with a large dark band in basal 0.65-0.85, (5) hindtarsal segment 3 with a dark band in basal 0.20-0.35, (6) vein C predominantly dark, subbasal, presectoral and sectoral dark spots fused into a very long, dark spot, occasionally with a few, interspersed, light scales, and apical dark spot relatively large, (7) vein R_2 with large preapical dark spot and (8) the preapical dark spot of vein M extending uninterrupted onto M_{1+2}; and in the **male genitalia** by the combination of (1) ventral claspette similar to *strodei*, except that setae usually on basal lobule only, not extending toward apex to base of apicolateral lobe, (2) apex of ventral claspette strongly expanded laterally into large rounded apicolateral lobe which appears slightly heavier than in *strodei* and (3) preapical plate moderate, circular to oval, very weakly sclerotized and ill-defined.

An. rondoni is the sister species of *strodei.* The male genitalia are almost identical with the exception of the characters mentioned above. Although I did not have the opportunity to study the **larva** of *rondoni,* several authors (Davis 1933:278-279; Correa and Ramos 1943; Galvao 1940:444-445) report that it is similar to that of *strodei,* differing only in that *rondoni* has (1) fewer branches on hair 1-P (11-14), (2) fewer branches on the palmate hairs (20-24) and (3) fewer teeth on the pecten.

Rozeboom (1963:112) believed that *rondoni* was a mutant melanic form of *strodei,* just as *bisignatus* and *trisignatus* are melanic mutants of *albimanus, cuyabensis* is of *triannulatus,* and *guarauno, delta* and *deltaorinoquensis* are of *aquasalis.* Davis (1933) stated that *rondoni* could not be a variety of *tarsimaculatus* or *strodei* because it "breeds true" when isolated. However, Rozeboom (1963:112) demonstrated that *bisignatus* (a mutant of *albimanus*) also breeds true when isolated from other "normal" individuals of *albimanus.* I do not discount the possibility of Rozeboom's

hypothesis being correct; however, at present I do not believe that *rondoni* is a mutant form of *strodei*. *An. rondoni* has been collected in considerable numbers (Davis and Shannon 1928) in numerous different localities. It has a fairly large distribution, occurring at times sympatrically with *strodei*. Besides the extra hindtarsal dark band and large prescutellar space, the wing spots of *rondoni* are very different from *strodei* and are unique within the Oswaldoi Subgroup. Furthermore, mutants of *strodei* that exhibit extra hindtarsal bands do not possess the other characters which distinguish *rondoni*. Whether or not hybridization occurs between *strodei* and *rondoni* has not been investigated. Until more is known about the biology of *rondoni* I am considering it a separate species, albeit with a high degree of affinity toward *strodei*. *An. rondoni* may be a relatively new species recently diverging from *strodei*. From its present distribution it would seem that *rondoni* evolved in the region of northern Argentina, Bolivia and southern Brazil.

BIONOMICS. Most of the discussion presented is from the work of Davis and Shannon (1928) on the bionomics of *rondoni* in and around the city of Ledesma, in the villages of Canitas and Calilegua, Jujuy, Argentina from March 1926 until May 1927.

Davis and Shannon first discovered the immatures of *rondoni* along the margin of a reservoir in Ledesma. They soon found that a shallow ditch adjacent to a reedy swamp behind the reservoir was a highly favored aquatic habitat of *rondoni*. From that ditch 100 larvae were collected from which 75 adults emerged: 72 were *rondoni*, 2 were *An. (Ano.) pseudopunctipennis* and one was *"tarsimaculatus."* Later Davis and Shannon encountered the immatures of *rondoni* in clear water such as in ditches, drying pools at the edge of swamps, a puddle in a road and in heavy growths of grass in a flooded meadow; the aquatic habitats were sometimes with considerable detritus, but not with algae. The type specimens were collected on the right margin of the Paraguay River, and later material was collected on the left margin of the S. Lourenco River. *An. rondoni* is most abundant in the province of Jujuy, Argentina and in Rincao, Sao Paulo, Brazil in March, during the late summer. In Jujuy, it is present all year, although occasionally in low numbers.

The adults are usually active early in the evening. On one occasion 120 females were collected on a horse between 1730 and 1800 h, flight commencing while it was still daylight (Davis and Shannon 1928). The females are commonly found inside houses (Davis and Shannon 1928; Pinto 1939:402, 404; Shannon and Del Ponte 1927:60). Of 1266 anophelines collected in houses in the area of Ledesma, 118 or 9.3% were *rondoni*. Davis and Shannon concluded that *rondoni* is not as domestic as *pseudopunctipennis*, "but still is found in houses in appreciable numbers."

MEDICAL IMPORTANCE. *An. rondoni* has never been incriminated as a vector of malaria. It has never been found naturally infected with *Plasmodium* sp. During the malaria season in Jujuy, Davis and Shannon (1928) dissected 88 individuals and all were negative. In 3 different experiments, Davis and Shannon unsuccessfully attempted to infect *rondoni* with *Plasmodium falciparum*, *P. vivax* and *P. malariae*. Shannon and Del Ponte (1927:60) reported that Davis was able to infect *rondoni* experimentally; however, I have not found any other reference to that work.

DISTRIBUTION (fig. 1). *An. rondoni* occurs in southern and southeastern South America. In Brazil it has been reported from the states of Acre, Goias, Mato Grosso, Parana, Sao Paulo, Santa Catarina and Rio Grande do Sul. In Bolivia it is known in the departments of Santa Cruz, Beni and Tarija (Gabaldon and Cova Garcia 1952: 196; Cerqueira 1943: 19). The southern distributional limit is in northern Argentina where it has been reported in the provinces of Chaco, Corrientes, Formosa, Misiones,

Salta, Santa Fe and Tucuman (Garcia and Ronderos 1962:161).

Material Examined: 69 specimens: 12 males, 10 male genitalia, 47 females.

ARGENTINA (62 specimens: 12M, 7Mgen, 43F). **Jujuy**: Calilegua, 5 May 1926, R. Shannon, 24F. Ledesma, 23 Mar 1926, R. Shannon, lot 18, 4Mgen (5, 6, 7, 8); same locality, 1926, N. Davis, R. Shannon, 3F (Bac Ent nota 18); same locality, 30 Mar 1927, R. Shannon, 1Mgen; same locality, 31 Mar 1927, E. Del Ponte, R. Shannon, 1F; same locality, Mar 1927, R. Shannon, 1M (187), 1M gen (37); same locality, Mar 1927, N. Davis, 9M, 7F [JH]; same locality and collector, 1927, 1M; same locality and collector, 21 Mar, 1M; same locality and collector, 1Mgen. Locality not specified, Nov [?1938], W. Paterson, 2F [BM]. **Salta**: Oran, 15 Mar 1961, R. Salta, 2F [AMNH]. **Province and locality not specified:** No data, 4F.

BOLIVIA (3F). **Beni**: Guayaramerin, 15 Apr 1947, S. Blatmas, 1F; same locality, 5 Jul 1947, 1F (47-12258). San Ignacio, 17 Sep 1943, Torres Munoz, 3053B, [KO] 116-9, 1F.

PARAGUAY (1F). **Olimpo**: P[uerto] Esperanza, Rio Paraguay, 30 Dec 1919, U. Cornell Expedition, 1F [CU].

COUNTRY NOT SPECIFIED (3Mgen). Locality not specified 3Mgen [JH].

13. Anopheles (Nys.) benarrochi Gabaldon, Cova Garcia & Lopez

Figs. 1, 4, 7, 29, 30

1941. *Anopheles (Nyssorhynchus) benarrochi* Gabaldon, Cova Garcia and Lopez 1941:3-22. TYPE: *Syntypes* male, female, pupa, larva and egg, La Ceiba (Trujillo), Venezuela [MDM].

Anopheles (Nyssorhynchus) benarrochi of Galvao (1943:146); Vargas (1943:59; 1959:377, 383); Causey, Deane and Deane (1944:2, 5; 1946:26); Lane (1944:263; 1949:402; 1953:277-278); Deane, L. M., Causey and Deane (1946:6, 8, 9, 12; 1948:900-901); Deane, M. P., Causey and Deane (1946:42, 45); Gabaldon and Cova Garcia (1946b:91; 1952:178, 189); Coher (1948:88-89); Senevet (1948a:278; 1948c:436); Bates and de Zulueta (1949:135); Levi-Castillo (1949:10, 15, 28, 58, 67, 72, 76, 82, 86); Stone, Knight and Starcke (1959:32); Cerqueira (1961:123); Forattini (1962:418); Belkin, Schick and Heinemann (1965:72); Morales-Ayala (1971:139); Cova Garcia and Sutil O. (1976:32; 1977:23, 44, 64, 89).

Anopheles benarrochi of Russell, Rozeboom and Stone (1943:37, 41, 44); Renjifo and de Zulueta (1952:600-601); Foote and Cook (1959:24, 26, 29); Cova Garcia (1961:41-42, 68, 93-94, 114, 130-131, 155); Mattos and Xavier (1965:271); Stojanovich, Gorham and Scott (1966b:20, 31, 40); Gorham, Stojanovich and Scott (1967:16, 47, 51; 1973:113, 139, 142); Elliott (1972: 757); Cova Garcia and Sutil O. (1975a:20; 1975b:213).

FEMALE (fig. 7). Wing: 3.3 mm. Proboscis: 2.05 mm. Palpus: 2.1 mm. Forefemur: 1.4 mm. Abdomen: 2.7 mm. Very similar to that of *aquasalis*. **Head:** Integument light brown to reddish brown. Interocular space about 3,4 ommatidial diameters. Proboscis about 1.45 length of forefemur. Palpal segments 1-3 as in group description; white apical band of segment 3 moderately large; segment 4 with a basal and an apical brown band of subequal size, mediolaterally white, usually with single row of brown scales on ventral surface; segment 5 with a small, brown, basal ring extending from apex of 4. **Antenna:** Flagellar segment 1 with numerous white scales; distally with elongate oblanceolate scales on dorsal and dorsomesal surfaces, scales shorter on dorsolateral surface; basally with moderately short, obovate or cuneate scales forming an incomplete band on dorsomesal, dorsal and lateral surfaces. Flagellar segments 2-13 each with basal whorl of 8-10 tan to silver setae. **Thorax:** Integument light brown to reddish brown. Anterior promontory scales extending short distance onto acrostichal line. Humeral scale tuft dark brown below, usually not extensive. Prescutellar space small, horseshoe shaped. Upper *stp* with 3,4 long setae, and a row of moderately small, cream, obovate scales. Lower *stp* with one long seta, and a small diagonal patch of scales. Upper *mep* with about 3,4 long setae; scales absent. **Legs:** Light scales on coxae usually white. Midfemur with both anteroapical spot

and knee spot moderate size, cream or white and conspicuous. Foretarsal segments 2 and 3 with a white band in apical 0.28 (0.2-0.4) and 0.65 (0.5-0.8) respectively; segment 4 occasionally with a light apical band; segment 5 with a cream to golden band in apical 0.25-0.50. Midtarsal segment 2 with a moderately long, cream to white band in apical 0.15-0.20; segment 3 with a small, cream, apical band; segment 4 all dark or with a few, golden, apical scales; segment 5 cream in about apical 0.5. Hindtarsal segment 2 with a brown band in about basal 0.40-0.55 (0.36-0.55). **Wing:** Light wing spots cream on anterior veins, white on posterior veins. Often dark wing spots on more posterior veins indistinct. Vein C humeral light spot about 2.5 or more of basal dark spot; subcostal light spot 0.4 (0.3-0.5) of subcostal dark spot; preapical light spot 0.35 (0.30-0.45) of preapical dark spot; apical dark spot small. R presectoral and sectoral dark spots moderately small. R_3 dark spots often light brown and inconspicuous. M mostly white, sectoral dark spot present or absent; with a small preapical dark spot not extending onto M_{1+2}. M_{1+2} apical dark spot, Cu subcostal dark spot and A subbasal dark spot often indistinct. Apical light fringe spot large, unbroken or broken by a few, small, dark scales; remainder of light fringe spots as in section description, except for 2 large, fairly conspicuous spots between base of wing and vein A. **Abdomen:** Tergite I with a few, cream, obovate scales medially on caudal border. Sternite I with a few scattered setae, no scales visible. Remainder of abdomen as in section description.

MALE. Wing: 3.4 mm. Proboscis: 2.7 mm. Forefemur: 1.6 mm. Abdomen: about 2.9 mm. Essentially as in female except for sexual characters. **Head:** Palpal segments 2 and 3 with a light dorsal stripe; segment 4 almost all cream to white, with or without a small, dark, basal band, and occasionally with a dark apical band, ventral surface cream to white with a few, scattered, dark scales. **Antenna:** About 0.75 length of proboscis. Flagellar segment 1 with long, thin, white, oblanceolate scales. **Legs:** Forefemur about 0.6 length of proboscis. Foretarsal segment 5 with about 7 short to moderately long, spiniform setae on basal plantar surface. Claw on foreleg large, curved and acuminate; submedian tooth thin, slightly recurved at apex; basal tooth short, strongly decurved.

MALE GENITALIA (fig. 29). **Segment VIII:** Sternite and tergite with moderately long, light, obovate scales. **Segment IX:** Sternite long, about 0.2 length of sidepiece, subtrapezoidal. Anterior apodeme a short band across anterior margin. **Sidepiece:** Tergal surface usually with 4,5 long, submedian tergomedial bristles and 1,2 long subapicolateral bristles; bristles mesad of tergomedial bristles moderately short. Combined length of parabasal spine and its tubercle long, apex of spine extending beyond lateral margin of aedeagus on other side and occasionally to tubercle of opposite parabasal spine; tubercle about 0.5 length of spine. Basal apodeme moderately long, about 0.15 length of sidepiece and thick. Longer, more dorsal accessory spine about 0.5 length of sidepiece; more ventral spine 0.8-0.9 of longer spine. Internal spine subequal to shorter accessory spine. **Clasper:** Spiniform fusiform, occasionally hooked apically, moderate, subequal in length to seta *b*. **Dorsal Claspette:** Slightly longer than 0.5 length of sidepiece. Leaflets broad and long, about 0.5 length of claspette; dorsal leaflet with a large basomesal projection. **Ventral Claspette:** Small, about 0.33 length of sidepiece; apex wide, width at apex about 0.5 length of claspette. Basal lobule small, narrow, curving mesad; setae along basal margin short, about equal to or slightly longer than width of aedeagus. Apex moderately expanded laterally, apicolateral margin sharply angled and moderately pointed. Depending on angle of observation, apical margin either appearing truncate or with a variously developed median sulcus; apical margin unsclerotized and distinctly rugose. Setae on

lateral margins extending toward apex to or nearly to base of apicolateral lobes. Preapical plate small, circular, heavily sclerotized. Refringent structure rooflike, with arms projecting basolaterally. **Phallosome**: Aedeagus 1.20-1.45 length of ventral claspette; apex rounded, about as broad as long; without leaflets.

PUPA (fig. 29). Abdomen: about 2.65 mm. Trumpet 0.5 mm. Paddle: 0.8 X 0.6 mm. **Cephalothorax**: Hairs 1-3-C moderately developed; 1-C 2,3 branched (1-3); 2,3-C 1-3 branched. Hair 4-C 3,4 branched, subequal to 5-C. Hair 5-C 3-5 branched (2-5). Hair 6-C 2,3 forked (1-3). Hair 7-C 3,4 branched (2-4) near base; 6,7-C subequal, moderately short. **Trumpet**: Pinna moderately pigmented; long, about 4.5-5.1 (4.4-5.5) length of meatus; in lateral aspect, not appearing to taper toward apex. Meatal cleft moderately pointed. **Metanotum**: Hair 10-C single or occasionally double, moderately long, subequal to 11-C and more than 0.5 length of 12-C. Hair 11-C 3-5 branched. Hair 12-C 1-3 branched in basal 0.3, moderately long. **Abdomen**: Hair 2-I 4-6 branched (4-7) about 0.3-0.5 from base, often dendritic, slightly longer than 3-I; 3-I thin, long. Hair 4-I 4-9 branched, moderately large. Hair 5-I 1-3 branched, long. Hair 6-I single or double, about 1.5-2.0 length of 7-I. Hair 7-I 3-5 branched (3-6). Hair 9-I single, slightly longer than 7-I. Hair 0-II-VII moderately developed; 0-II 3-6 branched; 0-III 4-8 branched (4-9); 0-IV,V 4-7 branched; 0-VI 4,5 branched; 0-VII 3-5 branched. Hair 1-II,III 6-10 and 5-9 branched respectively, strongly developed. Hair 3-II inserted very near to or on caudal margin of segment adjacent to 1-II; 3-III 1-3 branched (1-4); 3-IV 4-6 branched (4-7); 3-V 3-5 forked, moderately developed. Hair 5-III,IV 7,8 and 3-5 branched respectively, median branches longer than lateral; 5-V-VII long, subequal to or slightly shorter than length of segment; 5-V occasionally double. Hair 6-II 2,3 branched (1-3) near base, 1.2-1.7 length of 7-II; 6-III 3-5 forked (2-5). Hair 7-II 4-6 branched; 7-III-V moderate; 7-III, IV 3-6 branched (3-8); 7-V 2-4 branched (1-4); 7-VI,VII single or occasionally double, long. Hair 8-III-VII moderately developed; 8-III,VII 3-6 branched (2-8); 8-IV,VI 2-5 forked; 8-V 2,3 forked. Hair 9-II-VIII in general short and stout; 9-II minute, unpigmented; 9-III very small, about 2.0 or less length of 9-II; 9-IV heavy, small, about 2.0 of 9-III, pigmented; 9-V heavy, usually less than 2.0 of 9-IV; 9-VI slightly longer than 9-V; 9-VII,VIII heavy, acuminate, about 0.33 length of segment. Hair 10-III 2-5 branched, moderately developed. Hair 4-VIII 4-6 forked (3-8), subequal to 9-VIII. **Terminal Segments**: Male genital lobe long and broad; apex with distinct mammilliform protuberance. **Paddle**: Large and caudally broad. Emarginate at insertion of hair 1-P. External buttress about 0.66 length of paddle. External margin with short, fine, filamentous spicules extending around apex and becoming indistinct along inner margin. Hair 1-P moderately short; 2-P subequal to 1-P.

LARVA (fig. 30). Head: 0.6 mm. Antenna: 0.3 mm. Anal Saddle: 0.3 mm. In general large. **Head**: Heavily pigmented. Median tooth of mental plate moderately large, less than combined width of 2 adjacent teeth from one side. Hairs 2-C single and barbed in about apical 0.5, widely spaced, clypeal index about 1.4; hair 3-C plumose, subequal to 2-C, with moderately long, conspicuous branches in about apical 0.5. Hair 4-C 2-4 branched (1-4), small, occasionally reaching base of 2-C. Hairs 8,9-C weakly plumose, short; 8-C 4-7 forked, slightly longer than distance between insertion of hairs 5-C and 6-C; 9-C 6-10 forked (5-10), longer than 8-C. Hairs 10,12-C 3,4 and 4-6 branched respectively, moderately developed. Collar moderately narrow dorsomedially and heavily pigmented. **Antenna**: Moderately pigmented. Mesal margin with stout, medium length spicules increasingly shorter from middle toward base and apex; spicules usually absent in basal and apical 0.2. Hair 1-A 5-9 branched, long, at least 2.0 width of antenna at point of insertion, inserted about 0.35-0.40

from base of antenna, branches long. Hairs 2,3-A wide and long, about 0.3 length of antenna; mesal margins with conspicuous, featherlike, serrated fringe. **Thorax**: Moderately to strongly pigmented. Submedian prothoracic group (1-3-P) not sharing a common tubercle; palmate hair 1-P with 12-16 long, moderately broad, pointed leaflets; 2-P relatively few branched (11-16), arising from a very small tubercle, lateral branches equal to apical. Hair 14-P 6-9 branched from a moderately short stalk, lateral branches shorter than median. Mesothoracic hair 1-M 27-30 branched (23-30); 2-M 1-3 forked apically, moderately long. Metathoracic hair 2-T moderately long. Palmate hair 3-T with 9-12 (8-12) semitransparent, broad, moderately long, pointed leaflets. Hair 4-T 3-5 branched, moderately small. Prothoracic pleural group spine large, longer than spines of meso- and metathoracic group. **Abdomen**: Many hairs more extensively branched than those of *strodei*. Hair 0-II,III,VI,VII 3-5 branched (2-5); 0-IV,V 4-6 branched (4-7). Palmate hair 1-I with 8-13 (8-14) semitransparent, moderately long, broad, pointed leaflets; 1-II-VII with heavily pigmented, moderately broad, spreading leaflets, often apically truncate. Hair 2-II 4-6 branched (3-6); 2-V 3,4 branched, moderately large. Hair 5-I 3-5 branched, moderately developed; 5-III 9-13 branched (8-13), moderately large. Hair 9-I 5,6 branched (5-7); 9-IV 7-10 branched; 9-V 8-12 branched (8-13). Hair 11-I 3,4 branched, moderately large. Hair 13-I,II,III 5-7 (4-8), 7-12 (6-12) and 7-14 branched respectively, small; 13-IV 10-13 branched (6-13), small; 13-V 4-6 branched (4-7), large. **Spiracular Lobe**: Pecten with 11-15 teeth; most of median teeth subequal and of moderate length; basal serrations on ventral surface of teeth fairly conspicuous. Lateral arm of spiracular apparatus moderately long and thick. Hairs 8,9-S 2-5 branched. **Anal Segment**: Covered with moderately strong spicules. Hair 1-X moderately short, as long as or slightly longer than saddle; inserted on saddle, on or very near ventral margin. Anal gills about 0.35 mm, 1.00-1.25 length of saddle.

DISCUSSION. The adult female of *benarrochi* is very similar to that of *aquasalis* and, to a lesser extent, to that of *strodei*. In order to correctly identify these 3 species, the characters given below must be correlated and compared with those given in the Discussion sections of the latter 2 species. It must be emphasized that the number of specimens of *benarrochi* that were available for study was not large, and the majority were from the same general locality. For these reasons great care must be taken in examining material from localities other than those studied here. *An. benarrochi* can be distinguished from the other species in the Oswaldoi Subgroup in the female (except for occasionally *aquasalis*) by the combination of (1) palpal segment 4 usually with a row of brown scales on ventral surface, (2) light scales on coxae usually white, (3) foretarsal segment 3 with a white band in apical 0.5-0.8, (4) hindtarsal segment 2 brown in basal 0.40-0.55 (0.36-0.55), (5) light wing spots cream on anterior veins and white on posterior veins, (6) vein C with humeral light spot about 2.5 or more of basal dark spot, (7) vein R with presectoral and sectoral dark spots moderately small, (8) vein M mostly white, sectoral dark spot present or absent, (9) apical light fringe spot large, unbroken or broken by a few dark scales and (10) dark spots on veins R_3, M_{1+2} and M_{3+4}, Cu subcostal dark spot, and A subbasal dark spot often indistinct; in the male genitalia by the combination of (1) ventral claspette small, apex wide, width at apex about 0.5 length of claspette, (2) apex of ventral claspette rugose, moderately expanded laterally with apicolateral margin sharply angled and moderately pointed, appearing truncate or with a median sulcus, (3) setae on ventral claspette extending toward apex to or nearly to base of apicolateral lobe, (4) preapical plate small, circular, heavily sclerotized and (5) basal lobule narrow, curving mesad, with setae along basal margin about equal to or slightly longer than

width of aedeagus; in the **pupa** by the combination of (1) hairs 6,7-C subequal and moderately short, (2) pinna long, about 4.5-5.1 length of meatus, not appearing to taper toward apex in lateral aspect, (3) hair 10-C moderately long, subequal to 11-C and more than 0.5 length of 12-C, (4) hair 2-I 4-6 branched (4-7), long, slightly longer than 3-I, (5) hair 9-I slightly longer than 7-I, (6) hair 6-II 1.2-1.7 length of 7-II and (7) hair 9-III very small, about 2.0 or less length of 9-II, 9-V heavy, usually less than 2.0 of 9-IV, 9-VII,VIII heavy, short, about 0.33 length of segment; and in the **larva** by the combination of (1) hair 2-C single and barbed, 3-C plumose with moderately long branches in about apical 0.5, hairs 2-C widely spaced, clypeal index about 1.4, (2) hair 4-C small, (3) collar moderately narrow dorsomedially and heavily pigmented, (4) hair 1-A of antenna 5-9 branched, long, at least 2.0 width of antenna at point of insertion, (5) hairs 1,2-P not sharing a common sclerotized tubercle, (6) hair 13-IV 10-13 branched (6-13), small, (7) lateral arm of spiracular apparatus moderately long and thick and (8) hair 1-X moderately short, as long as or slightly longer than saddle, inserted on saddle, on or very near ventral margin.

An. benarrochi is the most highly derived species in the Oswaldoi Subgroup. The derived characters include in the male genitalia the small distinct ventral claspette with its narrow, mesally curved basal lobules; in the pupa the position of hair 3-II adjacent to 1-II; and in the larva the large antennal hair 1-A, the small numerously branched hair 13-IV and the short hair 1-X.

The closest allies of *benarrochi* are *rondoni* and *strodei,* with which it shares in the male genitalia the nonsetaceous, laterally expanded apicolateral lobes and the rugose apical margin of the ventral claspette, and in the larva the narrow collar and hair 1-X inserted on the saddle. It should be stressed that the latter 2 characters in the larva may be ancestral and may not be indicative of close phylogenetic relationship.

BIONOMICS. Very little is known of the natural history of *benarrochi.* The immatures have been reported from stagnant ground pools, abandoned wells and small streams, exposed to the full sun or partial shade, and in water containing a large amount of organic material (Deane, Causey and Deane 1948:900-901; Cerqueira 1961:123). *An. benarrochi* is not found in the lower Amazon basin, and nowhere is it encountered in great abundance (Deane, Causey and Deane 1948). Deane, Causey and Deane (1948) collected the larvae in association with *triannulatus, An. (Nys.) albitarsis* and *An. (Ano.) peryassui.*

The females rarely enter houses and feed primarily on animals. Of a total of 545 adults of *benarrochi* collected by Deane, Causey and Deane (1948) only 46 or 8.4% were from inside houses. Elliott (1972:757) reports that the peak hours of biting for the females in Peru is between 1800-2000 h and 0400-0600 h, which correlates with the observation of Deane, Causey and Deane (1948) that *benarrochi* is crepuscular.

