

STUDIES ON THE FAUNA OF CURAÇAO AND OTHER
CARIBBEAN ISLANDS: No. 23.

MOSQUITOES OF THE NETHERLANDS ANTILLES
AND THEIR HYGIENIC IMPORTANCE

by

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Introduction	p. 38
General information	p. 40
Previous reports	p. 44
<i>Morphology</i>	
Classification	p. 45
Morphological characteristics	p. 47
Taxonomic data	p. 63
Keys to the mosquitoes of the Netherlands Antilles	p. 67
<i>Biology</i>	
(Localities, breeding places, association, habits, distribution)	p. 80
<i>Hygienic importance</i>	
Mosquito-borne diseases	p. 97
Mosquitoes and traffic	p. 101
Rôle of the various water collections	p. 102
Control of mosquitoes and diseases	p. 104
Summary	p. 110
References	p. 113

Because of the scarcity of mosquito records of the Netherlands Antilles the author conducted several surveys on these islands.

From April 1941 to August 1947 collecting was done on Curaçao. The survey was not a continuous one, limited as it was to Sundays and holidays. The majority of the catches consisted of larvae, from which adults were reared. Collecting trips were quite successful during the rare rainy periods, but during the dry seasons several trips were made in vain. It is useful, however, to know the conditions during the latter, because of the scanty rainfall on Curaçao.

Only "snapshot surveys" were made on the other islands. Aruba was visited in December 1942, December 1944, August 1945 and July 1947; Bonaire in September 1942, April 1943, January and June 1944, June 1945, and May 1946; Klein Curaçao in March 1943; St. Martin, Saba and St. Eustatius in April 1947.

The mosquitoes collected by P. WAGENAAR HUMMELINCK in 1936-1937 and 1948-1949, which he allowed the author to identify, are included in this study.

Altogether, 20 species of mosquitoes have been found in the Netherlands Antilles (Table 3).

The natives of Curaçao, Aruba and Bonaire call the mosquito "sangura" (Dutch: muskiet, mug), while "muskita" means housefly (Dutch: huisvlieg). Mosquito larvae are called "microbio" or "bichi di awa".

The author must express his heartfelt gratitude to all those mentioned below, without whose help this work could hardly have been carried through.

Dr ALAN STONE, Curator of Culicidae of the United States National Museum, Washington, D.C., who verified the identification of all species. Dr LLOYD E. ROZEBOOM, Associate Professor of Parasitology of the Johns Hopkins School of Hygiene & Public Health, Baltimore. Dr MARK F. BOYD, Director of the Station for Malaria Research of the Rockefeller Foundation, Tallahassee, Florida. Prof. Dr N. H. SWELLENGREBEL, Director of the Institute of Tropical Hygiene and Geographical Pathology, Amsterdam. Mrs. Dr J. BONNE-WEPPER, Chief of the Entomological Laboratory of the Institute of Tropical Hygiene and Geographical Pathology, Amsterdam. Dr P. WAGENAAR HUMMELINCK, Curator of the Zoological Laboratory, Utrecht. The late Dr PORTER J. CRAWFORD, Ex-Director of the Rockefeller Foundation for the Caribbean Region. Dr ERNESTO OSORNO-MESA, Instituto de Estudios Especiales Carlos Finlay, Bogotá, Colombia. Dr W. M. BONNE, Ex-Director of the Public Health Service of the Netherlands Antilles, at present Director of the Division of Communicable Disease Service, W.H.O. Mr. H. VAN KOOTEN, Artist of the Zoological Laboratory, Utrecht.

TABLE 3.

Distribution of Mosquitoes in the Netherlands Antilles.

Species	Curaçao	Aruba	Bonaire	St. Maarten	Saba	St. Eustatius
<i>Wyeomyia celaenocephala</i> Dyar & Knab, 1906	+					
<i>Anopheles pseudopunctipennis pseudopunctipennis</i> Theobald, 1901	+	+				
<i>Anopheles albimanus</i> Wiedemann, 1821				+		
<i>Uranotaenia lowii</i> Theobald, 1901			+			
<i>Aedes taeniorhynchus</i> (Wiedemann, 1821)	+				+	
<i>Aedes busckii</i> (Coquillett, 1906)						+
<i>Aedes aegypti</i> (Linnaeus, 1762) [syn. <i>Stegomyia fasciata</i> (Fabricius, 1805)]	+	+	+	+	+	+
<i>Haemagogus anastasionis</i> Dyar, 1921	+	+				
<i>Psorophora cyanoescens</i> (Coquillett, 1902)		+				
<i>Psorophora confinnis</i> (Lynch Arribáizaga, 1891)	+	+	+			
<i>Psorophora pygmaea</i> (Theobald, 1903)				+		
<i>Deinocerites cancer</i> Theobald, 1901	+	+	+	+		
<i>Culex erraticus</i> (Dyar & Knab, 1905)	+					
<i>Culex americanus</i> (Neveu-Lemaire, 1902)				+	+	+
<i>Culex bahamensis</i> Dyar & Knab, 1906				+		+
<i>Culex habilitator</i> Dyar & Knab, 1906				+		
<i>Culex maracayensis</i> Evans, 1923	+					
<i>Culex nigripalpus</i> Theobald, 1901	+					
<i>Culex quinquefasciatus</i> Say, 1823 [syn. <i>Culex fatigans</i> Wiedemann, 1828].	+	+	+	+	+	+
<i>Megarhinus guadeloupensis</i> Dyar & Knab, 1906					+	
20 species	11	7	5	8	5	5

Specimens of nearly all species have been deposited with the United States National Museum in Washington, D.C.; some specimens in the Station for Malaria Research of the Rockefeller Foundation in Tallahassee, Florida, and at the Institute of Tropical Hygiene and Geographical Pathology in Amsterdam; specimens of *Anopheles pseudopunctipennis pseudopunctipennis* at the Parasitological Department of the Johns Hopkins School of Hygiene & Public Health in Baltimore, and of *Haemagogus anastasionis* at the Instituto de Estudios Especiales Carlos Finlay in Bogotá, Colombia.

GENERAL INFORMATION

TOPOGRAPHY

The Netherlands Antilles, belonging to the Lesser Antilles, consist of two groups of islands: (1) The Leeward Group, Netherlands Leeward Islands or Curaçao Group (*Curaçao*, *Klein Curaçao*, *Aruba*, *Bonaire* and *Klein Bonaire*), which is situated off the Venezuelan coast; (2) the Windward Group, Netherlands Windward Islands or St. Martin Group (*Saba*, *St. Eustatius* and the southern part of St. Martin, called *St. Maarten*), which lies east of Puerto Rico and the Virgin Islands.

Some confusion arises from the fact that the Netherlands Windward Islands fall within the area of the British Leeward Islands. To avoid misinterpretation the terms *Curaçao Group* and *St. Martin Group* have been used in this work.

The Curaçao Group lies between 11°59' and 12°37'30" N. Lat. and 68°12' and 70°4' W. Long., the St. Martin Group between 17°28'12" and 18°7'20" N. Lat. and 62°56'25" and 63°15' W. Long. The two groups are about 900 kilometres apart. Their total area being 950 square kilometres not including inland waters (Table 4).

CLIMATE

The Netherlands Antilles have a tropical climate. The temperature is high throughout the year with little variation. The average air *temperature* on Curaçao was 27.7 centigrades in the period 1930–1949; the absolute maximum being 35.8, the minimum 17.0. The coolest period is from January to February, the hottest from August to October. — The average temperature on St. Maarten was 26.9 centigrades from 1945 to 1950.

Fortunately the heat is relieved by the eastern trade *winds* which were measured to have an average velocity on Curaçao of 15 miles per hour (1947–1949) and 11 on St. Maarten (1945–1950).

The *rainfall* (Table 5) varies considerably on the two groups of islands. The Curaçao Group belongs to the region of the "steppe" climates of KÖPPEN. The lowest annual precipitation during the period 1930–1949 was measured on Aruba in 1941 (117.7 mm), and the highest on Curaçao in 1933 (1115.6 mm). The driest period is usually from March to April, the wettest from October to December. — The St. Martin Group has a much higher rainfall. The dry season is from February to April, the rainy season in May and from August to November.

The average relative *humidity* was 74 per cent on Curaçao from 1930 to 1949, and 76 per cent on St. Maarten from 1945 to 1950.

The *hurricane* season in the St. Martin Group falls during the months of August, September and October.

SOIL

The Curaçao Group is mainly built up of old volcanic rock series, covered partly by Quaternary coral limestone. The soil derived from the diabases is inherently fertile.

St. Martin's geology resembles more or less that of the Curaçao Group, but Saba and St. Eustatius are essentially young extinct volcanoes in various stages of denudation; their andesite lavas and tuffs form comparatively good soils.

For further data on geology and soil, with references concerning these and other subjects dealt with in this chapter, see the 1st and 17th paper of these *Studies*, vol. 1 and 4.

VEGETATION

The Curaçao Group lies within an area of low rainfall, about 500 mm annually. Their vegetation, accordingly, has a pronounced xerophytic character, and thorny shrubs and cactuses are predominant features in the islands' scenery. Irrigation is applied locally. Mangrove vegetation occurs here and there along the sea coast and the bays.

The St. Martin Group has an annual rainfall of about 1100 mm. The vegetation is chiefly of the semi-deciduous seasonal forest type, generally of a low kind. Denser forest is located only on the summit of Saba's The Mountain, and in the crater of St. Eustatius' Quill volcano.

POPULATION

In 1927 Aruba had a population of 9,000. Large scale immigration followed after the establishment of oil refineries by the Mexican Eagle Oil Company (in 1927) and the Lago Oil and Transport Co (in 1928). In 1951 the population was some 53,000, i.e. nearly six times as large as in 1927. — A similar increase took place on Curaçao. Since the Royal Dutch Shell (Curaçao Petroleum Industry Company) began to operate in 1915, the population increased from 33,000 to 102,000 in 1951.

The inhabitants of the other islands are largely small farmers. Their populations are constantly diminishing as a result of the steady emigration of young adults, especially males, to Curaçao and Aruba. Klein Curaçao and Klein Bonaire are uninhabited, except for a few temporarily residing fishermen and lighthouse men (Table 4).

The original inhabitants of the islands were American Indians. The islands have been in Spanish, British, French and Dutch hands. Several people settled in the islands: Negro slaves, Portuguese Jews from Brazil, Europeans, Americans, Asiatics, inhabitants of Madeira and the Azores, people from Surinam, Venezuela, other Caribbean islands, etc. Either in Curaçao or Aruba people of more than 40 nationalities live. — The majority of the people of St. Maarten and St. Eustatius are coloured; there are about 200 whites at Simson Bay, St. Maarten. The population of Saba is equally white and coloured.

There are no data on racial groups in the Curaçao Group. A few years ago the author made a survey of the incidence of abortion in Curaçao, and questioned 1,000 women at random: 9.9% were whites, 0.7% were Asiatics, 40.9% mulattoes and 48.5% negroes. — The population of Bonaire is mainly coloured. In Aruba the Amerindian element is strongly represented. Aruba has been Americanized in the sense that hundreds of Americans live there, and several American ships daily enter the harbours.

MEDICAL CARE

Soldiers, police-men, lower Government officials, personnel of the oil corporations, employees of steamship companies and air lines, and some others are treated free of charge. Indigent people are treated free, or practically so, by the Government. Patients suffering from venereal or any other contagious disease also have free treatment. Labourers are protected by the Workman's Compensation Act; the employers have to pay for their health and accident insurances.

TABLE 4.

The Netherlands Antilles.

Island	Area in square kilo- metres	Number of inhabitants (Jan. 1, 1951)	Capital
<i>Curaçao</i>	425	102,206	Willemstad
and <i>Klein Curaçao</i> . . .	1.2		
<i>Aruba</i>	175	53,211	Oranjestad
<i>Bonaire</i>	265	5,079	Kralendijk
and <i>Klein Bonaire</i> . . .	7		
<i>St. Maarten</i> (Netherlands St. Martin)	34.2	1,478	Philipsburg
<i>Saba</i>	12.5	1,129	Bottom
<i>St. Eustatius</i>	30.5	970	Oranjestad
Netherlands Antilles . . .	950.4	164,073	(Willemstad)

TABLE 5.

Average monthly Rainfall, 1930-1949, in mm
(computed from all available observations).

Month	<i>Curaçao</i>	<i>Aruba</i>	<i>Bonaire</i>	<i>St. Maarten</i>	<i>Saba</i>	<i>St. Eustatius</i>
January . . .	47.6	34.5	51.4	69.6	88.1	78.4
February . . .	22.0	18.3	23.2	36.1	45.9	35.9
March	10.1	6.1	12.5	45.9	43.0	38.1
April	14.0	8.2	13.6	67.9	63.3	45.2
May	20.2	20.2	23.5	137.9	123.1	90.1
June	21.7	10.8	18.2	91.1	83.4	67.8
July	25.3	17.2	16.7	96.1	91.3	99.1
August	32.5	16.7	33.4	106.0	116.3	121.3
September . .	30.3	24.6	31.5	138.4	120.4	127.5
October	87.6	60.3	72.7	119.1	125.8	106.4
November . . .	139.5	116.1	137.2	159.9	170.6	150.1
December . . .	113.1	80.5	94.3	79.3	94.3	78.1
<i>Total</i>	<i>564.3</i>	<i>412.8</i>	<i>528.6</i>	<i>1132.0</i>	<i>1166.0</i>	<i>1038.0</i>

There is one Government physician in each of the small islands: Bonaire, St. Maarten, Saba and St. Eustatius. They are assisted by midwives and nurses. In each island there are small hospitals and health centres.

The physicians in Bonaire and St. Maarten use motor cars, those on Saba and St. Eustatius usually horses. As the roads are mostly adequate patients may be visited easily. In mountainous Saba, however, trips are rather fatiguing. Each island has telegraph and telephone communication. Aruba, Bonaire and St. Maarten have a regular airplane service with Curaçao. Inter-island communication in the St. Martin Group is limited to schooners, sloops and motorboats.

The inhabitants of Curaçao and Aruba are provided with good medical service as a result of the economic prosperity. These islands have several hospitals, laboratories and health centres. In December 1946 there were 44 physicians in Curaçao (1 per 2007 inhabitants), and 26 on Aruba (1 per 1766). In 1950 there was, on an average, one physician per 1700 inhabitants in Curaçao and Aruba.

SANITARY CONDITIONS

The streets in the towns of Curaçao and Aruba are comparatively clean. Those of Willemstad are often very narrow; they are laid with asphalt, and so are the main roads in rural areas. The streets and roads of Bonaire are dusty. The few streets of the capitals of the St. Martin Group are paved with concrete.

The majority of the urban houses in the Curaçao Group are made of stone or brick, most of the rural houses of clay or wood. Those of the St. Martin Group are for the greater part made of wood; many of them are two- or even three-storeyed. The primitive houses, but also the large modern ones on Curaçao and Aruba usually have one floor only. The house famine is great as the building of new dwellings cannot keep pace with the immigration surplus.

The Government Water Supply Service distributes distilled sea water in towns and villages on Aruba, and distilled sea water mixed with ground water in the urban areas of Curaçao. The C.P.I.M. in Curaçao supplies distilled sea water mixed with ground water to their employees; distilled water mixed with water brought from the U.S.A. is distributed by the Lago in Aruba. Rainwater, ground and surface water are used in the other islands and in rural parts of Curaçao and Aruba.

Sewage disposal is in a very bad condition, except in the towns of the oil companies. Fortunately draining systems in Willemstad (Cur.), and in Oranjestad and St. Nicolaas (Ar.) are being established.

Garbage disposal is excellent in the settlements of the oil companies, but insufficient in other towns and very primitive in rural districts.

The food of the low-income people is inadequate, as it is mainly composed of corn-meal. Vegetables, fruits and milk are imported since the dry soil in the Curaçao Group is not suitable for agriculture, horticulture and cattle-breeding.

PREVIOUS REPORTS

In 1792 ZIMMERMAN L'AINÉ, cited by DE HULLU (1919), complained of mosquitoes on St. Eustatius.

BOSCH (1829) mentioned the presence of mosquitoes on Curaçao and St. Eustatius.

TEENSTRA (1836) divided the mosquitoes of Curaçao into singing and silent species. The former sat down in a curved position; the latter were more oblong and had black legs, they bit much more, but were less troublesome than the singing ones. Did TEENSTRA mean *Anopheles pseudopunctipennis* when describing the silent species?

SIMONS (1868), in collaboration with the military physician N. ANSLIJN, reported the presence of "*Culex pitriens*. L." and "*Culex annulatus*. L." on Curaçao. They probably meant *Culex pipiens* (*C. quinquefasciatus*) and *Aedes aegypti*.

The entomologist J. R. H. NEERVOORT VAN DE POLL collected insects in the Netherlands Antilles in 1884, but no mosquitoes are known from his material.

VAN KOL (1904) stated that *Culex* species were found on Saba, but no *Anopheles*.

BONNE & BONNE-WEPISTER (1917) reported that the number of *Stegomyia* was rather small on Curaçao. In 1925 they mentioned *Culex fatigans* (= *C. quinquefasciatus*); in 1947 they informed the author that they found *Aedes aegypti* and *Culex fatigans* on Curaçao in 1915.

WATERMAN (1917, 1919a) stated that *Stegomyia fasciata* (= *Aedes aegypti*) was a common domestic mosquito on the islands. He also found *Culex fatigans* at Rif, Willemstad (1919). In 1946 he informed the author that he collected a few *Anopheles* specimens on Curaçao between 1916 and 1919 and that *Aedes aegypti* was abundant.

VAN KOL (1919) reported *Stegomyia fasciata* as a common domestic mosquito.

EVANS (1921) caught *Aedes* (*Stegomyia*) *fasciata* and *Culex* (*Culex*) *quinquefasciatus* on Curaçao.

KUMM (1931) mentioned EVANS' finding of *Aedes aegypti* on Curaçao.

BERGMAN (1924) stated that a few Anophelines were seen on Curaçao at the end of 1924 after heavy rains, but that they were probably imported by ships.

EMANUELS (1947 in litt.) observed *Aedes aegypti* and possibly *Culex fatigans* on St. Maarten and Saba, and *Anopheles "tarsimaculatus"* on French St. Martin between 1923 and 1927.

TH. J. C. BUYS, cited by LENS (1927) and PHILIPSZOON (1942) examined 16 specimens of *Stegomyia* on Curaçao, but *Anopheles* was not found.

HOFFMAN (1930) who collected mosquitoes in the Lesser Antilles in 1929 mentioned that the only interesting entomological find was that of *Aedes* (*Stegomyia*) *aegypti* in a tree hole on St. Martin.

LAMPE (1936) reported that *Stegomyia fasciata* was a common domestic mosquito.

ELISHEWITZ (1951, in litt.) made a rather thorough survey of the mosquitoes on Aruba 1946-1947, but has not yet published his findings.

BENJAMINS (1915), VAN KOL (1919), LENS (1928), VERWEY (1937), WINCKEL (1939), PHILIPSZOON (1942), HENDERSON (1945) and SWELLENGREBEL & WINCKEL (1947) stated that there appeared to be no *Anopheles* species in some or in all of the islands.

Brief reports of the author's studies on mosquitoes of the Netherlands Antilles have been published in several papers (VAN DER KUYP, 1941-1947, 1941a-1947a, 1948a, 1948b, 1949a, 1949b, 1950, 1953a, 1953b).

MORPHOLOGY

CLASSIFICATION

American mosquitoes are classified in different ways by DYAR (1928) and EDWARDS (1932). Both classifications of the mosquitoes of the Netherlands Antilles are given here.

EDWARDS has used the word "group" twice in his classification; for example, he has divided the *Uranotaenia* group into 3 genera (*Zeugomyia*, *Hodgesia* and *Uranotaenia*) and the genus *Uranotaenia* again into: group A (*Uranotaenia*) and group B (*Pseudoficalbia*). So the category Group is used to indicate a subdivision higher than genus, and another subdivision lower than subgenus. Both subdivisions have proved to be of great use.

In order to avoid making errors the author has changed the word Group of EDWARDS' first subdivision into subtribe.

Classification of the Subfamily CULICINAE Theobald

after DYAR

- Tribe *Sabethini* Howard, Dyar & Knab
 - Genus *WYEOMYIA* Theobald
 - Subgenus *Phillozomyia* Dyar
 - W.(P.) celaenocephala* Dyar & Knab 1906
- Tribe *Anophelini* Dyar & Shannon
 - Genus *ANOPHELES* Meigen
 - Subgenus *Anopheles* Meigen
 - A.(A.) pseudopunctipennis*
 - pseudopunctipennis* Theobald 1901
 - Subgenus *Nyssorhynchus* Blanchard
 - A.(N.) albimanus* Wiedemann 1821
- Tribe *Uranotaeniini* Dyar & Shannon
 - Genus *URANOTAENIA* Lynch Arribálzaga
 - U. lowii* Theobald 1901
- Tribe *Megarhinini* Dyar & Shannon
 - Genus *MEGARHINUS* Robineau-Desvoidy
 - Subgenus *Megarhinus* Robineau-Desvoidy
 - M.(M.) guadeloupensis* Dyar & Knab 1906

after EDWARDS (slightly modified)

- Tribe *Anophelini*
 - Genus *ANOPHELES* Meigen
 - Subgenus *Anopheles* Meigen
 - Group *Anopheles*
 - Anopheles* series
 - A.(A.) pseudopunctipennis*
 - pseudopunctipennis*
 - Theobald 1901
 - Subgenus *Nyssorhynchus* Blanchard
 - Group *Nyssorhynchus*
 - Albimanus* series
 - Albimanus* subseries
 - A.(N.) albimanus* Wiedemann 1821
- Tribe *Megarhinini*
 - Genus *MEGARHINUS* Robineau-Desvoidy
 - Group *Megarhinus*
 - M.(M.) guadeloupensis* Dyar & Knab 1906
- Tribe *Culicini*
 - Subtribe *Sabethes*
 - Genus *WYEOMYIA* Theobald
 - Subgenus *Wyeomyia* Theobald
 - W.(W.) celaenocephala* Dyar & Knab 1906
 - Subtribe *Uranotaenia*
 - Genus *URANOTAENIA* Lynch Arribálzaga
 - Group *Uranotaenia*
 - U. lowii* Theobald 1901

Tribe *Culicini* DyarGenus *Aedes* MeigenSubgenus *Taeniorhynchus* Lynch Arribálzaga

A.(T.) taeniorhynchus (Wiedemann 1821)

Subgenus *Howardina* Theobald

A.(H.) busckii (Coquillett 1906)

Subgenus *Stegomyia* Theobald

A.(S.) aegypti (Linnaeus 1762)

Genus *Haemagogus* WillistonSubgenus *Haemagogus* Williston

H.(H.) anastasionis Dyar 1921

Genus *Psorophora* Robineau-DesvoidySubgenus *Janthinosoma* Lynch Arribálzaga

P.(J.) cyanescens (Coquillett 1902)

Subgenus *Grabhamia* Theobald

P.(G.) confinnis (Lynch Arribálzaga 1891)

P.(G.) pygmaea (Theobald 1903)

Genus *Deinocerites* Theobald

D. cancer Theobald 1901

Genus *Culex* LinnaeusSubgenus *Mochlostyrax* Dyar & KnabSection *Choeroporpa* Dyar

Culex (M.) erraticus (Dyar & Knab 1905)

Subgenus *Melanoconion* TheobaldSection *Melanoconion* Theobald

Culex (M.) americanus (Neveu-Lemaire 1902)

Subgenus *Culex* LinnaeusSection *Transculicia* Dyar

C.(C.) bahamensis Dyar & Knab 1906

Section *Cacoculex* Dyar

C.(C.) habilitator Dyar & Knab 1906

C.(C.) maracayensis Evans 1923

Section *Culex* Linnaeus

C.(C.) nigripalpus Theobald 1901

C.(C.) quinquefasciatus Say 1823

Subtribe *Aedes*Genus *Aedes* MeigenSubgenus *Ochlerotatus* Lynch ArribálzagaGroup *Taeniorhynchus*

A.(O.) taeniorhynchus (Wiedemann 1821)

Subgenus *Howardina* Theobald

A.(H.) busckii (Coquillett 1906)

Subgenus *Stegomyia* TheobaldGroup *Stegomyia*

A.(S.) aegypti (Linnaeus 1762)

Genus *Haemagogus* WillistonGroup *Haemagogus*

H. anastasionis Dyar 1921

Genus *Psorophora* Robineau-DesvoidySubgenus *Janthinosoma* Lynch Arribálzaga

P.(J.) cyanescens (Coquillett 1902)

Subgenus *Grabhamia* Theobald

P.(G.) confinnis (Lynch Arribálzaga 1891)

P.(G.) pygmaea (Theobald 1903)

Subtribe *Culex*Genus *Deinocerites* TheobaldGroup *Deinocerites*

D. cancer Theobald 1901

Genus *Culex* LinnaeusSubgenus *Melanoconion* Theobald

C.(M.) erraticus (Dyar & Knab 1905)

Subgenus *Micraedes* Coquillett

C.(M.) americanus (Neveu-Lemaire 1902)

Subgenus *Culex* LinnaeusGroup *Culex**Tarsalis* series

C.(C.) bahamensis Dyar & Knab 1906

C.(C.) habilitator Dyar & Knab 1906

C.(C.) maracayensis Evans 1923

Salinarius-apicinus series

C.(C.) nigripalpus Theobald 1901

Pipiens series

C.(C.) quinquefasciatus Say 1823

MORPHOLOGICAL CHARACTERISTICS

Apart from the author's own material, data have been drawn chiefly from THEOBALD (1901-1910), HOWARD, DYAR & KNAB (1912-1917), BONNE & BONNE-WEPSTER (1925), DYAR (1928), EDWARDS (1932), KOMP (1942) and HILL & MACDOWELL HILL (1948).

As a matter of fact, those using the descriptions and keys have to be familiar with the nomenclature of the morphological characteristics of the mosquitoes.

It should be borne in mind that after running a mosquito through a key, the identification must be verified by comparing the morphological characteristics with the description since the mosquito may be a species which is not included in this paper.

The description of the larvae refers to the fourth instar.

Wyeomyia celaenocephala Dyar & Knab, 1906

Larva

Head rounded, as long as wide. Upper dorsal hair in 3, lower in 2 and long; ante-antennal tuft in 3. Antenna small; a small tuft of 2 hairs near apex.

Abdomen. Lateral hairs of 2 long and 2 short ones on first segment, 2 long ones on second segment and a single, very long hair on third to eighth segments. Lateral comb of eighth segment of many scales in a dense row; single scale with elliptical base, apical half a broad, flat process, finely fringed, with a median, blunt-tipped tooth. Air-tube tapered; 6 times as long as wide; no pecten; about 15 simple, long hairs, some near the base short and double. Anal segment longer than wide; nearly ringed by the plate; no ventral brush; subventral tuft short, of about 10 hairs on each side; dorsal tuft of 2 long hairs on each side; lateral hair single, long; 4 anal gills, about 2 times as long as the segment, ensiform.

Adult

Proboscis dark, with blue reflection; slender, about as long as abdomen. Palpi short in both sexes. Antennae nearly similarly haired in both sexes. Occiput with black scales with green and blue reflection, a violaceous patch at vertex, a white patch at the side below. Prothoracic lobes with shining blue and violaceous scales. Mesonotum with dark, broad scales with metallic reflection. Pleurae with silvery white scales; upper sternopleural and pronotal bristles absent, spiracular and pre-alar ones present. Postnotum with a tuft of bristles, but without scales.

Abdomen without bristles, except for a bristly fringe on hind margin of segment 7; dark dorsally, with slight blue reflection; silvery white ventrally, the colours separated on the sides in a straight line.

Legs long and slender, dark with blue reflection; second mid tarsus with apex white, mid tarsi 3-5 white on outer side.

Wings dark; scales broadly linear, denser at the apices of veins 2-4; squama without hairs.

Male genitalia. Sidepiece about twice as long as wide; broad at base; tip strongly tapered; 2 setae near middle. Clasper with rather stout, irregularly constricted stem; apex trilobed; mid lobe broad, conical, with a row of coarse spines; inner (apical) lobe long, slender, pilose, its tip divided into 2 digits; outer lobe slender, angularly curved, with several subapical teeth. Mesosome 2 stout cones, each with 2 spines at tip. Tenth sternite thick and long, the tip toothed. Ninth tergite conical, lobes with 2 stout spines and connected by a slender, curved bridge.

***Anopheles pseudopunctipennis pseudopunctipennis* Theobald, 1901**

E g g

Black, long, narrow, with one end blunt and the other tapered. Dorsal surface flattened, ventral convex; polygonal markings on exochorion, except for tapered tip. Floats large, placed on dorsal surface, touching one another along the mid-dorsal line; each float with about 30 ridges. Frill broad, collar-like, separated from the floats.

L a r v a

Head longer than wide. Clypeal hairs long, simple, of about equal length. Frontal hairs feathered, with a central main stem and many lateral hairs arising along its length; large and prominent. Antenna light in colour; usually a single short hair below middle.

Thorax. Dorsal submedian prothoracic hair group not from a common chitinized base; inner hair short, bifid or trifid; middle hair split at tip, with a few lateral branches; outer hair longer than inner one, simple. Anterior meso- and metathoracic pleural hairs heavy, spine-like. Tubercles of mesothoracic pleural group with a heavy, long, curved spur, and a second short one; of pro- and metathoracic group with one curved spur.

Abdomen. Palmate hairs absent on first 2 segments, though represented by short thickened hairs, but present on third to seventh segments; each hair with about 15 long leaflets, with few serrations, ending in long, slender filaments. Long lateral hairs of segments 1 and 2 long, feathered, double; of segment 3 long, feathered, single; of segments 4, 5 and 6 long, slender, with a single main stem and many lateral branches. No air-tube. Posterior flap of spiracular apparatus with a pair of upwardly projecting, tusk-shaped appendages with black core, very variable in length.

P u p a

Respiratory trumpet with wide opening, scoop-shaped. Abdomen with postero-lateral hairs placed almost exactly at corners; those on segments 3-8 spine-like, pointed; hairs 2 and 5 (posterior) on segments 5-7 rather small, some bifid. Paddle oval, with rather short, hooked terminal hair at tip of midrib; accessory hair on midrib some distance from tip; tip fringed with fine hairs; upper external border denticulate.

A d u l t

Proboscis dark, long, slender. Palpi as long as proboscis in both sexes, with terminal segment entirely white, segment 4 dark, with a very narrow apical and a wider basal white ring, segment 3 dark, with a few white scales at tip, segment 2

dark, with a narrow apical white ring; male palpi clubbed at tip. Occiput with erect, truncate, white scales centrally. Mesonotum dark, with broad gray median stripe. Scutellum crescent-shaped.

Abdomen dark, with long, pale hairs, but without scales.

Legs dark.

Wings with fine, hair-like, black and yellowish white scales; costa black, with 2 white spots; subcostal one very broad and subapical one broad; vein 1 with 6 subequal areas of alternating white and black, base white, tip narrowly white; vein 2 with extreme base white, followed by alternating black and white areas to base of fork, upper fork with basal half black, apical half white, extreme tip black, lower branch black, extreme tip white; vein 3 white at base, followed by a narrow, black area, a large white one in center, and a black tip; vein 4 white to fork, with 2 black spots centrally, upper and lower branches black, the tips white; vein 5 white at base, followed by a broad black area, beyond white to fork, upper branch with white base, followed by a narrow black spot and a white one, apical $\frac{2}{3}$ black, but extreme tip white, lower branch white with black apex, extreme tip white; vein 6 with basal half white, apical half black, extreme tip white; fringe dark, but white at ends of veins.

Male genitalia. Sidepiece about twice as long as wide, conical, with 2 unequal, parabaasal spines; internal spine long, slender, at outer $\frac{1}{3}$; all 3 spines with curved, pointed tips. Clasper longer than sidepiece, curved, with short terminal spine. Claspette with 3 flattened, appressed, curved, blade-like, apical filaments from the conical base of the outer (dorsal) lobe; inner (ventral) lobe large, rounded, hairy, with 2 very long, stout, curved, apical setae and a much smaller one between them. Mesosome rather small, nearly tubular, strongly curved dorsally; basal arms long, widely divergent; the basal plates very large; 2 unequal mesosomal leaflets on each side, small, delicate, deeply serrate. Tenth sternite (anal lobe) low, conical, with fine microtrichia. Ninth tergite narrow, band-like, sclerotized; lateral lobes short, with rounded tips.

Anopheles albimanus Wiedemann, 1821

Egg

Black, long, broad, with both ends blunt. Dorsal surface flattened, ventral convex; small silvery spots (little white stars) on exochorion. Floats large, extending nearly from pole to pole, dorso-lateral, paired, with a broad area of exposed dorsal endochorion between them; each float with about 25 ridges. Frills on both ends, very narrow, touching the floats and curving below the tips of the egg.

Larva

Head longer than wide. Clypeal hairs simple, anterior ones long, of nearly equal length, finely branched; their bases about equally spaced one from another. Frontal hairs feathered, subequal, the bases equidistant. Antenna light in colour, spined, tuft small, branched, at about $\frac{1}{4}$ – $\frac{1}{3}$ from base.

Thorax. Dorsal submedian prothoracic hair group from a common chitinized base; inner hair stout, about half as long as middle hair, the shaft much thickened and widened, with many hair-like lateral branches; middle hair long, the shaft thickened at base, with many fine lateral branches; outer hair short, simple, one fourth as long as middle hair. Anterior meso- and metathoracic pleural hairs long and simple. Spurs long and pointed.

Abdomen. Palmate hairs present on abdominal segments 1-7; those on segments 1 and 7 small; each hair with about 15-20 leaflets; these leaflets narrow, smooth, transparent, lanceolate. Long lateral hairs of segments 1-3 long, feathered; double on segments 1 and 2, single on segment 3; on segments 4-6 long, slender, single and simple. No air-tube; lateral wings of median plate of posterior flap of respiratory apparatus very short.

P u p a

Respiratory trumpet short, with wide opening. Abdomen with postero-lateral hairs placed almost exactly at corners; those on segments 3-8 spine-like; that on segment 4 blunt, those on segments 5-8 larger and pointed; hairs 2 and 5 (posterior) on segments 5-7 large and simple. Paddle oval, with short terminal hair at tip of midrib; accessory hair on midrib some distance from tip; upper external border denticulate.

A d u l t

Proboscis dark. Palpi as long as proboscis in both sexes, with terminal segment white; segment 4 dark with a few grayish scales; segments 3 and 2 dark with a narrow white apical band. Occiput with many long white scales centrally. Mesonotum dark gray, with three dark spots and pale longitudinal lines. Scutellum crescent-shaped.

Abdomen dark, with long pale setae and with scales; postero-lateral scale tufts on segments 3-7.

Legs dark and white. Fore leg: femur and tibia dark with a few light scales; tibia and tarsal segments 1-3 with a white tip; 4 and 5 dark. Mid leg: femur dark with white patches; tibia and tarsal segments 1 and 2 dark with white tips; segments 3-5 dark. Hind leg: femur dark with a white patch at tip; tibia and tarsal segment 1 dark with white tip; basal half of segment 2 dark, apical half, white; segments 3 and 4 white; 5 white with a narrow basal black ring.

Wings dark with white spots; costa with 6-7 white spots; second white basal spot larger than the preceding black one; subcosta and veins with alternating areas of black and white.

Male genitalia. Sidepiece about three times as long as wide, conical; with one short, stout parabasal spine, inserted on a distinct tubercle near base; internal spine long and slender, at outer $\frac{2}{5}$, curved before tip; 2 accessory spines from a prominence basal to internal spine, long and stout; parabasal and accessory spines hooked at tip. Clasper about as long as sidepiece, curved, with short terminal spine; a small subapical seta on outer aspect. Claspette lobes consisting of two outer (dorsal) lobes, and two inner (ventral) lobes; the latter are fused together; dorsal lobes consisting of a long slender pedicel with three long, pointed, curved, leaf-like filaments with central ribs; fused ventral lobe is a cylindrical columnar body with a grooved ventral face basally, supporting a table lamp-shade-like structure with a median sulcus, preapical plate small, a pair of hairless, membranous, testicle-like ventral lobes below the tip. Mesosome rather small, slightly tubular with rounded tip, curved dorsally; without leaflets; the sides subapically produced triangularly, nearly meeting in the midline on the ventral surface; basal plates moderate, triangular, with points ventrally. Tenth sternite (anal lobe) slender, conical; paraprocts well developed, triangularly expanded at base, tips incurving, forming a hood over mesosome. Ninth tergite without processes; central part membranous; lateral sclerotized portions finely haired.

Uranotaenia lowii Theobald, 1901**Larva**

Head longer than wide; black. Upper and lower dorsal hairs single, spine-like; ante-antennal tuft multiple. Antenna small, stout, spinulated; a single small hair before middle.

Abdomen. Lateral comb of eighth segment of 7 scales; single scale a long, slender thorn, fringed with spinules. Air-tube about 4 times as long as wide; pecten of 12 teeth running to about middle, followed by a multiple tuft; single tooth with rounded tip with a fringe of spinules. Anal segment longer than wide; ringed by the plate, which shows spinules along its posterior border; ventral brush of a few tufts posterior to the plate; dorsal tuft of 5 long hairs on each side; lateral tuft small, of 5 hairs; 4 anal gills, $\frac{1}{2}$ - $\frac{3}{4}$ as long as the segment, with blunt tips.

Adult

Proboscis dark, moderate. Palpi very short in both sexes. Antennae slightly more plumose in male than in female. Occiput dark, with a broad band of silvery blue scales on each side. Prothoracic lobes with broad, flat, silvery blue scales. Mesonotum light yellow brown, with a black central stripe; a black spot in front of the wing-base, with a center of silvery blue scales. Pleurae yellowish, with brown central spot, upper sternopleural and spiracular bristles present, postspiracular ones absent, only one pronotal and one lower mesepimeral bristle present.

Abdomen dark, the sides of segments 4-6 with large silvery patches on the apices; venter golden yellowish.

Legs dark, femora pale below; femora and tibiae with apical white spots; hind tarsi 3-5 white.

Wings dark, scales somewhat denser along the costa; a line of silvery blue scales at base of veins 4 and 5; second marginal cell about $\frac{1}{3}$ the length of its petiole; microtrichia absent; squama without hairs.

Male genitalia. Sidepiece $1\frac{1}{2}$ times as long as wide, stoutly conical; basal lobe low, strongly hairy. Clasper broad, stout, short, thickened outwardly, elliptical, with about 15 short, terminal spines. Mesosomal plates broad, united by a broad bridge; with blunt lateral arm; a rounded triangular process outwardly of it. Tenth sternite not distinct; instead 2 large, curved, divaricate rods.

Aedes taeniorhynchus (Wiedemann, 1821)**Larva**

Head rounded. Upper and lower dorsal hairs single; ante-antennal tuft of about 7-8 hairs. Antenna moderate, minutely spined; a very small tuft, double or triple, near middle.

Abdomen pilose. Lateral comb of eighth segment of about 20 scales in a triangular patch; single scale rounded apically, with a fringe of subequal broad spinules. Air-tube stout, tapered outwardly; about $1\frac{1}{2}$ -2 times as long as wide; pecten of 14-18 teeth running to middle, followed by a 6-8-haired tuft; single tooth with 4-6 basal branches. Anal segment wider than long; ringed by the plate; ventral brush well developed, posterior to the plate; dorsal tuft of a long hair and a 10-haired brush on each side; lateral hair single, rather long; 4 anal gills, half as long as the segment, tapered.

Adult

Proboscis long, slender, dark, with a white ring at middle. Palpi with white

tips. Occiput dark, a small white spot on the side and whitish below. Mesonotum dark, a few whitish scales posteriorly, and over the roots of the wings. Pleural bristles: upper sternopleural and postspiracular ones present, spiracular ones absent.

Abdomen dark, with basal segmental white bands, separated from the quadrate lateral spots; venter pale, the segments with broad, black apical bands; tip pointed, segment 7 narrow, 8 much narrowed and retracted.

Legs dark; femora pale beneath; tarsi with basal white rings; hind tarsus 5 entirely white; claws of front and mid legs of female toothed (1.1-1.1-0.0); fore claw with 2 teeth and hind one with one tooth on male front and mid legs (2.1-2.1-0.0).

Wings dark; scales narrow.

Male genitalia. Sidepiece 3 times as long as wide, conical at tip; with median longitudinal groove, reaching to tip; basal lobe small, densely hairy. Clasper rather strongly swollen at middle, with very long terminal spine. Claspette with columnar base and narrowly sickle-shaped filamentous seta with a retrose tooth at middle. Mesosome simple, not divided into lateral lobes and without teeth. Tenth sternite concave, elliptical, rather long, with inner margin and the tip thickened, the tooth laterally directed. Ninth tergite with 2 small bristly lobes close together, with 3-4 small setae.

Aëdes busckii (Coquillett, 1906)

Larva

Head rounded. Upper dorsal hair single, lower double; ante-antennal tuft of 2-3 hairs. Antenna moderate, sparsely spined; a single small hair near middle.

Thorax with coarse stellate tufts like cactus spines.

Abdomen. Coarse stellate tufts on segments. Lateral comb of eighth segment of 20-30 scales in 2-3 rows; single scale elongate, tip blunt, fringed with spinules. Air-tube about $2\frac{1}{2}$ times as long as wide; pecten of 8-9 teeth running to $\frac{1}{2}$ - $\frac{3}{5}$, followed by a single tuft of 2-4 hairs; single tooth a long spine with a basal branch. Anal segment as long as wide; not quite ringed by the plate; spinules on posterior border; ventral brush moderate, posterior to the plate; dorsal tuft of a long hair and a brush of 4 hairs on each side; lateral hair rather long, in 4; 4 anal gills, 2 as long as the segment and 2 half as long, rounded.