MEDICAL IMPORTANCE. *An. benarrochi* has never been implicated as a vector of malaria. Deane, Causey and Deane (1948) dissected 31 blood-fed females and found none infected with *Plasmodium* sp.

DISTRIBUTION (fig. 1). *An. benarrochi* is limited primarily to the Orinoco basin and the eastern versant of the Andes including the llanos plateau region of Colombia, parts of the upper Amazon in Brazil (Rondonia, Acre, Amazonas) and Loreto, Peru.

Material Examined: 293 specimens: 60 males, 33 male genitalia, 85 females, 64 pupae, 51 larvae; 6 progeny rearings.

COLOMBIA (286 specimens: 57M, 30Mgen, 85F, 64p, 50L; 6 progeny rearings). **Meta:** Villavicencio, 1947, L. Rozeboom, CV-P 34 (progeny rearing), 8M, 7Mgen, 9F, 15p, 9L; same data, CV-P 35 (progeny rearing), 6M, 3Mgen, 8F, 15p, 9L; same data, CV-P 36, 1F; same data, CV-P 37 (progeny rearing), 10M, 4Mgen, 12F, 18p, 13L; same data, CV-P 40 (progeny rearing), 1F, 1p, 5L; same data, CV-P 42 (progeny rearing), 19M, 4Mgen, 24F, 14L; same data, [CV-]P 42 (progeny rearing),

1Mgen, 10F [JH]; same data, CV-P 43 (progeny rearing), 9M, 3Mgen, 10F, 15p; same data, [CV-]P 43 (progeny rearing), 5M, 5Mgen, 10F [JH]; same data, 3Mgen [JH].

PERU (7 specimens: 3M, 3Mgen, 1L). **Loreto**: Iquitos, Apr 1931, R. Shannon, 3M, 3Mgen; same locality, A. Cornejod, 1L.

TRIANNULATUS SUBGROUP

14. Anopheles (Nys.) triannulatus (Neiva & Pinto)

Figs. 1, 4, 7, 31, 32

1922. *Cellia triannulata* Neiva and Pinto 1922b:356-357. TYPE: *Holotype* female, Fazenda Sao Joao, right bank of Rio Cuiaba (Mato Grosso), Brazil [LU; not in IOC] (Belkin, Schick and Heinemann 1971:6).

1923. *Cellia cuyabensis* Neiva and Pinto 1923:235-236. TYPE: *Lectotype* small wing mounted on slide (403) together with wing of type of *rondoni,* marked Matto Grosso, C. Pinto, remainder of adult apparently lost, Fazenda Sao Joao, right bank of Rio Cuiaba (Mato Grosso), Brazil [IOC; designation of Belkin, Schick and Heinemann 1971:7]. Synonymy with *triannulatus* by Galvao and Barretto (1939b:150-154).

1925. *Anopheles bachmanni* Petrocchi 1925:71-75. TYPE: *Syntypes* males and females, Corrientes, Entre Rios, Formosa, Argentina [NE; according to O. H. Casal in Belkin, Schick and Heinemann 1968:10]. NEW SYNONYMY.

1927. *Anopheles (Nyssorhynchus) davisi* Paterson and Shannon 1927:1277-1280. TYPE: *Holotype* male (200) with associated genitalia on slide, Tres Pozos, Embarcacion (Salta), Argentina, 20 Apr 1927, Paterson, Shannon and Shannon [USNM]. TRANSFERRED SYNONYMY.

1928. *Anopheles (Nyssorhynchus) perezi* Shannon and Del Ponte 1928:56-57. TYPE: *Syntypes* females, [La Finca] Santa Barbara, Departamento de la Capital (Tucuman), Argentina, 7 Apr 1927, Shannon and Del Ponte [NE; according to O. H. Casal in Belkin, Schick and Heinemann 1968:10]. TRANSFERRED SYNONYMY.

1941. *Anopheles (Nyssorhynchus) triannulatus* var. *chagasi* Galvao 1941:92-95. TYPE: *Syntypes* females and eggs, type locality restricted to Manaus (Belkin, Schick and Heinemann 1971:7), originally described from Chaves (Para), and Itacoatiara and Manaus (Amazonas), Brazil [LU]. Synonymy with *triannulatus* by Lane (1949:404).

Anopheles (Nyssorhynchus) triannulatus of Dyar (1928:437); Edwards (1932:45); Galvao and Lane (1937e:214; 1941:10-18); Pinto (1939:406-425); Lane (1939:29-30); Galvao and Barretto (1939b:150-156); Galvao (1940:437-443; 1943:144, 149, 150, 151); Komp (1941a:93, 97; 1941b:792; 1942:37, 43, 69-71, 80, 118-120, 132, 156-158; 1956:39); Correa and Ramos (1942a:42-43; 1944b:132); Fonseca and Fonseca (1942:94, 95, 97, 99); Rozeboom (1942a: 241-242; 1963:112); Simmons and Aitken (1942:39, 45, 53, 61, 97-99); Bruce, Knigin, Yolles and Graham (1943:441-442); Cerqueira (1943:19-20); Fonseca and Unti (1943:49-50); Galvis (1943:89-91); Unti and Ramos (1943:28); Causey, Deane and Deane (1944:2, 4, 5; 1946:26); Lane (1944:262-268; 1949:404); Deane, L. M., Causey and Deane (1946:7, 9, 10; 1948:901-904); Deane, M. P., Causey and Deane (1946:38, 39, 42, 45); Floch and Abonnenc (1946b:3, 5; 1947:7; 1951:52-55); Gabaldon and Cova Garcia (1946a:19-20; 1946b:121-124); Amaral and Penido (1947:168); Arnett (1947:198-199; 1950:106, 110, 112); Senevet (1948a:278; 1948c: 434-439); Vargas (1948:157-158); Bates and de Zulueta (1949:134, 137, 139); Levi-Castillo (1949:9, 10, 11, 13, 16, 28, 67, 73, 77, 82, 86); Duret (1950a:474-475; 1950b:302; 1952:348); Carvalho and Rachou (1951:475-476, 480); Rachou and Ferraz (1951:542, 547-553); Rachou and Ricciardi (1951:424-426, 432-437); Horsfall (1955:185); Bejarano (1956:9, 10, 20, 21; 1957:327-328, 339-342; 1959:319, 325); Rozeboom and Kitzmiller (1958:244); Vargas V. (1958b); Castro, Garcia and Bressanello (1959:550); Stone, Knight and Starcke (1959:34); Faran (1961:11-12); Forattini (1962:311, 400-405); Belkin, Schick and Heinemann (1968:10; 1971:6, 7); Consolim and Galvao (1973:177); Cova Garcia, Pulido F. and Amarista M. (1978: 157).

Anopheles triannulatus of Rozeboom (1941:101-102); Vargas (1940a:199-200; 1941:114); Russell, Rozeboom and Stone (1943:26, 30, 37, 41, 50); Floch and Abonnenc (1944a:1-7; 1946a:2); Renjifo and de Zulueta (1952:600-601); Vargas V. (1958c); Foote and Cook (1959:20, 23); Maciel (1962:475-476); Vincke and Pant (1962:2-4, 6, 7, 10); Mattos and Xavier (1965:274-275); Stojanovich, Gorham and Scott (1966a:13, 18, 35; 1966b:22, 28, 44); Gorham, Stojanovich and Scott (1967:15, 45, 46, 60; 1973:111, 151).

Anopheles (Nyssorhynchus) triannulatus triannulatus of Galvao and Lane (1941:11-17); Vargas (1941:114, 118; 1959:376, 382); Galvao (1943:149, 150); Lane (1953:274-276); Vargas V. (1956:28, 33; 1957; 1958b); Bejarano (1957:339-342; 1959:305, 321); Cerqueira (1961:127-128); Garcia and Ronderos (1962:137-139, 161-162); Morales-Ayala (1971:139).

Anopheles triannulatus triannulatus of Vargas (1943:58).

Anopheles (Anopheles) triannulata of Bonne and Bonne-Wepster (1925:520-521).

Cellia triannulata of Bonne (1924:133, 134).

Anopheles (Nyssorhynchus) tarsimaculatus var. *triannulatus* of Christophers (1924:40-41, 91).

Anopheles (Nyssorhynchus) bachmanni of Root (1926b:684-696, 714-715); Davis (1928:562); Dyar (1928:427, 430, 435); Shannon and Del Ponte (1928:55); Hill (1930:712; 1934:425-429); Shannon and Davis (1930:488); Shannon (1931:10, 22; 1933:118, 126-132); Curry (1932:566-572; 1934:646); Edwards (1932:45); Antunes and Lane (1933:91-97); Townsend (1933a:101); Senevet (1934:47-49; 1937:361-362); Komp (1936a:161); Galvao and Lane (1937a:77, 78; 1937e:214, 223); Galvao, Lane and Correa (1937:41); Galvao and Amaral (1938:13); Rozeboom (1938a:101-102; 1938b:290-300); Kumm and Ruiz (1939:438); Pinto (1939:406-425); Kumm, Komp and Ruiz (1940:389, 391, 410, 419); Komp (1941a:95); Floch and Abonnenc (1942a:2; 1942b:2); Cova Garcia and Sutil O. (1976:31; 1977:22, 46, 62, 88).

Anopheles bachmanni of Petrocchi (1923:139); Muehlens, Petrocchi and Zuccarini (1925:265); Hill (1928:355); Benarrochi (1931:691-693); Davis (1931:46-47, 49-50); Kumm (1932:4); Pinto (1932:287); Rozeboom (1935:521-528); Kumm and Novis (1938:503); Clark, Komp and Jobbins (1940:62); Gabaldon, Lopez and Ochoa Palacios (1940:38); Gabaldon, Ochoa Palacios and Perez Vivas (1940:42-55); Cova Garcia and Sutil O. (1975a:22; 1975b:211).

Anopheles (Nyssorhynchus) triannulatus bachmanni of Garcia and Ronderos (1962:137, 138, 139, 162); Morales-Ayala (1971:139).

Anopheles triannulatus bachmani (!) of Cova Garcia (1961:39-40, 68, 91-92, 113, 128-129, 154).

Anopheles buchmanni (!) of Clark (1934:642).

Nyssorhynchus (Nyssorhynchus) bachmanni of Lima (1928:98-100).

Nyssorhynchus bachmanni of Townsend (1934:494).

Anopheles (Nyssorhynchus) davisi of Shannon and Del Ponte (1928:43-45); Pinto (1939:406-425); Castro (1959a:174); Castro, Garcia and Bressanello (1959:549).

Anopheles davisi of Renjifo and de Zulueta (1952:600-601).

Anopheles (Nyssorhynchus) triannulatus davisi of Galvao and Lane (1941:11-17); Galvao (1943:144, 149, 151); van der Kuyp (1949a:67-68); Rey and Renjifo (1950:534, 537); Lane (1953:276-277); Vargas V. (1956:28); Bejarano (1956:9, 20, 21; 1957:339-342; 1959:305, 320); Vargas (1959:382).

Anopheles triannulatus davisi of Vargas (1943:58).

Anopheles (Nyssorhynchus) cuyabensis of Dyar (1928:437); Edwards (1932:45); Galvao and Lane (1937e:214); Pinto (1939:410, 412-414).

Nyssorhynchus (Nyssorhynchus) cuyabensis of Lima (1928:103).

Anopheles (Nyssorhynchus) tarsimaculatus var. *cuyabensis* of Christophers (1924:40, 90).

Anopheles (Anopheles) cuyabensis of Bonne and Bonne-Wepster (1925:521).

Anopheles (Nyssorhynchus) perezi of Edwards (1932:45).

Anopheles tarsimaculatus in part (?) of Edwards (1922:75).

Nyssorhynchus tarsimaculatus in part of Townsend (1933b:1, 7-12).

FEMALE (fig. 7). Wing: 2.6 mm. Proboscis: 1.8 mm. Palpus: 1.65 mm. Forefemur: 1.15 mm. Abdomen: 2.2 mm. A small, often predominantly dark species. **Head:** Integument brown to dark brown. Interocular distance about 3,4 ommatidial diameters. Proboscis about 1.55 length of forefemur. Dorsal surface of palpal seg-

ment 2 with or without a few light scales; dorsal surface of segment 3 with few to several, light scales forming a longitudinal stripe from about 0.5 distad of base to near apex; palpal segments 2 and 3 with a small to moderately wide, white, apical band; segment 4 variable but always with a basal and an apical, dark band, ventral surface dark scaled, and mediolateral surface from almost completely dark with few light scales to predominantly white; segment 5 white with or without a few dark scales at base extending from apex of 4. **Antenna:** Base of flagellar segment 1 dorsolaterally with small, white, obovate scales; apical 0.5 on dorsomesal surface with several long, narrow, lanceolate scales. **Thorax:** Integument reddish brown to very dark brown or maroon. Light scales of scutum moderately long and narrow. Upper *stp* with 3-5 long setae, and a patch of silver, cuneate to obovate scales in a horizontal arc. Lower *stp* with 1,2 long setae, and a patch of scales similar to those of upper *stp* in a diagonal row. Upper *mep* with 2-6 setae closely approximated dorsocaudally; scales absent. Anterior *mep* with a conspicuous, moderately large patch of silver to white, cuneate scales oriented horizontally at same level as scales on upper *stp*. **Legs:** Light coxal scales usually white. Foretarsal segments 2 and 3 with a pale cream to white band in apical 0.20 (0.15-0.35) and 0.6 (0.35-0.75) respectively; segment 4 with a pale cream to white band in apical 0.55 (0.45-0.65); segment 5 dark, occasionally with a few, golden, apical scales. Midtarsal segments 1 and 2 with a cream apical band; segments 3-5 completely dark or with a few, light, apical scales. Hindtarsal segment 2 with a dark band in basal 0.5 (0.4-0.7). **Wing:** Dark wing spots predominantly large. Light wing spots usually cream to yellowish at least on veins C and R. Vein C often almost completely dark, light spots occasionally obsolete; basal dark spot usually reaching humeral crossvein; humeral light spot small, almost always shorter (0.5-1.3) than basal dark spot; subbasal dark spot longer than subbasal light spot; subcostal light spot about 0.15 (0.1-0.2) of subcostal dark spot; preapical light spot about 0.25 (0.1-0.4) of preapical dark spot; apical dark spot moderately large and conspicuous. R presectoral dark spot usually large. R_2 preapical dark spot large, usually at least 0.5 length of vein. R_{2+3} about 0.5 of R_2. M sectoral dark spot variable, usually very large, often 0.7 of vein. M_{3+4} preapical dark spot and vein A subcostal dark spot large. Light fringe spots as in section description. **Abdomen:** Sternite I with a few, moderately long to long setae along lateral margin, no scales visible. Remainder of abdomen as in section description except tergites II-VII usually not as densely and extensively covered with silver to cream scales as in other species in section, and light scales concentrated toward midline of tergites.

MALE. Wing: 2.75 mm. Proboscis: 2.3 mm. Forefemur: 1.30 mm. Abdomen: about 2.6 mm. Essentially as in female except for sexual characters. **Head:** Palpal segments 2 and 3 with or without light dorsal stripe; segment 2 usually with only a few light scales; segment 4 with a basal and an apical, white band, and a subbasal and a subapical, moderately large to large, dark band, mediolaterally with or without cream to white scales which are less extensive than those of the Oswaldoi Subgroup. **Antenna:** About 0.8 length of proboscis. Flagellar segment 1 with long, white, oblanceolate scales. **Legs:** Forefemur 0.6 length of proboscis. Basal plantar surface of foretarsal segment 5 with moderately long, spiniform setae; setae conspicuously longer apically, about 0.3 length of segment 5. Claw on foreleg large, curved, acuminate; submedian tooth about 0.2 length of claw, with conspicuously recurved apex; basal tooth moderately short and decurved.

MALE GENITALIA (fig. 31). **Segment VIII:** Tergite and sternite with moderately broad, light scales. Tergite with light scales and interspersed darker scales. **Segment IX:** Sternite long, about 0.2 length of sidepiece, subtrapezoidal. Anterior apo-

deme large, about 0.33 length of sternite, subtriangular. **Sidepiece:** Moderately narrow, conical. Tergal surface with 3-5 long, submedian tergomedial bristles, basal bristles shorter than apical; with very few, short to moderate bristles (occasionally absent) mesad of tergomedial bristles and one or 2 long subapicolateral bristles. Parabasal spine long, its tubercle about 0.5 or less length of spine, and apex of spine often extending beyond lateral margin of aedeagus on other side. Basal apodeme thick, moderately long, about 0.20-0.25 length of sidepiece. Accessory spines usually not appearing blunt but sharply hooked apically; longer, more dorsal spine about 0.5 length of sidepiece; more ventral spine 0.70-0.85 of longer spine. Internal spine subequal to shorter accessory spine, apically retrorse. **Clasper:** Spiniform thin, short, equal to or slightly shorter than seta *b*. **Dorsal Claspette:** Pedicel moderately heavy, indented subbasally; base rounded, mesally hooked. Leaflets very broad, strongly curved, less than 0.5 length of claspette; dorsal leaflet with base produced into prominent, mesally rounded or triangular basomesal projection. **Ventral Claspette:** Without setae. Long, about 0.5 length of sidepiece; apex wide, width at apex 0.6-0.7 length of claspette. Basal lobule moderately large. Lateral margins of claspette tapering slightly medially toward apex. Apex truncate and rugose. Apicolateral margins produced into large, striated, auriculate, laterally projecting lobes. Preapical plate near apex, small, oval, heavily sclerotized, often appearing as 2 small, heavily sclerotized, adjacent, circular dots embedded in a small, moderately sclerotized, oval plate. Transparent, inverted U shaped, membranous band mesally bordering vertex and lateral margins of basal lobules. Basal lobules interconnected by a weakly sclerotized, speckled membrane; membrane conspicuously more sclerotized at vertex of mesal cleft than basally. **Phallosome:** Aedeagus narrow, long, subequal to length of ventral claspette; apex rounded, about 1.5 as long as wide; without leaflets.

PUPA (fig. 31). Abdomen: 2.13 mm. Trumpet: 0.4 mm. Paddle: 0.65 X 0.44 mm. Small and dark. Branches of hairs relatively long. **Cephalothorax:** Brown to brownish black. Hairs 1-3-C 2,3 branched (1-4); 2-C slightly shorter than 1,3-C. Hairs 4,5-C 2-4 branched (2-5); 5-C about 1.5 length of 4-C. Hairs 6,7-C 1-3 branched; 6-C forked about 0.5 from base, shorter than 7-C; 7-C with one branch very long (0.3 mm), about 1.5-2.0 length of other branch(es). **Trumpet:** Pale yellow to yellow. Pinna very long, about 4.0-6.5 (3.4-8.0) length of meatus, narrow; in lateral aspect, not appearing to taper toward apex. Meatal cleft long, open and basally rounded. **Metanotum:** Hair 10-C single, short, much shorter than 11-C and 0.5 or less length of 12-C. Hair 11-C 3 branched near base. Hair 12-C 2,3 branched (2-4). **Abdomen:** Brown to brownish black, darker dorsomedially. Float hair (1-I) with 7-15 major branches, secondarily very dendritic. Hair 2-I 3-6 branched near base, moderately long; 3-I single, subequal to 2-I. Hair 4-I 4-6 branched (4-7), moderately large, subequal to 2-I. Hair 5-I single and long. Hair 6-I single, very long (0.35 mm), about 2.0 length of 7-I. Hair 7-I 3-6 branched (1-6). Hair 9-I single, subequal to 6-I. Hair 0-II-VII few branched (2-5), moderately small. Hair 1-II,III strongly developed; 1-II 8-11 branched (8-12); 1-III 4-8 branched, median branches longer than lateral; 1-IV-VII very long, 1.75-2.00 length of segment; 1-V,VI longer than 1-IV,VII. Hair 3-IV 3-6 branched (2-6), moderately long; 3-V 2-4 forked. Hair 5-III 5-8 branched (5-9), lateral branches shorter than median; 5-IV double or triple, long; 5-V-VII single, subequal to length of segment. Hair 6-II single, very long, about 2.0 length of 7-II; 6-III 1-3 forked, long. Hair 7-II 3-6 branched; 7-III,IV 4 or fewer branched, moderately small; 7-V 1-3 branched, about 1.5 length of 8-V; 7-VI,VII single, long. Hair 8-III-VII 1-3 branched, small. Hair 9-II,III thin, sharp, small, unpigmented; 9-III slightly longer than 9-II; 9-IV moderately small, 2.0 or more length of 9-II,III, pigmented;

9-V 2.7-6.0 (2.3-6.0) length of 9-IV; 9-V-VIII slender, curved, acuminate, very long; 9-V,VI slightly shorter than 9-VII,VIII; 9-VII 1.1-1.4 (0.90-1.42) length of 9-VI; 9-V-VIII about 0.5 or more length of segment. Hair 10-III 2,3 forked, moderately long. Hair 4-VIII 2-4 forked, subequal to 9-VIII. **Terminal Segments**: Male genital lobe broad, with a moderately large mammilliform protuberance. **Paddle**: Large, weakly oblique, truncate; midrib fairly distinct, extending almost to apex. External buttress about 0.68 length of paddle. External margin with moderately short, filamentous spicules extending around apex and along inner margin to 0.66 from base; spicules very short on inner margin. Hair 1-P moderately large. Hair 2-P less than or equal to 1-P.

LARVA (fig. 32). Head: 0.5 mm. Antenna: 0.25 mm. Anal Saddle: 0.27 mm. In general small and dark. **Head**: Usually very dark and strongly pigmented. Median tooth of mental plate moderately narrow, less than combined widths of 2 adjacent teeth from one side. Inner and outer clypeal hairs (2,3-C) single, and simple or barbed in about apical 0.5; 3-C shorter than 2-C; hairs 2-C widely spaced, clypeal index about 1.3. Hair 4-C 2-4 branched, small, not reaching base of 2-C, inserted slightly laterad of an imaginary median line separating 2-C and 3-C. Hairs 8,9-C 3-5 branched (2-6), long, about 2.0 distance separating insertion of 5-C and 6-C. Hair 10-C 2-4 branched, large. Hairs 12,13-C 4-7 branched (3-7), large. Hair 15-C 3-5 forked. Collar narrow dorsomedially, heavily pigmented. **Antenna**: Darkly pigmented. Mesal margin with strong, stout spicules; ventral surface with stouter, shorter spicules. Hair 1-A 4-6 branched (3-6), short. Hairs 2,3-A large, about 0.4 length of antenna. **Thorax**: Moderately to heavily pigmented at least medially; grayish brown to almost black. Submedian prothoracic group (1-3-P) with 1,2-P not sharing a common tubercle; palmate hair 1-P with 15-20 (13-20) very narrow to narrow, lanceolate leaflets (rarely filiform); 2-P 16-23 branched, arising from small pigmented tubercle, about 3.0 length of 1-P. Hair 11-P double, branched 0.25 from base. Hair 14-P 11-14 branched (9-15) from an elongated, flattened shaft, lateral branches shorter than median. Mesothoracic hair 1-M 26-40 branched. Metathoracic palmate hair 3-T with 9-14 large, narrow, semitransparent leaflets. Hair 4-T 3-5 branched, moderately long. Pro-, meso- and metathoracic pleural group spines large; mesothoracic spine larger than pro- and metathoracic spines. **Abdomen**: Hairs usually proportionally longer than those of other species in group. Hair 0-II-VI 6-11 branched (5-12). Palmate hair 1-I with 14-17 (12-18) semitransparent, narrow, pointed leaflets; 1-II-VII with about 20-30 pigmented, narrow, pointed leaflets. Hair 2-II 6-9 branched (5-10), large; 2-V single or occasionally double, very long. Hair 5-I 4-6 branched (3-6), moderately developed; 5-III 7-11 branched. Hair 9-I 6-9 branched (5-10), branches long; 9-IV,V 7-12 branched (6-12). Hair 11-I 5-7 branched (3-7), large. Hair 13-I 3 branched (2-4), very large; 13-II 7-11 branched, moderately large; 13-III,IV 4-6 branched (3-7), large; 13-V triple, very large. Sclerotized tergal plate VII about 2.0 size of tergal plate VI. **Spiracular Lobe**: Pecten with 14-18 teeth; many of median teeth subequal; serrations conspicuous in basal half of teeth. Hairs 8,9-S 4-7 branched, large; 8-S smaller than 9-S. Lateral arm of spiracular apparatus long, directed laterally, truncate at lateral apex and reaching spiracular openings. **Anal Segment**: Covered with moderately long spicules. Saddle reddish brown. Hair 1-X long; inserted on saddle near ventral margin, about 0.3 cephalad of caudal margin. Anal gills slightly longer than saddle.

DISCUSSION. The monotypic Triannulatus Subgroup can be distinguished from the Oswaldoi Subgroup in the **female** by (1) anterior mesepimeron with a conspicuous patch of silver to white, cuneate scales, (2) palpal segment 4 with mediolateral surface having a reduced number of light scales, (3) foretarsal segment 4 with a light

band in apical 0.55 (0.45-0.65), (4) foretarsal segment 5 dark, occasionally with a few, apical, golden scales, (5) hindtarsal segment 2 brown in basal 0.5 (0.4-0.7), (6) vein C with large dark spots, light spots occasionally obsolete, humeral light spot small, 0.5-1.3 length of basal dark spot, apical dark spot moderately large and conspicuous and (7) vein M with sectoral dark spot usually very large, often 0.7 length of vein; in the **male genitalia** by (1) ventral claspette without setae, apicolateral margins produced into 2 large, striated, auriculate, laterally projecting lobes, (2) preapical plate small, oval, heavily sclerotized and (3) aedeagus long, subequal to length of ventral claspette, with apex about 1.5 as long as wide; in the **pupa** by the combination of (1) pinna narrow, very long, about 4.0-6.5 (3.4-8.0) length of meatus, not appearing to taper toward apex in lateral aspect, (2) hair 7-C with one branch about 1.5-2.0 length of other branch(es), (3) hair 10-C single, short, 0.5 or less length of 12-C, (4) hair 3-I subequal to 2-I, (5) hair 6-I,II very long, about 2.0 length of hair 7 on same segment, (6) hair 9-III slightly longer than 9-II, unpigmented, 9-IV 2.0 or more length of 9-III, 9-V 2.3 or more length of 9-IV, 9-V,VI slightly shorter than 9-VII,VIII and about 0.5 or more length of segment and (7) paddle large, weakly oblique, truncate; and in the **larva** by the combination of (1) hairs 2-C single, and simple or barbed, widely spaced, clypeal index about 1.3, (2) collar narrow dorsomedially, heavily pigmented, (3) palmate hair 1-P with 15-20 (13-20) very narrow to narrow, lanceolate leaflets, 2-P 16-23 branched, arising from a small pigmented tubercle, about 3.0 length of 1-P, (4) hair 14-P 11-14 branched (9-15) from an elongated, flattened shaft, (5) hair 11-I 5-7 branched, large, and 13-I 2-4 branched, very large, (6) hair 13-III,IV 4-6 branched (3-7), large, (7) tergal plate of segment VII large, about 2.0size of tergal plate VI and (8) lateral arm of spiracular apparatus long, directed laterally.

Although the chaetotaxy of the larva and pupa varies, morphologically *triannulatus* is fairly uniform throughout its range. In the larva, there is considerable variation in the number and width of the leaflets of hair 1-P and in the length of the lateral arms of the spiracular apparatus which varies from long to very long. In the pupa, hair 1-III usually has 3 branches in specimens from Brazil and 4,5 branches in those from Panama. On an average, pupae examined from Brazil had one fewer branch per hair than pupae from Panama. In the female, the sectoral dark spot of vein M usually is smaller in Panamanian specimens than in the Brazilian specimens, although this is a highly variable character.

An. triannulatus possesses several derived characters including in the female (1) presence of a patch of light scales on the anterior mesepimeron, (2) apical light band of foretarsal segment 4 and (3) the unique wing spotting; in the male genitalia (1) shape of the apex of the ventral claspette and (2) shape of the aedeagus; and in the larva (1) elongated, flattened shaft of hair 14-P and (2) long lateral arms of the spiracular apparatus. These derived characters which distinguish *triannulatus* from the Oswaldoi Subgroup necessitates, I believe, placement of *triannulatus* in a monotypic subgroup.

In addition, *triannulatus* retains several ancestral characters which it shares with the Albimanus Group and with some species of the Argyritarsis Section, such as, in the adult, the small amount of white on palpal segment 4 and the predominantly dark foretarsal segment 5; in the male genitalia, the absence of setae on the ventral claspette; and in the larva, the number and width of the branches of hair 1-P and the large, sparingly branched hair 13-I,III,IV.

Within the Oswaldoi Subgroup, *triannulatus* shows a greater affinity to the Strodei Complex than to the Oswaldoi Complex. This species shares many synapomorphic

characters with *strodei* and *rondoni* such as, in the male genitalia, the apicolateral expansion of the ventral claspette; in the pupa, the very long pinna of the trumpet and the very long, slender hair 9-VII,VIII; and in the larva the relatively narrow collar and hairs 1-3-P not sharing a common tubercle.

The taxonomy of *triannulatus* has been very confusing in part due to the numerous mutant forms which have been described as separate nominal species. In fact, the description of *triannulatus* by Neiva and Pinto (1922b) was based on an anomalous specimen that had extra black basal bands on the second and third hindtarsal segments. In 1923, Neiva and Pinto described another mutant form, *cuyabensis,* distinguished from *triannulatus* by having only one extra basal black ring on the fourth hindtarsal segment. Petrocchi (1925) described the more typical form she called *bachmanni,* clearly illustrating its male genitalia. Later, 2 other nominal species were described, *davisi* Paterson and Shannon 1927 and *perezi* Shannon and Del Ponte 1928, both said to be very closely related to *bachmanni.* Lima (1928:103), after examining a cotype of *cuyabensis,* stated that this species was extremely similar to *bachmanni.* Dyar (1928:435) the same year listed *davisi* and *perezi* as synonyms of *bachmanni.* In 1930, Pinto synonymized *bachmanni* with *cuyabensis,* stating, *"Os estudos de Davis reforcam o nosso ponto de vista de que a pequena mancha negra existente na base do IV articulo do tarso posterior de* A. cuyabensis *e uma variacao. Caso este fato venha a se confirmar o* A. bachmanni *caira forcosamente na sinonimia de* A. cuyabensis *que foi descrito dois anos antes."* Galvao and Barretto (1939:150-154) synonymized *cuyabensis, bachmanni, davisi* and *perezi* with *triannulatus* based on Pinto's (1939:406-425) observations and on their own findings. These investigators studied material from Itapira, Brazil and discovered specimens of *cuyabensis* together with *bachmanni.* Pinto (1939) concurred with Galvao and Barretto after comparing the holotype of *triannulatus* with a female identified by Shannon as *bachmanni* (no. 2899, Resistencia) and with topotypic material of *cuyabensis.* Pinto stated that all 3 were the same species, *triannulatus* being the senior synonym. He also considered the holotypes of *triannulatus* and *cuyabensis* as atypical forms similar to those described in other species in the section. Pinto studied the larvae, males and females of *bachmanni* from other localities in Brazil and found the male genitalia to be the same as those of the topotypic material of *triannulatus* and *cuyabensis.* In the same publication (Pinto 1939), he also listed *perezi* as a synonym of *triannulatus.*

Later, Galvao and Lane (1941:11-14) examined abundant material of *triannulatus* and stated that they had observed all forms corresponding to the descriptions of *bachmanni, cuyabensis* and *triannulatus.* However, Galvao and Lane recognized *triannulatus* as being composed of 2 subspecies, *t. triannulatus* and *t. davisi.* The principal characters reportedly used to distinguish *t. triannulatus* from *t. davisi* were (1) pattern of the exochorion in the egg, (2) larval hair 1-P filamentous and with more branches (20-30) than in *davisi,* (3) female smaller than that of *davisi* and (4) adult wing with sectoral dark spot of Cu larger and reaching the furcation (Paterson and Shannon 1927; Galvao and Lane 1941; Rozeboom 1942a:241-242; Deane, Causey and Deane 1948:901-904). Some investigators believe that the differences between *triannulatus* and *davisi* are so striking that *davisi* merits species status (Deane, Causey and Deane 1948). I have examined adults from very near the type locality of *bachmanni,* from the type locality of *davisi* and from Salobra and other localities in Mato Grosso, Brazil where Galvao reportedly collected *t. triannulatus.* Though there is some variation in the size of wing spots, I could not see anything in the adults which would lead me to consider *triannulatus* as being composed of 2 subspecies. Likewise in the larva, although the number and width of the branches of hair 1-P and the

length of the lateral arms of the spiracular apparatus varied, the variation was usually intrapopulational and present as a continuum. It is possible, however, that I did not ever see a true example of *t. triannulatus*, since it is considered to be much less common than *t. davisi*. In that case, my consideration of *triannulatus* as being composed of a single variable taxon may be incorrect.

Galvao (1941) described another variety of *triannulatus, chagasi,* from Chaves (Para), and Itacoatiara and Manaus (Amazonas), Brazil. *An. chagasi* was later synonymized with *triannulatus* by Lane (1949:404).

An. triannulatus, like several of the other species in the section, has been reported to be highly polymorphic in the egg stage. Galvao (1940:441-442) recognized 4 types of *triannulatus* eggs: 2 types were of *t. triannulatus* and 2 of *t. davisi*; this is discussed in detail in Rozeboom (1942a:241-242).

BIONOMICS. The immatures of *triannulatus* are most commonly collected in permanent ponds, lakes, canals, slow streams or river margins, ditches, and swamps, either exposed to the full sun or partially shaded. Occasionally *triannulatus* is collected in semipermanent and temporary rock holes, small ground pools, and animal tracks. The immatures are found in clear, fresh water, never brackish, and are usually associated with *Pistia* sp. Other commonly associated aquatic plants are *Eichhornia* sp, *Azolla* sp, *Utricularia* sp, *Jussiaea* sp, *Elodea* sp and *Salvinia* sp. The immatures have been collected in association with 7 other species in the Albimanus Section: *albimanus, oswaldoi, ininii, nuneztovari, rangeli, strodei* and on one occasion *aquasalis.* Other mosquitoes collected with *triannulatus* are *Anopheles (Ano.) apicimacula, An. (Ano.) neomaculipalpus, Uranotaenia (Ura.) apicalis, Ur. (Ura.) leucoptera, Ur. (Ura.) lowii, Ur. (Ura.) pulcherrima, Culex (Cux.) coronator* group, *Cx. (Mel.) bastagarius, Cx. (Mel.) dunni, Cx. (Mel.) educator, Cx. (Mel.) egcymon, Cx. (Mel.) elevator, Cx. (Mel.) ensiformis, Cx. (Mel.) erraticus, Cx. (Mel.) ocossa, Cx. (Mel.) panocossa, Cx. (Mel.) zeteki* group, *Aedeomyia (Ady.) squamipennis, Mansonia (Man.) dyari* and *Ma. (Man.) leberi. An. triannulatus* is most abundant in Colombia during the dry season (Bates and de Zulueta 1949:137) and is common in Panama from April to September, "from the end of the dry season well into the rainy season" (Arnett 1947:198-199).

The adult females are primarily exophilic and zoophilic. They are rarely found inside houses. In French Guiana, Floch and Abonnenc (1944a:1-7) collected 2102 anophelines in houses, of which 6 were *triannulatus.* Deane, Causey and Deane (1948:901-904) reported that of 15,583 specimens of *triannulatus* collected, only 714 or 4.6% were taken in houses. They stated that *triannulatus* feeds outside, although it will feed readily on man. Rozeboom (1938b: 294-297) in Panama found that only 0.5% of the anophelines in houses were *triannulatus,* and they preferred to feed on pigs rather than humans. He collected *triannulatus* in numbers around stables and pig sties. The only contrary finding was by Gabaldon (1949:765), who reported a large number of *triannulatus* inside a house in the Rio Apure region of Venezuela. Hill (1934) collected *triannulatus* in the area around Maracay, Venezuela in stables, houses, dairy farms, and a farm and an orphanage where malaria epidemics were a yearly occurrence. He performed precipitin tests on 262 blood engorged females and found 14 had fed on man, 173 on horses and 38 on cattle; 37 did not react to the test. He concluded that *triannulatus* "definitely perfers animal blood." However, several investigators (Rozeboom 1935:527; Deane, Causey and Deane 1948:901-904; Floch and Abonnenc 1947:7) have stated that *triannulatus* is a vicious biter, feeding readily on man outside even during the day although most actively at dusk.

MEDICAL IMPORTANCE. Throughout most of its range, *triannulatus* does not seem to be important as a vector of malaria. Only once *triannulatus* was found to have a natural oocyst infection and that was in Cojedes, Venezuela (Gabaldon and Cova Garcia 1946a:19-20). Benarrochi (1931) incriminated *triannulatus* as a possible vector of malaria at a boy's school near Maracay, Venezuela, as it was the most common species present during a marlaria epidemic. Hill (1934:428) stated that with a high density "it is probable that this species can act as a malaria transmitter."

Several investigators (Godoy and Pinto 1923; Bonne and Bonne-Wepster 1925; Rozeboom 1935; Floch and Abonnenc 1944a; Fonseca and Unti 1943:50) have experimentally infected *triannulatus* with *Plasmodium vivax* and *P. falciparum.* In comparing the susceptibility of *triannulatus* to infection with *P. vivax* and *P. falciparum* with that of *albimanus,* Rozeboom (1935:524-525) found a larger percentage of the specimens of *triannulatus* refractory to infection.

Because of the feeding behavior and low susceptibility to plasmodial infection, *triannulatus* is probably not a serious health threat, except when present in very large numbers.

DISTRIBUTION (fig. 1). *An. triannulatus* is widely distributed throughout South America east of the Andes as far south as the Argentine provinces of Chaco, Corrientes, Formosa, Jujuy, Salta, Santa Fe, Tucuman and Misiones. East of the Andes, it occurs throughout Brazil, Paraguay, most of Bolivia, the Guianas, Colombia, Venezuela, Ecuador and Peru. On the Pacific side of the Andes, *triannulatus* extends as far south as Tumbes, Peru. It is found in Central America as far north as central Nicaragua.

Material Examined: 2354 specimens: 545 males, 84 male genitalia, 1058 females, 301 pupae, 366 larvae; 262 individual rearings: 93 larval, 156 pupal, 13 incomplete; 3 progeny rearings.

ARGENTINA (52 specimens: 12M, 6Mgen, 32F, 1 lp). **Chaco:** Resistencia, 22 Feb 1927, R. Shannon, 7M, 1Mgen, 5F; same data except 23 Feb, 1M, 4Mgen; same data except 25 Feb, 1Mgen; same locality, Feb 1927, N. Davis, 2M, 1F [JH]; same locality, L. Rozeboom, 10M, 5F. **Jujuy:** Ledesma, Mar 1923, N. Davis, 1F. **Salta:** Embarcacion, 20 May 1927, R. Shannon, 2M, 5F. **Province not specified:** Salta Alto, Sierra, Apr 1960, 8F. Santa Barbara, Finca, 8 Apr 1927, E. Del Ponte, 4F; same locality and date, R. Shannon, 2F. Santa Maria, 19 Nov 1962, R. Salta, 1F [AMNH]. Locality not specified, N. Davis, 1 lp [JH].

BOLIVIA (63F). **Beni:** Guayaramerin, 19 Apr 1947, S. Blatman, 31F; same locality, 13 May 1947, 8F; same locality, 8 Jun 1947, 7F (47-12258); same locality, 23 Jun 1947, 12F (47-12258). San Ignacio, 17 Sep 1943, 3052, KO 117-27, 1F; same locality, 18 Sep 1943, Torres Munoz, 3055-A, KO 117-25, 1F. Trinidad, Aug 1946, E. Soracho, 3F.

BRAZIL. Amazonas (1F): Manaus, Jun 1931, R. Shannon, 1F. **Bahia** (7F): Bonfim, 26 Jan 1930, N. Davis, R. Shannon, 1F; same locality and collectors, 1F. Itapira, Mar 1931, 1F [JH]. R. Barboza, 21 Apr 1930, J. Serafim, 1F. Locality not specified, H. Kumm, 3F [BM1931-302]. **Mato Grosso** (3M, 2Mgen, 10F): Maracaju, Dec 1937, 2M, 1Mgen; same locality, 1937, 1M, 1Mgen, 1F. Salobra, 1936, J. Lane, 6F. Westborder, May 1931, R. Shannon, 3F. **Para** (597 specimens: 71M, 1Mgen, 346F, 127p, 52L&d; 127 ind rear: 40 l, 87p). Altamira, 150 km W of, 5 Nov 1974, J. Reinert *et al.*, coll. 77, 1 pM, 2 pF; same data except 163 km W of Altamira and 6 Nov, coll. 85, 3 lpM, 6 lpF, 6 pM, 1 pF; same data except 164 km W of Altamira, coll. 98, 2F; same data except 158 km W of Altamira and 9 Nov, coll. 111, 1M, 3 lpM, 2 lpF, 5 pM, 5 pF. Bacuri, Gleba 36, Lote 05, 23 Oct 1974, J. Reinert *et al.*, coll. 31, 2 pF; same data except Lote 02, coll. 33, 1F, 5 lpM, 12 lpF, 16 pM, 13 pF; same data except 26 Oct, coll. 50, 1M, 2F, 3 lpM, 4 lpF, 3 pM, 1 pF; same data except Gleba 29, Lote 03 and 25 Oct, coll. 44, 1 lpM, 1 lpF; same data except Lote 09 and 28 Oct, coll. 60, 2 pM; same data except Gleba 34, Lote 02, coll. 62, 1M, 1F, 4 pM, 5 pF; same data except Gleba 38, Lote 02 and 29 Oct, coll. 64, 1 pF. Belem, BRA 42, BRB 9. Boa Vista, 12 Aug, C. Town-

send, 3F. Fordlandia, Jun 1931, R. Shannon, 1M, 1Mgen, 49F. Itupiranga, 17 Feb 197[6], Moramay, 1 pM (1050); same locality and collector, 1 Jun 1976, 2 pM, 1 pF (1200). Maraba area, 4 May 1976, 10F (M-6); same locality, 6 May 1976, 1F (M-8); same locality, 18 May 1976, D. Roberts, 14F (R-1); same data except 19 May, 15F (R-2); same locality, 20 May 1976, 20F (R-3); same locality, 22 May 1976, D. Roberts, 26F (R-5); same data except 23 May, 3F (R-3); same data except 8 Jun, 6F (M-2); same data except 9 Jun, 4F (M-3); same data except 10 Jun, 5F (M-4); same locality, 14 Jun 1976, 1F (M-6); same locality, 15 Jun 1976, D. Roberts, 6F (M-7); same data except 16 Jun, 1F (M-8); same data except 24 Jun, 3F (A-1); same locality, 29 Jun 1976, 11F (M-1); same locality, 30 Jun 1976, 7F (M-2); same locality, 1 Jul 1976, 6F (M-3); same locality, 2 Jul 1976, 8F (M-4); same locality, 3 Jul 1976, 10F (M-5); same locality, 6 Jul 1976, 2F (M-7); same locality, 7 Jul 1976, 3F (M-8); same locality, 8 Jul 1976, 4F (M-9); same locality, 9 Jul 1976, 1F (M-8); same locality, 12 Jul 1976, 7F (M-12); same locality, 17 Aug 1976, 1F (C-7); same locality, 9 Sep 1976, 1F (A-7), 1F (N-1); same locality, 8 Oct 1976, 3M (1262); same locality, 11 Oct 1976, 1F (1263); same locality, 19 Oct 1976, 6F (1); same locality, 21 Oct 1976, 5F (1); same locality, 28 Oct 1976, 2F (1); same locality, 8 Nov 1976, 5F (1); same locality, 9 Nov 1976, 5F (2); same locality, 10 Nov 1976, 1F (1), 1F (2); same locality, 12 Nov 1976, 2F (2); same locality, 19 Nov 1976, 1F (2); same locality, 1976, D. Roberts, 2M, 17F. Maraba area, Fonte Lenta, 1176, Kiu 13-M-A, 1 pM, 2 pF. Palestina, 100 km SW of Maraba, 18 Aug 1976, Moramay, 1 pM (1045). Trinidad, Botanical Gardens, Oct 1924, J. Petroca, 1M. **Pernambuco** (1M, 8F): Recife, Sep 1929, 8F; same locality, Oct 1929, R. Shannon, 1M. **Rio Grande do Norte** (11 specimens: 1M, 1Mgen, 8F, 1 L): Natal, Cajupiranga, 16 Nov 1943, MacCreary, Bricker, 3F; same locality, 19 Jan 1944, 1F; same locality, 20 Jan 1944, 1M, 1Mgen; same locality, 24 Mar 1945, det. H. Dalmat, 1F [CU]. Natal, Rio Cajupiranguinha, 21 Apr 1945, det. H. Dalmat, 1F [CU]. Natal, Lagoa Segui, 23 Apr 1945, det. H. Dalmat, 1F [CU]. Rio Cajupiranga, on road to San Jose, 6 Jan 1945, H. Dalmat, 1L [CU]. San Jose, 13 Oct 1944, H. Dalmat, 1F [CU]. **Pernambuco** (1M): Afogados [de Ingazeira], 1944, H. Dalmat, 1M. **Rondonia** (14F): Porto Velho, Rio Madeira, May 1931, R. Shannon, 14F. **Sao Paulo** (1M, 1Mgen): Juquia, J. Lane, 1M, 1Mgen. **Sergipe** (1F): Estancia, Dec 1929, R. Shannon, 1F. **State not specified** (2Mgen, 2F): Parahyba, 20 Mar 1930, 2Mgen; same locality, Mar 1930, R. Shannon, 1F. Piraja, BRR 4, 1F.

COLOMBIA (270 specimens: 91M, 20Mgen, 63F, 45p, 51L&l; 8 larval ind rear; 3 progeny rearings). **Amazonas**: Leticia, 25 Jul 1975, J. Kitzmiller, COZ 74, 2M, 2F. **Antioquia**: Arquia, L. Dunn, 2F. La Pintada, COK 45A, 2M. Murindo, L. Dunn, 2F. **Atlantico**: Barranquilla, Nov-Dec 1924, L. Dunn, 1M, 9F; same locality, 24 Nov [1943], E. Palacio, COT 33, 1F. Calamar, 1966, J. Bequaert, 1M [MCZ]. **Boyaca**: Lago de Palagua, COM 601, 602, 603. Puerto Boyaca, COM 604, 650, 651. **Cordoba**: Monteria, COB 12, COL 421, 427. **Magdalena**: Aracataca, Mar 1913, J. Egbert, 1F. **Meta**: Villavicencio, 2 Jun 1942, W. Komp, KO 117-18, 19M, 4F; same locality and collector, ?1942, KO 120A-23, 1M; same locality, 1 Jun 1944, COK 38, 4F; same locality, 15 Jun 1944, COK 44A, 4F; same locality, 1944, M. Bates, CV 90, 1F; same locality, 6 May 1947, L. Rozeboom, CV-P 25 (progeny rearing), 16M, 3Mgen, 14F, 12p, 14L; same locality and collector, 1947, CV-P 31 (progeny rearing), 6M, 1Mgen, 6F, 13p, 13L; same data, CV-P 39 (progeny rearing), 12M, 5F, 12p, 13L; same locality, 9 May 1947, 1L. **Department not specified**: Cauca Valley, Jul 1943, W. Earle, KO 117-17, 1M. Locality not specified, COR 538, 1M, 1F; COR 508, 1F.

COSTA RICA (14 specimens: 6M, 1Mgen, 5F, 2L). **Province not specified**: Barranca, H. Kumm, No. 450, KO H-18-35, 3M, 1F; same locality and collector, No. 450, 2F [BM], 2M, 2L; same locality, 1M, 1Mgen, 2F.

ECUADOR (61 specimens: 12M, 1Mgen, 11F, 24p, 13 l; 23 ind rear: 13 l, 10p). **Napo**: Limoncocha, 4 Jun 1977, Y. Huang, coll. 48, 2 pF, 1 lpM; same locality and collector, 5 Jun 1977, coll. 49, 2 pM, 1 pF, 6 lpM, 1 lpF, 1p. Tena, 1.5 km S of, 13 May 1977, Y. Huang, coll. 26, 1Mgen, 1 pM, 3 pF, 1 lpM, 3 lpF; same locality and collector except 12.5 km SE of Tena, 24 May 1977, coll. 38, 1 lpF. **Pastaza**: Puyo, 5-9 May 1977, Y. Huang, coll. 28, 1 pM.

FRENCH GUIANA (15 specimens: 5M, 2Mgen, 3F, 2p, 3 l; 2 larval ind rear). **Guyane**: Cayenne, 1943, H. Floch, ?3M, 2F; same locality, FG 122. Lac du Rorota, 15 Oct 1939, FGA 7-224, 1F.

GUYANA (55 specimens: 18M, 5Mgen, 28F, 1p, 3L; 1 p ind rear). **East Berbice-Corentyne**: New Amsterdam, Jul 1936, 1Mgen. **East Demerara-West Coast Berbice**: Georgetown, 28 Sep 1945,

KO 117-21, 1F; same locality, 1 Oct 1945, KO 117-23, 1F; same data, KO 117-24, 1F; same locality, GUY 40; same locality, W. Beveridge, 1M, 1F [BM1931-210]. Hyde Park, 30 Jul 1941, BGR 3, 3M, 3Mgen. MacKenzie, Sep 1945, KO 117-26, 4F. **District not specified:** Coast, Sep 1949, BGR 9, 2M, ?15F. Locality not specified, 1940, G. Bevier, KO 117-11, 8M, 1F; same date and collector, 2M, 2F; 1942, G. Bevier, KO 117-4, 2F; no data, 3L (1B).

PANAMA AND CANAL ZONE (907 specimens: 291M, 37Mgen, 283F, 89P&p, 207L&l; 88 ind rear: 28 l, 55p, 5inc). **Bocas del Toro:** Almirante, 1932, W. Komp, 1M, 1Mgen. **Canal Zone:** Barro Colorado Island, 20 Feb 1942, KO 111-14, 2F; same locality and date, KO 117-8, 1F. Cano Saddle, 7 May 1923, R. Shannon, 6F. Empire, 16 Jun 1944, ASM 43-2, 7M, 4Mgen, 4L [CU], 2L. Empire, Rio Mandinga, 24 Aug 1944, Wood, Van Doran, ASM 131-5, 3L [CU], 2L. Fort Clayton, 23 Apr 1944, 3F. Gamboa, 5 Apr 1939, W. Komp, 1M, 2F; same locality, 10 Jun 1943, Col. Elton, 9F; same locality, 10 Jun 1943, W. Komp, 2F; same locality, 22 Jun 1944, Stearns, Middlekauff, ASM 12-1, 1L [CU]; same locality, 28 Sep 1944, Van Doran, Turney, ASM 194, 2L; same data, 1 L [CU]; same locality, 6 Jan 1947, PAX 239, 4M, 4F; same locality, 28 Jan 1947, 5M, 5F; same locality, 18 Apr 1947, H. Brooks, 3F, 3 l; same locality and collector, 22 May 1947, 1M, 4F; same locality and date, 1M; same locality, PA 912A. Gatun Lake, Apr 1935, PAX 47, 38M; same locality, 23 May 1939, 2M; same locality, 8 Aug 1940, W. Komp, 1Mgen. Juan Mina, Rio Chagres, 23 May 1939, 3M; same locality, PA 1122, 1124, 1125, 1160, 1161. La Pita, 11 Feb 1922, J. Shropshire, 1M, 2F. Mandinga Bridge, 22 Jan 1942, 3M, 4F. Mendoza, Gatun Lake, 18 May 1939, 1M. Pedro Miguel, 27 Jan 1947, 1M, 5F. Rio Chagres at Las Guacas, 23 Feb 1940, PAX 174, 14M, 14 F; Rio Chagres, below Las Guacas, 31 Mar 1944, E. Pierce, KO 117-14, 4M, 2F. Rio Chagres, 12 Feb 1942, 1M, 1F; same locality, 12 Feb 1943, KO 117-2, 20M, 19F; same locality, 31 Mar 1944, 3 l; same locality, 5 Jan 1947, 2M, 3F; probably same locality, KO 117-16, 2M, 2F. Rio Chilibre, PA 27. Rio Gatun, 10 Apr 1945, KO 117-22, 6F. Rio Gatuncillo, PA 1136. Rio Mandinga, Aug 1937, W. Komp, KO H-18-31, 11M. Rio Paja, 5 Jan 1934, 1M, 2 l; same locality, 1 l. Locality not specified, Feb 1933, D. Curry, 2M, 1F [BM1933-504]; 26 Feb-22 Mar 1944, H. Hoogstraal, 1M. **Cocle:** La Vieja, 7 Nov 1936, L. Rozeboom, 3L [JH]. **Colon:** Colon, 24 Jun 1921, W. Chidester thru J. Zetek, 1F. Santa Rosa, 30 Aug 1935, L. Rozeboom, 2L. **Panama:** Juan Mina, 6 Aug 1943, G. Fairchild, KO 117-3, 13F; same locality and collector, 5 Oct 1943, KO 117-6, 6F; same locality and collector, KO 117-5, 4F; same locality, PA 12, 31. La Chorrera, 31 May 1944, ASM 29, 1L [CU], 1L; same locality, 19 Sep 1944, Van Doran, ASM 168, 1L; same locality, 27 Nov 1944, Wood, Griffing, ASM 298-1, 5L [CU]; same data, ASM 299-2, 1L [CU]; same locality, 7 Dec 1944, K. Frick, R. Arnett, ASM 333, 3L; same locality, 8, 9 Jan 1945, Wood, Van Doran, ASM 370-2, 1F; same locality, 13 Jan 1945, K. Frick, ASM 377, 1L. Las Guacas, Dec 1934, 11M, 7M gen, 3F; same locality, 5 Feb 1935, PAX 42, 81M, 67F; same locality, 4 Apr 1935, 15M, 4Mgen; same locality, 14 Aug 1936, L. Rozeboom, 2L; same locality and collector, 6 Feb 1937, 1F; same locality and collector, 19 Mar 1937, 1F; same locality and date, 2M, 1F [AMNH]; same locality, L. Rozeboom, 24 May 1937, 1M, 1Mgen; same locality, 6 Aug 1937, 1L [JH]; same locality, Aug 1937, 1M, 1Mgen. Pacora, La Joya, Feb 1945, KO 117-20, 2F. Pedregal, PA 1163. Pequeni, PA 942. Rio Abajo, 7 Jul 1944, K. Frick, R. Arnett, ASM 59, 1L. Tocumen, PA 557, 559, 1066, 1144, 1145, 1148, 1162. **Province not specified:** Rio Pescado, 16 Jul 1936, L. Rozeboom, 1L. Locality not specified, 17 Dec 1934, 1L; 14 Aug 1936, L. Rozeboom, 4L; 1937, 3M, 8F; 1937, 621001-7, 8, 1M, 1F.