Adult

Proboscis dark, long, slender. Occiput with a median golden line; dark brown on the sides, variegated with silver scales. Mesonotum dark, thinly scaled; 2 narrow, golden, median lines running back $\frac{2}{3}$, followed by a single golden, median line; lateral to these are 2 more golden lines; a silver marginal line, rather broad and broken into 3 spots. Pleurae with patches of silver scales, upper sternopleural and postspiracular bristles present, spiracular ones absent.

Abdomen pointed at tip, segment 7 narrow, 8 much narrowed and retracted; dorsum dark, the sides with basal segmental silvery patches; venter dull golden, the posterior segments with a broad, black, apical band.

Legs dark; first fore tarsus, first 2 mid tarsi and first 3 hind tarsi white at base; claws of female simple; one tooth on fore claw of male front and mid legs (1.0-1.0-0.0).

Wings dark; scales narrow.

Male genitalia. Sidepiece twice as long as wide, conical, with median, longitudinal groove, reaching to tip; basal lobe small, with a single stout seta, and minute

hairs on its base. Clasper moderate, stout on basal $\frac{2}{3}$; terminal spine about $\frac{1}{8}$ as long as clasper. Claspette rudimentary; with a stout seta from a conical base, as long as base. Mesosome simple, not divided into lateral plates, and without teeth. Tenth sternite large, thickened and rounded apically; the tooth small and directed laterally. Ninth tergite small, each lobe with about 4 long, very stout spines.

***Aëdes aegypti* (Linnaeus, 1762)**

Larva

Head rounded. Upper and lower dorsal hairs and ante-antennal hair single. Antenna small, smooth; a single small hair at middle.

Thorax. Subventral processes beak-shaped, 4 in number; on segment 2 each process with a long stout spine and many smaller ones at its base, on segment 3 a large stout spine with 2 smaller ones at base.

Abdomen. Lateral comb of eighth segment of 8–11 scales in a single row; single scale with central spine and several pronounced, lateral branches. Air-tube stout, tapered on outer half; about 2 times as long as wide; pecten of about 14 teeth running nearly to middle, followed by a single tuft of 3 hairs; single tooth long, with 2 large and a few small lateral spinules. Anal segment as long as wide; not quite ringed by the plate; ventral brush moderate, posterior to the plate; dorsal tuft of 2 long hairs and a 2-haired shorter one on each side; lateral hair rather long, double; 4 anal gills, 2–3 times as long as the segment, with rounded tips.

Adult

Proboscis dark. Palpi short, dark, tip white in female; male palpi long, with 4 white rings. Occiput dark, with broad, flat scales; a silvery white median stripe; eye-margins silvery white, 2 white spots on the sides. Prothoracic lobes with a large patch of silvery white scales at middle, and many black bristles. Mesonotum with a conspicuous lyre-shaped, silvery white ornament. Pleurae dark, with patches of silvery white, flat scales; upper sternopleural and postspiracular bristles present, spiracular ones absent.

Abdomen with pointed tip, segment 7 narrow, 8 much narrowed and retracted; dorsum dark, narrow basal white bands on segments 3–6, not reaching the sides; silvery white, basal, triangular, lateral spots; venter yellowish, silvery white scales mixed with a few black ones, segment 6 with broad, black, apical band, segment 7 entirely black.

Legs with femora half white basally; tibiae black; hind tarsi with white, basal rings, narrow on tarsus 3, very broad on tarsi 4 and 5 or 5 entirely white; fore and mid legs with white basal rings on tarsi 1 and 2; claws toothed on front and mid legs in female (1.1–1.1–0.0); only one tooth on large claw of front leg in male (1.0–0.0–0.0).

Wings dark, scales broadly linear, those on vein 2 denser and broader.

Male genitalia. Sidepiece $1\frac{1}{2}$ times as long as wide, broadly conical, with median longitudinal groove, reaching to tip; a patch of spine-like setae and hairs on inner margin. Clasper shorter than sidepiece, simple, slightly broadened at middle; tip narrowed, with a short subterminal spine. Claspette absent. Mesosome divided into 2 lateral plates, with short, fine, apical teeth. Tenth sternite flattened; apical portion slender, pointed; basal portion broadened, a subterminal branch on median side. Ninth tergite with prominent triangulate lateral lobes, each with 5–6 apical, small hairs.

Haemagogus anastasionis Dyar, 1921**Larva**

Head rounded. Upper and lower dorsal hairs single; ante-antennal tuft in 3. Antenna small, uniform; a single small hair near middle.

Abdomen. Lateral comb of eighth segment of 8 scales in a single row; single scale long, pointed, slender, curved, fringed with spinules. Air-tube stout, slightly tapering; twice as long as wide; pecten of about 16 teeth (13–21), running to about middle, followed by a single tuft of 2–3 hairs; each tooth with a short one near base. Anal segment wider than long; nearly ringed by the plate; posterior margin with spicules; ventral brush posterior to the plate, of about 10 tufts of 2–5 hairs; dorsal tuft of a long hair and a brush of 5–6 hairs; lateral hair rather long, in 3–4; 4 anal gills, unequal, about half as long as the segment, rounded.

Adult

Proboscis blue-black, long and very slender. Palpi equally short in both sexes. Antennae heavily plumose in male. Occiput metallic blue-green; a narrow silvery border behind the eyes. Prothoracic lobes approximate, collar-like, with blue and white scales. Mesonotum bright metallic blue-green. Pleurae with silvery scales; upper sternopleural and spiracular bristles absent, pronotal ones present.

Abdomen metallic blue-violet, with lateral silvery spots confluent the whole length; venter banded, silvery at base, blue apically; tip pointed; segment 8 retracted.

Legs blue-black; tarsal claws toothed on fore and mid legs in both sexes (1.1–1.1–0.0).

Wings dark, with narrow scales; second marginal cell shorter than its petiole.

Male genitalia. Sidepiece $2\frac{1}{2}$ times as long as wide; narrowly conical, with stiff hairs at extreme base; setae and some lanceolate scales on inner margin. Clasper cylindrical, slender, short, with cylindrical terminal spine, half as long as clasper. Claspette with slender, hairy stem; filament scythe-shaped. Mesosome a broad plate with revolute edges, widening outwardly. Tenth sternite narrow, with rounded, hooked tips. Ninth tergite rudimentary, lobes with setae.

Psorophora cyanescens (Coquillett, 1902)**Larva**

Head rounded. Upper and lower dorsal hairs single; ante-antennal tuft in 3. Antenna long, minutely densely spined; a 2-haired tuft near middle.

Abdomen. Lateral comb of eighth segment of 4–5 scales in a single row; single scale broad, with a long central spine and 2 lateral branches on each side. Air-tube stout, wider in middle (barrel-shaped); 3 times as long as wide; pecten of 3–4 teeth, scattered over basal $\frac{1}{3}$; single tooth a long spine with a basal branch; a long terminal hair on each side, arising from lateral respiratory flap. Anal segment longer than wide; completely ringed by the plate; ventral brush piercing the ring; dorsal tuft of a long hair and a brush on each side; lateral hair single; 4 anal gills, equal, 2 times as long as the segment, with pointed tips.

Adult

Proboscis moderate, slender, blue-black. Occiput with small brassy scales. Mesonotum with broad brassy scales, uniformly distributed. Pleurae with white scales; upper sternopleural, spiracular and postspiracular bristles present.

Abdomen pointed at tip, segment 7 narrow, 8 much narrowed and retracted; dorsum dark metallic violet; the apices of the segments with broad transverse bands of yellowish scales, interrupted in the middle on all but the first 2 segments; venter pale.

Legs not mottled; femora yellowish, with an apical blue-black ring; tibiae and tarsi dark with violet reflection; all claws with one tooth in female (1.1-1.1-1.1); large claws of male front and mid legs with 2 teeth, other claws with one tooth (2.1-2.1-1.1).

Wings dark; scales narrow.

Male genitalia. Sidepiece more than twice as long as wide; cylindrical; inner apical angle slightly produced, hairy. Clasper swollen beyond middle, fringed on inner margin with short setae and denticles; terminal spine rather long, retrose. Claspette with long slender stem, attached to sidepiece except at base and tip; tip triangularly expanded, with 6-8 short setae. Mesosome a small basal cylinder. Tenth sternite rather large; inner margin thickened; the tip with laterally projecting point. Ninth tergite rudimentary.

***Psorophora confinnis* (Lynch Arribáizaga, 1891)**

Larva

Head rounded. Upper and lower dorsal hairs and ante-antennal tuft multiple. Antenna very long; a large tuft near middle.

Abdomen. Lateral comb of eighth segment of 6 scales in a single row; single scale pointed, with many lateral branches. Air-tube stout, wider in middle (barrel-shaped), 3 times as long as wide; pecten of 4 teeth, scattered over basal $\frac{2}{5}$, followed by a single tuft of 5 hairs; single tooth with 3-4 lateral branches. Anal segment wider than long; completely ringed by the plate; ventral brush piercing the ring; dorsal tuft of a long hair and a brush on each side; lateral hair small, double; 4 anal gills, 2 times as long as the segment, with pointed tips.

Adult

Proboscis moderate, dark with a broad, yellowish band at middle. Occiput with few small whitish scales and many erect, black bristles behind. Mesonotum with small, light and brown scales, forming a mottled pattern. Pleurae with narrow, whitish scales; upper sternopleural, spiracular and postspiracular bristles present.

Abdomen pointed at tip, segment 7 narrow, 8 much narrowed and retracted; dorsum dark; the apices of the segments with transverse bands of whitish scales; venter mainly dark.

Legs speckled with white; femora sparsely speckled, with narrow white, subapical ring; tibiae coarsely speckled outwardly; tarsus 1 with a pale ring, the other tarsi white at base and black at tip; female claws simple; large claws of male front and mid legs with one tooth (1.0-1.0-0.0).

Wings with dark and white scales mixed, the dark ones predominating; a dark spot at base of vein 3; scales narrowly ovate.

Male genitalia. Sidepiece 3 times as long as wide; cylindrical; inner apical angle produced, hairy. Clasper strongly swollen at middle; tip slender, terminal spine short. Claspette with slender stem, soldered to sidepiece; tip triangularly expanded, with 6 rather long setae. Mesosome a basal pointed cylinder. Tenth sternite large; inner margin thickened; the tip bent. Ninth tergite rudimentary.

Psorophora pygmaea (Theobald, 1903)**Larva**

Head rounded. Upper and lower dorsal hairs single, equal, long; ante-antennal tuft in 3-5. Antenna half as long as head, spinulated, a 4-6-haired tuft near middle.

Abdomen. Lateral comb of eighth segment of 6-7 scales in a single curved row on a week chitinization; single scale broad, with a long central spine and several lateral branches on each side. Air-tube stout, wider in middle (barrel-shaped); 3 times as long as wide; pecten of 6 teeth, scattered over basal $\frac{2}{3}$, followed by a single, very small tuft of 4 hairs; single tooth a long spine with 3 basal branches. Anal segment wider than long, completely ringed by the plate; ventral brush piercing the ring; dorsal tuft of a long hair and a brush on each side; lateral hair small, in 3-5; 4 anal gills, equal, 2 times as long as the segment, with pointed tips.

Adult

Proboscis moderate, dark with a broad, whitish band at middle. Occiput with few small whitish scales and many erect black bristles behind. Mesonotum with small, light and brown scales, forming a mottled pattern. Pleurae with narrow, whitish scales; upper sternopleural, spiracular and postspiracular bristles present.

Abdomen pointed at tip, segment 7 narrow, 8 much narrowed and retracted; dorsum dark; the apices of the segments with transverse bands of whitish scales, bands wider in middle; venter mainly dark.

Legs speckled with white; femora sparsely speckled, with narrow white subapical ring; tibiae sparsely speckled outwardly; hind tarsus I without a central ring; tarsi with joints narrowly white at base and broadly black at tip; female claws simple.

Wings with dark and white scales mixed, the dark ones predominating; scales narrowly ovate.

Male genitalia. Sidepiece about 3 times as long as wide, cylindrical; inner apical angle slightly produced, hairy. Clasper moderately swollen beyond the middle; tip slender and with a laterally directed spine. Claspette small, with slender stem, soldered to sidepiece; tip triangularly expanded, with 4 setae. Mesosome a basal pointed cylinder. Tenth sternite large, inner margin thickened; the tip bent; a terminal sharp spine. Ninth tergite rudimentary.

Deinocerites cancer Theobald, 1901**Larva**

Head rounded, with a prominent angular projection on each side covering base of mandible. Upper dorsal hair in 4-5, lower single, long; ante-antennal tuft multiple. Antenna moderate, slender, sparsely spined; a small, multiple tuft near middle.

Abdomen. Lateral comb of eighth segment of numerous scales in a patch; single scale with expanded tip, feathered at apex with a row of subequal spinules. Air-tube 4 times as long as wide; pecten of 4-7 teeth on basal $\frac{1}{3}$, followed by a tuft of 2-7 hairs; another very small 2-haired tuft near apex; single tooth a thorn with 1, sometimes 2 lateral teeth at its base. Anal segment longer than wide; plate divided in dorsal and ventral parts; ventral brush well developed, posterior to the plate; dorsal tuft of a long hair and a brush on each side; lateral hair single, small; only 2 anal gills, $\frac{1}{4}$ - $\frac{1}{2}$ as long as the segment, rounded.

A d u l t

Proboscis dark, rather long, slender. Palpi short, about similar in both sexes. Antennae $1\frac{1}{2}$ times as long as the proboscis; first joint longer in male than in female, 3 times as long as the second in female, and 2 times in male. Occiput with narrow, curved, golden-brown scales; a row of bristles along eye-margins. Prothoracic lobes with black bristles. Mesonotum dark, with many long hairs, narrow, curved, golden-brown scales, and a pair of narrow, bare, subdorsal stripes. Pleural bristles: upper sternopleural ones present, spiracular and postspiracular ones absent.

Abdomen dark and very hairy dorsally; venter gray.

Legs dark and long.

Wings dark; scales narrow.

Cerci large, subconical; each with 2 flattened filaments at tip.

Male genitalia. Sidepiece about twice as long as wide; stout, conical; inner apical angle produced and bearing fine setae; a large basal excavation; lobe at middle, with 2 stout setae and a spine. Clasper stout, club-shaped on outer half; hairy on outer side, with 2 equal terminal spines in an apical notch. Mesosome of 2 paired plates; inner one with elliptical base and long, horn-like tip; outer one flat, with rounded tip. Tenth sternite broad, flattened, with about 15 broad, blunt teeth in a row on the margin; a group of spines with tubercular bases on the flat surface. Ninth tergite forming 2 very long, bare, finger-like lobes.

Culex erraticus (Dyar & Knab, 1905)**L a r v a**

Head rounded. Upper dorsal hair multiple, short; lower single, long; ante-antennal tuft multiple. Antenna large, spinulated; a large tuft at outer $\frac{1}{3}$.

Abdomen densely spicular pilose. Lateral comb of eighth segment of about 15 scales in an irregular double row; single scale elongate, tapering to a sharp point, fringed with spinules basally. Air-tube about 6 times as long as wide; pecten of 15 simple teeth running to $\frac{1}{3}$, followed by five 7-haired tufts on posterior margin, decreasing in size apically; 2 small lateral tufts, double or triple; single tooth a short, broad spine with many basal branches. Anal segment longer than wide; ringed by the plate; plate pilose; ventral brush posterior to the plate; dorsal tuft of 2 long hairs and a short one on each side; a single small lateral hair; 4 anal gills, half as long as the segment, with blunt tips.

A d u l t

Proboscis dark, moderate. Occiput with a triangular area of narrow, curved, golden scales on vertex; the sides with flat black scales, nearly meeting on the eye-margin; some flat white ones below. Mesonotum dark, with narrow, pale golden scales. Pleurae dark; upper sternopleural bristles present, spiracular and postspiracular ones absent.

Abdomen dark dorsally, with narrow, white, basal, segmental bands, and large, white lateral spots; venter with broad, white, basal, segmental bands.

Legs dark; femora pale below and white at tip; tibiae white apically.

Wings dark; scales narrow, those near tip broadened.

Male genitalia. Sidepiece much swollen, subglobular, nearly twice as long as wide; excavated on inner side; subapical lobe divided into 2 parts; the inner (basal) division divided into 2 subequal arms, each with a capitate apical filament; outer (apical) division stoutly columnar, with 4 rods with hooked tips and a large distorted

leaf-like appendage. Clasper snout-like; the snout occupying more than outer half, sharply enlarged after constriction; anterior (outer) crest solid, of appressed or consolidated spines, with a stout horn; terminal horn long, terminal spine hooked. Mesosomal plate simple, small, concavely furcate, inner limb horn-like. Tenth sternite very small, crumpled; with comb-shaped tips bent inward nearly at right angles. Ninth tergite small, shortly stemmed; lobes ovate, with many setae.

***Culex americanus* (Neveu-Lemaire, 1902)**

Larva

Head nearly circular. Upper dorsal hair in 5, lower in 4; ante-antennal tuft multiple. Antenna long, slender, spined; a large tuft before middle.

Thorax with coarse, stellate tufts like cactus spines.

Abdomen glabrous; coarse, stellate tufts on segments. Lateral comb of eighth segment of many long scales in about 3 rows; single scale a tooth, fringed apically. Air-tube about 8 times as long as wide; pecten of 15–18 long teeth, running to $\frac{1}{3}$ – $\frac{2}{5}$, followed by three 3–6-haired tufts on posterior margin; two 2–3-haired lateral tufts, one within the pecten; single tooth a thorn, fringed with spinules. Anal segment longer than wide; ringed by the plate; long spinules on posterior margin; ventral brush well developed, posterior to the plate; dorsal tuft of a long hair and 3 shorter ones on each side; lateral hair small, single; 4 anal gills, about as long as the segment, pointed.

Adult

Proboscis dark, moderate, swollen at tip. Palpi over $\frac{1}{3}$ the length of the proboscis in both sexes. Occiput dark, with sparse, narrow, curved scales; those on the sides narrow and flat. Mesonotum dark, with sparse narrow, curved scales. Pleurae pale; upper sternopleural bristles present, spiracular and postspiracular ones absent.

Abdomen dark, with lateral basal segmental whitish spots; venter pale.

Legs dark; femora pale below.

Wings dark; scales narrow and hair-like, even outwardly not more than linear.

Male genitalia. Sidepiece twice as long as wide; elongate ovate; subapical lobe divided into 2 divisions which are approximate and appressed; inner (basal) division cleft, inner limb double, with 2 short setaform filaments; outer limb rather long, with a moderate, pointed filament; outer (apical) division wider than long, with 3–5 setae. Clasper rather long, slender, a little enlarged at base, with a small, articulated terminal spine. Mesosomal plate small, simple, slightly curved and pointed. Tenth sternite with narrow edge, tip comb-shaped, with about 12 flat, blunt teeth. Ninth tergite rather large, separated, rounded, broadly conical, with about 4–6 fine setae from tubercular bases.

***Culex bahamensis* Dyar & Knab, 1906**

Larva

Head rounded. Upper and lower dorsal hairs and ante-antennal tuft multiple. Antenna large, spinulated; a large tuft at outer $\frac{1}{3}$.

Abdomen finely pilose. Lateral comb of eighth segment of many scales in a triangular patch; single scale elongate, rounded, fringed with spinules. Air-tube stout; coarsely pilose apically; 5–6 times as long as wide; pecten of 8–10 teeth, running to middle; 6 large multiple tufts on posterior margin, the basal 2 within the pecten; single tooth broad, with 1–4 basal branches. Anal segment longer than wide;

ringed by the plate; ventral brush well developed, posterior to the plate; dorsal tuft of a long hair and a 4-haired brush on each side; lateral hair small, double; only 2 anal gills, half as long as the segment, rounded.

A d u l t

Proboscis moderate, uniform, dark, with a broad whitish band at middle. Occiput dark, with narrow, curved, pale scales; flat white ones on the sides. Mesonotum dark, with 3 darker lines, and narrow, curved scales. Pleurae pale, with brown spots; upper sternopleural bristles present, spiracular and postspiracular ones absent.

Abdomen dark, with basal segmental white bands; those on segments 2-5 distinctly widened in middle into triangular spots; venter pale.

Legs dark; femora pale below; tarsi with very narrow white rings at both ends.

Wings dark, scales narrow.

Male genitalia. Sidepiece twice as long as wide; rounded, conical; subapical lobe quadrate, with 2 thickened, blade-like appendages and a smaller one; a patch of setae on the stem, one at its base and another one some distance from the lobe. Clasper roundedly bent beyond base, smooth; tapering to a truncate tip. Mesosomal plate thin, short, with quadrate apical point; a long tooth from its base much exceeding it. Tenth sternite small, with subequal spines all over the tip; basal arms long, curved. Parameres curved, multilaminar and denticulate. Ninth tergite small, lobes with setae.

Culex habilitator Dyar & Knab, 1906

L a r v a

Head rounded. Upper dorsal hair in 4, long; lower in 3, also long; ante-antennal tuft multiple. Antenna large, spinulated below tuft; a large tuft at outer $\frac{1}{3}$.

Thorax pilose.

Abdomen pilose. Lateral comb of eighth segment of many scales in a triangular patch; single scale elongate, widened at tip, fringed with spinules. Air-tube about 7 times as long as wide; pecten of about 15 teeth, running to $\frac{1}{4}$, followed by 4 tufts, triple and double, the subapical one moved laterally out of line; single tooth broad, with 4-5 branches. Anal segment longer than wide; ringed by the plate; ventral brush posterior to the plate; dorsal tuft of 2 long hairs and a short one on each side; lateral hair single, small; 4 anal gills, about as long as the segment, with blunt tips.

A d u l t

Proboscis moderate, dark, with a very narrow or obsolete white ring at outer third. Occiput dark, with narrow, curved scales; flat white ones on the sides. Mesonotum dark, with narrow, curved, red-brown scales, paler posteriorly. Pleurae pale, upper sternopleural bristles present, spiracular and postspiracular ones absent.

Abdomen dark, with basal segmental white bands, widening at the sides; venter mainly pale.

Legs dark; femora white below; tibiae white at tips; tarsi with narrow white rings at both ends.

Wings dark, scales narrow.

Male genitalia. Sidepiece $2\frac{1}{2}$ times as long as wide; conical; tip narrowed and curved; subapical lobe narrow, columnar, with a long and a small rod. Clasper curved, swollen at middle, attenuated apically, with a subterminal spine. Mesosomal plate denticulate on the edge, with a very long tooth from the base, twice as long

as the plate. Tenth sternite stout, tufted with fine spines. Ninth tergite small, with setae.

Culex maracayensis Evans, 1923

Larva

Head rounded. Upper and lower dorsal hairs in 4-6; ante-antennal tuft multiple. Antenna large; a large tuft at outer $\frac{1}{3}$.

Abdomen finely spicular. Lateral comb of eighth segment of many scales in a patch; single scale elongate, fringed with many long spinules. Air-tube stout, tip spicular; about 5 times as long as wide; pecten of about 10 teeth, running to $\frac{1}{3}$, followed by 5-6 hair-tufts; single tooth a thorn, with 2-3 basal teeth on one side. Anal segment as long as wide; ringed by the plate; ventral brush posterior to the plate; dorsal tuft of a long hair and a brush of 3-5 hairs on each side; lateral hair triple, small; 4 anal gills, as long as the segment, tapered.

Adult

Proboscis moderate, uniform, dark with broad white median ring. Occiput with narrow, curved, whitish scales, flat white ones on the sides, and many dark, erect forked bristles. Mesonotum dark, with 3 darker lines, and narrow, curved scales. Pleurae pale; upper sternopleural bristles present, spiracular and postspiracular ones absent.

Abdomen dark, with rather uniform, narrow, white, basal, segmental bands; venter mainly pale.

Legs dark; femora pale below and with white tips; tarsi with white rings at both ends.

Wings dark, scales narrow.

Male genitalia. Sidepiece $2\frac{1}{2}$ times as long as wide; conical, with a very large basal excavation; subapical lobe with a basal hair and 3 unequal rods. Clasper stout at base, very narrow at tip, with an articulated subterminal spine. Mesosome with 3 limbs distally on each half; inner one thumb-shaped with denticulate appearance at margin; second limb triangular, with a sharp external angle and a rounded inner part, the latter with a row of blackish teeth; apical limb horn-like. Tenth sternite spinose at apical margin; setae laterally; basal arm long, C-shaped. Ninth tergite small, lobes with setae.

Culex nigripalpus Theobald, 1901

Larva

Head rounded. Upper and lower dorsal hairs in 3, long; ante-antennal tuft multiple. Antenna large, spinulated below the tuft; a large tuft before outer $\frac{1}{3}$.

Abdomen pilose. Lateral comb of eighth segment of many scales in a triangular patch; single scale elongate, widened at tip, with an apical fringe of spinules. Air-tube about 7 times as long as wide; pecten of 11-15 teeth running to $\frac{1}{4}$, followed by 3-4 hairs, single or double; the subapical one moved laterally out of line; single tooth broad, with 4-6 branches. Anal segment longer than wide; ringed by the plate; ventral brush well developed, posterior to the plate; dorsal tuft of a long, a shorter and a short hair on each side; lateral hair single, small; 4 anal gills, 1-2 times as long as the segment, tapered.

Adult

Proboscis dark, moderate, uniform. Occiput dark, with narrow, curved scales.

Mesonotum dark, with very small, narrow, curved scales. Pleurae greenish; upper sternopleural bristles present, spiracular and postspiracular ones absent.

Abdomen dark, with very narrow, basal, segmental, white bands, widening on the sides; the bands are more pronounced in male; venter mainly pale; segments 5-7 with lateral basal white spots.

Legs dark; femora white below; tibiae whitish at tips.

Wings dark; outstanding scales long and slender.

Male genitalia. Sidepiece more than twice as long as wide; conical; subapical lobe quadrate, with 3 rods, a leaf, and a lateral seta. Clasper curved, somewhat flattened on outer half, with a subterminal spine. Mesosomal plate broadly quadrate, with a radial pecten at base of inner angle; inner arm flat and curved, minutely denticulate on the margin; outer arm thumb-shaped, 3-4 teeth between, a long horn from the base exceeding the plate. Tenth sternite stout, tufted apically with fine spines, but on outer side flat, blunt, short ones; basal arm long, curved. Ninth tergity with many setae from the 2 lobes.

***Culex quinquefasciatus* Say, 1823**

Larva

Head rounded. Upper and lower dorsal hairs and ante-antennal tuft multiple. Antenna large, spined below the tuft; a large tuft at outer $\frac{1}{3}$.

Abdomen. Lateral comb of eighth segment of many scales in a triangular patch; single scale narrow, apex rounded and fringed with spinules. Air-tube rather stout, tapered on outer half; 4 times as long as wide; pecten of about 11 teeth running to $\frac{1}{3}$; single tooth with 4-6 branches, followed by 4 hair-tufts on posterior margin, basal two 5-9-haired, subapical one usually 3-haired and moved laterally out of line, apical tuft usually 2-haired¹). Anal segment about as long as wide; ringed by the plate; ventral brush well developed, posterior to the plate; dorsal tuft of 2 long hairs and a shorter one on each side; lateral hair single, small; 4 anal gills, 1-2 $\frac{1}{2}$ times as long as the segment, tapered.

¹) Some larvae from St. Eustatius showed a few *variations* (fig. 14): air-tube 4-5 times as long as wide, with 5 pairs of hair-tufts on posterior margin, or 4 tufts on one side and 5 on the other; basal tuft within the pecten, subapical one moved laterally out of line; basal two tufts 4-haired, third 3-4-haired, apical two 2-haired.

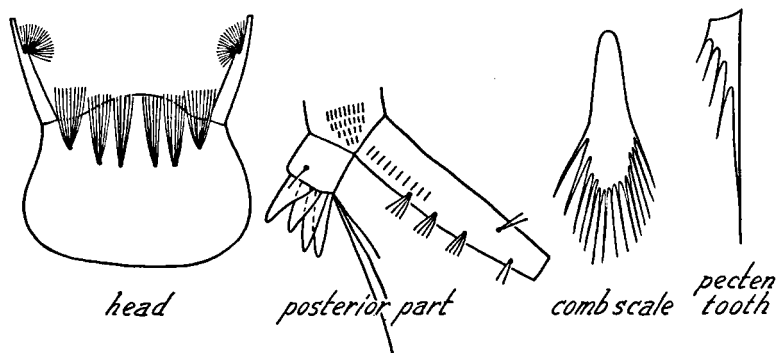


Fig. 14. Some abnormal larval characteristics in *Culex quinquefasciatus* from St. Eustatius.

Adult

Proboscis dark, moderate. Occiput dark, with narrow, curved, whitish scales. Mesonotum dark, with 2 narrow bare lines, coarse, narrow, lanceolate, curved, light brown scales, and some darker brown hairs. Pleurae pale; upper sternopleural bristles present, spiracular and postspiracular ones absent.

Abdomen dark, with basal segmental white bands, with convex caudal margins, separated from the lateral basal white spots, except in male; venter mainly pale.

Legs dark; femora pale below; tibiae and tibiae with slight whitish tips.

Wings dark, scales narrow.

Male genitalia. Sidepiece more than twice as long as wide; conical, with large basal excavation; subapical lobe with 8 appendages: 3 rods with hooked tips, 2 small setae, a filament, a leaf, and a seta. Clasper moderate, slender, with a subterminal, articulated spine. Mesosomal plate small, with dorsal arm long, pointed; at its base a long, broad, band-like, pointed ventral arm exceeding the other parts. Tenth sternite tufted apically with fine spines; elongate, with very small, lateral, basal, thumb-shaped, curved arm at right angles. Ninth tergite with 4-5 setae.

Megarhinus guadeloupensis Dyar & Knab, 1906**Larva**

Head rather large, heavily chitinized, subquadrate, longer than wide; mouth brushes prehensile, composed of 10 stout, closely appressed curved lamellae placed in a regular row. Antenna rather long, cylindrical, slender; 2 hairs and a small tuft close together at apical third.

Abdomen. Lateral hairs multiple, no float-hairs; few hairs dorsally; no dorsal chitinous plates; laterally on segments 1-7 are 3 chitinous plates one above the other and bearing stout, shortly plumose hairs. Lateral comb of eighth segment replaced by a large lateral chitinous plate without scales, but with 2 stiff, stout, spinulose setae on posterior margin. Air-tube tapered, about 3 times as long as wide; no pecten; 1 pair of tufts at basal fifth. Anal segment about as long as wide; ringed by the plate which is spinose on posterior margin; ventral brush of coarse feathered hairs; dorsal tuft a long brush on each side; lateral hair single, stout, spinulose; 4 anal gills, very short, bud-like.

Pupa

Respiratory trumpet tubular, with small openings. Abdomen with postero-lateral hairs placed some distance from apical corners of segments 2-7; a small hair at apical corner of segment 8. Paddle with outer portion produced beyond tip of midrib; no terminal and accessory hairs; fringe present.

Adult

Proboscis black with violet reflection, very stout, rigid, apical half more slender and bent downward at nearly a right angle, so that the proboscis is hook-like. Palpi dark purple, distinctly jointed, in female $\frac{3}{4}$ of the length of the proboscis, in male as long; blunt in female, pointed in male. Antennae filiform. Occiput bright bluish green. Prothoracic lobes very prominent, bright metallic blue. Mesonotum with blackish scales; green around the margin; a median stripe metallic blue. Pleurae with silvery white scales; upper sternopleural and spiracular bristles present; postspiracular and pronotal ones absent; lower mesepimeral bristles present. Scutellum evenly rounded and scaled. Postnotum brown, nude.

Abdomen completely clothed with broad flat scales; green basally, blue and violet apically; yellowish silvery laterally and ventrally; with a dark median, longitudinal ventral stripe on segments 1-6; last segment with terminal bristles; no lateral tufts.

Legs rather stout, dark with violet reflection; femora pale golden below; tibiae with small bristles; second mid tarsus and fourth hind tarsus white; no white markings of tibiae and tarsi in male.

Wings dark violet; scales short and broad, scanty.

Male genitalia. Sidepiece about $2\frac{1}{2}$ times as long as wide; conical, tip narrowed; basal lobe large, with 3 stout spines apically and many short setae. Clasper long, slender, nearly uniform, with a long sharp spine subapically and a row of short hairs on inner side. Mesosome consisting of two slender plates, one on each side, bulbous basally, attenuated apically; inner margins of plates reversely toothed; the two halves connected by a transverse bridge. Tenth sternite large, narrow, dark apically, with a single laterally directed point. Ninth tergite with about 6 setae and a narrow bridge, slightly thickened.

TAXONOMIC DATA

In the following pages some special characteristics are described which may be helpful in the preliminary identification of some species at first glance.

E G G S

Wyeomyia celaenocephala

Eggs simple; laid singly in bromeliads. (Curaçao.)

Anopheles pseudopunctipennis pseudopunctipennis

Eggs boat-shaped, with polygonal markings, one collar-like frill, lateral floats with about 30 ridges; laid singly. (Curaçao, Aruba.)

Anopheles albimanus

Eggs boat-shaped, with small silvery spots, a frill on both ends, lateral floats with about 25 ridges; laid singly. (St. Martin.)

Uranotaenia lowii

Eggs simple, very small; laid in small rafts. (Bonaire.)

Aedes species

Eggs with hexagonal markings; laid singly.

Psorophora species

Eggs elongate oval, sheathed in a thin, brittle, transparent envelope or pellicle, with spiny processes, apices of which project in the direction of the anterior pole; laid singly.

Culex species

Eggs simple, of normal size; laid in large, boat-shaped rafts.

Megarhinus guadeloupensis

Eggs almost round, with minute spines; laid singly. (Saba.)

L A R V A E

Wyeomyia celaenocephala

A pale yellow larva; found in bromeliads; ventral brush on anal segment and pecten on air-tube both absent; more than 30 hairs on air-tube. (Curaçao.)

Anopheles pseudopunctipennis pseudopunctipennis

Live larva parallel to the water surface; inner submedian prothoracic hair short, bifid or trifid; palmate hairs on abdominal segments 3-7; the leaflets of these hairs serrated, ending in long filaments; air-tube absent; posterior flap of spiracular apparatus with tusks. (Curaçao, Aruba.)

Anopheles albimanus

Live larva parallel to the water surface; inner submedian prothoracic hair stout, with many hair-like lateral branches; palmate hairs on abdominal segments 1-7; the leaflets of these hairs smooth, lanceolate; air-tube absent. (St. Martin.)

Uranotaenia lowii

A small larva, lying often parallel to the water surface when alive; head black, longer than wide, with 4 spine-like hairs. (Bonaire.)

Aedes taeniorhynchus

Usually in beach pools with high chlorine contents; skin pilose; air-tube about $1\frac{1}{2}$ -2 times as long as wide, with 14-18 pecten teeth and a single hair-tuft. (Curaçao; Saba.)

Aedes busckii

Tree hole breeder; coarse stellate tufts on thorax and abdomen like cactus spines; air-tube $2\frac{1}{2}$ times as long as wide, with a single hair-tuft and 8-9 pecten teeth. (St. Eustatius.)

Aedes aegypti

Found in artificial receptacles in and around the houses; very widespread; thorax with beak-shaped subventral processes; all head hairs single. (All six islands.)

Haemagogus anastasionis

Found usually in tree holes; air-tube 2 times as long as wide, with about 16 pecten teeth and a single hair-tuft; anal gills very small; lateral hair on anal segment in 3-4. (Curaçao, Aruba.)

Psorophora cyanescens

Upper and lower dorsal head hairs single; air-tube 3 times as long as wide, wider in middle (barrel-shaped), with 3-4 pecten teeth and a pair of long terminal hairs; anal segment with ventral brush piercing the dorsal plate. (Aruba.)

Psorophora confinnis

Upper and lower dorsal head hairs multiple; air-tube 3 times as long as wide, wider at middle (barrel-shaped), with 4 pecten teeth followed by a single hair-tuft; anal segment with ventral brush piercing the dorsal plate. (Curaçao, Aruba, Bonaire.)

Psorophora pygmaea

Upper and lower dorsal head hairs single; air-tube 3 times as long as wide, wider at middle (barrel-shaped), with 6 pecten teeth followed by a single hair-tuft; anal segment with ventral brush piercing the dorsal plate. (St. Martin.)

Deinocerites cancer

Found in crab holes; mandible angularly projecting laterally; only one pair of

short anal gills; air-tube 4 times as long as wide, with 4-7 pecten teeth and 2 pairs of hair-tufts. (Curaçao, Aruba, Bonaire; St. Martin.)

Culex erraticus

Body densely spicular pilose; air-tube with 7 pairs of hair-tufts, decreasing in size apically. (Curaçao.)

Culex americanus

Found in bromeliads; coarse stellate tufts on thorax and abdomen like cactus spines; air-tube with 3 pairs of hair-tufts on posterior margin and 2 lateral ones of which one is within the pecten. (St. Martin, Saba, St. Eustatius.)

Culex bahamensis

Only one pair of short anal gills; air-tube 5-6 times as long as wide, pilose apically, with 8-10 pecten teeth and 6 hair-tufts. (St. Martin, St. Eustatius.)

Culex habitator

Found in crab holes; skin pilose; air-tube 7 times as long as wide, with 15 pecten teeth and 4 hair-tufts which are double and triple. (St. Martin.)

Culex maracayensis

Body finely spicular; air-tube 5 times as long as wide, spicular apically, with 10 pecten teeth and 5-6 hair-tufts. (Curaçao.)

Culex nigripalpus

Body pilose; air-tube 7 times as long as wide, with 11-15 pecten teeth and 3-4 hairs, single or double. (Curaçao.)

Culex quinquefasciatus

Found usually in artificial receptacles and ground pools in and around the houses; very widespread; air-tube 4 times as long as wide, with about 11 pecten teeth and 4 hair tufts, the subapical one moved laterally out of line. (All six islands.)

Megarhinus guadeloupensis

Found in bromeliads; very large; mouth-brushes prehensile, with 10 stout flattened rods; air-tube 3 times as long as wide, with one tuft, but no pecten; no comb scales on eighth segment; anal gills bud-like. (Saba.)

ADULTS

Wyeomyia celaenocephala

A small, slender, spider-like mosquito, brown and black with blue reflection; postnotum with a tuft of setae; abdominal segments 1-6 without hairs; black of dorsum of abdomen and white of venter separated laterally in a straight line; legs very long and bent forward over the head when resting or flying. (Curaçao.)

Anopheles pseudopunctipennis pseudopunctipennis

A large, grayish mosquito; typical Anopheles position when resting; female palpi as long as proboscis; male palpi long, clubbed at tip; palpi and wings with dark and white spots, scutellum rounded; abdomen without scales; legs dark. (Curaçao, Aruba.)

Anopheles albimanus

A medium-sized mosquito; typical Anopheles position when resting; female palpi as long as proboscis; male palpi long, clubbed at tip; palpi, wings and legs with dark and white spots; apical half of hind tarsal segment 2 white; segments 3 and 4 white, 5 white with a narrow basal black ring; scutellum rounded; abdomen with lateral scale tufts on segments 3-7. (St. Martin.)

Uranotaenia lowii

A very small, delicate mosquito, brilliantly coloured; prothoracic lobes with silvery blue scales; wings without microtrichia; squama bare; second marginal cell about $\frac{1}{3}$ as long as its petiole. (Bonaire.)

Aedes taeniorhynchus

A medium-sized black mosquito; mesonotum with several golden lines; tip of abdomen pointed; legs with white bands; female claws toothed. (Curaçao; Saba.)

Aedes busckii

A small black mosquito; mesonotum with several golden lines; tip of abdomen pointed; legs with white bands; female claws simple. (St. Eustatius.)

Aedes aegypti

A small to medium-sized, black, domestic pest mosquito; the whole body with brilliant silvery white markings; mesonotum with a lyre-shaped ornament; tip of abdomen pointed. (All six islands.)

Haemagogus anastasionis

A bright blue-green mosquito; palpi equally short in both sexes; prothoracic lobes approximate, collar-like; tip of abdomen pointed. (Curaçao, Aruba.)

Psorophora cyanescens

A medium-sized blue-black mosquito; tip of abdomen pointed; yellowish abdominal segmental bands apically; wings and tarsi dark; female claws toothed. (Aruba.)

Psorophora confinnis

A medium-sized grey-brown mosquito; proboscis with yellowish central band; tip of abdomen pointed; yellowish abdominal segmental bands apically; wings with dark and white scales mixed; hind tarsus 1 with a central ring; claws of female simple. (Curaçao, Aruba, Bonaire.)

Psorophora pygmaea

A medium-sized grey-brown mosquito; proboscis with yellowish central band; tip of abdomen pointed; yellowish abdominal segmental bands apically; wings with dark and white scales mixed; hind tarsus 1 without a central ring; claws of female simple. (St. Martin.)

Deinocerites cancer

A medium-sized mosquito; spider-like when flying; found in crab holes; antennae much longer than proboscis; male antennae and palpi similar to those of female; cerci with 2 filaments. (Curaçao, Aruba, Bonaire; St. Martin.)

Culex erraticus

A small brown mosquito; occiput with a triangular area of golden scales. (Curaçao.)

Culex americanus

A small light-brown and yellowish mosquito; palpi about $\frac{2}{5}$ as long as proboscis. (St. Martin, Saba, St. Eustatius.)

Culex habilitator

A medium-sized black mosquito; found in crab holes; proboscis with narrow white ring. (St. Martin.)

Culex quinquefasciatus

A medium-sized brown, domestic pest mosquito. (All six islands.)

Megarhinus guadeloupensis

Very large; brilliantly coloured (iridescent); proboscis very stout, rigid, hook-like. (Saba.)