PARAGUAY (2M, 2Mgen, 7F). **Capital:** Asuncion, 1925, F. Soper, 1Mgen; same data, 1M [JH]. **Central:** Asuncion, 12 km on rd. to Villa Rica, 10 Oct 1942, KO 111-1, 3F. **La Cordillera:** San Bernardino, Fiebrig, 1M, 1Mgen, 2F. **Department and locality not specified:** 1922, Fiebrig, 2 F [BM].

PERU (86F). **Loreto:** Iquitos, Mar-Apr 1931, R. Shannon, 68F; same locality, 22 Jul 1975, J. Kitzmiller, PERZ 33, 2F. San Antonio, 17 Aug 1965, J. Hitchcock, Jr., 2F; same locality and collector, 18 Aug 1965, 3F; same locality and collector, 21 Aug 1965, 1F; same locality and collector, 23 Aug 1965, 4F; same locality and collector, 25 Aug 1965, 6F.

SURINAME (27 specimens: 3M, 1Mgen, 1F, 4p, 18L&l; 4 ind rear: 2p, 2inc). **Paramaribo:** Paramaribo, J. Bonne-Wepster, 1F. **Suriname:** Ma Retraite, SUR 206. **District not specified:** Kropie Kreek, 25 Sep 1974, 16L. Nord, Kabelstation, 26 Jun 1946, E. Kuyp, 1M, 1Mgen, 2 lp.

VENEZUELA (132 specimens: 27M, 3Mgen, 79F, 8p, 15L&l; 8 ind rear: 2 l, 1p, 5inc). **Aragua:** Maracay, 20 Aug 1926, M. Nunez Tovar, 9F; same locality and collector, 3 Sep 1926, 16F; same locality and collector, 9 Oct 1926, 11F; same locality and collector, 10 Oct 1926, 9F; same locality, 11 Sep 1926, 1F; same locality, 12 Mar 1927, 1F (No. 9); same locality, 10 May 1927, 1F [JH]; same locality, 12 May 1927, F. Root, 1F [BM1929-194]; same locality and collector, 24 May 1927, 2M, 2F [BM1929-194]; same locality, 17 May 1927, 3l (17) [JH]; same locality, 31 May 1927, 1M (No. 45); same locality, 7 Jun 1927, 3 lp (Nos. 54a, b, d) [JH]; same locality, 8 Jun 1927, F. Root, 1M [BM1929-194]; same locality, 18 Jun 1927, 1 lp (77a) [JH]; same locality, 21 Jun 1927, 1 lp (83a) [JH]; same locality, 1L. **Carabobo:** Mariara, VZ 68. Valencia, 10 Aug 1927, M. Nunez Tovar, 1M, 1F. **Cojedes:** Rd. to San Carlos, 10 Dec 1941, H. Hanson, KO 111-6, 5F. **Distrito Federal:** Caracas, 19 Apr 1938, A. Gabaldon, KO H-18-32, 7F; same data, KO H-18-34, 18M, 4F. **Guarico:** Calabozo, 22-31 May 1941, VZK 48, 1M, 3F. Chaguaramas, 4 Jul 1945, E. Winton, 1M. **Monagas:** Caripito, KO 117-12, 1M, 1F; same locality, 5 Sep 1936, KO 117-15, 1M, 2F. **State not specified:** Cap El Callai, CDC, 2L. Locality not specified, 4 Mar 1937, Anduze, 2M gen [CU]; 1949, 1Mgen, 2L; no data, 8L, 2F.

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FIGURES

1. Distribution of *albimanus, triannulatus, strodei, rondoni* and *benarrochi*
2. Distribution of *oswaldoi, noroestensis, aquasalis, ininii* and *anomalophyllus*
3. Distribution of *galvaoi, rangeli, trinkae* and *nuneztovari*
4. Hypothesized phylogenetic tree of Albimanus Section
5. *Anopheles (Nyssorhynchus) albimanus*: male and female heads and claws; male foretarsus 5; female thorax, legs, wing and abdomen
6. Wings of *oswaldoi, galvaoi, noroestensis, aquasalis, ininii, anomalophyllus* and *rangeli*
7. Wings of *trinkae, nuneztovari, strodei, rondoni, benarrochi* and *triannulatus*
8. *Anopheles (Nyssorhynchus) albimanus*: male genitalia and pupa
9. *Anopheles (Nyssorhynchus) albimanus*: larva
10. *Anopheles (Nyssorhynchus) oswaldoi*: male genitalia and pupa
11. *Anopheles (Nyssorhynchus) oswaldoi*: larva
12. Male genitalia of *rondoni* and *galvaoi*
13. *Anopheles (Nyssorhynchus) noroestensis*: male genitalia and pupa
14. *Anopheles (Nyssorhynchus) noroestensis*: larva
15. *Anopheles (Nyssorhynchus) aquasalis*: male genitalia and pupa
16. *Anopheles (Nyssorhynchus) aquasalis*: larva
17. *Anopheles (Nyssorhynchus) ininii*: male genitalia and pupa
18. *Anopheles (Nyssorhynchus) ininii*: larva
19. *Anopheles (Nyssorhynchus) anomalophyllus*: male genitalia and pupa
20. *Anopheles (Nyssorhynchus) anomalophyllus*: larva
21. *Anopheles (Nyssorhynchus) rangeli*: male genitalia and pupa
22. *Anopheles (Nyssorhynchus) rangeli*: larva
23. *Anopheles (Nyssorhynchus) trinkae*: male genitalia and pupa
24. *Anopheles (Nyssorhynchus) trinkae*: larva
25. *Anopheles (Nyssorhynchus) nuneztovari*: male genitalia and pupa
26. *Anopheles (Nyssorhynchus) nuneztovari*: larva
27. *Anopheles (Nyssorhynchus) strodei*: male genitalia and pupa
28. *Anopheles (Nyssorhynchus) strodei*: larva
29. *Anopheles (Nyssorhynchus) benarrochi*: male genitalia and pupa
30. *Anopheles (Nyssorhynchus) benarrochi*: larva
31. *Anopheles (Nyssorhynchus) triannulatus*: male genitalia and pupa
32. *Anopheles (Nyssorhynchus) triannulatus*: larva

Fig. 1


NYSSORHYNCHUS
Tropic of Cancer
Albimanus Group
albimanus
Tropic of Cancer
Triannulatus Subgroup
triannulatus
strodei
Equator
Equator
strodei complex
benarrochi
rondoni
Tropic of Capricorn
NORTH & SOUTH AMERICA
KILOMETERS
STATUTE MILES

Fig. 2

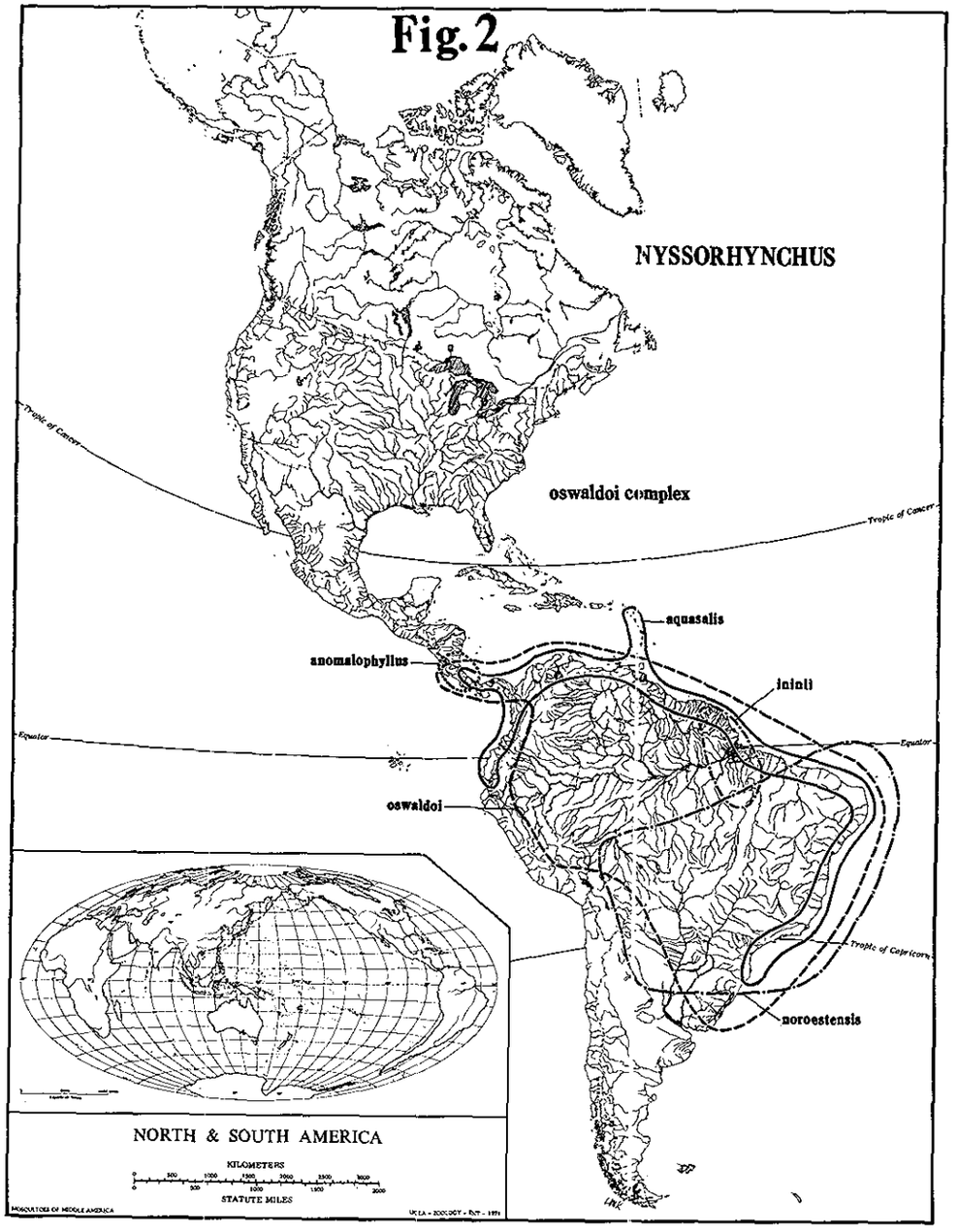
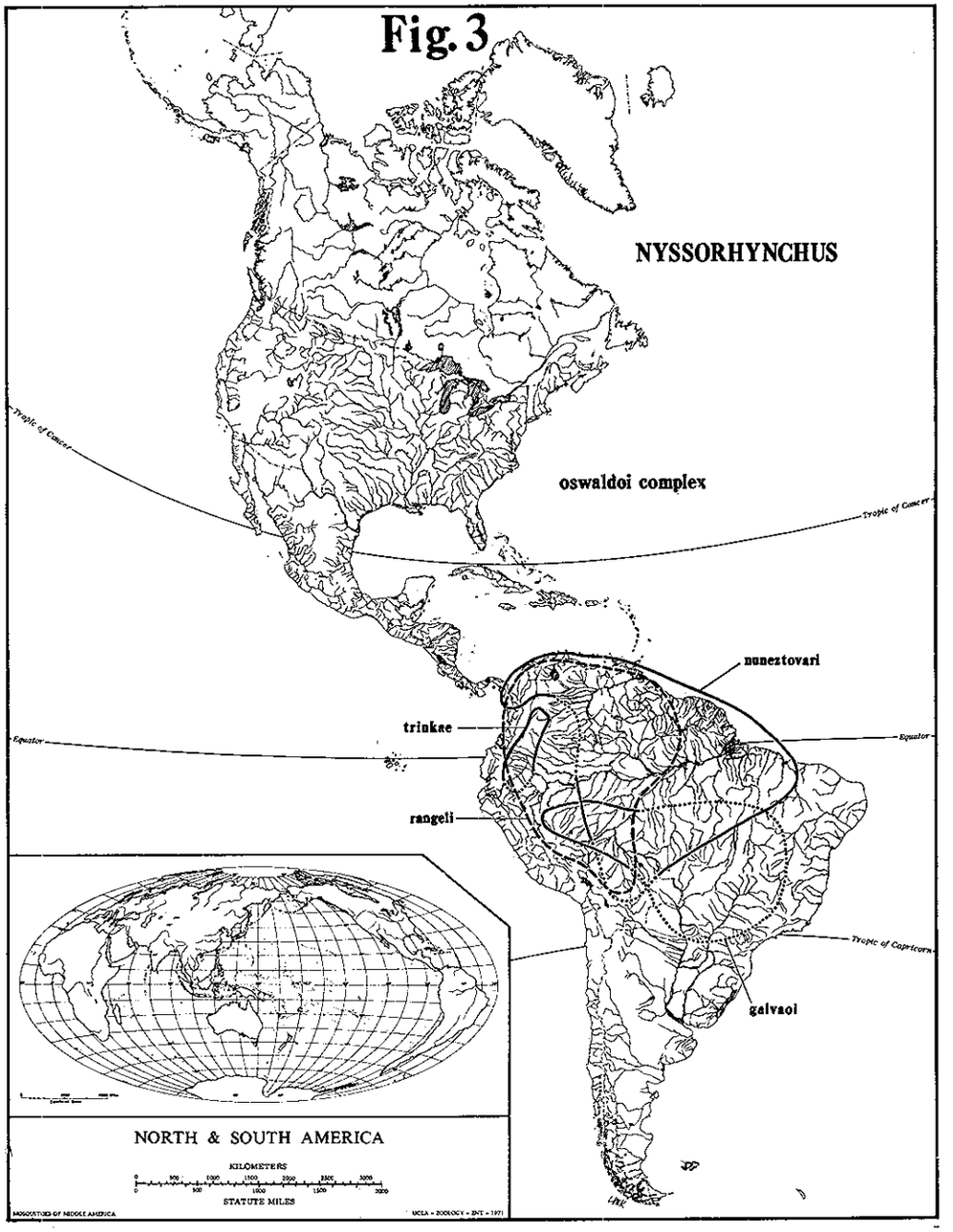

NYSSORHYNCHUS
Tropic of Cancer
oswaldoi complex
Tropic of Cancer
aquasalis
anomalophyllus
intermedius
Equator
Equator
oswaldoi
Tropic of Capricorn
nigrotaeniatus
NORTH & SOUTH AMERICA
KILOMETERS
STATUTE MILES

Fig. 3


NYSSORHYNCHUS
oswaldoi complex
Tropic of Cancer
Tropic of Cancer
nuneztovari
trinkae
Equator
Equator
rangeli
Tropic of Capricorn
galvaoi
NORTH & SOUTH AMERICA
KILOMETERS
STATUTE MILES

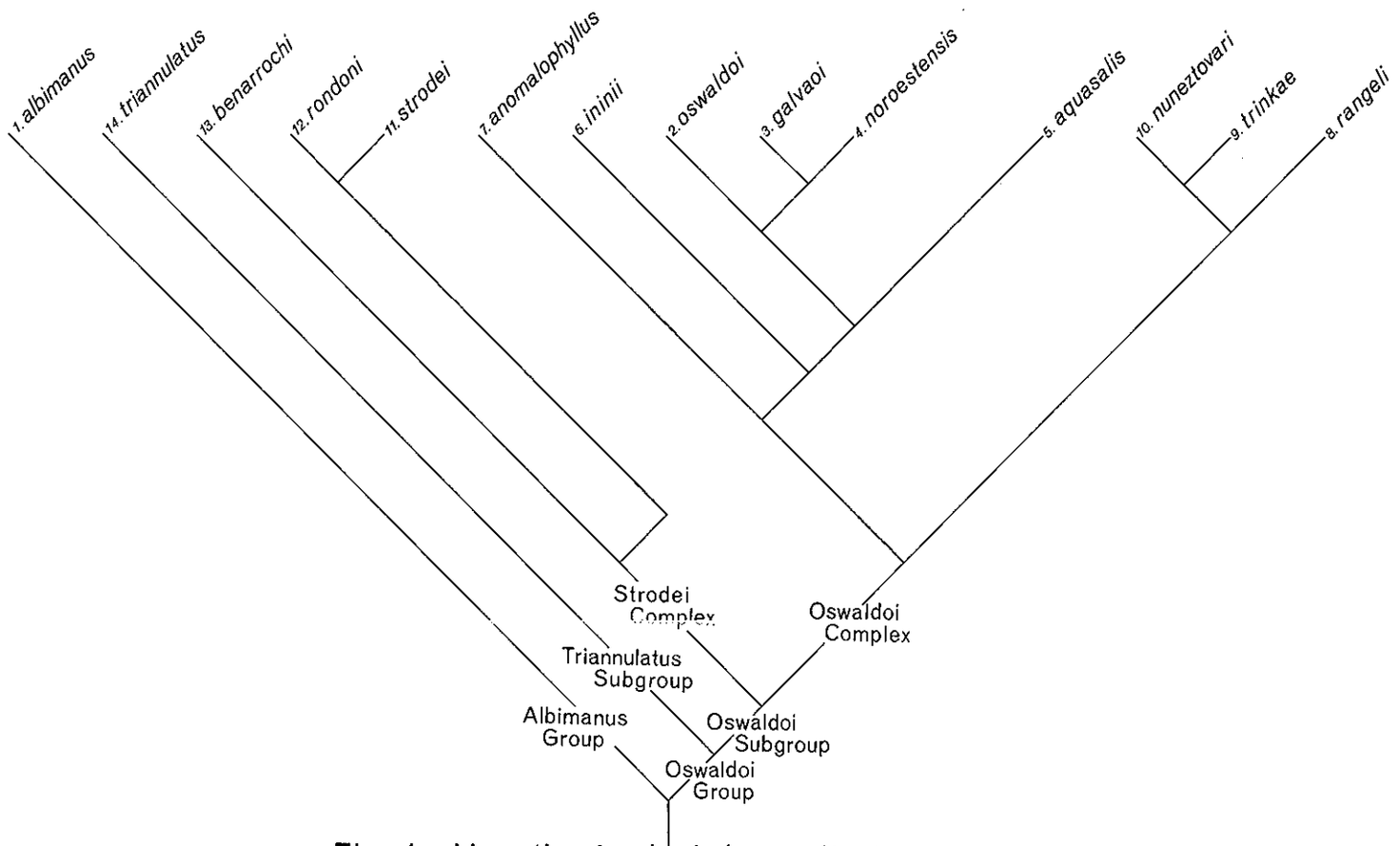


Fig. 4 Hypothesized phylogenetic tree of the Albimanus Section.

Fig. 5

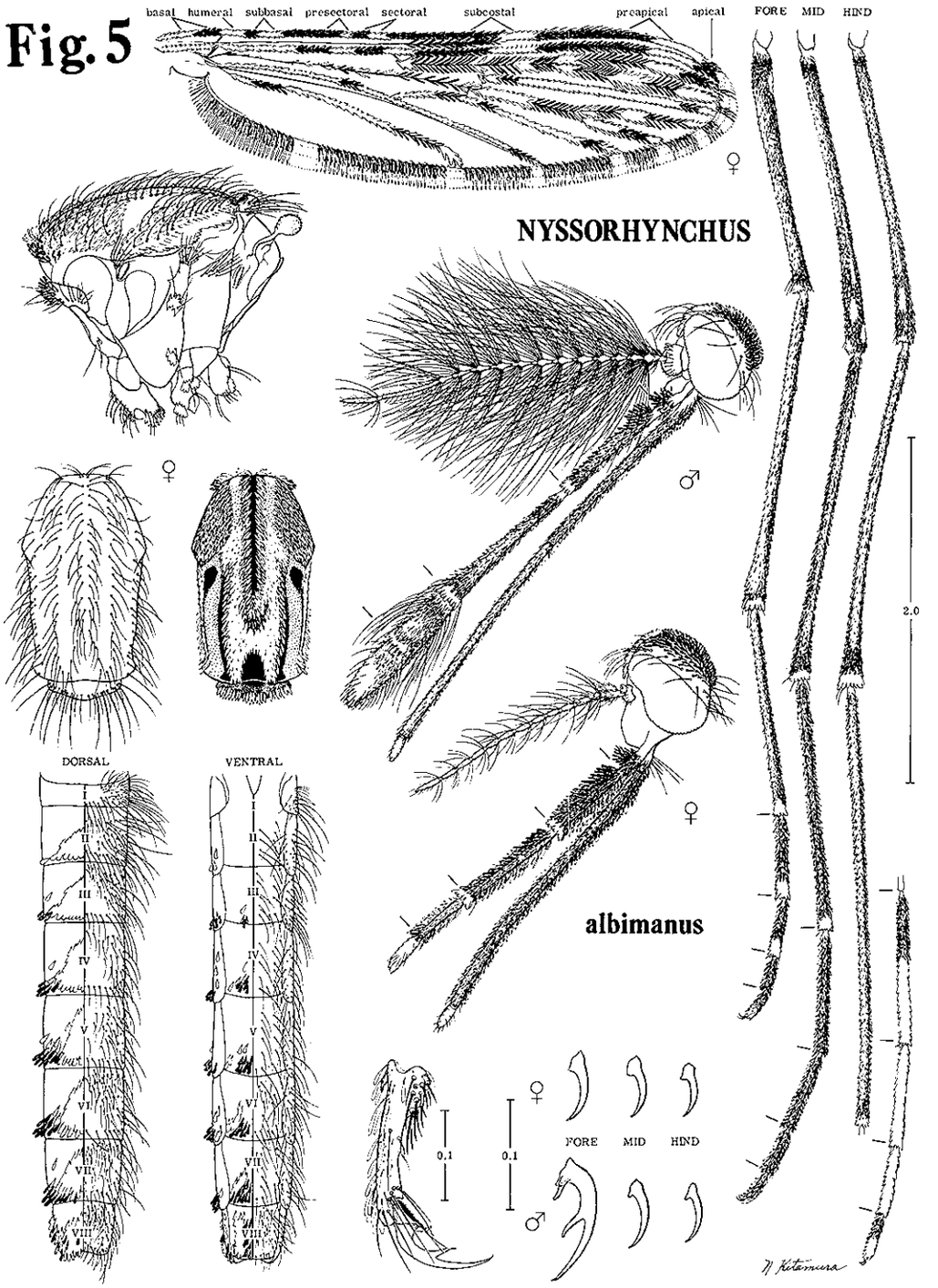
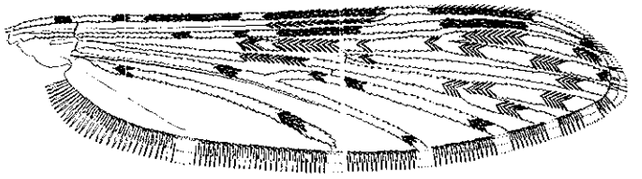

basal
humeral
subbasal
prosectoral
sectoral
subcostal
preapical
apical
♀
NYSSORHYNCHUS
♂
♀
DORSAL
VENTRAL
albimanus
♀
FORE
MID
HIND
0.1
0.1
♂
FORE
MID
HIND
2.0
N. Ketamura