KEYS TO THE MOSQUITOES OF THE NETHERLANDS ANTILLES

KEY TO THE EGGS

- 1 Eggs almost round, with minute spines, laid singly *Megarhinus guadeloupensis*
Eggs oval, with or without spines, laid singly or in rafts 2
 - 2 Eggs boat-shaped, with lateral floats, laid singly 3
Eggs egg-shaped, without lateral floats, laid singly or in rafts 4
 - 3 Polygonal markings on exochorion, one collar-like frill separated from the floats which almost meet along the mid-dorsal line
Anopheles pseudopunctipennis
Oval small silvery spots on exochorion, 2 frills touching the floats which are widely separated *Anopheles albimanus*
 - 4 Eggs with spiny processes, laid singly *Psorophora* species
Eggs without spiny processes, laid singly or in rafts 5
 - 5 Eggs with hexagonal markings, laid singly *Aedes* species
Eggs without hexagonal markings, laid singly or in rafts 6
 - 6 Eggs laid singly *Wyeomyia celaenocephala*
Eggs laid in rafts 7
 - 7 Eggs very small, laid in small rafts *Uranotaenia lowii*
Eggs of normal size, laid in large rafts *Culex* species
- No data on eggs of *Haemagogus anastasionis* and *Deinocerites cancer* are known to the author.

KEY TO THE LARVAE

[Fig. 15-19]

- 1 Air-tube of eighth abdominal segment absent 2
Air-tube of eighth abdominal segment present 3
- 2 Inner submedian prothoracic hair short, in 2 or 3; palmate hairs on abdominal segments 3-7; respiratory apparatus with spiracular tusks
Anopheles pseudopunctipennis
Inner submedian prothoracic hair large, with many hair-like lateral branches; palmate hairs on abdominal segments 1-7; respiratory apparatus normal
Anopheles albimanus
- 3 Air-tube without pecten 4
Air-tube with pecten 5
- 4 Anal segment without ventral brush; lateral comb of eighth segment present, with numerous scales; mouth brushes ciliform with numerous hairs
Wyeomyia celaenocephala
Anal segment with ventral brush; lateral comb of eighth segment replaced by a chitinous plate without scales, but with 2 stout spinulose setae on posterior margin; mouth brushes prehensile, with 10 stout curved rods
Megarhinus guadeloupensis
- 5 Mandible angularly projecting laterally *Deinocerites cancer*
Mandible concealed 6

- 6 Air-tube with a single pair of ventral tufts 7
 Air-tube with 3 or more pairs of ventral tufts 14
- 7 Head longer than wide; head hairs developed into spines . . . *Uranotaenia lowii*
 Head nearly circular or transverse; head hairs normal 8
- 8 Anal segment ringed by dorsal plate, ventral hair-tufts piercing the ring; air-tube wider at middle 9
 Anal segment not quite ringed by dorsal plate, or if ringed, the hair-tufts posterior to the ring; air-tube wider at base 11
- 9 Upper and lower dorsal head hairs multiple *Psorophora confinnis*
 Upper and lower dorsal head hairs single 10
- 10 Air-tube with a pair of long terminal hairs; pecten of 4 spines; lateral hair of anal segment single *Psorophora cyanoescens*
 Hairs at tip of air-tube inconspicuous; pecten of 6 spines; lateral hair of anal segment in 3-5 *Psorophora pygmaea*
- 11 Lateral comb of eighth segment of 8-11 teeth in a single row 12
 This comb of about 20 teeth, not in a single row 13
- 12 Anal gills about half as long as width of anal segment; ante-antennal hair in 3; scales of lateral comb of eighth segment very finely fringed
Haemagogus anastasionis
 Anal gills about twice as long as width of anal segment; ante-antennal hair single; scales of lateral comb of eighth segment with several large lateral branches *Aedes aegypti*
- 13 Air-tube $2\frac{1}{2}$ times as long as wide; lateral hair on anal segment in 4; coarse stellate tufts on thorax and abdomen *Aedes busckii*
 Air-tube $1\frac{1}{2}$ -2 times as long as wide; lateral hair on anal segment single; skin pilose *Aedes taeniorhynchus*
- 14 One pair of anal gills *Culex bahamensis*
 Two pairs of anal gills 15
- 15 Dorsal tuft of anal segment of a 5-haired brush and a long hair
Culex maracayensis
 Dorsal tuft of anal segment without a brush 16
- 16 Air-tube about 4 times as long as wide *Culex quinquefasciatus*
 Air-tube 6 or more times as long as wide 17
- 17 Lower head hairs long and single; body densely hairy *Culex erraticus*
 Lower head hairs in multiple tufts 18
- 18 3-4 hair-tufts on air-tube, single or double *Culex nigripalpus*
 4-5 hair-tufts on air-tube, double and triple 19
- 19 4 hair-tufts on air-tube; dorsal tuft of anal segment of 2 long hairs and a short one; skin pilose *Culex habilitator*
 5 hair-tufts on air-tube; dorsal tuft of anal segment of one long hair and 3 shorter ones; coarse stellate tufts on thorax and abdomen
Culex americanus

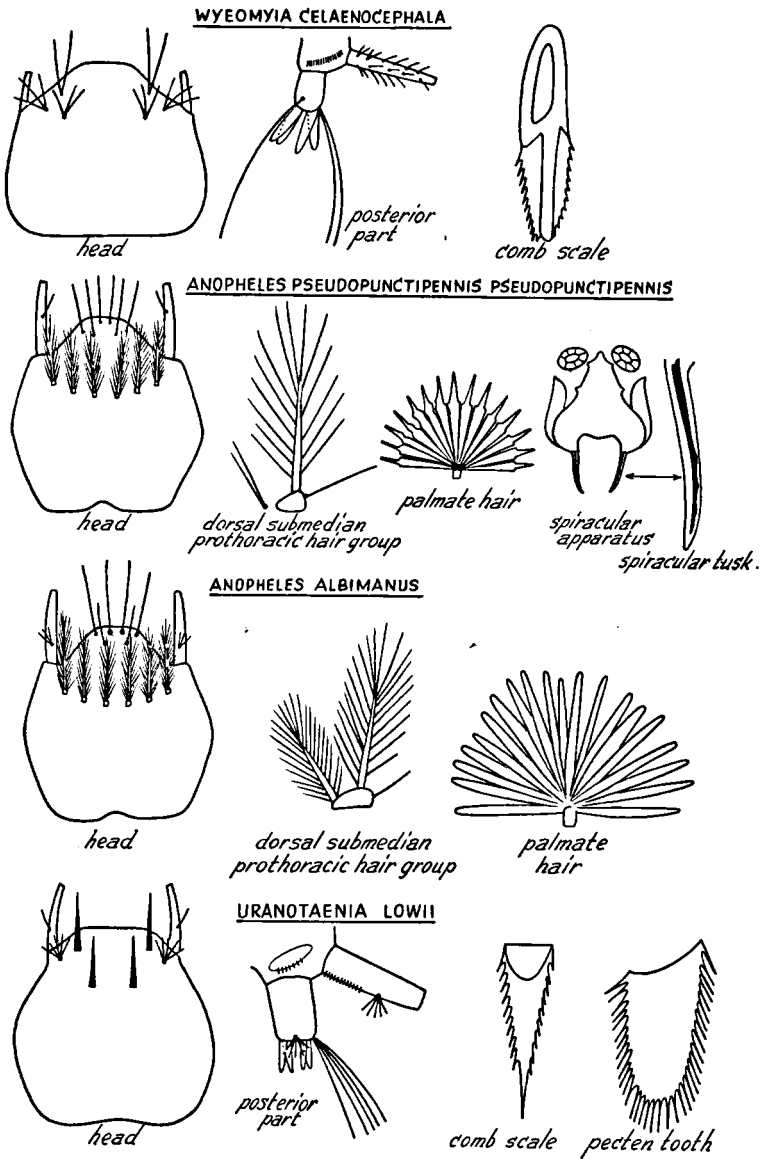


Fig. 15. Some taxonomic larval characteristics in *Wyeomyia celaenocephala*, *Anopheles pseudopunctipennis*, *A. albimanus* and *Uranotaenia lowii*.

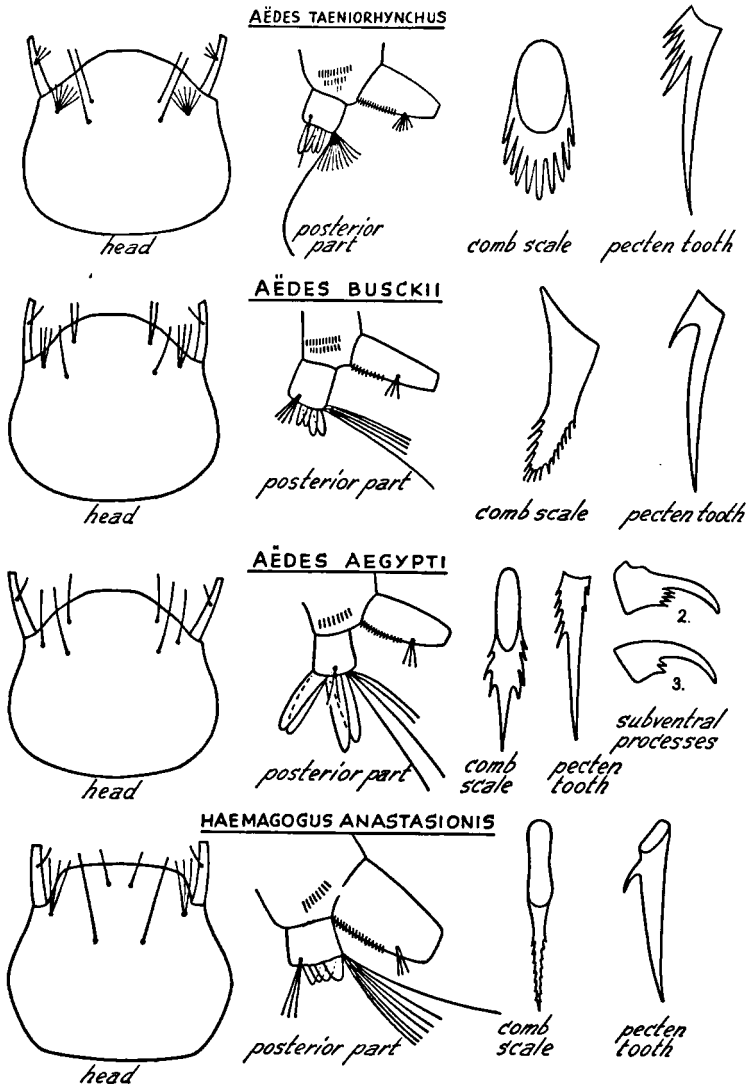


Fig. 16. Some taxonomic larval characteristics in *Aedes taeniorhynchus*, *A. busckii*, *A. aegypti* and *Haemagogus anastasionis*.

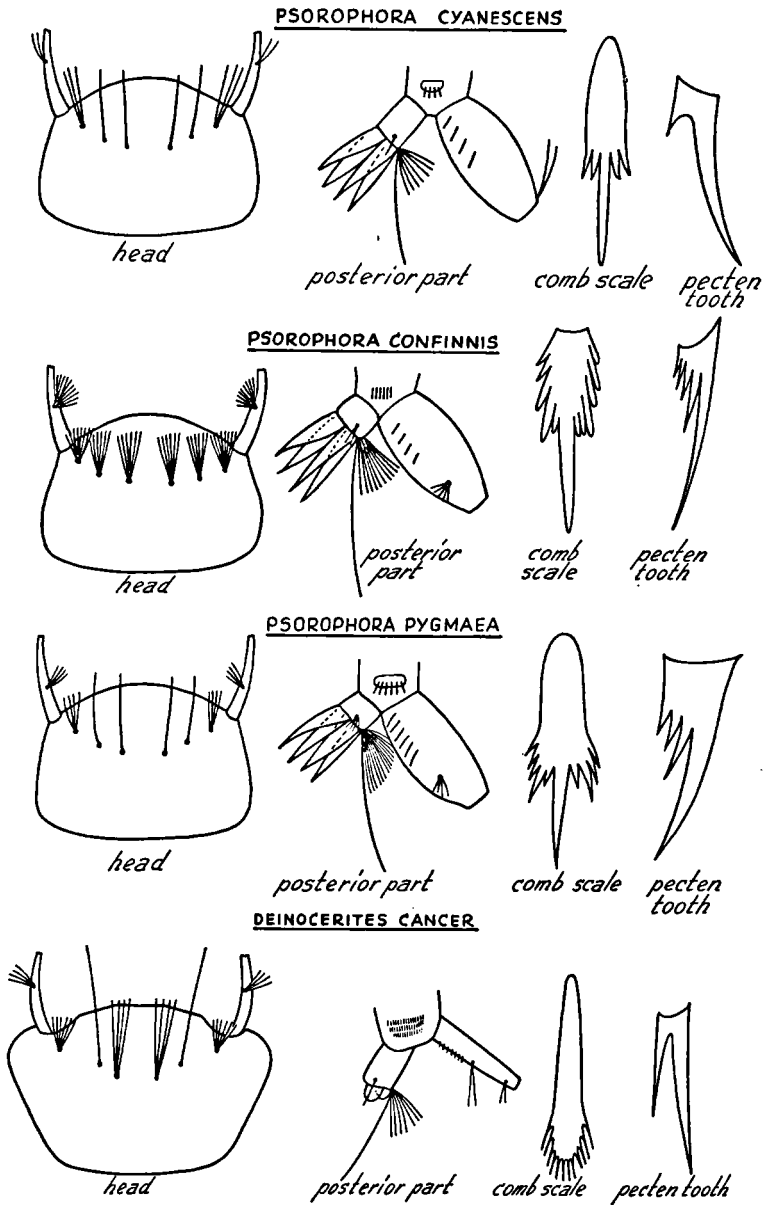


Fig. 17. Some taxonomic larval characteristics in *Psorophora cyanescens*, *P. confinnis*, *P. pygmaea* and *Deinocerites cancer*.

TABLE

Morphological characteristics

b = brush h = hair(s) la = large lo = long(er)
r = row(s) s = single

Species	Antennal hair	Head hairs			Number of scales of lateral comb of 8th segment	Air-tube		
		Upper	Lower	Ante-antennal		Length compared with maximum width	Number of pecten teeth	Number of hairs on each side
<i>Wyeomyia celaenocephala</i>	sm, in 2	in 3	in 2	in 3	n in 1 r	6 ×	0	15
<i>Anopheles pseudopunct.</i>	sm, s	clypeal h lo, simple; frontal h lo, feathered			17 lo + sh	no air-tube; spiracular tusks		
<i>Anopheles albimanus</i>	sm, in 3-5	clypeal h lo, finely branched; frontal h lo, feathered			12-17 lo + sh	no air-tube		
<i>Uranotaenia lowii</i>	sm, s	spine-like		m	7 in 1 r	4 ×	12	1
<i>Aedes taeniorhynchus</i>	sm, in 2-3	s	s	m	20 in a p	1 1/2 - 2 ×	14-18	1
<i>Aedes busckii</i>	sm, s	s	in 2	in 2-3	20-30 in 2-3 r	2 1/2 ×	8-9	1
<i>Aedes aegypti</i>	sm, s	s	s	s	8-11 in 1 r	2 ×	14	1
<i>Haemagogus anastasionis</i>	sm, s	s	s	in 3	8 in 1 r	2 ×	16	1
<i>Psorophora cyanescens</i>	sm, in 2	s	s	in 3	4-5 in 1 r	3 ×	3-4	1
<i>Psorophora confinnis</i>	la, m	m	m	m	6 in 1 r	3 ×	4	1
<i>Psorophora pygmaea</i>	sm, m	s	s	3-5	6-7 in 1 r	3 ×	6	1
<i>Deinocerites cancer</i>	sm, m	m	s	m	n in a p	4 ×	4-7	2
<i>Culex erraticus</i>	la, m	m	s	m	15 in 2 r	6 ×	15	7
<i>Culex americanus</i>	la, m	m	m	m	n in 3 r	8 ×	15-18	5
<i>Culex bahamensis</i>	la, m	m	m	m	n in a p	5-6 ×	8-10	6
<i>Culex habilitator</i>	la, m	m	m	m	n in a p	7 ×	15	4
<i>Culex maracayensis</i>	la, m	m	m	m	n in a p	5 ×	10	5-6
<i>Culex nigripalpus</i>	la, m	m	m	m	n in a p	7 ×	11-15	3-4
<i>Culex quinquefasciatus</i>	la, m	m	m	m	n in a p	4 ×	11	4
<i>Megarhinus guadeloup.</i>	sm, 3 h	4 h instead of ante-antennal h, median one in 4			0	3 ×	0	1

6.

of mosquito larvae.

m = multiple n = numerous p = patch
 sh = short(er) sm = small

Species	Anal segment				Other characteristics
	Dorsal tufts on each side	Lateral hair	Anal gills		
			Num- ber	Length compared with width of anal segment	
<i>W. cel.</i>	2 lo h	very lo, s	4	2 ×	no ventral b; lo lateral h on abdom. segm. 1-8
<i>A. pseud.</i>	1 lo h + 1 b	very lo, s	4	$\frac{1}{2}$ ×	head lo than wide; palmate h on abdom. segm. 3-7
<i>A. albm.</i>	2 lo h	very lo, s	4	$\frac{1}{2}$ ×	head lo than wide; palmate h on abdom. segm. 1-7
<i>U. lowii</i>	5 lo h	sm, in 5	4	$\frac{1}{2}$ - $\frac{3}{4}$ ×	head lo than wide, black; sm larva
<i>A. taen.</i>	1 lo h + 1 b	rather lo, s	4	$\frac{1}{2}$ ×	skin pilose
<i>A. bus.</i>	1 lo h + 1 b	rather lo, in 4	4	$\frac{1}{2}$ -1 ×	coarse stellate tufts on thorax and abdomen like cactus spines
<i>A. aeg.</i>	2 lo h + 1 double sh h	rather lo, in 2	4	2-3 ×	2 pairs of subventral processes on thorax, beak-shaped
<i>H. anast.</i>	1 lo h + 1 b	rather lo, in 3-4	4	$\frac{1}{2}$ ×	coarse tufts on thorax and abdomen
<i>P. cyan.</i>	1 lo h + 1 b	sm, s	4	2 ×	air-tube wider at
<i>P. conf.</i>	1 lo h + 1 b	sm, in 2	4	2 ×	middle; ventral b.
<i>P. pygm.</i>	1 lo h + 1 b	sm, in 3-5	4	2 ×	piercing dorsal ring
<i>D. canc.</i>	1 lo h + 1 b	sm, s	2	$\frac{1}{4}$ - $\frac{1}{2}$ ×	mandible angularly projecting laterally
<i>C. errat.</i>	2 lo h + 1 sh h	sm, s	4	$\frac{1}{2}$ ×	skin densely spicular pilose
<i>C. amer.</i>	1 lo h + 3 sh h	sm, s	4	1 ×	skin glabrous; coarse stellate tufts on thorax and abdomen like cactus spines
<i>C. baham.</i>	1 lo h + 1 b	sm, in 2	2	$\frac{1}{2}$ ×	skin finely pilose; air-tube densely pilose apically
<i>C. habil.</i>	2 lo h + 1 sh h	sm, s	4	1 ×	skin pilose
<i>C. marac.</i>	1 lo h + 1 b	sm, in 3	4	1 ×	skin finely spicular; air-tube spicular apically
<i>C. nigr.</i>	2 lo h + 1 sh h	sm, s	4	1-2 ×	skin pilose
<i>C. quinq.</i>	2 lo h + 1 sh h	sm, s	4	1-2 $\frac{1}{2}$ ×	skin glabrous
<i>M. guad.</i>	1 b	very lo, s	4	$\frac{1}{4}$ ×	giant size; mouth brushes prehensile, of 10 stout rods

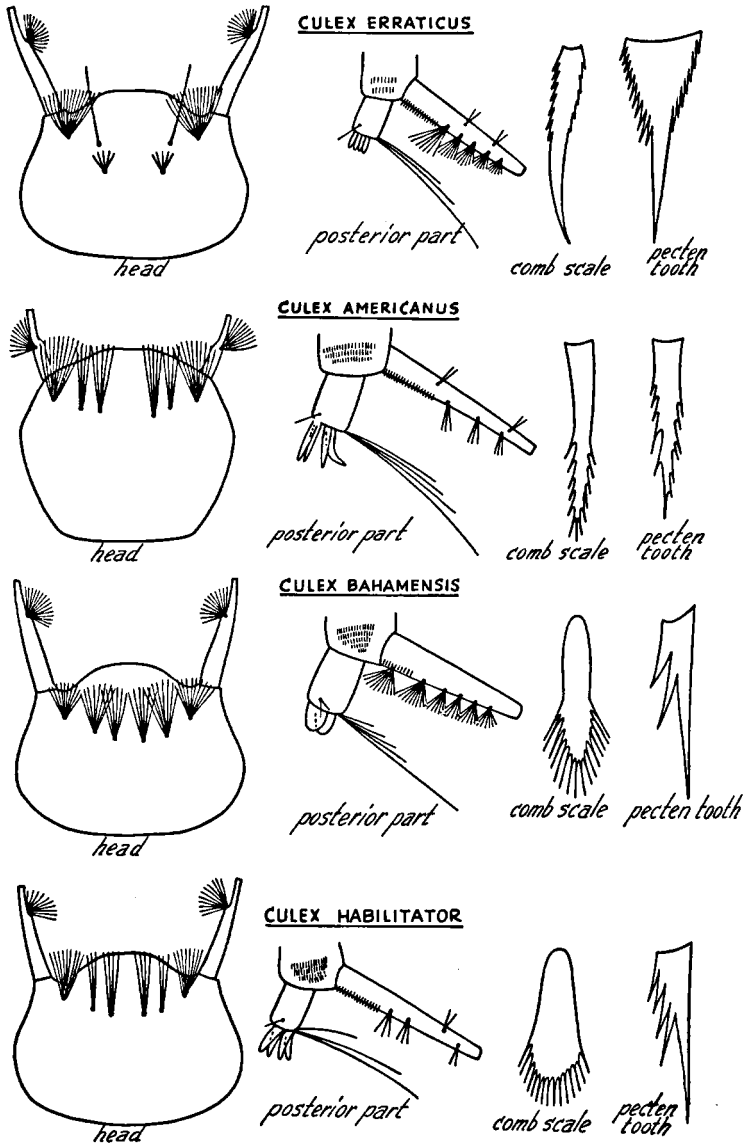


Fig. 18. Some taxonomic larval characteristics in *Culex erraticus*, *C. americanus*, *C. bahamensis* and *C. habilitor*.

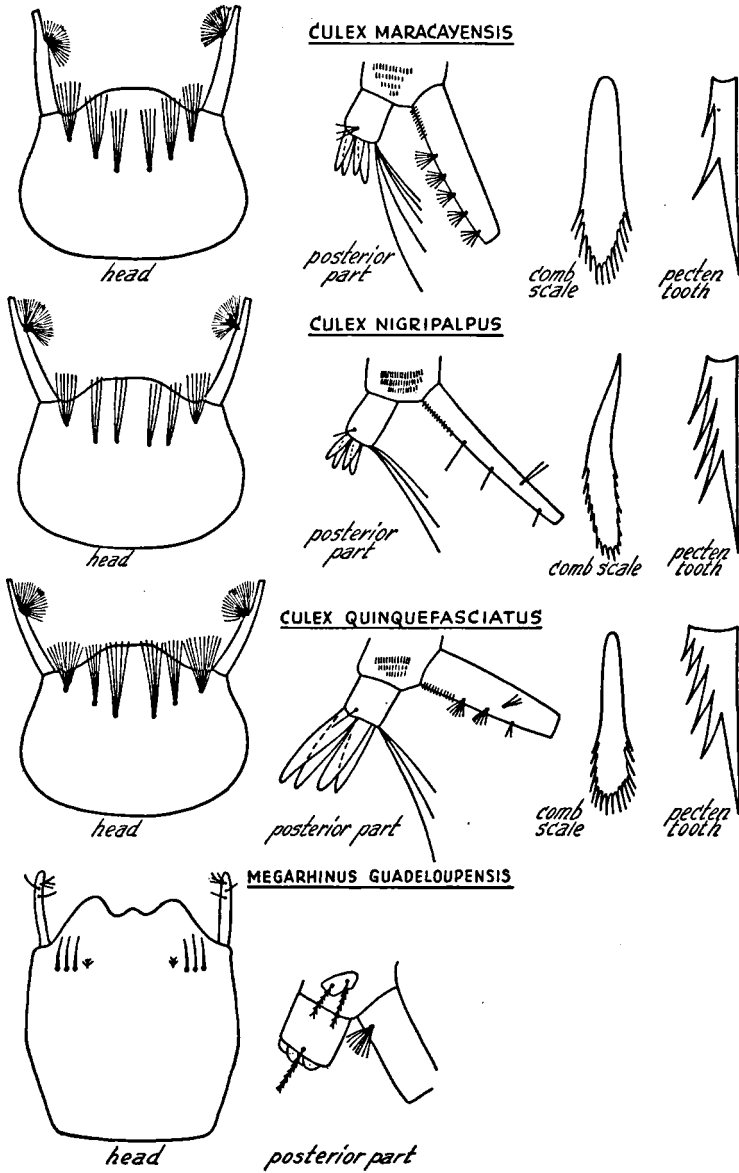


Fig. 19. Some taxonomic larval characteristics in *Culex maracayensis*, *C. nigripalpus*, *C. quinquefasciatus* and *Megarhinus guadeloupensis*.

KEY TO THE PUPAE

- 1 Abdominal segments 7 and 8 with large postero-lateral hair tufts; paddles small, smooth and without fringe and terminal hair
Wyeomyia celaenocephala
 Abdominal segments 7 and 8 with postero-lateral spines, hairs, or small tufts; paddles large and broad, smooth or serrated, with or without terminal hair and fringe 2
- 2 Postero-lateral hairs of abdominal segments almost exactly at corners; those on segments 3-8 spine-like; respiratory trumpets widely open; scoop-shaped; paddles with terminal and accessory hairs, the latter some distance from tip 3
 Postero-lateral hairs of abdominal segments some distance from apical corners; respiratory trumpets with small openings, tubular; paddles with or without a terminal hair; accessory hair, if present, placed beside terminal hair 4
- 3 Postero-lateral spine on segment 4 pointed; hairs 2 and 5 on segments 5-7 rather small, some bifid *Anopheles pseudopunctipennis*
 Postero-lateral spine on segment 4 blunt; hairs 2 and 5 on segments 5-7 large and simple *Anopheles albimanus*
- 4 Terminal and accessory hairs absent; outer portion of paddle produced beyond tip of midrib *Megarhinus guadeloupensis*
 Terminal hair present; accessory hair present or absent; outer portion of paddle not longer than midrib 5
- 5 Tracheoid portion of respiratory trumpet running to basal half of tubular part *Uranotaenia lowii*
 Tracheoid portion running to much less than $\frac{1}{2}$ 6
- 6 Paddles with a single terminal hair which is longer than paddle itself
Deinocerites cancer
 Paddles with one or 2 short terminal hairs 7
- 7 Paddles with serrated margin; segment 9 without lateral hair 8
 Paddles with smooth margin; segment 9 with a lateral hair 11
- 8 Paddles with accessory hair beside branched terminal one *Psorophora confinnis*
 Paddles with a single unbranched terminal hair 9
- 9 Postero-lateral hairs on segment 7 usually single, rarely double; those on segment 8 usually 4-branched (range from 1-7) *Aedes aegypti*
 Postero-lateral hairs on segment 7 at least 3-branched; those on segment 8 at least 5-branched 10
- 10 Postero-lateral hairs on segment 7 usually 4-branched (range from 3-5), on segment 8 about 5-branched *Aedes busckii*
 Postero-lateral hairs on segment 7 about 7-branched, on segment 8 about 9-branched *Aedes taeniorhynchus*
- 11 Postero-lateral hairs on segment 8 about as long as paddles, 3-branched
Culex americanus
 Postero-lateral hairs on segment 8 much shorter than length of paddles 12
- 12 Postero-lateral hairs on segment 8 about 6-8-branched 13
 Postero-lateral hairs on segment 8 about 10-branched 14
- 13 Open portion of respiratory trumpet oval *Culex quinquefasciatus*
 Open portion of respiratory trumpet funnel-shaped, with a slit-like base
Culex erraticus

- 14 Triangular plates of metanotum enclosing the halteres with one of the hairs
 4-6-branched *Culex maracayensis*
 This hair 9-12-branched *Culex bahamensis*
 No data on pupae of *Haemagogus anastasionis*, *Psorophora cyanescens* and *pygmaea*,
Culex habilitator and *nigripalpus* are known to the author.

KEY TO THE ADULT MOSQUITOES

- 1 Abdomen not covered with flat scales; female palpi as long as proboscis; male
 palpi long, clubbed at tip; scutellum rounded; wings distinctly white-
 marked 2
 Abdomen covered with flat scales; female palpi much shorter than proboscis;
 male palpi long or short, but not clubbed at tip; scutellum rounded or
 trilobed; wings dark. 3
- 2 Legs dark; abdomen without scales *Anopheles pseudopunctipennis*
 Legs with dark and white spots, hind tarsal segments 2 (apical half), 3 and 4
 white, 5 white with a narrow basal black ring; abdominal segments 3-7
 with lateral scale tufts *Anopheles albimanus*
- 3 Very large mosquito; proboscis very stout, rigid, hook-like, outer half slender;
 scutellum evenly rounded and scaled *Megarhinus guadeloupensis*
 Medium-sized or small mosquito; proboscis flexible, of uniform thickness,
 outer half not bent downward; scutellum trilobed, with separated tufts
 of setae 4
- 4 Bright blue-green mosquito; prothoracic lobes approximate, collar-like . .
 Haemagogus anastasionis
 Differently coloured; prothoracic lobes well separated 5
- 5 Wings without microtrichia; second marginal cell about $\frac{1}{3}$ as long as its
 petiole; prothoracic lobes with silvery blue scales *Uranotaenia lowii*
 Wings with microtrichia; second marginal cell at least as long as its petiole;
 prothoracic lobes without silvery blue scales 6
- 6 Postnotum with a tuft of setae; abdomen without bristles, except for segment
 7; abdominal tergites entirely dark; venter white; the 2 colours separated
 laterally in a straight line; wing squama bare *Wyeomyia celaenocephala*
 Postnotum bare; abdomen with hairs on each segment; abdominal segments
 with pale bands dorsally or laterally; black of dorsum and white of venter
 not separated in a straight line; wing squama fringed 7
- 7 Postspiracular bristles present; tip of abdomen pointed, segment 7 narrow,
 8 much narrowed and retracted; pulvilli absent or hair-like 8
 Postspiracular bristles absent; tip of abdomen blunt, segment 7 not narrowed,
 8 short, but not retracted; pulvilli broad and distinct 13
- 8 Spiracular bristles present; abdominal segments with pale scales apically 9
 Spiracular bristles absent; abdominal segments with pale scales basally 11
- 9 Dark species, with metallic violet colour; wings dark, femora and tibiae not
 mottled; hind tarsi dark; claws of female toothed *Psorophora cyanescens*
 Grey brownish species, without violet colour; wings with white and dark
 scales uniformly mixed; femora and tibiae speckled with white; hind tarsi
 with basal rings; claws of female simple 10
- 10 Tibiae distinctly white-spotted; hind tarsus 1 with a central ring; tarsal
 white rings wide; $\frac{1}{4}$ - $\frac{1}{3}$ of the segment *Psorophora confinnis*
 Tibiae sparsely white-speckled; hind tarsus 1 without a central ring; tarsal
 white rings narrow, less than $\frac{1}{4}$ of the segment *Psorophora pygmaea*

- 11 Mesonotum with conspicuous lyre-shaped silver ornament . . . *Aedes aegypti*
 Mesonotum differently marked 12
- 12 Claws of female simple; one tooth on fore claws of male front and mid legs;
 proboscis black; mesonotum with several golden lines; occiput with one
 golden line; hind tarsus 5 dark *Aedes buschii*
 Claws of fore and mid legs of female toothed; fore claws with 2 teeth and hind
 ones with one tooth on male front and mid legs; proboscis with white
 ring at middle; mesonotum and occiput without golden lines; hind tarsus
 5 entirely white *Aedes taeniorhynchus*
- 13 Antennae much longer than proboscis; second joint of female antennae 8–14
 times as long as wide; male antennae and palpi about similar to those of
 female; cerci with 2 filaments *Deinocerites cancer*
 Antennae not longer than proboscis; second joint of female antennae less than
 6 times as long as wide; male with bushy antennae and long palpi; cerci
 without filaments 14
- 14 Proboscis with white ring 15
 Proboscis without white ring 17
- 15 Proboscis with very narrow or obsolete white ring at outer third
Culex habilitor
 Proboscis with broad white ring at middle 16
- 16 Basal white bands on abdominal segments distinctly widened in middle into
 triangular spots; white bands at articulations of legs very narrow
Culex bahamensis
 Basal white bands on abdominal segments rather uniform; white bands at
 articulations of legs distinct *Culex maracayensis*
- 17 Palpi of male and female more than $\frac{1}{3}$ as long as proboscis *Culex americanus*
 Palpi of female less than $\frac{1}{3}$ as long as proboscis; male palpi longer than pro-
 boscis 18
- 18 Abdomen dorsally with conspicuous segmental bands of white scales
Culex quinquefasciatus
 Abdomen unbanded dorsally or with narrow segmental bands 19
- 19 Outstanding scales of wing near tip broadened; occiput with triangular area
 of narrow, curved, golden scales in middle; the sides with broad, flat
 scales; small mosquito *Culex erraticus*
 Outstanding scales of wing long and slender; occiput with narrow scales only;
 medium-sized mosquito *Culex nigripalpus*

KEY TO THE MALE GENITALIA

- 1 Apex of clasper trilobed *Wyeomyia celaenocephala*
 Apex of clasper not trilobed 2
- 2 Mesosome nearly tubular 3
 Mesosome not tubular 4
- 3 Sidepiece with 3 spines: 2 parabasal and 1 internal; ventral claspette lobes
 not fused together; mesosome with 2 pairs of apical leaflets
Anopheles pseudopunctipennis
 Sidepiece with 4 spines: 1 parabasal, 2 accessory and 1 internal; ventral

- claspette lobes fused together, with a pair of testicle-like lobes; mesosome without leaflets *Anopheles albimanus*
- 4 Claspette with several apical appendages 5
Claspette, if present, with a single apical appendage 7
- 5 Claspette with 4 appendages *Psorophora pygmaea*
Claspette with 6 or more appendages 6
- 6 Inner apical angle of sidepiece slightly produced; clasper fringed on inner margin with short setae and denticles, claspette with 6-8 short setae
Psorophora cyanescens
Inner apical angle of sidepiece strongly produced; clasper smooth on inner margin, claspette with 6 rather long setae *Psorophora confinnis*
- 7 Sidepiece with a fringe of lanceolate scales on inner edge
Haemagogus anastasionis
Sidepiece without this fringe 8
- 8 Mesosomal halves simple 9
Mesosomal halves with hooks, rods and plates 12
- 9 Sidepiece without a median, longitudinal groove reaching to tip; large basal lobe on sidepiece, with 3 stout spines apically and many short setae; clasper with a row of short hairs on inner side *Megarhinus guadeloupensis*
Sidepiece with such a groove, basal lobe, if present, small; clasper without these hairs 10
- 10 Claspette absent; mesosome with teeth, divided into 2 plates *Aedes aegypti*
Claspette present; mesosome without teeth, and not divided 11
- 11 Claspette well developed, with columnar base and filamentous seta
Aedes taeniorhynchus
Claspette rudimentary, with a stout seta from a conical base *Aedes busckii*
- 12 Tenth sternite not distinct; a pair of slender, chitinous, divergent, lateral rods instead *Uranotaenia lowii*
Tenth sternite distinct 13
- 13 Sidepiece with inner apical angle produced; clasper with 2 equal terminal spines *Deinocerites cancer*
Sidepiece with inner apical angle not produced; clasper with one spine . . . 14
- 14 Tenth sternite comb-shaped apically, the teeth blunt 15
Tenth sternite with an apical tuft of pointed spines 16
- 15 Clasper simple *Culex americanus*
Clasper with snout-like termination *Culex erraticus*
- 16 Lobe of sidepiece with 2 appendages *Culex habitator*
Lobe of sidepiece with more than 2 appendages 17
- 17 Lobe of sidepiece with 3 appendages (2 blade-like and one setaform)
Culex bahamensis
Lobe of sidepiece with more than 3 appendages 18
- 18 This lobe with 4 appendages (3 rods and a basal hair) . . *Culex maracayensis*
This lobe with more than 4 appendages 19
- 19 This lobe with 5 appendages (3 rods, a leaf and a seta) . . . *Culex nigripalpus*
This lobe with 8 appendages (3 rods, 3 setae, 1 filament and 1 leaf)
Culex quinquefasciatus

BIOLOGY

In the following pages the

- (1) *finding places,*
- (2) *types and characteristics of the breeding places,*
- (3) *association with other mosquitoes,*
- (4) *biting habits and resting places,*
- (5) *distribution and density*

of the various mosquitoes have been described in so far as the species has been observed in the Netherlands Antilles.

Several tables have been prepared to summarize the biological data. Chlorine contents and pH values of the breeding places are given in Table 7. The types of breeding places are shown by Table 12. Table 8 deals with the frequency of association. Table 9 summarizes the biting habits and resting places. Tables 3, 10, 13, 14 and 15 give the distribution and density of the mosquitoes.

A summary is given of the geographical distribution of the species, of their habitats, and the times of their findings — except for *Aedes aegypti* and *Culex quinquefasciatus* on Curaçao and Aruba, as they are very common on these two islands (see maps, fig. 20, 21, 23), and of *Psorophora confinnis* on Aruba (see maps, fig. 21, 23).

The Station numbers refer to HUMMELINCK's localities, described in the 1st, 4th and 17th papers of this series. — To the report on the mosquitoes collected by him (VAN DER KUYP, 1953a) the following data may be added: *Anopheles ps. pseudopunctipennis*, Curaçao, Sta. 392, Tanki di Steenen Koraal, very shallow pool, Cl 1560 mg/l, 17.IV.1949, larvae. *Culex americanus*, Saba, Sta. 519, Bromeliad at Upper Rendez Vous, Cl 140 mg/l, 26.VII.1949, numerous larvae. *Megarhinus guadeloupensis*, Saba, Sta. 519, as before, larva.

On the Curaçao Group, with its scanty rainfall, the mosquitoes are often found in unusual breeding places.

When mentioning the distribution of the species in other American countries, stress is laid on the Antilles and Venezuela.

All mosquitoes found on the Curaçao Group have been reported from Venezuela; those found on the St. Martin Group from the adjacent Lesser Antilles or from the Greater Antilles.

The author could not find any mosquitoes on Klein Curaçao in March 1943, and Klein Bonaire was not visited. HUMMELINCK did not observe mosquitoes either on the same islands in 1936/37 and 1948/49, while his water-samples did not yield any larvae.

Wyeomyia celaenocephala [Fig. 20]

CURAÇAO. Christoffelberg: various bromeliads, ♀♀ in jungle; Dec. 1945, Aug. 1946, Sta. 235B Dec. 1948.

Breeding in various bromeliads: *Bromelia lasiantha*, growing on the ground, singly or in large numbers together, contained up to 100 ml of rainwater; *Tillandsia utriculata*, containing up to 300 ml, was attached to various trees (*Tamarindus*, *Acacia*, *Caesalpinia*, *Lemaireocereus*, *Haematoxylon*, *Prosopis*, *Malpighia*, *Bursera*, etc.); *Ananas comosus*, attached to a rock, contained a few hundred ml of rainwater. — The water was clear or slightly turbid, yellowish, and contained some plant decay.

Adults were found in association with *Haemagogus anastasionis*.

They bit fiercely in the shade of trees in daytime.

Reported from Central America and Venezuela. — Found on the Christoffelberg, a steep hill on Curaçao; in small numbers during the dry season, but abundant after rains, because of the innumerable bromeliads, each containing 0- abt 30 larvae and pupae.