Fig. 6

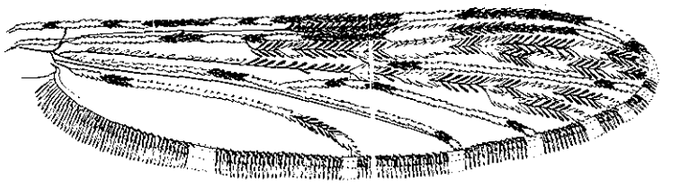
NYSSORHYNCHUS

oswaldoi

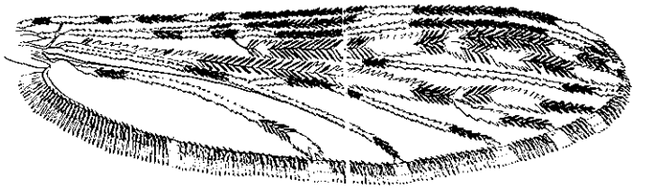
galvaoi



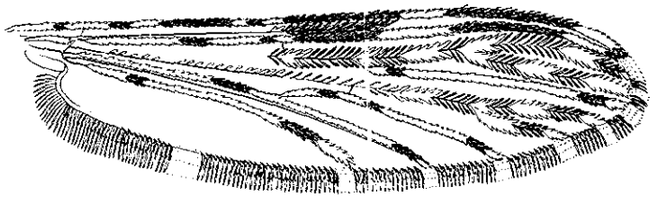
noroestensis



aquasalis



ininii



anomalophyllus

rangeli

Fig. 7

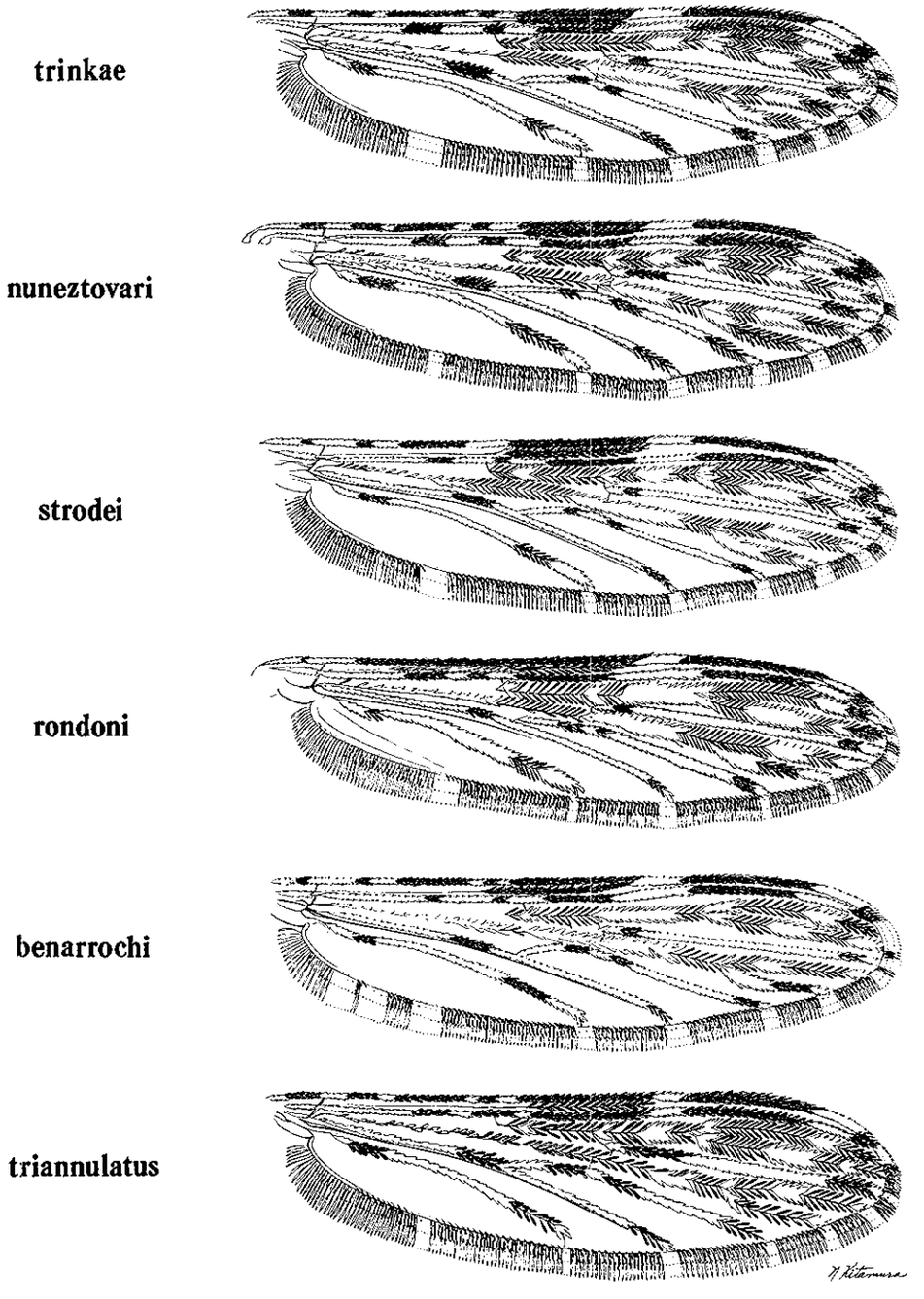

trinkae
nuneztovari
strodei
rondoni
benarrochi
triannulatus

Fig. 8

NYSSORHYNCHUS

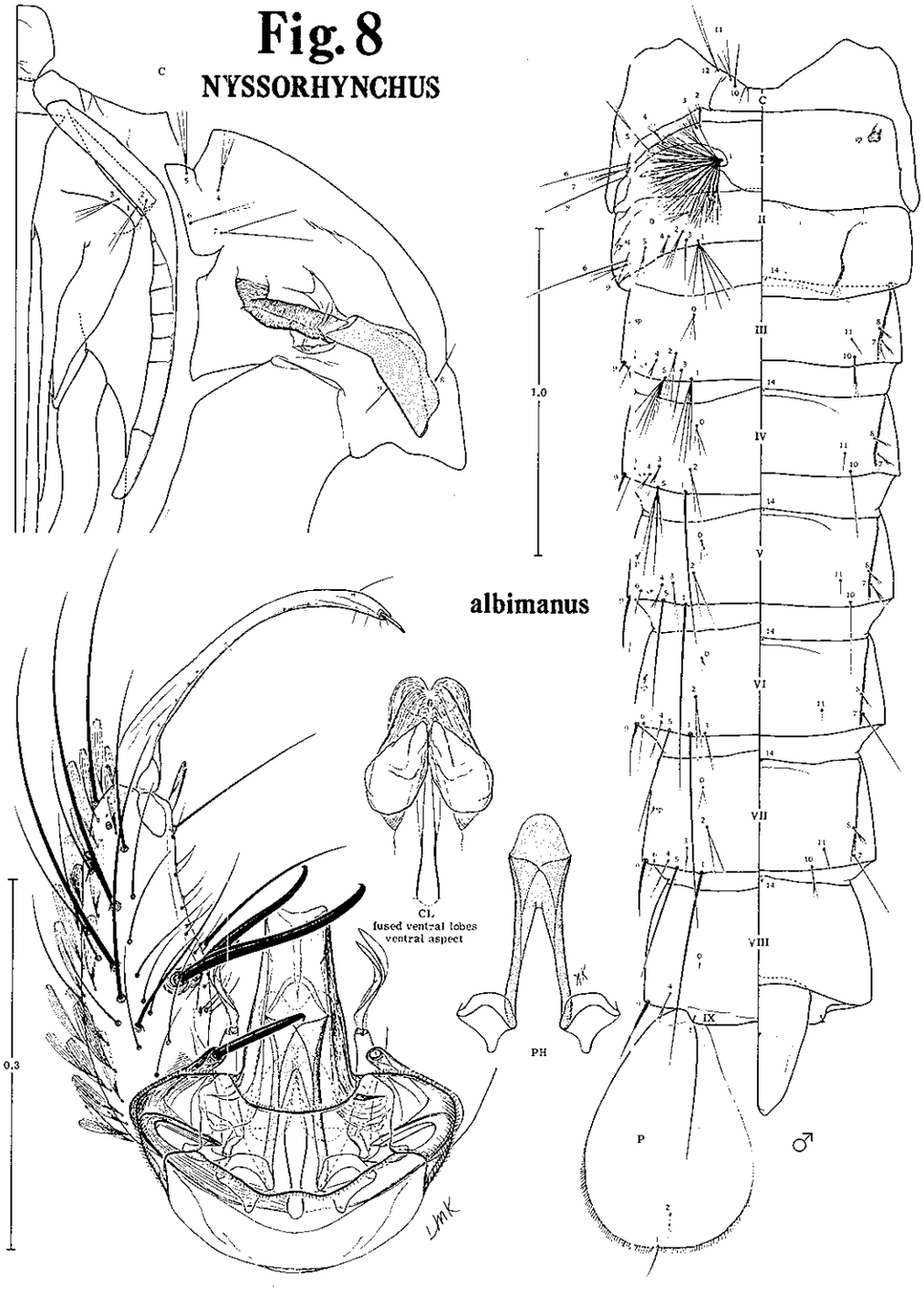


Fig. 9

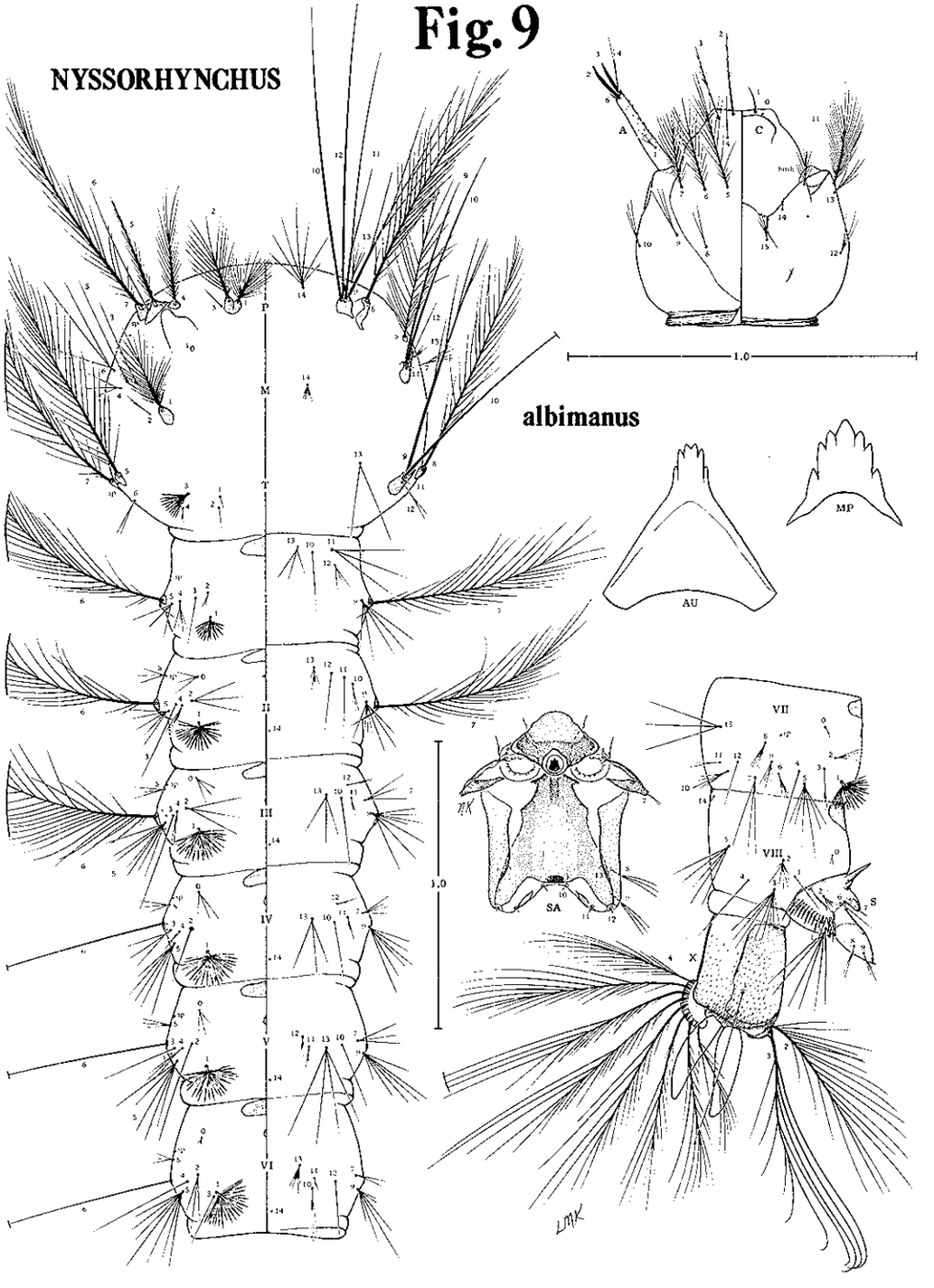

NYSSORHYNCHUS
albimanus
A
C
hmh
1.0
MP
AU
SA
VII
VIII
S
X
P
M
T
I
II
III
IV
V
VI
1.0

Fig. 10

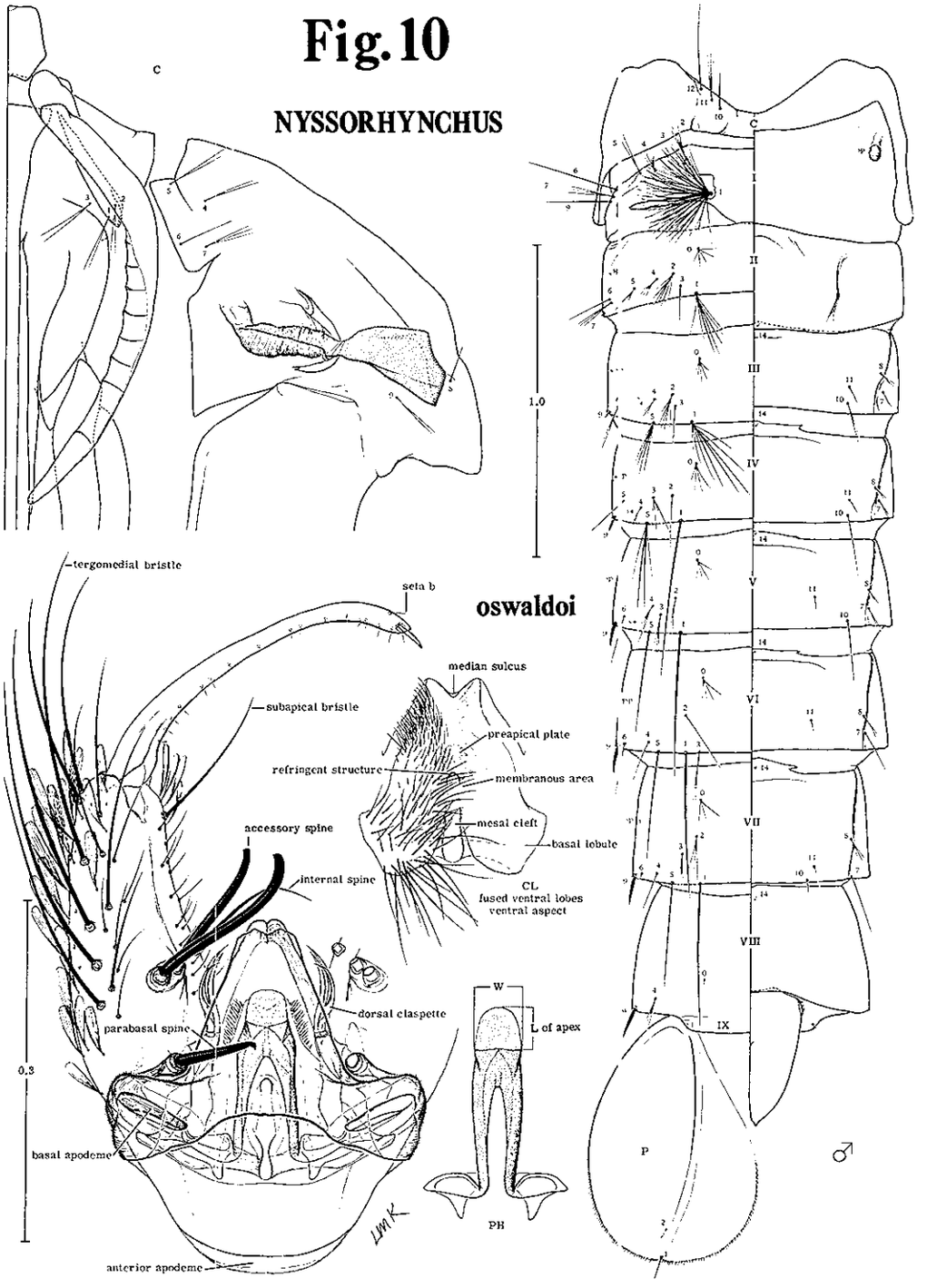

NYSSORHYNCHUS
oswaldoi
C
1.0
tergomedial bristle
seta b
subapical bristle
accessory spine
internal spine
parabasal spine
dorsal elaspette
basal apodeme
anterior apodeme
0.3
median sulcus
preapical plate
refringent structure
membranous area
mesal cleft
basal lobule
CL
fused ventral lobes
ventral aspect
W
L of apex
PH
I
II
III
IV
V
VI
VII
VIII
IX
P
♂

Fig. 11

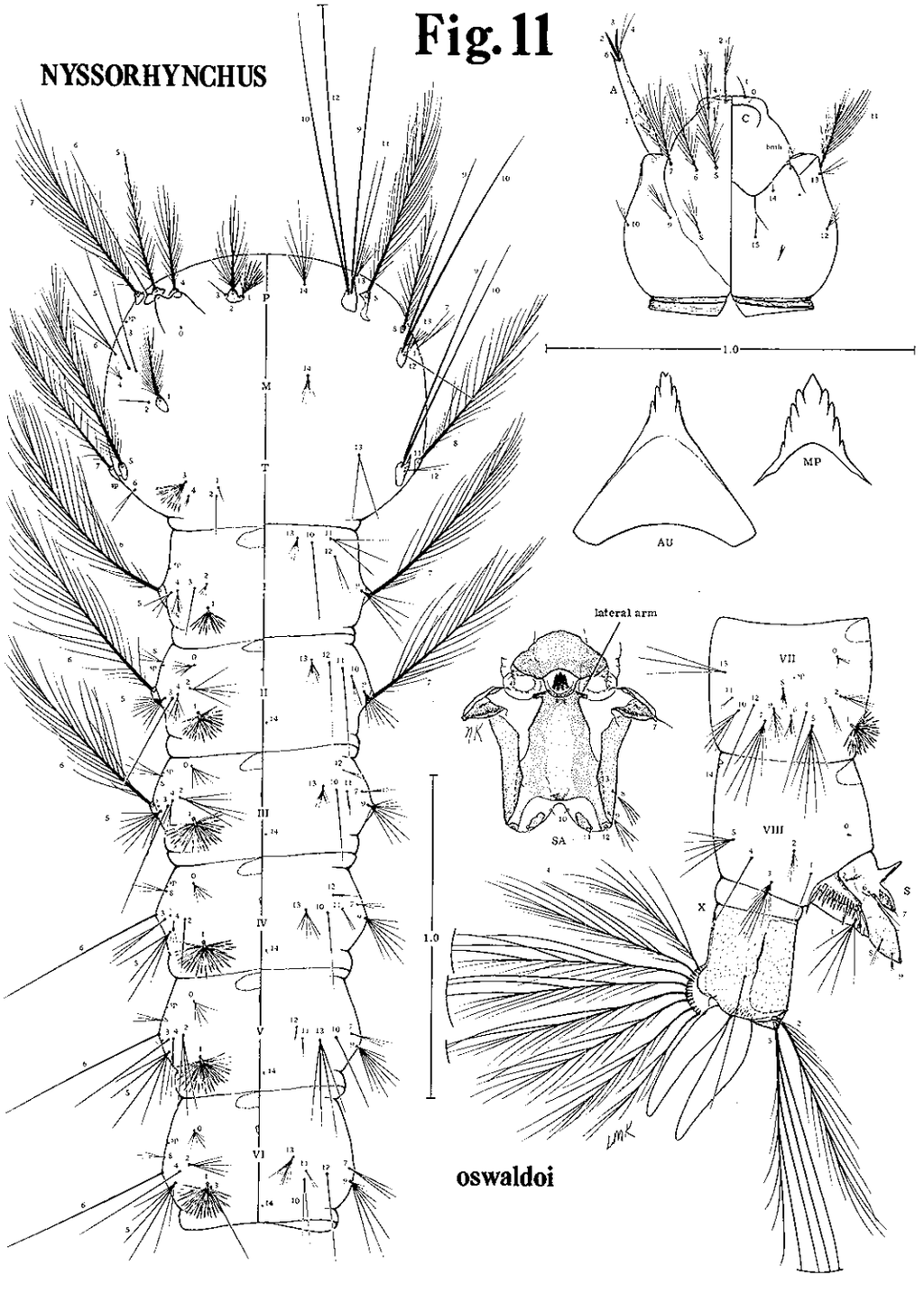

NYSSORHYNCHUS
A
C
1.0
MP
AU
lateral arm
SA
VII
VIII
X
S
1.0
oswaldoi

Fig. 12

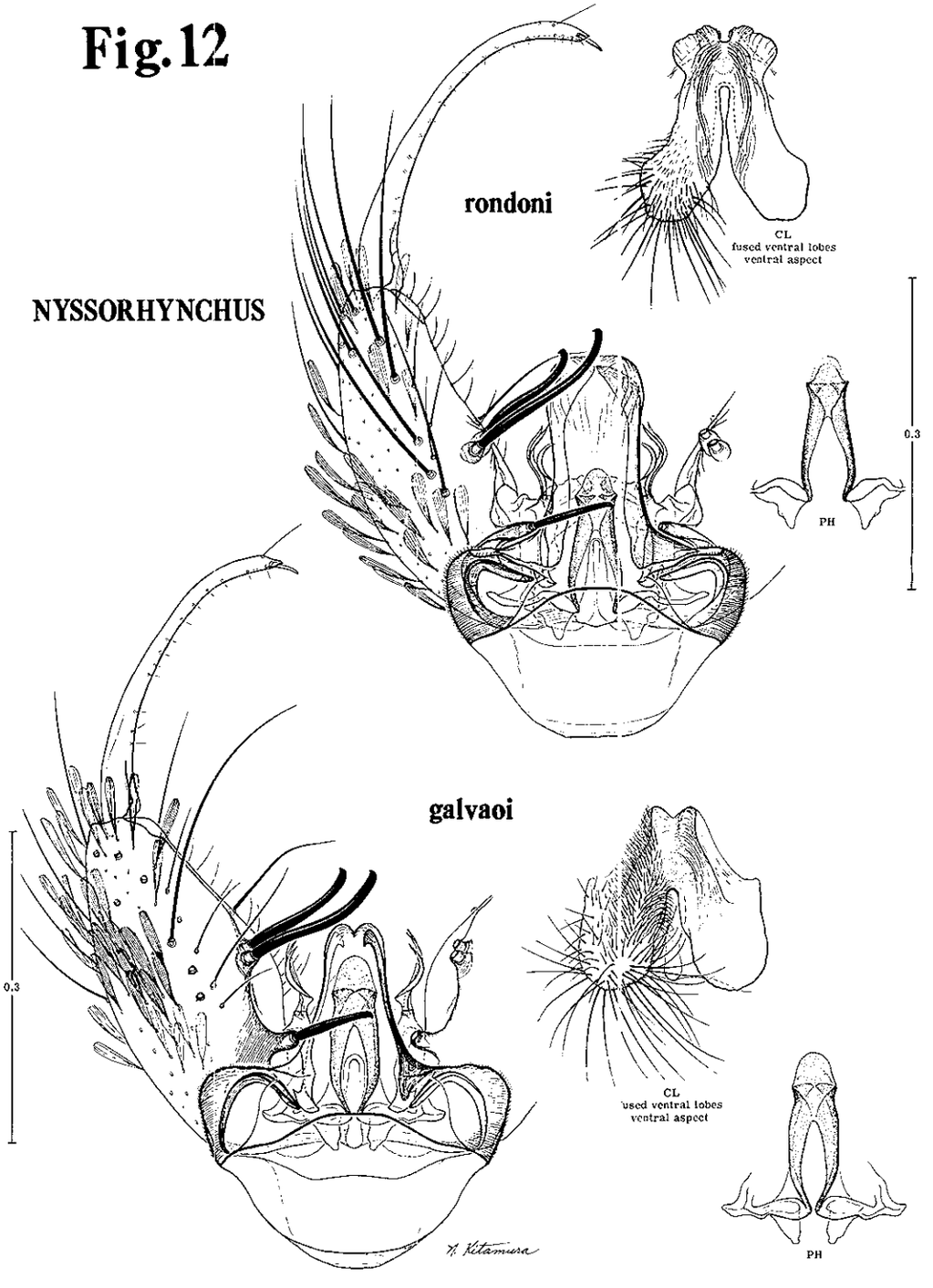

NYSSORHYNCHUS
rondoni
CL
fused ventral lobes
ventral aspect
PH
0.3
galvaoi
CL
used ventral lobes
ventral aspect
PH
0.3
N. Kitamura

Fig. 13

NYSSORHYNCHUS

noroestensis

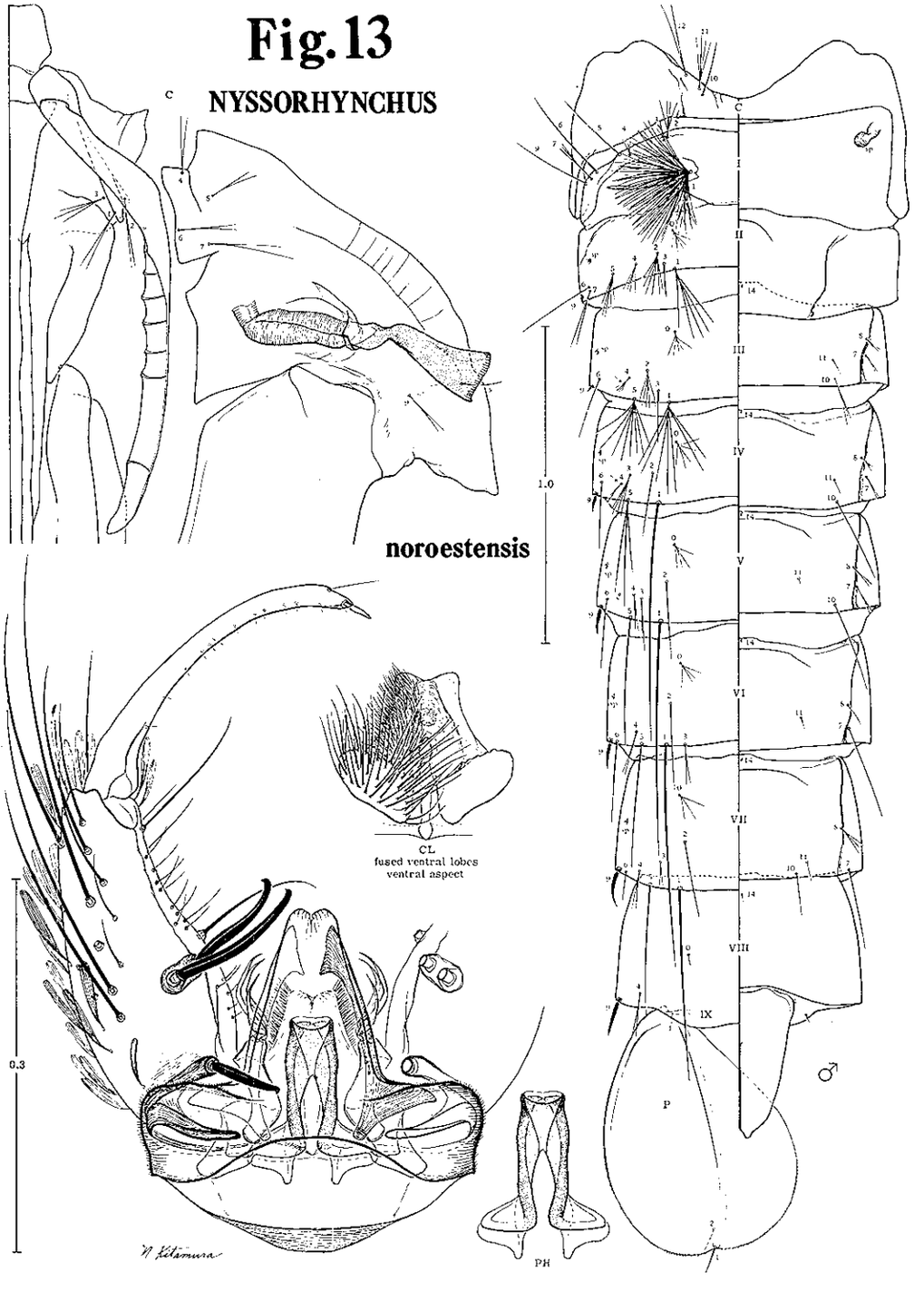
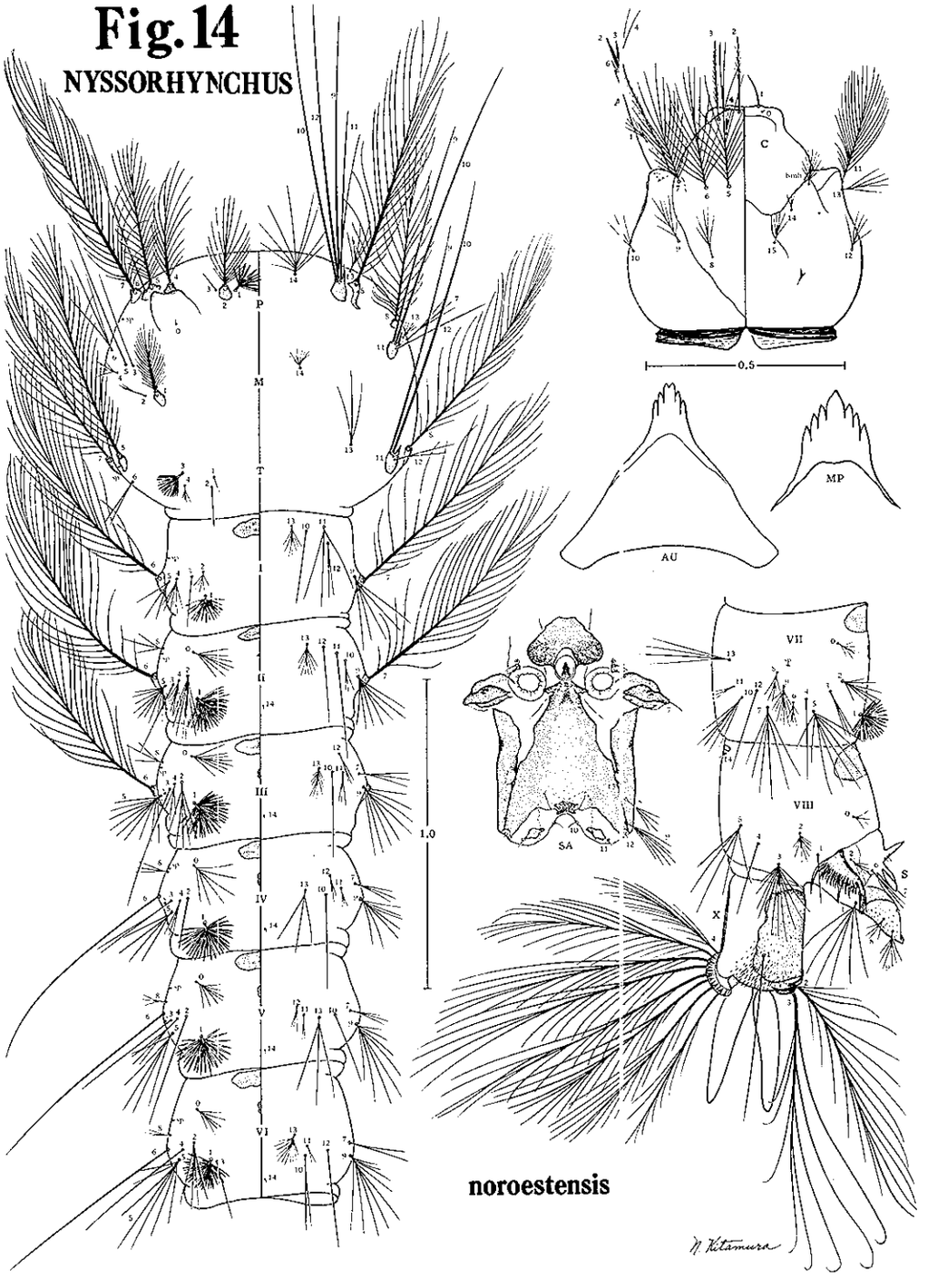


Fig. 14

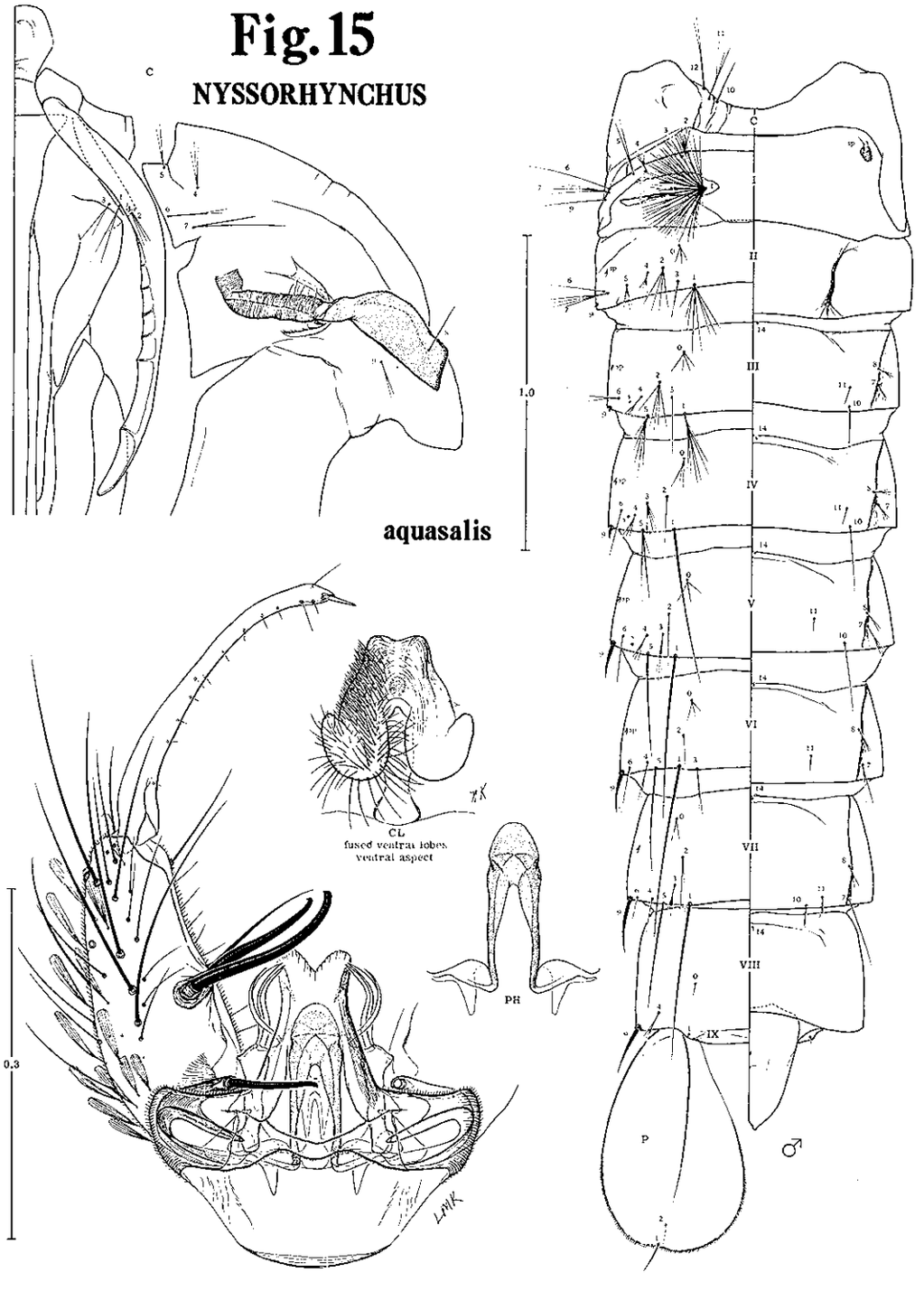
NYSSORHYNCHUS



noroestensis

Fig. 15

NYSSORHYNCHUS



aquasalis

Fig. 16

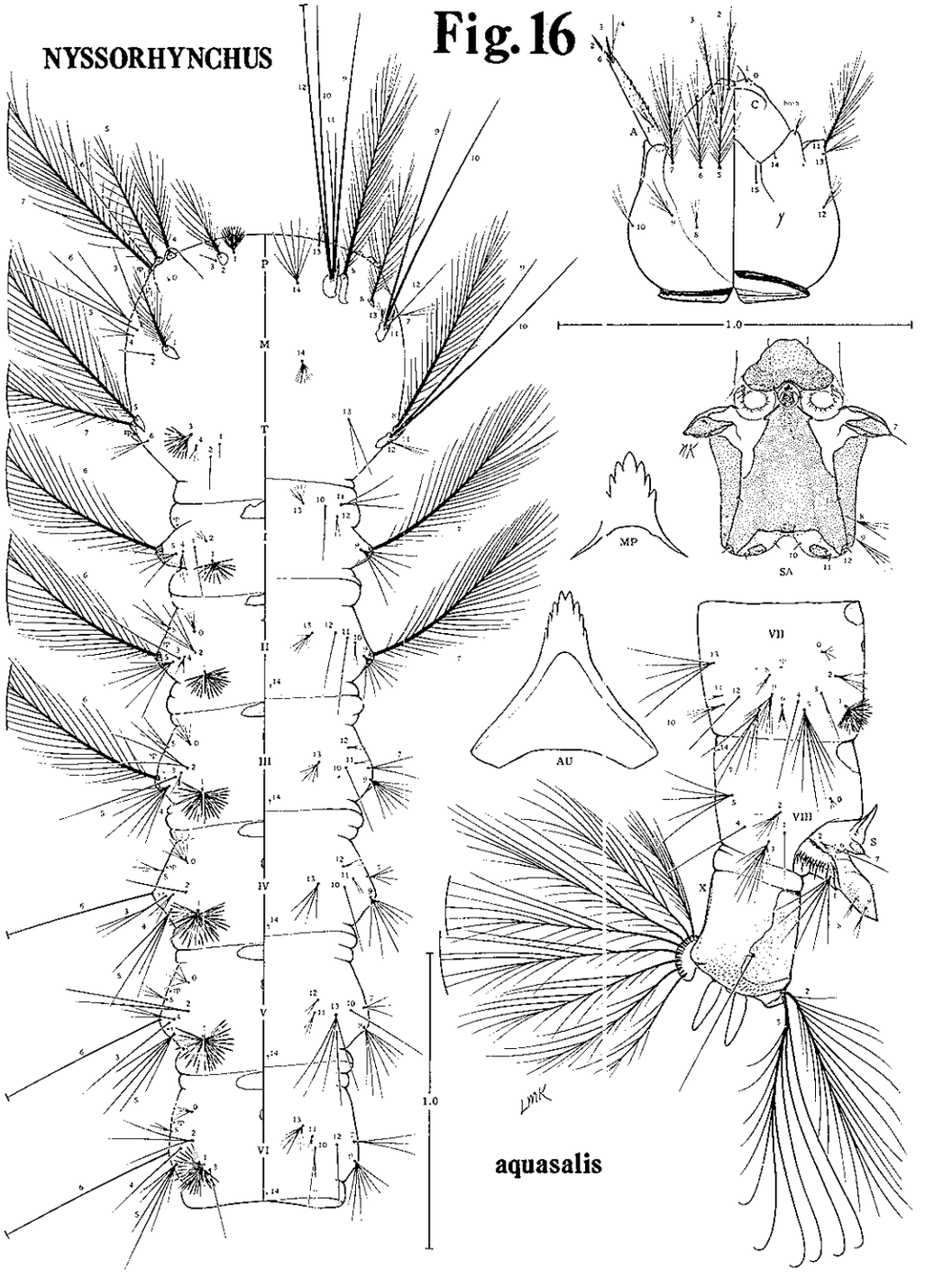

NYSSORHYNCHUS
P
M
T
I
II
III
IV
V
VI
1.0
A
C
y
1.0
MP
SA
AU
VII
VIII
X
S
LMK
aquasalis

Fig. 17

NYSSORHYNCHUS

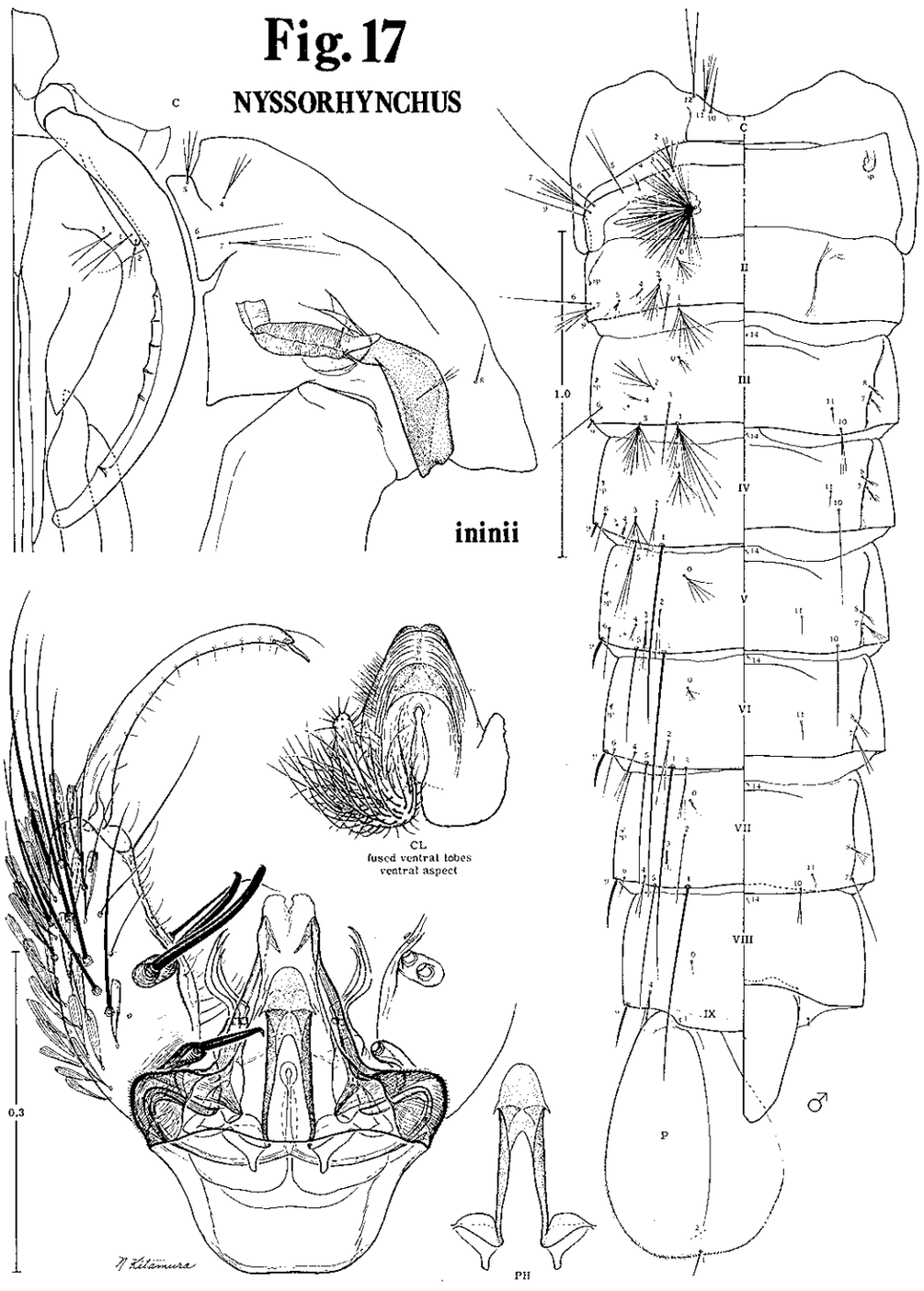


Fig. 18

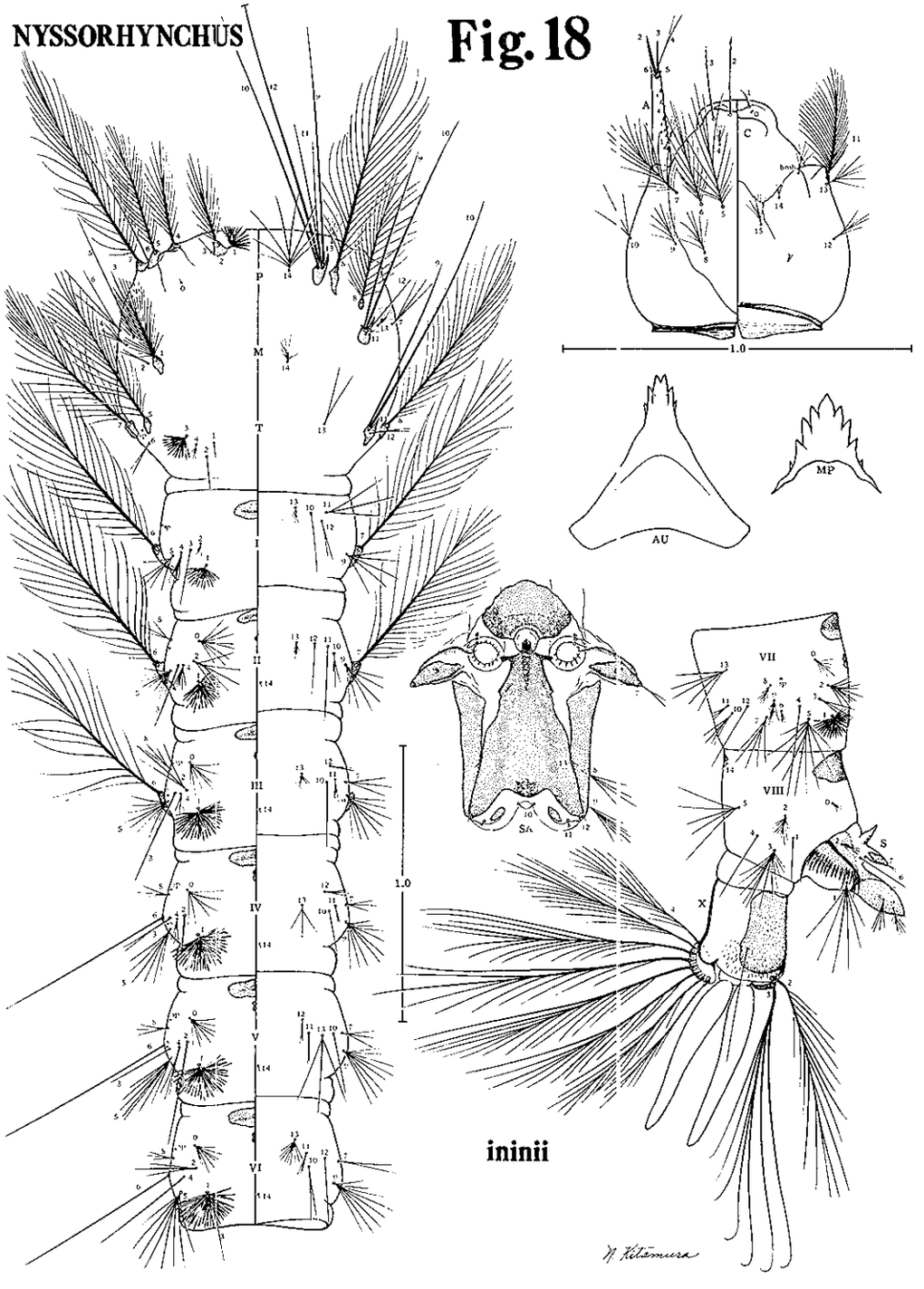

NYSSORHYNCHUS
P
M
T
I
II
III
IV
V
VI
1.0
A
C
bmu
1.0
AU
MP
Sk
VII
VIII
IX
X
ininii
M. Kitamura