Anopheles pseudopunctipennis pseudopunctipennis [Fig. 20, 21, 23]

CURAÇAO. Fuik: pond, concrete troughs and tank; Feb. 1945. Klein, St. Joris: pond, concrete tank; Mar. 1945. Rosa Villa: ground pool; Feb. 1945. Santa Barbara: ground pool, concrete trough; Dec. 1945. Groot St. Joris: ground pool, July 1942; ponds, Apr. 1945. Montagne di Rey: concrete tank, Feb. 1945; ground pool, Mar. 1945. Brakkeput Ariba: barrel, concrete tanks, wells, ground pool; Apr. 1945. Santa Catharina: concrete tanks; Mar. 1945. Santa Rosa: tin, concrete tank; Mar. 1945. Noord Santa Rosa: concrete tank; Mar. 1945. Scherpenheuvel: swamp; Feb. 1945. Zuurzak: swamp, pond; Feb. 1945. Ronde Klip: concrete trough; Mar. 1945. Vetter: barrel, concrete tank; Apr. 1942. Oost Jongbloed: ground pool; Mar. 1945. Brievengat: pond; Feb. 1943. Nabij Vergenoeging: concrete tanks; Aug. 1941. Van Engelen: concrete trough; June, July, Aug. 1941; house, July 1941. Tera Corá: pool, Sta 396c Feb. 1949. Mahaai: concrete trough, Mar. 1945. Cerrito: concrete tank; Aug. 1942. Poos Cabaai: concrete trough; Dec. 1944. Noordkant: concrete tank; Apr. 1942. Rio Canario: concrete tanks; Apr. 1942. Otrabanda (Frederikstraat): enamelled washing-bowl; May 1941. Steenen Koraal: pond, Mar. 1945; pool, Sta. 392 Apr. 1949. Veeris: concrete tanks; May 1942, June 1944. Seroe Papaja: pond; Mar., June 1945. Koenoeke Hatoen: pond, boggy land; Mar. 1945. Mahoema: pond; Mar. 1945, Jan. 1947. Hato: ponds, Sta. 75 Oct. 1936, Aug., Sep., Dec. 1941, Dec. 1942; concrete tanks, Dec. 1942, Mar. 1943; ditches, Dec. 1942, Feb. 1943; swamp, Jan. 1943; stagnant temporary ground pools, Aug. 1943, June 1944; spring-fed ground pool, Sta 76A Oct. 1936, Sep. 1945, Jan. 1947. Julianadorp: swamps; Feb., Mar. 1945. Groot Piscadera: swamp; Apr. 1945. Klein Piscadera: swamp; May 1945. Jan Doret: concrete tank; May 1942. Blauw: pond; Mar. 1945. Groot St. Michiel: concrete tanks; Nov., Dec. 1941, May, Nov. 1942, Nov.,

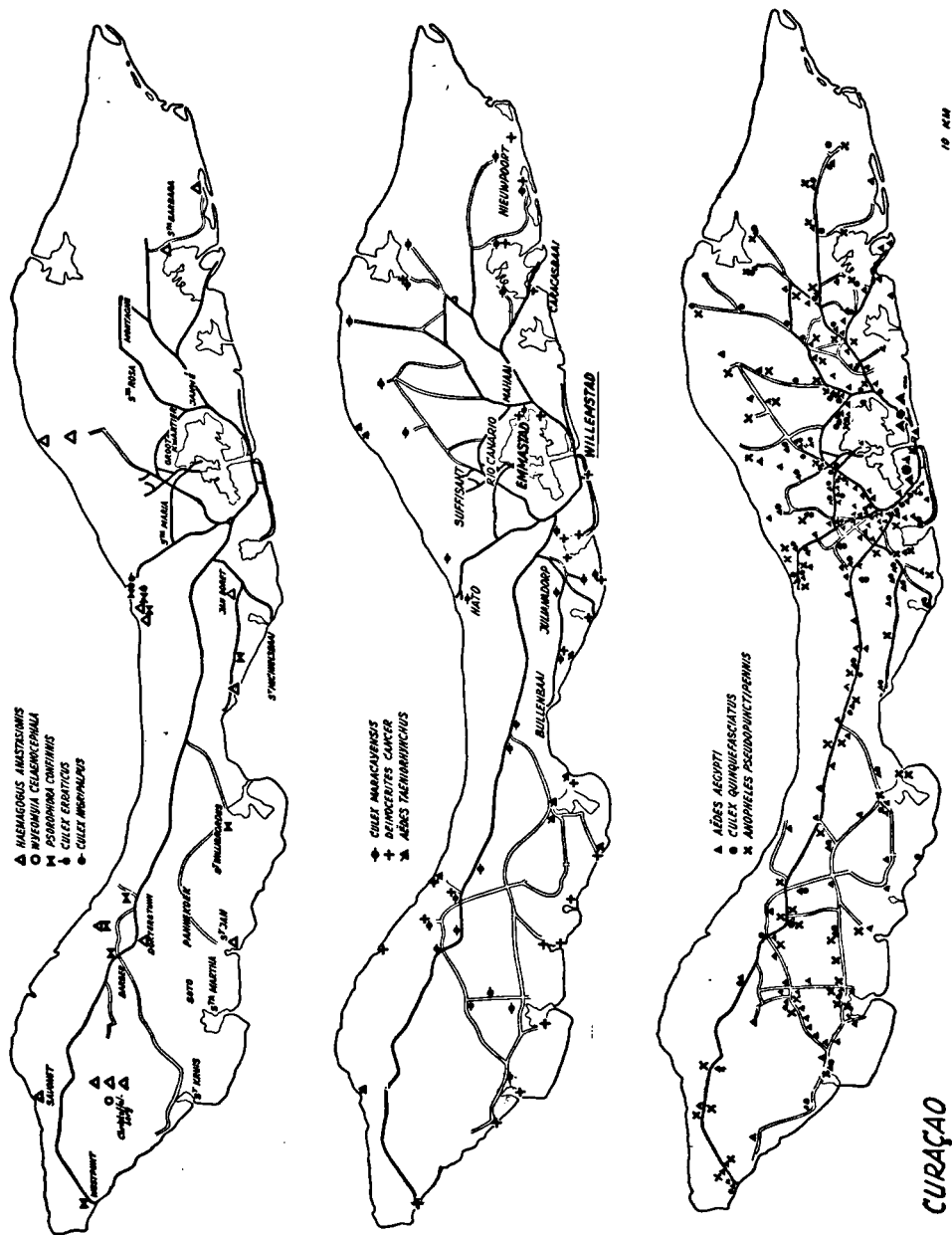


Fig. 20. Finding places of mosquitoes on Curaçao (nearly all 1941-1947). (Symbols of *C. mar.* and *A. taen.* as yet to be placed in the centre of the open space at the left, near Christoffelberg, and of *C. mar.* near Savonet.)

Dec. 1943, June 1944. Klein St. Michiel: concrete tank; May 1942. Mal Pais: concrete tank; Nov. 1941. Groote Berg: pond; Jan., Feb. 1943, Feb. 1947. Martha Koosje: pond; Feb. 1943, Feb. 1945, Feb. 1947, Sta. 397d Apr. 1949. Koenoeke Abau: ground pools; Jan., Mar. 1945. Daniel: ponds; Feb. 1943, Apr., May 1945, Jan. 1947. Boca Santa Maria: spring-fed ground pool; July 1945. St. Willebrordus: pond; May, June 1945, Feb. 1947. Fontein: pond; Jan. 1945. Ascencion: small stream; Jan. 1945. Patrick: ponds, concrete tanks; Feb. 1943, swamps, ponds, ditches, small stream, boggy land; Mar. 1945. Dokterstuin: ponds; May, July, Nov. 1943, Jan., Mar., Apr. 1945, Feb. 1947, concrete trough; May 1943, ditch; Jan. 1945. St. Jan: ditch; Aug. 1945. Pannekoek: small stream; Feb. 1945. Klein St. Jan: swamp; Feb. 1945. Barber: well, boggy land, ground pools; Jan. 1945. Oost Soto: small stream; Jan. 1945. West Soto: well, small stream; Feb. 1945. Hofje Abau: well; Jan. 1945. Klein St. Martha: boggy land, Feb. 1945; pond, Feb. 1947; cowshed, Feb., Mar. 1947. Flip: small stream; Jan. 1945. Cas Corrá: swamps; Jan. 1945. Santa Cruz: swamps, Jan., Feb. 1945; well, Feb. 1945. Savonet: spring-fed ground pool, Sta. 88 Nov. 1936; concrete troughs, May, July 1943, Oct. 1944. Boca Tabla: pond; Jan. 1945. Westpunt: small stream; Jan. 1945.

ARUBA. Rooi Prins: spring-fed ground pool, Sta. 104 Jan. 1937.

Found breeding 52 times in 26 temporary or permanent ponds, 34 times in 27 concrete tanks in gardens and yards, 21 × in 17 stagnant or very slowly streaming ground pools, 18 × in 15 temporary swamps, 11 × in 9 ditches in gardens and along the roads, 15 × in 7 concrete troughs, 8 temporary small streams, 6 wells, 4 boggy lands whether or not with foot prints, 2 barrels, one tin and one washing-bowl. — All the breeding places contained green algae, except for the washing-bowl and a ground pool. Some of them were shaded, but the majority was sunlit. — The wells were about 15 m deep; the water level being about 1–2 m below the ground surface during the rainy season, and there were thick masses of green algae. When the water level was much lower during the dry season, the water did not contain many algae and no larvae were found. — The water was clear, usually colourless, sometimes greenish, rarely brownish or greyish.

The mosquito was found breeding 173 times in total; in association with *Culex maracayensis* 29 ×, *Psorophora confinnis* 12 ×, *C. quinquefasciatus* 7 ×, *C. erraticus* 5 ×, *C. quinq.* + *Aedes aegypti* and *C. quinq.* + *C. marac.* 2 ×, *A. taeniorhynchus* and *P. conf.* + *C. nigripalpus* 1 ×. — Adults were found once together with *A. aeg.* + *C. quinq.* in a house and once with *C. quinq.* in a cowshed.

Though the mosquito will bite regularly in the open near its breeding places in the daytime, it was found only once in a house at Van Engelen, Curaçao. Several animal habitations were examined, but the species was found only twice in a cowshed at Klein St. Martha, Curaçao.

Reported from southwestern U.S.A. to Chile and northern Argentina; Venezuela and the Lesser Antilles. — Usually in very small numbers, but widespread on Curaçao after heavy rains. Found once in Willemstad (Otrabanda, Frederikstraat). Larvae were taken in Rooi Prins, Aruba.

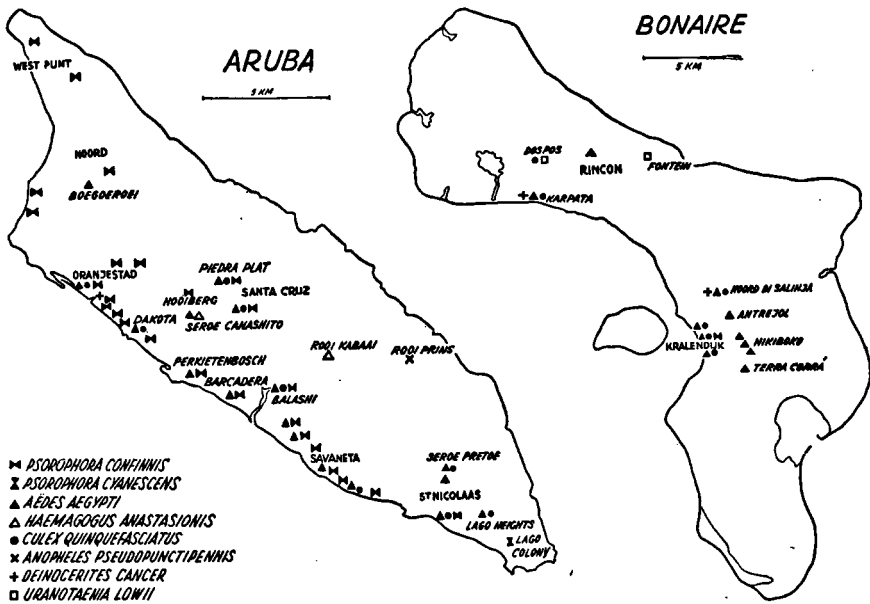


Fig. 21. Finding places of mosquitoes on Aruba and Bonaire (nearly all 1942–1947). (A symbol of *P. conf.* as yet to be placed near Fontein, Bonaire.)

Anopheles albimanus [Fig. 22]

ST. MAARTEN. Rockland, Cul de Sac: well; Sta. 538 May 1949.

Found breeding in a well. — Water level 2 m below surface, 1 m deep, $2\frac{1}{2}$ m wide, in rock debris with green algae. — The water was clear and colourless.

Reported from southeastern U.S.A. to Venezuela and Ecuador; Greater and Lesser Antilles. — Found only once as a larva in Doctor's Well on Rockland, St. Maarten.

Uranotaenia lowii [Fig. 21]

BONAIRE. Dos Pos: pond; Apr. 1943, Jan. 1944.

Collected in a sunlit pond, with algae, grasses and other vegetation. — The water was turbid and yellowish.

They were found twice, once together with *Culex quinquefasciatus*.

Reported from southwestern U.S.A. to Argentina; Venezuela and the Antilles. — Found in very small numbers at Dos Pos, Bonaire.

Aedes taeniorhynchus [Fig. 20, 22]

CURAÇAO. Boca Plaja Canao: beach pools; Feb. 1942, Feb. 1943. Boca Santoe Pretoe: beach pools; Jan., Feb., Apr. 1942, Feb., Nov. 1943, Sep. 1944. Vaersenbaai: beach pool; June 1945. Boca Santa Maria: spring-fed ground pool; July 1945. St. Willebrordus: puddles; June 1945. Daaibooibaai: beach pool; June 1945. Boca Ascencion: beach pools; Nov. 1945. Savonet: spring-fed ground pool; Sta. 88a Dec. 1948. Boca Grandi: beach pool; Oct. 1944.

SABA. Spring Bay: well; Sta. 517 July 1949.

Found 15 times in 10 stagnant beach pools up to 3×3 m, 2 puddles, 2 spring-fed pools and 1 well. — Some of the breeding places contained algae, but the greater part did not show any vegetation; the majority was sunlit, a few were shaded. — The water was usually dark brown and clear, rarely turbid. Often temporary.

Found breeding 20 times, once together with *Anopheles pseudopunctipennis*.

The author was attacked several times by ♀♀ in the jungle near the breeding places, but they were not found in houses. They are severe biters.

Reported from U.S.A. to Brazil and Perú; Venezuela and the Antilles. — Found near the coast in 9 localities on Curaçao and once on Saba. Numerous in the breeding places.

Aedes busckii [Fig. 22]

ST. EUSTATIUS. The Quill: tree hole; Apr. 1947.

Found breeding in a rot-hole, in *Pisonia fragrans*, containing turbid, dark brown rainwater with plant decay.

A few adults were found in a tree hole. They did not bite the author.

Reported from the Lesser Antilles. — Found only once in the jungle of the Quill, St. Eustatius.

Aedes aegypti [Fig. 20, 21, 22, 23]

CURAÇAO. See maps (fig. 20, 23).

ARUBA. See maps (fig. 21, 23).

BONAIRE. Kralendijk, Plaja Pabau: cistern, stoneware jar, Sep. 1942; houses, Sep. 1942, Apr. 1943, Jan. 1944. Plaja, centre: drums, Sep. 1942, Apr. 1943; houses, June 1945, May 1946. Sabana: cisterns; Sep. 1942, Apr. 1943. Plaja Pariba: barrels, Sep. 1942, Apr. 1943, June 1945; drums, Sep. 1942, Jan. 1944, June 1945. Nikiboko, Noord: earthen water pitcher, Sep. 1942; barrel, Apr. 1943. Meimei: drum; Sep. 1942. Nikiboko, Zuid: drums; Sep. 1942, Apr. 1943. Terra Corrá: drum; Jan. 1944. Antreol: drums, Apr. 1943, June 1945; concrete trough, tin, June 1945; house, Sep. 1942. Noord di Salinja: barrel, Sep. 1942; drum, June 1945. Rincón: drums, Sep. 1942, Apr. 1943, June 1945; cisterns, Sep. 1942, Apr. 1943, May 1946; barrels, Jan. 1944. Karpata: cisterns, concrete trough; June 1945.

ST. MAARTEN, Apr. 1947. Philipsburg: drums, stoneware jars, barrel, wooden tub, basin, houses, autocar (adults). Belvédère: drum. Middle Region: drums. Sugar Garden: drum. Madam: drum. Over the Pond: drum. William's Hill: basin, drum.

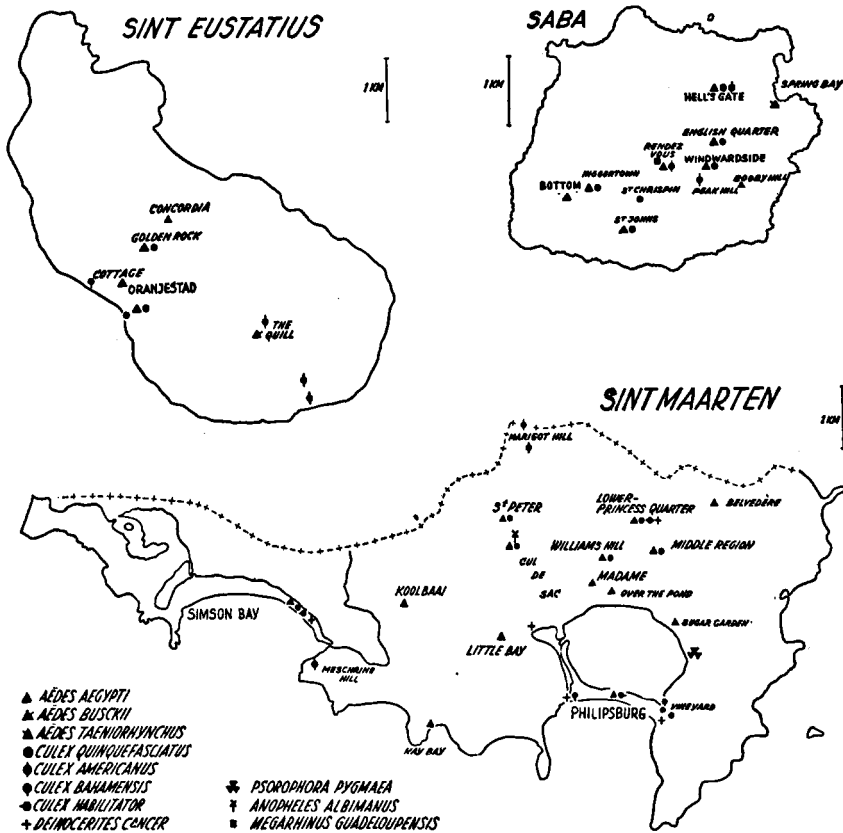


Fig. 22. Finding places of mosquitoes on St. Eustatius, Saba and Netherlands St. Martin (the greater part Apr. 1947). (Symbols of *C. bah.* and *C. hab.* as yet to be placed east of Philipsburg.)

Lower Princess Quarter: drum. St. Peter: drum, cowshed (ad.). Cul de Sac: drums. Little Bay: drum. Kay Bay: drums. Koolbaai: stoneware jars, cistern, wooden mortar. Simson Bay: drums, stoneware jars.

SABA, Apr. 1947. Bottom: drums, cisterns, barrel, houses. Niggettown: barrel. Upper St. John's: cistern. Lower St. John's: yard (ad.). Rendez Vous: cistern. Windwardside: cisterns, barrels, rock hole, houses. Booby Hill: buckets. English Quarter: barrels. Upper Hell's Gate: cistern.

St. EUSTATIUS, Apr. 1947. Oranjestad: barrels, drums, concrete trough, wooden tubs, stoneware jars, earthen water pitcher, iron trough, concrete block, houses. Cottage: drum. Golden Rock: yard. Concordia: drum.

Breeding was observed in 447 drums, 243 barrels, 41 cemented cisterns, 40 concrete troughs, 25 buckets, 20 stone jars, 17 tins, 10 vases, glasses or bottles,

9 rock holes, 8 basins, 8 earthen water pitchers, 6 iron wheelbarrows, 5 concrete tanks, 4 flower pots, 4 wooden tubs, 4 cemented floors, 4 enamelled washing bowls, 3 boats, 2 kerosine tins, 2 bathing tubs, 2 empty battery cases, 2 toilet bowls, 2 bathing pools, 1 iron trough, 1 cemented vessel, 1 roof gutter, 1 wooden mortar, 1 hollow concrete block, 1 flushing reservoir of watercloset, and 1 concrete gutter in a garden: the drums, barrels, cisterns and concrete troughs being the principal habitats. — The breeding places were always either in the vicinity of or within the houses. They were usually shaded. There was a layer of decomposed organic matter in some of the receptacles; others held algae; the flower-pots contained earth and plants. — The water was usually clear, but sometimes turbid or polluted.

Found breeding 918 times in total; together with *Culex quinquefasciatus* 172 ×, with *C. quinq.* + *Anopheles pseudopunctipennis* and *C. quinq.* + *Psorophora confinnis* 2 ×, and with *Haemagogus anastasionis* once. — Innumerable times adults were found in association with *C. quinq.* in houses or in the vicinity of human habitations; once with *C. quinq.* + *P. conf.* + *H. anast.* and *C. quinq.* + *A. pseud.*

The most common domestic pest mosquito. Found in houses, hospitals, hotels, schools, boarding-schools, offices, barracks, prisons, privies and other buildings; in autocars, schooners and airplanes; in a cowshed; in yards, streets, etc., but always in the vicinity of human dwellings, mainly in bedrooms and toiletrooms. — The ♀♀ bite in the daytime, especially early in the morning and late in the afternoon, but also at night. They usually select the bare lower legs of women, and are rather silent in attack. The ♂♂, on the other hand, make much noise; they are particularly annoying when one tries to take a nap.

Reported from the tropical and subtropical regions of the world; Venezuela and the Antilles. — The most common mosquito on all of the inhabited islands. Widespread throughout the year, abundant during the rainy season.

A few thousands of adults were caught in houses; Table 13 shows their densities on the various islands. Percentages of infested yards are given in Table 14. The density of larvae varied from one to a few hundreds in one dip.