Fig. 19

NYSSORHYNCHUS

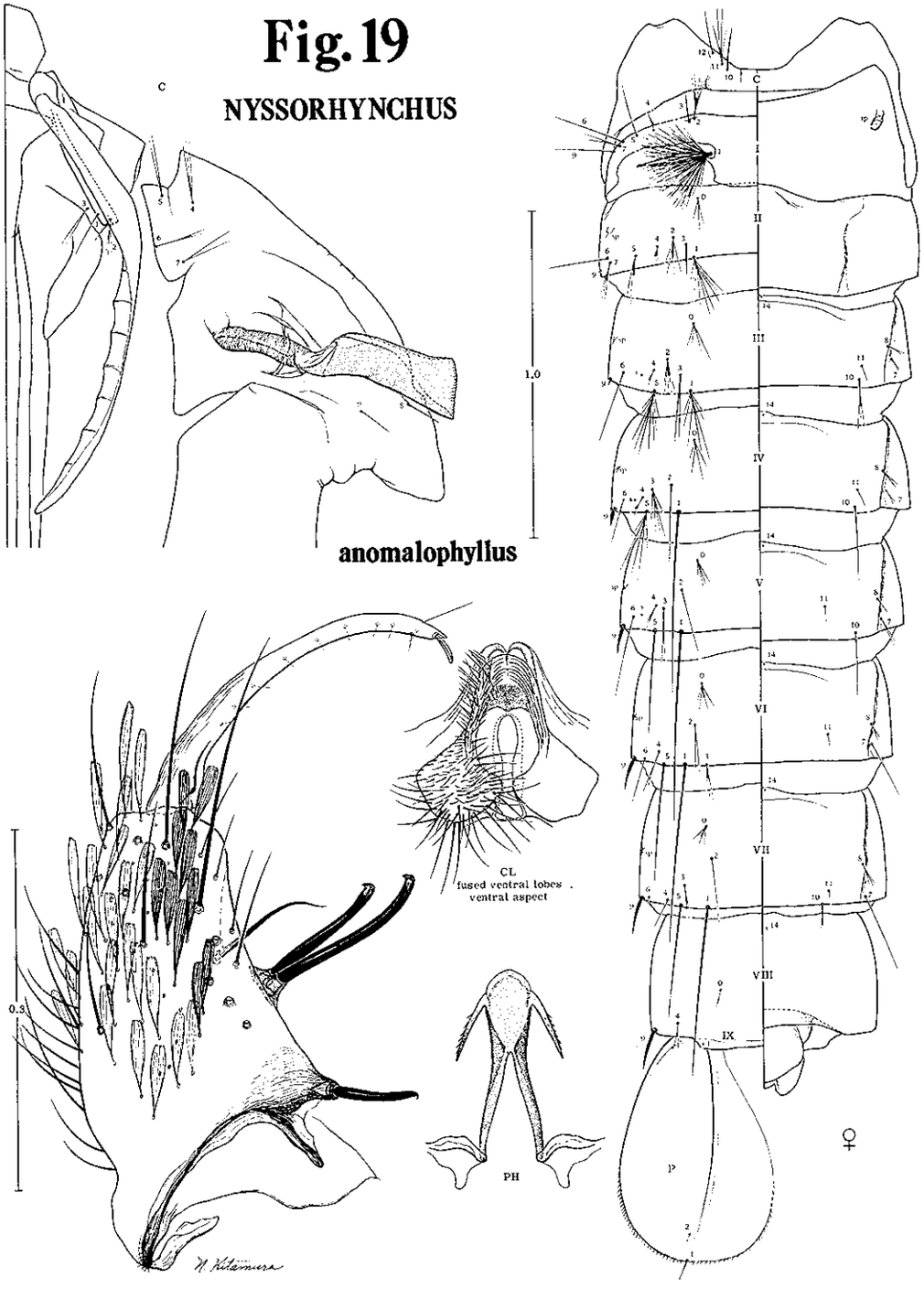


Fig. 20

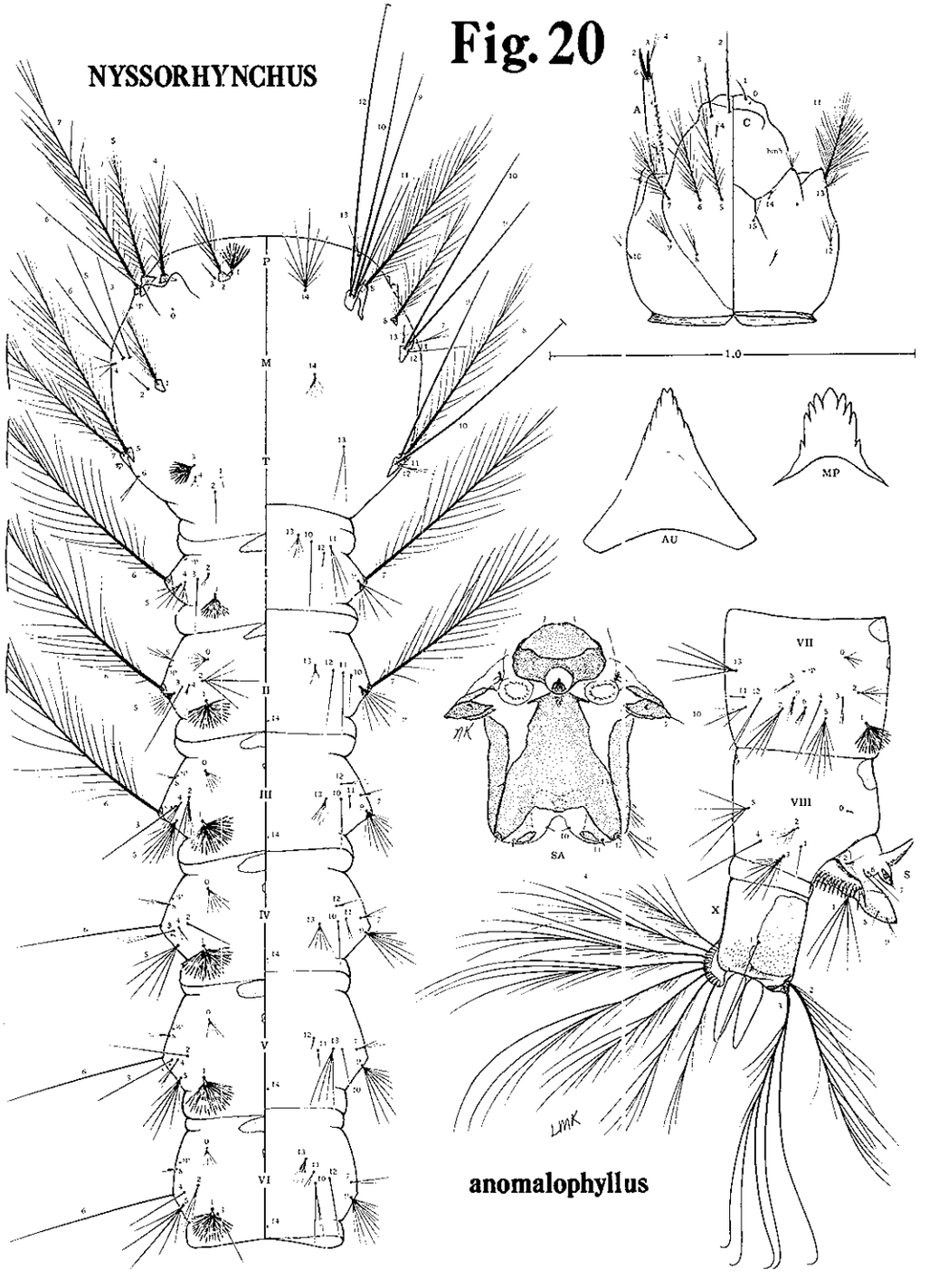


Fig. 21

NYSSORHYNCHUS

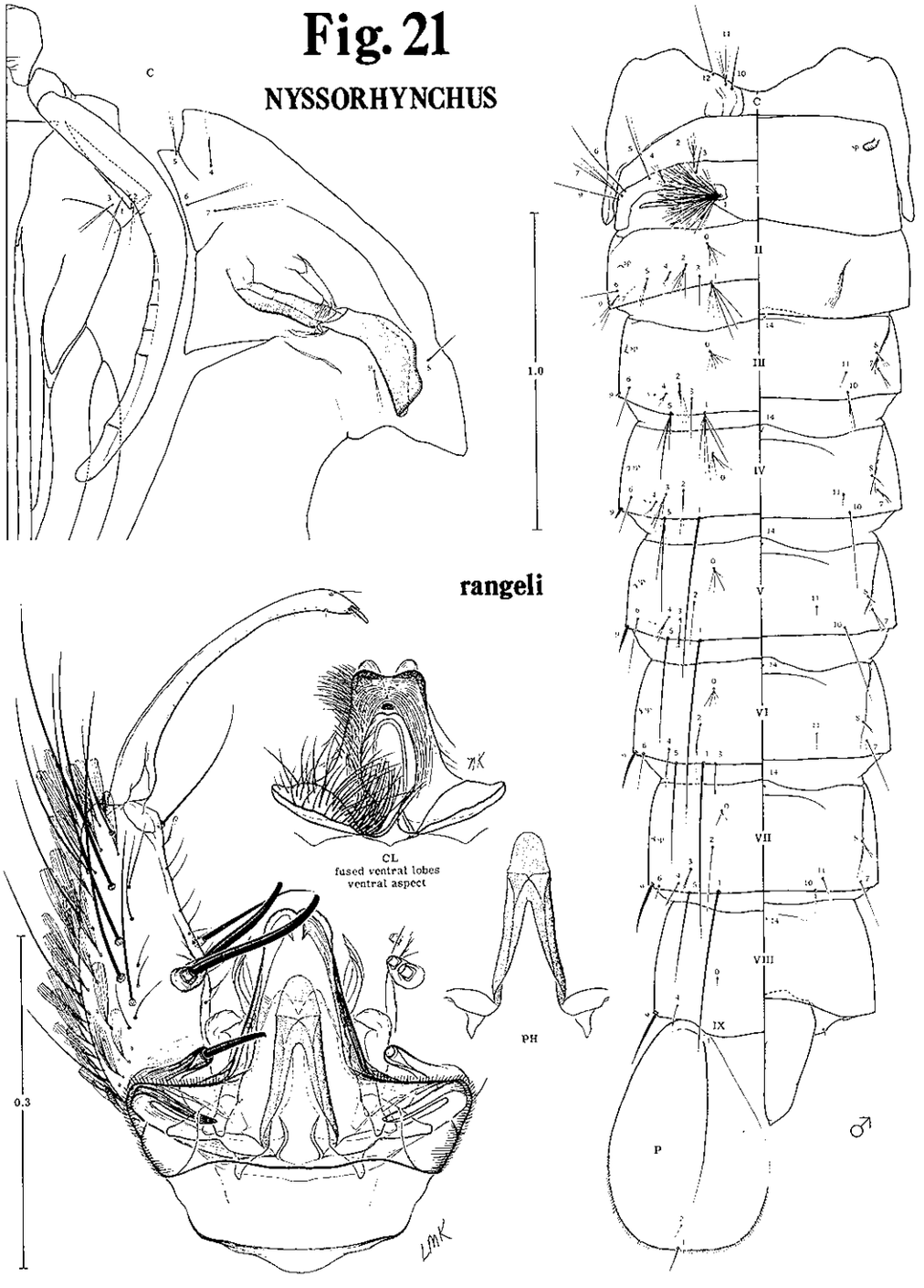


Fig. 22

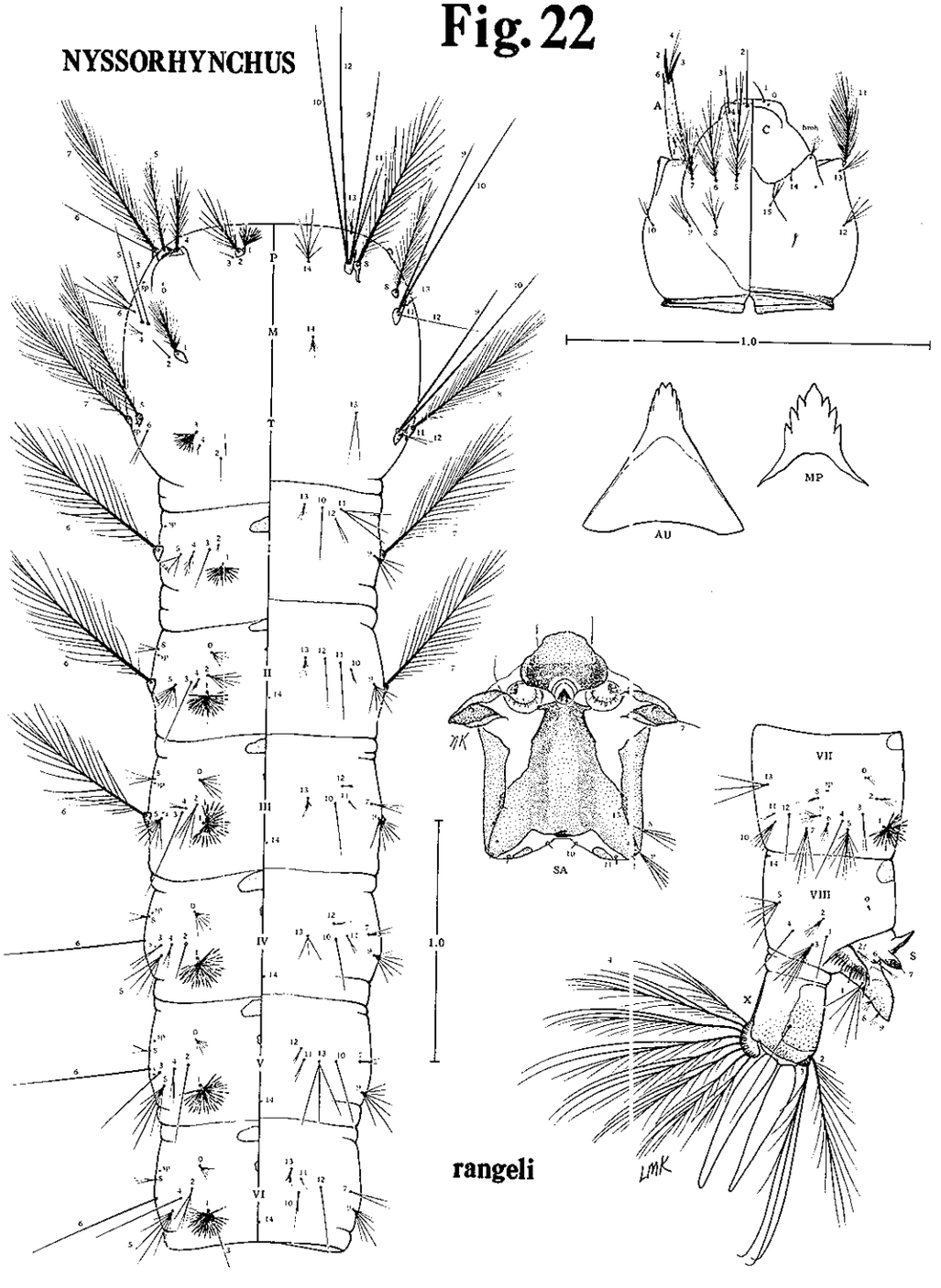

NYSSORHYNCHUS
rangeli
A
C
bmh
1.0
AU
MP
SA
VII
VIII
X
LMK
P
M
T
I
II
III
IV
V
VI

Fig. 23

NYSSORHYNCHUS

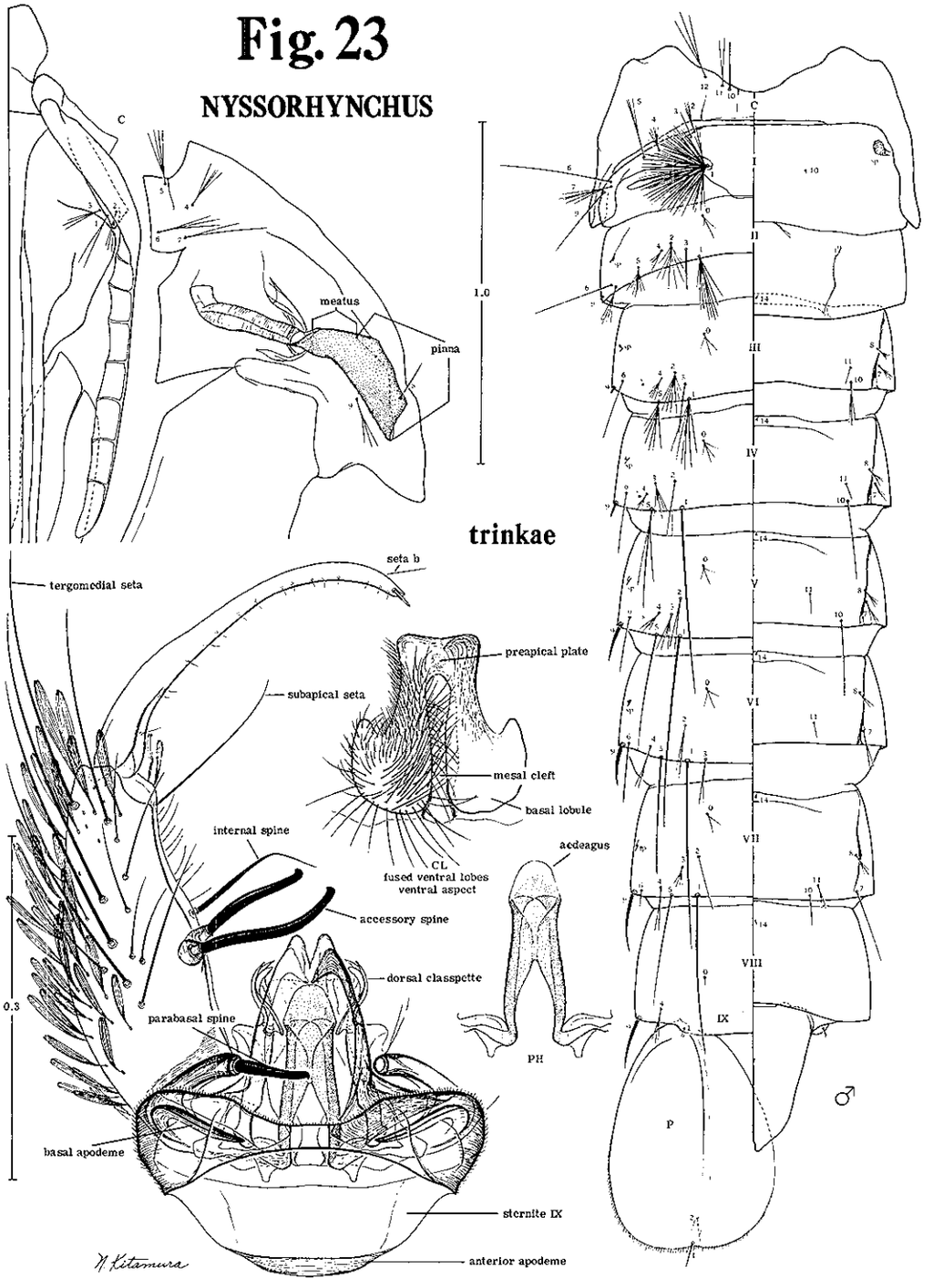
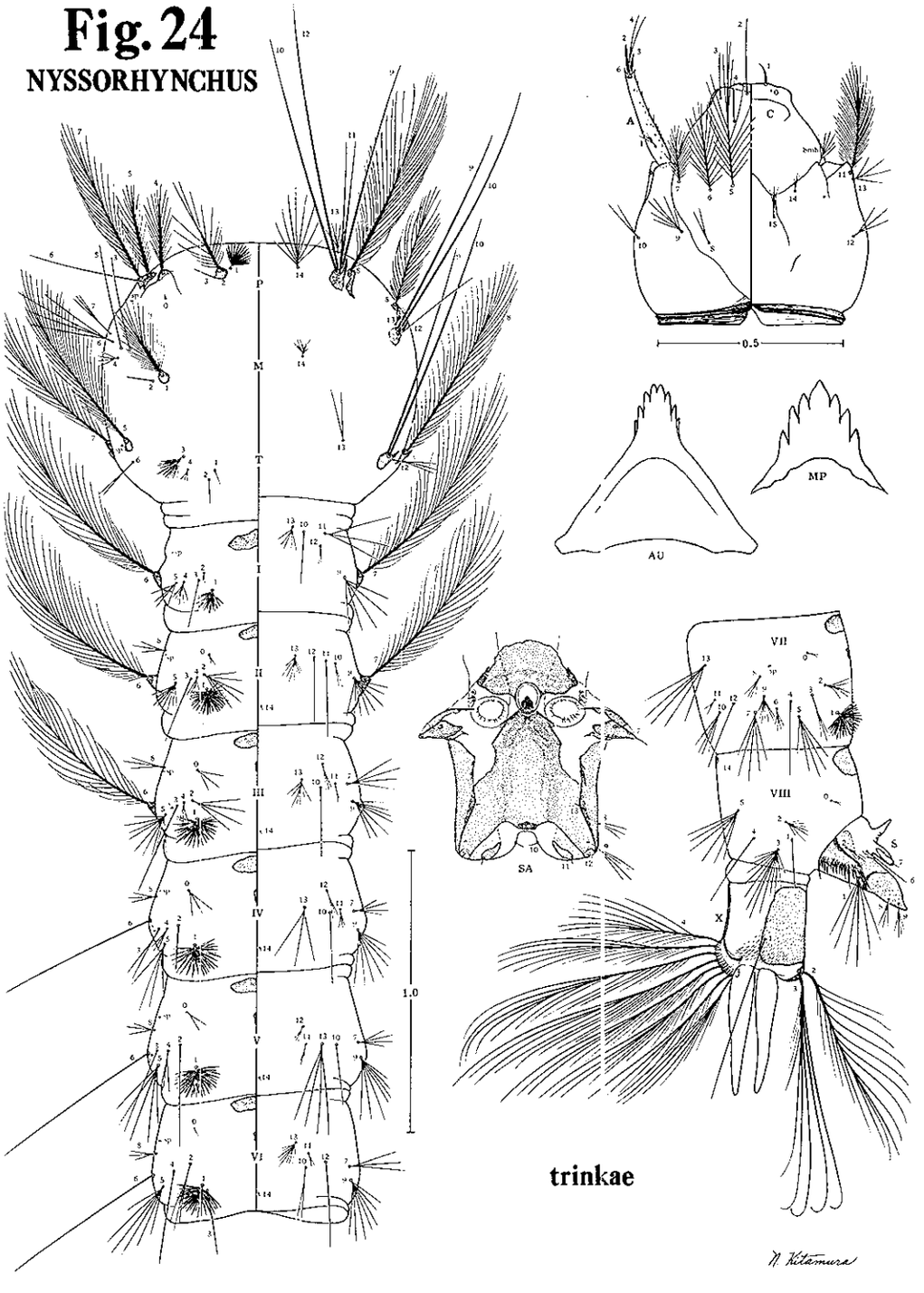


Fig. 24

NYSSORHYNCHUS



trinkae

Fig. 25

NYSSORHYNCHUS

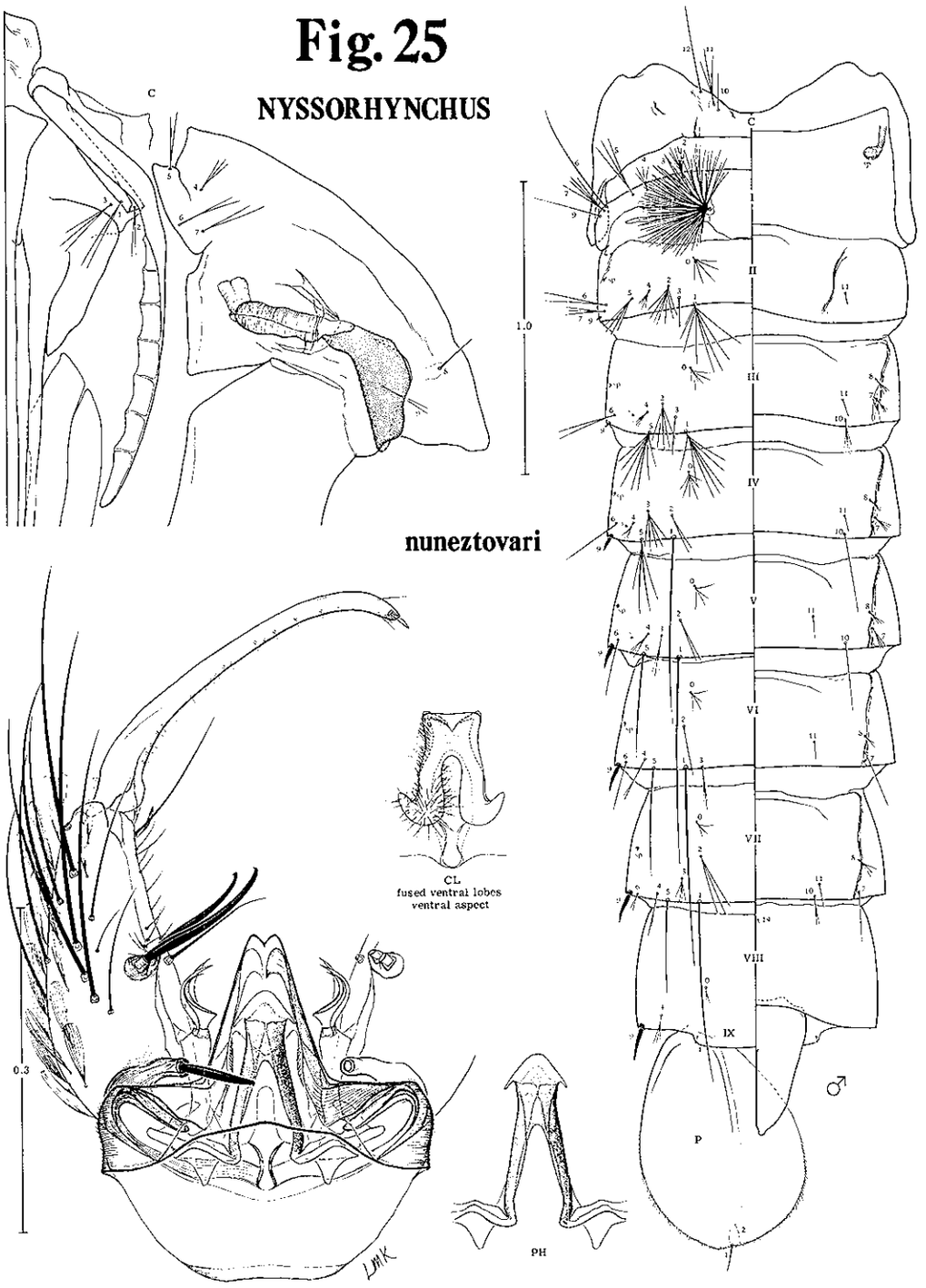


Fig. 26

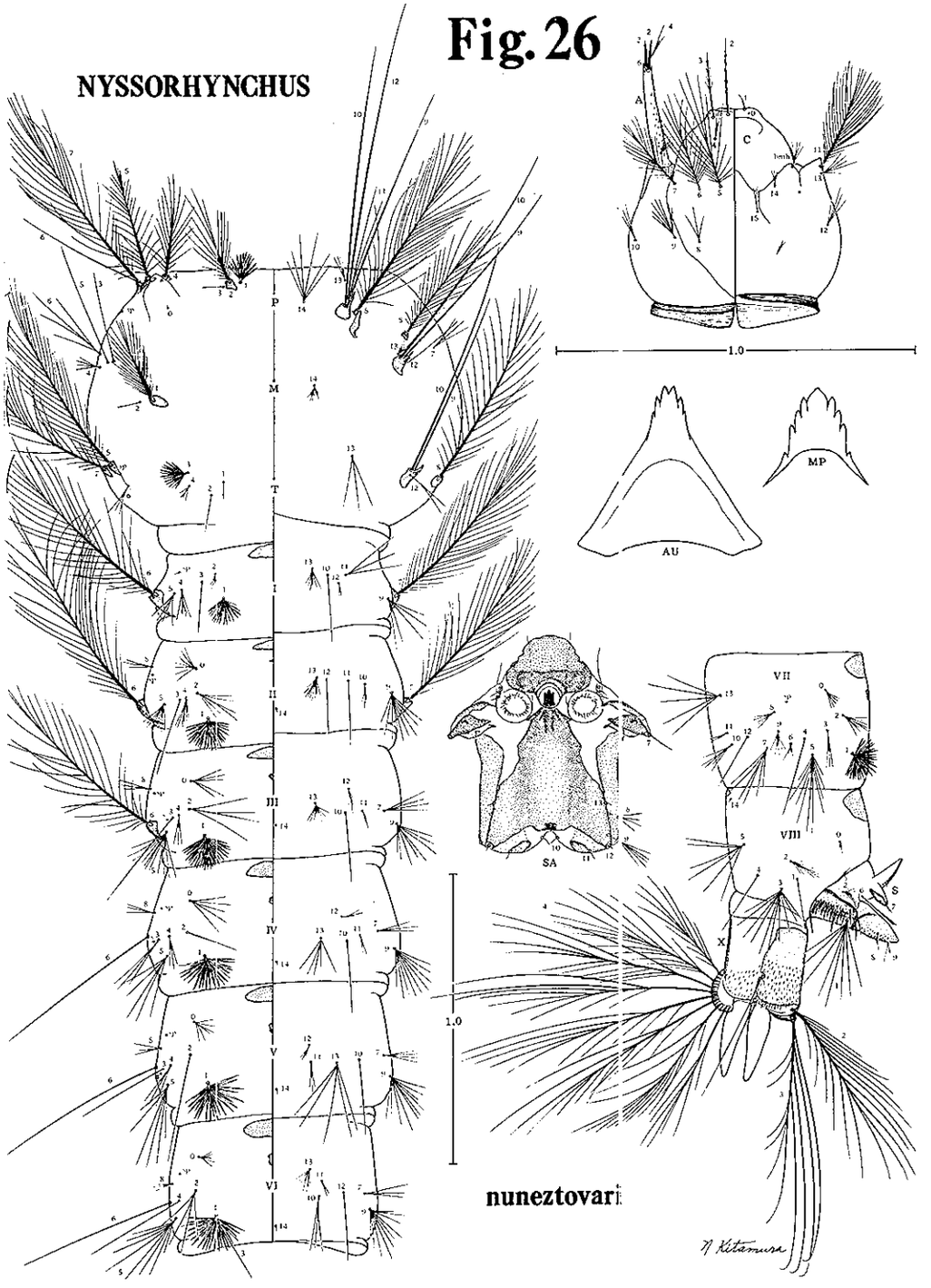

NYSSORHYNCHUS
A
C
1.0
MP
AU
SA
VII
VIII
X
S
P
M
T
I
II
III
IV
V
VI
1.0
nuneztovari

Fig. 27

NYSSORHYNCHUS

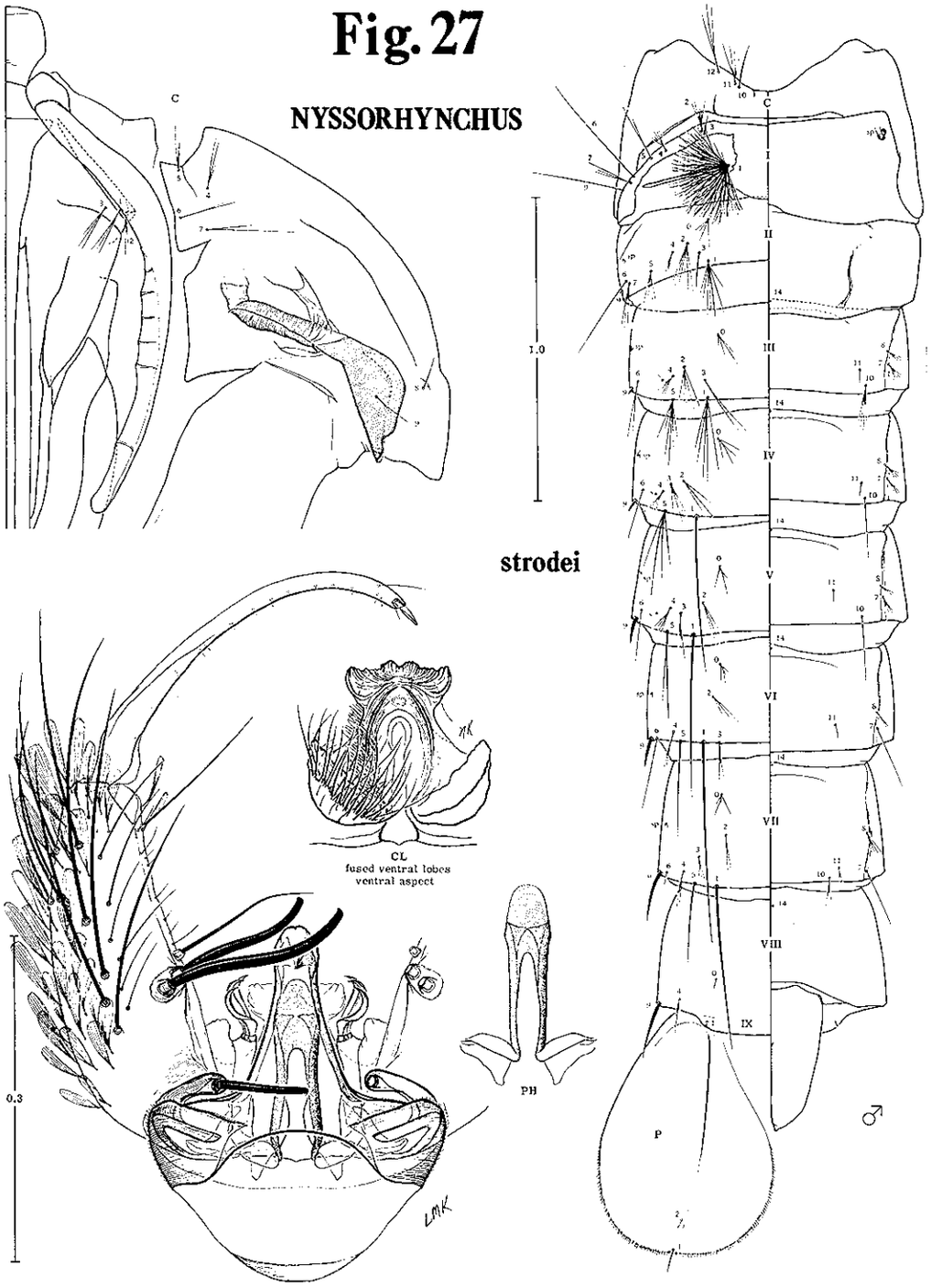
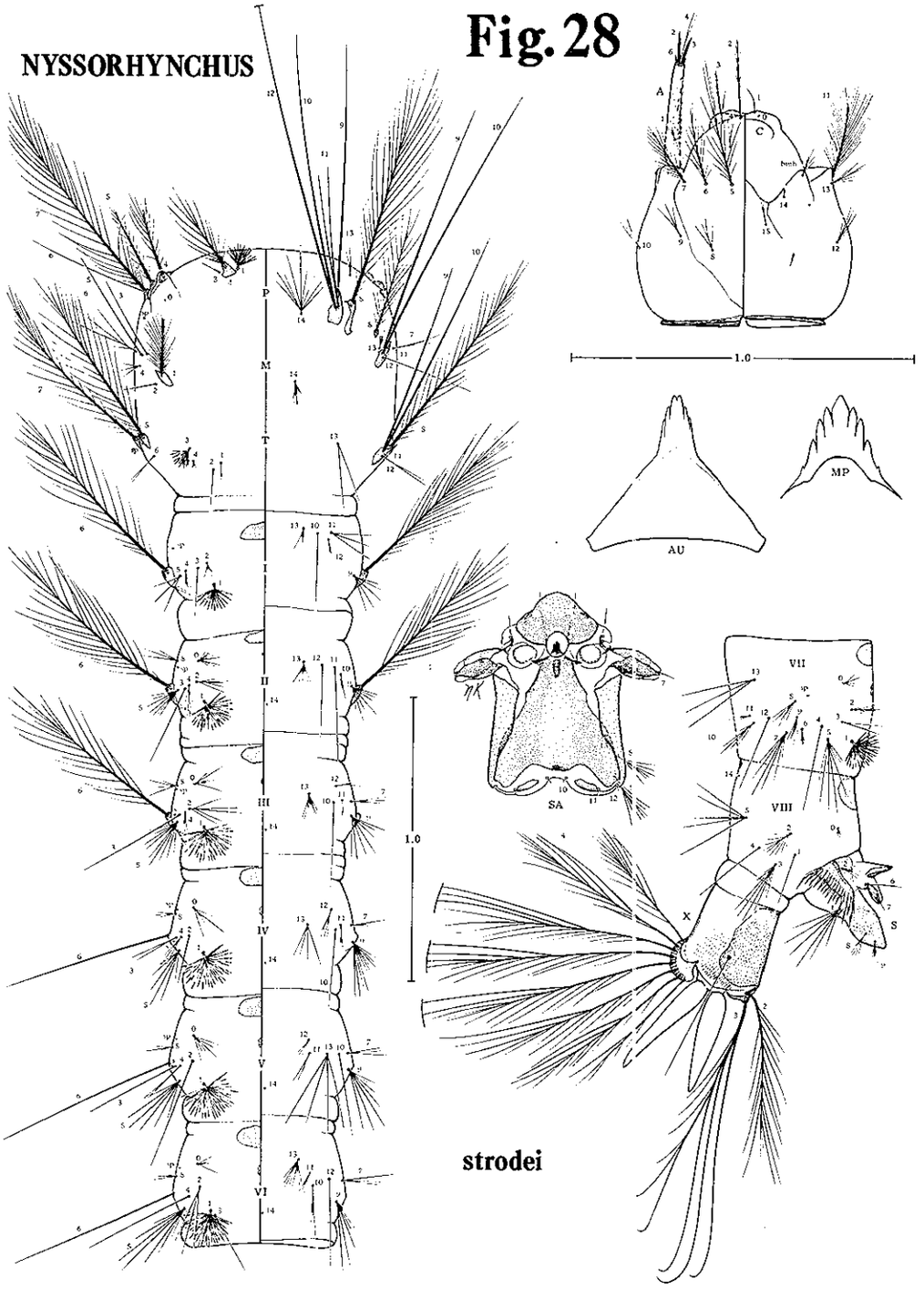


Fig. 28



strodei

Fig. 29

NYSSORHYNCHUS

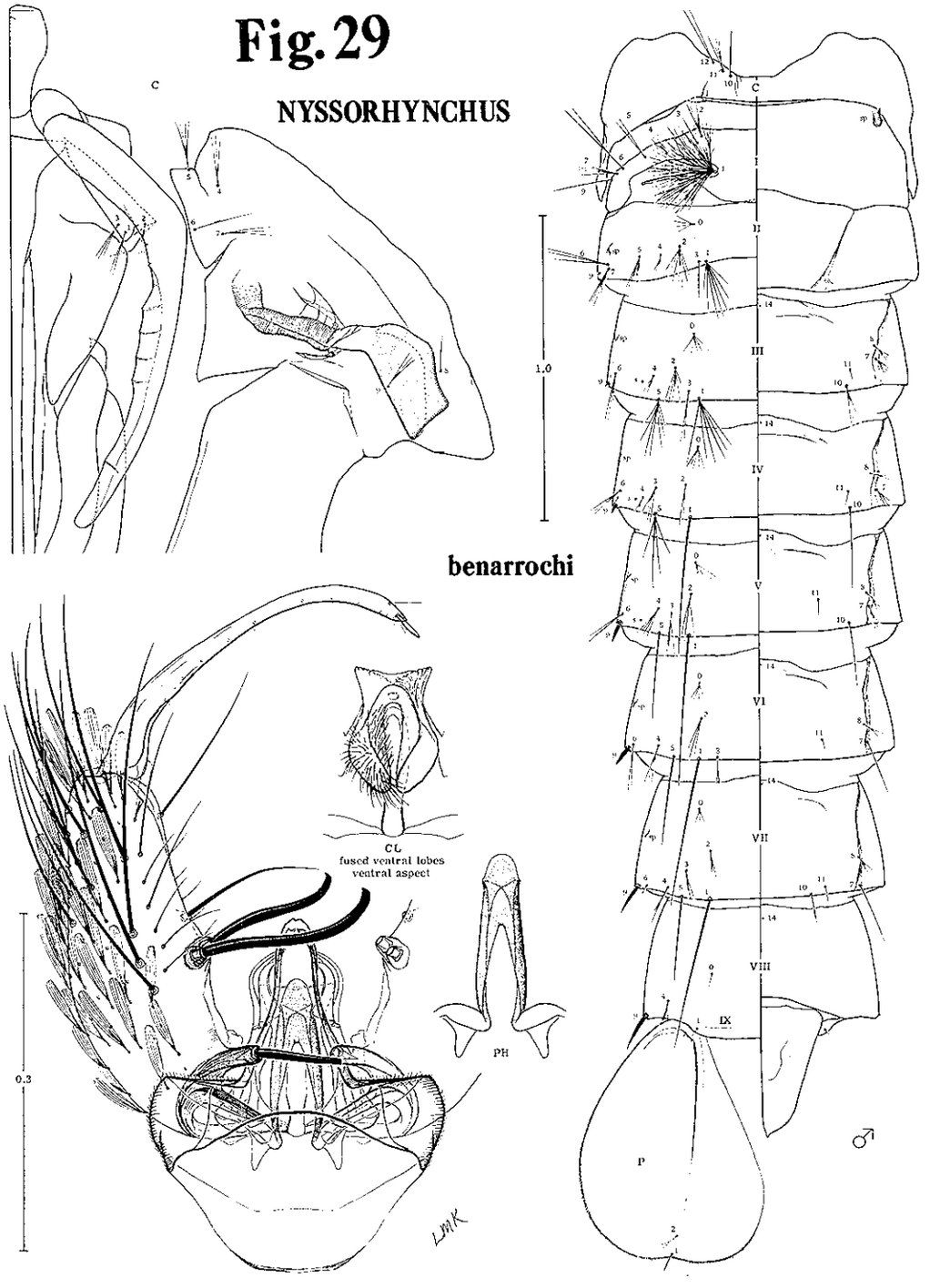


Fig. 30

NYSSORHYNCHUS

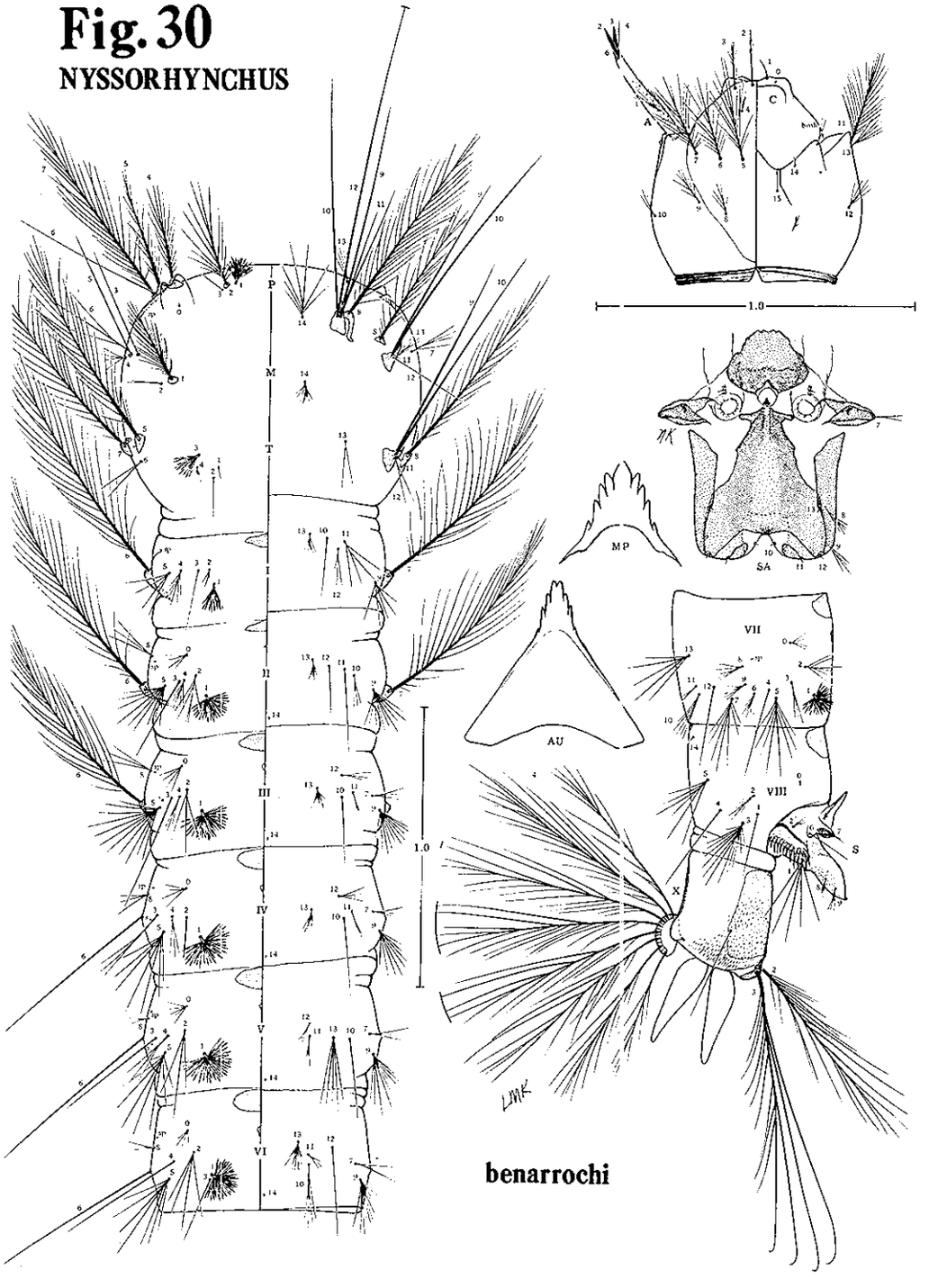


Fig. 31

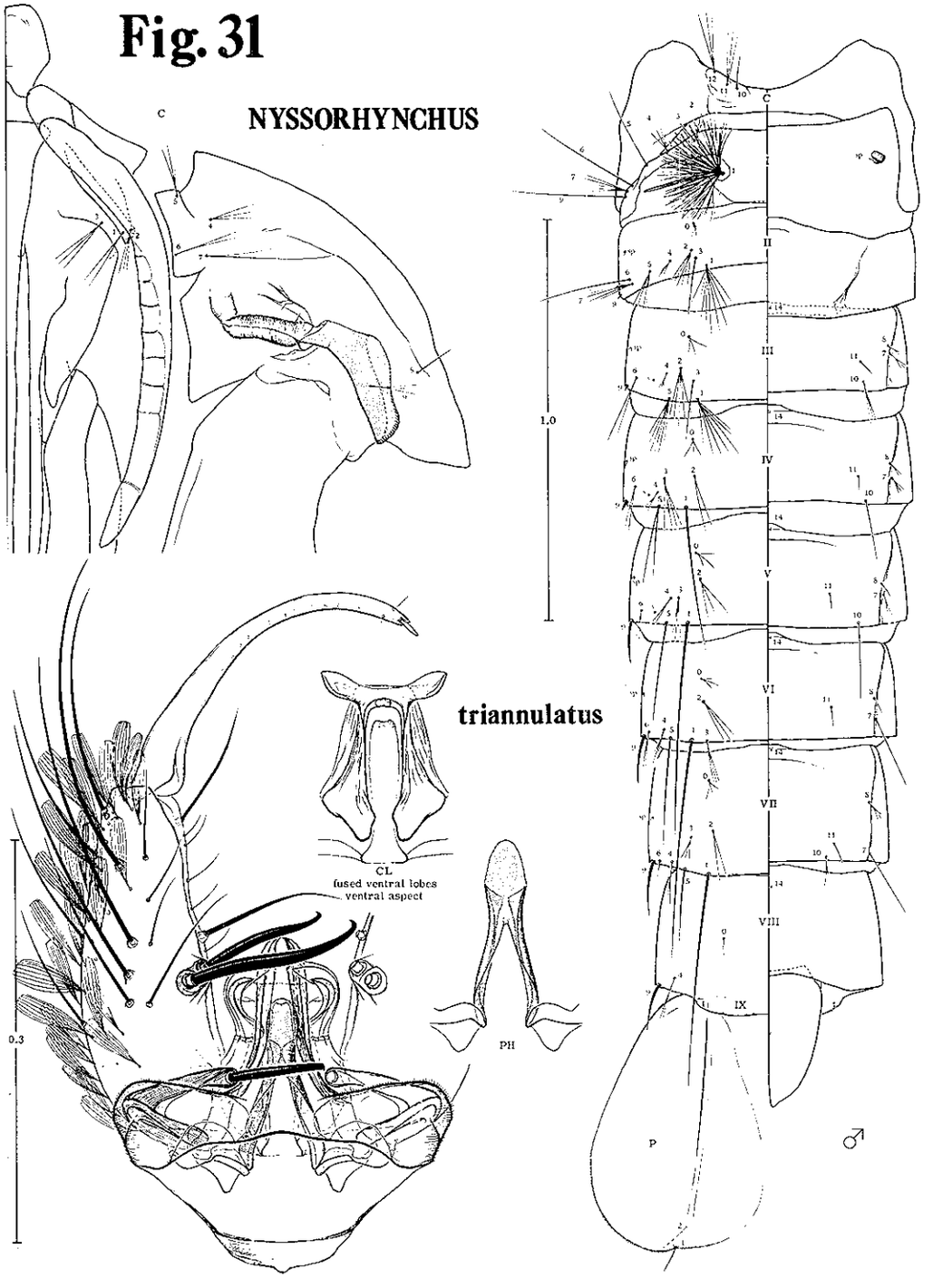

NYSSORHYNCHUS
triannulatus
C
I
II
III
IV
V
VI
VII
VIII
IX
P
♂
1.0
0.3
CL
fused ventral lobes
ventral aspect
PH

Fig. 32

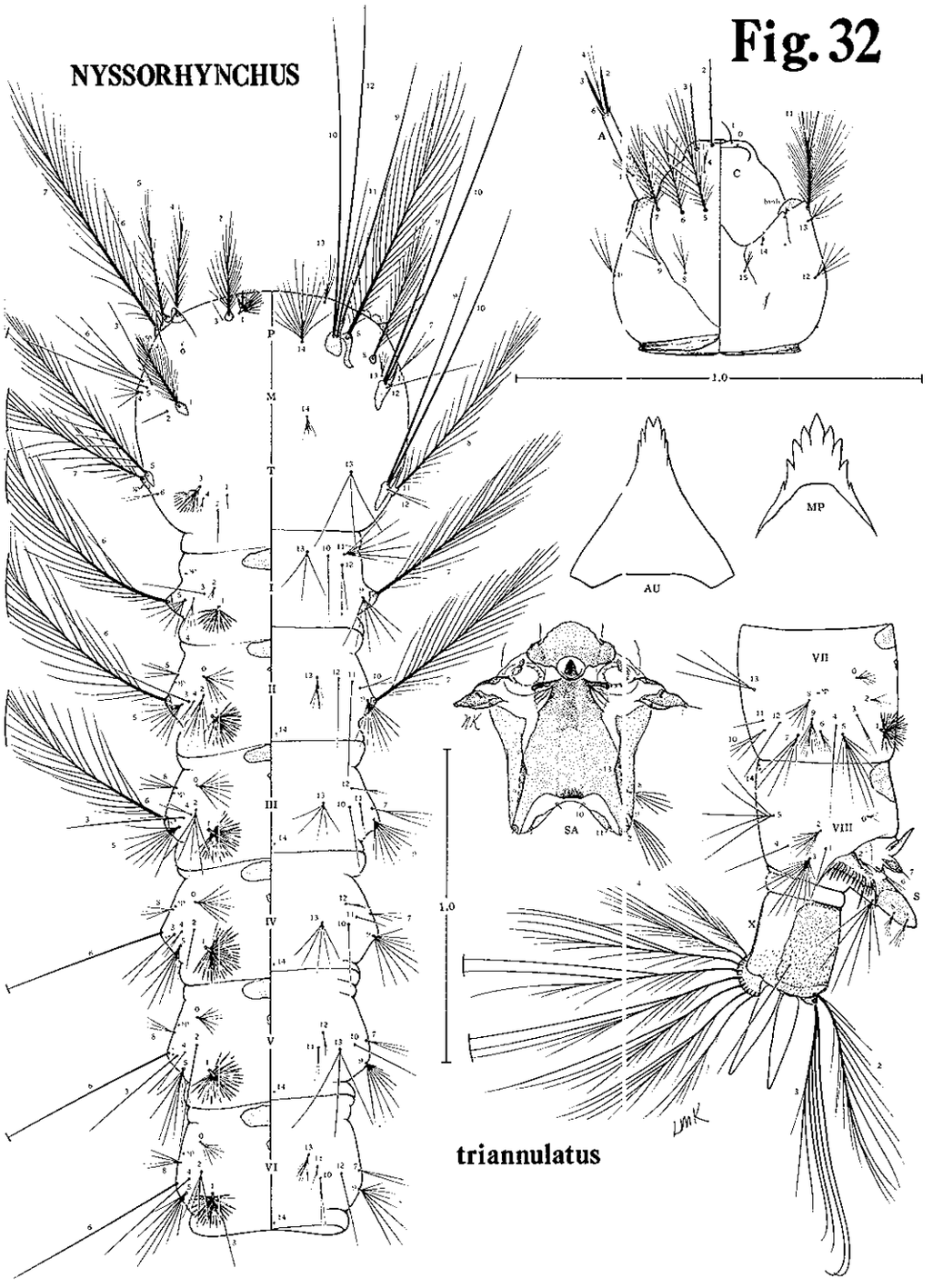


TABLE OF DISTRIBUTIONS

DISTRIBUTION		SPECIES	1. albimanus	2. oswaldoi	3. galvaoi	4. norteestensis	5. aquasalis	6. intii	7. anomalophylus	8. rangeli	9. trinkae	10. nuneztovari	11. strodei	12. rondoni	13. benarrochi	14. triannulatus
UNITED STATES	Florida		●													
	Texas		●													
MEXICO	North		●													
	South		●										✪			
GUATEMALA			●										✪			
BELIZE			●													
EL SALVADOR			●													
HONDURAS			●										✪			
NICARAGUA			●				✪									✪
COSTA RICA			●	●			●		●				●			●
PANAMA	West		●	✪			●		●				●			●
	Central		●	●			●						●			●
	East		●	●			✪					●	✪			✪
ECUADOR	Pacific		●				✪									✪
	Amazon			✪						●	◐					●
PERU				●						●					●	●
COLOMBIA	Pacific		✪				✪			✪						✪
	Caribbean		●	✪						●		●	✪			●
	Orino-Amazon			●						●	◐		●		●	●
VENEZUELA	Caribbean		●	●			●			●		●	●		✪	●
	Orinoco			●						●		●	✪			●
BAHAMAS			●													
GREATER ANTILLES			●													
LESSER ANTILLES	Leeward		●				●									
	Windward						●									
TRINIDAD				●			●									
GUIANAS				●			●	✪		✪		●	✪			●
BRAZIL	Amazon			●	●		●	◐		●		●	●		✪	●
	Northeast			●	?	●	●						●			●
	South			●	●	●	●			✪			●	✪		●
PARAGUAY				✪	✪	✪							●	●		●
ARGENTINA				✪		●							●	●		●
BOLIVIA				●		●				●	?	?	●	●		●

CONSPECTUS OF TAXONOMIC CHANGES

Resurrected From Synonymy

strodei Root 1926, from synonymy with *evansi* (Brethes 1926), to specific rank, p 129-130.

New Synonymies

albertoi Unti 1941, from variety of *evansi* (Brethes 1926), to synonymy with *strodei* Root 1926, p 123, 128.

arthuri Unti 1941, from variety of *evansi* (Brethes 1926), to synonymy with *strodei* Root 1926, p 123, 128.

bachmanni Petrocchi 1925, from subspecies of *triannulatus* (Neiva and Pinto 1922), to synonymy with *triannulatus*, p 141, 147.

deltaorinoquensis Cova Garcia, Pulido F. and Amarista M. 1978, to synonymy with *aquasalis* Curry 1932, p 75, 83-84.

lloydi Unti 1941, from variety of *evansi* (Brethes 1926), to synonymy with *strodei* Root 1926, p 123, 128.

ramosi Unti 1940, from variety of *evansi* (Brethes 1926), to synonymy with *strodei* Root 1926, p 123.

Transferred Synonymies

artigasi Unti 1941, from synonymy with *arthuri* Unti 1941, to synonymy with *strodei* Root 1926, p 123, 128.

davisi Paterson and Shannon 1927, from synonymy with *bachmanni* Petrocchi 1925, to synonymy with *triannulatus* (Neiva and Pinto 1922), p 141, 147-148.

metcalfi Galvao and Lane 1937, from synonymy with *oswaldoi* (Peryassu 1922), to synonymy with *noroestensis* Galvao and Lane 1937, p 67, 73.

perezi Shannon and Del Ponte 1928, from synonymy with *bachmanni* Petrocchi 1925, to synonymy with *triannulatus* (Neiva and Pinto 1922), p 141, 147.

Nomina Dubia

evansi (Brethes 1926), to *nomen dubium*, p 129-130.

gorgasi Dyar and Knab 1907, from synonymy with *albimanus* Wiedemann 1820, to *nomen dubium*, p 14.

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Invalid taxa are in *italics*; valid taxa treated in detail by present paper are in **boldface**. Major page references are in **boldface**; page reference to key is shown by suffix "k"; figure numbers are in *italics*.

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