Haemagogus anastasionis [Fig. 20, 21]

CURAÇAO. Newport: ♀♀ in jungle; Apr. 1946. Santa Barbara: tree hole, Dec. 1945; ♀♀ in jungle, Dec. 1945. Brievengat: ♀♀ in jungle; Feb. 1943. Boca Santoe Pretoe: rock hole; Apr. 1945. Hato: hollow cactus stump, Nov. 1944; tree holes, Sept., Oct., Nov. 1945, Jan. Dec. 1946, Jan. 1947; ♀ in house, Feb. 1947, ♀♀ in the open and in jungle, Dec. 1942, Jan., July, Aug., Sep., Dec. 1943, Sep., Oct., Nov. 1945. Gr. Piscadera: leaf base of cocopalm, Sta. 339A Jan. 1949. Gr. St. Michiel: ♀♀ in garden; Nov. 1941. Bullenbaai: tree hole; Nov. 1945. St. Jansbaai: ♀♀ in jungle; Aug. 1945. Dokterstuin: ♀♀ in garden; Jan. 1942. Patrick: ♀♀ in jungle; Mar. 1945. Christoffelberg: Sta. 235B Dec. 1948; Punte Capro, tree hole, ♀♀ in jungle; Pos Maron, ♀♀ in jungle; Piedra Baka, tree hole, ♀♀ in jungle; all Dec. 1945. Boca Grandi: ♀♀ in jungle; Oct. 1944.

ARUBA. Seroe Canashito: rock hole; Dec. 1936. Rooi Kabaai: tree hole; Sta. 404 Dec. 1948.

Collected in one leaf base, in 2 small rock holes and 12 times in 7 tree holes in *Bursera tomentosa*, *B. simaruba*, *Caesalpinia coriaria*, *Achras sapota*, *Hippomane mancinella* and *Lemaireocereus griseus*, 30–125 cm above the ground. The rock holes

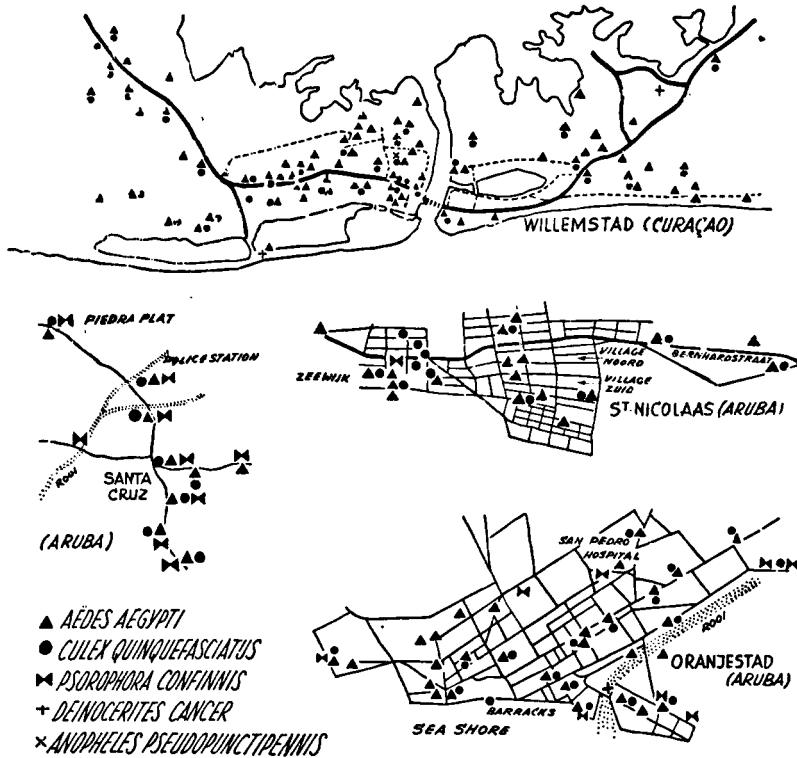


Fig. 23. Finding places of mosquitoes at Willemstad, Santa Cruz, St. Nicolaas and Oranjestad (1941-1947).

and the cactus were sunlit. — All the breeding places contained dark brown, turbid rainwater with a layer of humus; one of the rock holes held goat feces.

Adult ♂♂ were reared from larvae and pupae.

Found breeding 15 times in total; together with *Culex quinquefasciatus* 6 × in a tree hole and with *Aedes aegypti* once in a rock hole. — One ♀ was found in a house at Hato, in association with *A. aeg.* + *Psorophora confinnis* + *C. quinq.* On Curaçao ♀♀ were caught together with *Wyeomyia celaenocephala*, with *P. conf.*, with *A. taeniorhynchus*, and with *Deinocerites cancer* + *P. conf.*

Usually occurring in the jungle, sometimes in gardens, found once in a house. — Although they were often caught a few miles from human habitation they attacked man readily in the shade of trees in the daytime. Their bite is painful. They usually come back at once after being driven away, so they were easily caught. After catching the first group of mosquitoes it was difficult to find other specimens at the same spot. It is therefore assumed that they concentrate forces when in action.

Reported from Costa Rica and Colombia. — Caught in 13 localities spread on Curaçao, and in 2 on Aruba. Not abundant, found only after occasional heavy rains.

Psorophora cyanescens [Fig. 21]

ARUBA. Lago Colony: Oct. 1950 (1 adult, collected by dr R. C. Carrell, chief Medical Department Lago Oil Corporation, received for identification through the kind offices of dr F. J. Rutten, Government bacteriologist on Curaçao).

Reported from southeastern U.S.A. to Argentina; Venezuela. — Found only once on Aruba.

Psorophora confinnis [Fig. 20, 21, 23]

CURAÇAO. Hato: ponds, Dec. 1942; ditches, Dec. 1942, Feb. 1943, Jan. 1947; temporary swamps, Dec. 1942, Jan. 1943; concrete tanks, Dec. 1942, Mar. 1943, Dec. 1946, Jan. 1947; stagnant temp. ground pools, Jan., Mar., July, Aug., Sep., Oct., Nov., Dec. 1943, June, July, Nov., Dec. 1944, May, June 1945, Jan. 1947, Aug. 1949; houses, Dec. 1942, Jan., Feb. 1943, Jan., Feb. 1947. Mal Pais: temp. swamp, ground pools; Dec. 1944. St. Willebrordus: ground pools; Jan. 1943. Ascencion: adults in garden; May 1945. Patrick: adults in garden; Mar., Apr. 1945. Barber: ground pools; Jan. 1945. Westpunt: ground pool; Jan. 1945.

ARUBA. See maps (fig. 21, 23).

BONAIRE. Kralendijk, Plaja: ground pools; Feb. 1944, Sta. 376a Feb. 1949. Fontein: adults in garden; June 1944.

Found breeding on Aruba in hundreds of rock holes, in hundreds of ground pools in the jungle, in gardens, in yards and along the roads, 12 × in 6 ditches, 10 temporary swamps, 6 × in 3 concrete tanks, 2 temporary ponds and 1 well. — The majority of the breeding places was temporary and held rainwater. Some contained green algae and grass, but usually there was no vegetation. The majority was sunlit; some were shaded. — The water was usually clear and colourless, sometimes turbid, greenish or greyish.

Found breeding together with *Anopheles pseudopunctipennis* 12 ×, with *Culex quinquefasciatus* 5 ×, with *C. nigripalpus* 3 ×, with *Aedes aegypti* + *C. quinq.* 2 ×, and with *A. ps.* + *C. nigr.* once. — Adults were found in a house in association with *A. aeg.* + *C. quinq.* + one *Haemagogus anastasionis*.

Adult ♀♀ were caught in the open near their breeding places and in several houses at the airport of Hato, Curaçao. — They are fierce biters; they attacked even in an autocar.

Reported from the U.S.A. to Argentina; Venezuela and some of the Antilles. Usually very rare, but very widespread and abundant on Curaçao, Aruba and Bonaire after heavy rains.

Psorophora pygmaea [Fig. 22]

ST. MAARTEN. Rolands Canal, Philipsburg Upstreet: puddle; Sta. 531 May 1949.

Collected in a small temporary pool, in a ditch, with grasses. — The water was rather clear, yellowish brown.

Reported from the U.S.A. (Florida), the Bahamas, the Greater Antilles and the adjacent Lesser Antilles. — Found once on St. Martin in large numbers.

Deinocerites cancer [Fig. 20, 21, 22, 23]

CURAÇAO, in crab holes. Fuik: July 1945. Fuikbaai: Apr. 1946. Spaanse Water: Dec. 1945. Caracasbaai: June 1945. St. Jorisbaai: Apr. 1945. Schottegat: Zeelandia, June 1945; Hel, Willemstad, Jan. 1947. Rifwater, Willemstad: June 1945. Piscaderabaai: Nov. 1945; Veeris, Sep. 1945; Kl. Piscadera, May, Sep. 1945. Blauwbaai: Jan. 1946. Boca San Michiel: Nov. 1945. Mal Pais: June 1945. Boca Santa Maria: July 1945. Daaibooibaai: June 1945. Plaja Boto, Cas Abau: July 1945. Boca Ascencion: Nov. 1945; Ascencion, May 1945. Patrick: Mar., Apr. 1945. St. Jansbaai: Aug. 1945; St. Jan, Aug. 1945. Plaja Grandi: Jan. 1946. Santa Marthabaai: Aug. 1945. St. Kruisbaai: June 1945. Lagoenbaai: May 1946. Westpuntbaai: Apr. 1946.

ARUBA. Oranjestad, Rooi Lagoen: crab holes; Aug. 1945.

BONAIRE. Noord di Salinja: crab hole; June 1945. Karpata: well; June 1945.

ST. MAARTEN, in crab holes, Apr. 1947. Philipsburg, Trench. Rolands Canal, Philipsburg. Lower Princess Quarter. Cul de Sac. Simson Bay.

Found breeding in crab holes in 35 localities, one well and one beach pool. — The crab holes were usually near the sea or near bays. They had a depth of a few decimetres in boggy soil, but one was about 120 cm deep in dry ground. They had a diameter of about 10–15 cm. The beach pool was sunlit and contained algae. — The water was usually turbid and greyish.

Once occurring together with *Culex quinquefasciatus* in a well, once with *C. bahamensis* in a beach pool and once with *C. habilitator* in a crab hole. — Adults were found 3 times in association with adult *C. hab.* in crab holes.

Adult ♂♂ and ♀♀ escaped from the crab holes when smoke was blown or a stick was stirred into these. In the latter case they moved bit by bit and returned to the same or to an adjacent crab hole, so they were easily caught. They were found rarely in the open, in the vicinity of their breeding places, never in houses. — They sat on the clothes, but did not bite. Reared and captured ♀♀ also did not bite.

Reported from the U.S.A. to British Guiana; Venezuela and the Antilles. — Widespread in crab holes along the coast and the bays on Curaçao and St. Martin; found in two localities on Bonaire, and in one on Aruba.

Culex erraticus [Fig. 20]

CURAÇAO. Hato: ponds, Sta. 75 and 78 Oct. 1936, Aug. Sept., Dec. 1941, June, July, Dec. 1942; temporary ground pool, July 1943.

Collected 9 × in 2 ponds and once in a stagnant ground pool. — The ponds — Tanki Mamaja and Tanki Monpos — were sunlit and contained green algae, *Najas*, some *Chara*, *Echinodorus* and grasses. The ground pool was without vegetation, but shaded. — The water was clear, greenish or colourless.

The mosquito was found breeding 10 times, including 5 × in association with *Anopheles pseudopunctipennis* and once with *Culex quinquefasciatus* + *C. nigripalpus*.

Reported from the U.S.A. and Venezuela. — Found in small numbers in 1936 and in 1941–1943 at the airport of Hato. In 1942 the ponds were regularly oiled, and in 1943 they were filled up by the Americans. After this the species has not been found again.

Culex americanus [Fig. 22]

ST. MAARTEN, in bromeliads. Meschrine Hill near Simson Bay: Sta. 540 May 1949. Marigot Hill: Apr. 1947.

SABA, in bromeliads. Peak Hill: Apr. 1947. Rendez Vous: Apr. 1947, Sta. 519 July 1949. Upper Hellsgate: Apr. 1947.

ST. EUSTATIUS, in bromeliads. White Wall: Sta. 424 and 425 July 1949. The Quill: Apr. 1947, Sta. 504 July 1949.

Breeding in various bromeliads, usually *Tillandsia utriculata*, attached to rocks and trees (*Mangifera*, *Pisonia*, etc.), containing up to 200 ml of rainwater, with plant decay. — The water was clear or slightly turbid, and yellowish.

Adults were reared from larvae and pupae.

Found breeding in association with a single *Megarhinus guadeloupensis*.

Reported from the Greater Antilles, the adjacent Lesser Antilles and French Guiana. — Found in 2 localities on St. Martin, in 3 on Saba and 2 on St. Eustatius. Taking into consideration the innumerable bromeliads on the rocks and the trees, this species must be very widespread on these islands.

Culex bahamensis [Fig. 22]

ST. MAARTEN. Philipsburg, Trench: beach pool; Apr. 1947. Philipsburg Upstreet: cistern, Sta. 530 May 1949; concrete trough near Great Saltpond, Apr. 1947, Sta. 1134 May 1949.

ST. EUSTATIUS. Oranjebaai: well, Apr. 1947; trough, Sta. 511A July 1949.

Found in 2 concrete troughs, a cemented cistern, a well and a beach pool. The breeding places were usually sunlit, and contained algae and sometimes *Ruppia*. — The water was clear, colourless or greyish.

Five breeding places were sampled. Once the species was associated with *Deinocerites cancer* and once with *Culex quinquefasciatus*.

Reported from Florida, the Bahamas, Greater Antilles and Virgin Islands. — Found in 3 localities on St. Martin, Dutch part, and in 2 on St. Eustatius.

Culex habilitator [Fig. 22]

ST. MAARTEN, in crab holes, Apr. 1947. Rolands Canal near Philipsburg. Lower Princess Quarter. Simson Bay.

Breeding in a shady crab hole near the beach. The depth about 40 cm, the diameter about 12 cm. — The water was turbid and greyish.

The larvae were found together with *Deinocerites cancer*. — Adults were taken in association with *D. canc.* in 3 localities.

Adult ♂♂ and ♀♀ were found in crab holes; they were not caught in houses. The author was not bitten by the ♀♀.

Reported from the Greater Antilles and the Virgin Islands. — Found on St. Martin in small numbers in 3 localities in crab holes.

Culex maracayensis [Fig. 20]

CURACAO. Fuik: pond, concrete troughs; Feb. 1945. Newport: concrete trough; Apr. 1946. Santa Barbara: pond; Dec. 1945. Klein St. Joris: pond; Mar. 1945. Groot St. Joris: ponds; Apr. 1945. Brakkeput Ariba: well, ground pools; Apr. 1945. Santa Catharina: concrete tanks; Mar. 1945. Ronde Klip: concrete trough; Mar. 1945. Brievangat: pond, Feb., Mar. 1943; concrete tank, Mar. 1944. Zeelandia: swamps; Mar. 1945. Veeris: pond; May 1942, July, Aug. 1943, June 1944. Seroe Papaja: pond; June 1945. Hato: ditches, ground pools; May 1946. Blauw: pond, swamp; Mar. 1945. Blauwbaai: pond, boggy land; Mar. 1945. Groot St. Michiel: ground pools; Dec. 1943. Mal Pais: ground pools; Mar. 1945. Martha Koosje: pond, ditch; Feb. 1945. Koenoe Abau: ground pools; Jan. 1945, Jan. 1947. Kloof: ground pool; Jan. 1945. Ascencion: small stream, Jan. 1945; pond, May 1945. Patrick: ponds, Feb. 1943; small streams, ditch, Mar. 1945. Dokterstun: ponds; Dec. 1941, Nov. 1943, Mar. 1945, Apr. 1946, Jan., Feb. 1947. Barber: ground pool; June 1945. Rio Magdalena: pond; Aug. 1945. Hofje Abau: ground pool; Jan. 1945. Klein St. Martha: ground pool; Feb. 1947. Savonet: ground pool, Sta. 89 Oct. 1936; concrete trough, May 1943. Christoffelberg: spring-fed ground pool, Sta. 88 Nov. 1936; ground pool, Dec. 1945. Santa Cruz: swamps, Jan. 1945; swamps, ponds, small stream, Feb. 1945.

Found 28 × in 19 ponds, 19 × in 17 ground pools in yards, gardens, the jungle, and along the roads, 7 × in 6 concrete troughs, 6 × in 4 swamps, in 5 concrete tanks, 4 ditches, 3 small streams, 1 well, and once in boggy land with foot prints. — Some of the breeding places contained algae, grass or other plants, others showed no vegetation; some were sunlit, but the majority was shaded. — The water was usually clear, colourless or greenish, but a few breeding places contained dirty, turbid, brown water with plant decay.

The mosquito was found breeding 74 times in total; in association with *Anopheles pseudopunctipennis* 29 ×, with *Culex quinquefasciatus* 4 × and with both 2 times.

Adults were not caught, though larvae abounded during the rainy season. They were reared from larvae.

Reported from Venezuela and Colombia. — Found on Curaçao; usually in small number in a few breeding places, but very widespread after heavy rains.

Culex nigripalpus [Fig. 20]

CURACAO. Hato: temporary ground pool; Jan., July, Aug., Sep., Nov. 1943.

Found breeding in a temporary, shaded ground pool, without vegetation. — The rainwater was slightly turbid and greyish.

The mosquito was found breeding 5 times in total; 3 times together with *Psorophora confinnis*, once with *P. conf.* + *Anopheles pseudopunctipennis* and *Culex quinquefasciatus* + *C. erraticus*.

Reported from southwestern U.S.A. to Brazil; Venezuela and the Antilles. — Larvae were taken several times from the same temporary ground pool near the airport of Curaçao, 1943. After this year the species could not be refound by the author.

Culex quinquefasciatus [Fig. 20, 21, 22, 23]

CURAÇAO. See maps (fig. 20, 23).

ARUBA. See maps (fig. 21, 23).

BONAIRE. Kralendijk, Plaja Pabau: houses; Sep. 1942, Apr. 1943, Jan. 1944; Plaja: drums, Sep. 1942, Apr. 1943; concrete trough, Sep. 1942; houses, June 1945, May 1946. Plaja Pariba: drums; Sep. 1942, Apr. 1943, Jan. 1944. Noord di Salinja: drum; June 1945. Karpata: concrete trough, well; June 1945. Rincón: puddle in garden; Sta. 374 Feb. 1949. Dos Pos: pond; Jan. 1944.

ST. MAARTEN, Apr. 1947. Philipsburg: stoneware jars, drums, wooden case, houses, public privy (adults). Vineyard: stoneware jars. Middle Region: drum, iron trough. William's Hill: basin. Lower Princess Quarter: stoneware jar. St. Peter: drum. Cul de Sac: drum. Simson Bay: stoneware jar.

SABA, Apr. 1947. Niggertown: barrel. Lower St. Johns: cistern. St. Crispin: drum. Windwardside: cisterns. English Quarter: barrel. Upper Hellsgate: cistern.

ST. EUSTATIUS, Apr. 1947. Oranjestad: barrels, drum, stoneware jar, iron trough, toilet bowl, houses. Oranjebaai: boat, concrete tank, well, cisterns; cistern, Sta. 507 July 1949. Golden Rock: iron trough, Sta. 512 July 1949.

Found breeding in 104 drums, 52 barrels, 45 ground pools, 33 concrete troughs, 20 buckets, 15 concrete tanks, 12 cemented cisterns, 8 stoneware jars, 6 storm-water catch basins, 6 wells, 6 iron wheelbarrows, 6 × in 3 ponds, 4 temporary swamps, 4 wooden tubs, 4 cemented floors, 4 boats, 4 basins, 3 tins, 3 enamelled washing bowls, 3 iron troughs, 3 coconut shells, 6 × in a tree hole, 2 rock holes, 2 concrete gutters, 2 wooden cases, 1 earthen water pitcher, 1 bathing tub, 1 empty battery case, 1 kerosine tin, 1 bathing pool, 1 watering can and 1 coconut spathe. The drums, barrels, cisterns, concrete troughs, ground pools, wells, storm-water catch basins, ponds and temporary swamps were the principal habitats. — The artificial receptacles sometimes contained algae; the earth-bound breeding places usually had no vegetation. The breeding places were either in the vicinity of or within the houses; two were found a few miles from human habitation, but where gardeners worked regularly. They were often shaded, but the majority was sunlit. — The water was usually turbid, often polluted and stinking.

This mosquito was found breeding 362 times in total; together with *Aedes aegypti* 172 ×, with *Anopheles pseudopunctipennis* 7 ×, with *Haemagogus anastasionis* 6 ×, with *Psorophora confinnis* 5 ×, with *Culex maracayensis* 4 ×, with *A. aeg.* + *A. pseud.*, *C. mar.* + *A. pseud.* and *A. aeg.* + *P. conf.* 2 ×, with *Deinocerites cancer*, *Uranotaenia lowii*, *C. bahamensis* and *C. erraticus* + *C. nigripalpus* once. — Innumerable times adults were found in association with *A. aeg.* in houses and often outdoors near human habitation, once with *A. pseud.*, *A. pseud.* + *A. aeg.* and *A. aeg.* + *P. conf.* + *H. anast.*

The "common house *Culex*" was found in houses, hospitals, hotels, schools, boarding-schools, offices, barracks, prisons, privies and other buildings; in autocars, in two cowsheds; in yards, streets, etc., but always in association with man. They were found in dark places, especially in the bedroom and toiletroom. — They bite painfully in the evening and at night.

Reported from the warmer regions of the world, between the 39th parallel of latitude north and south; Venezuela and the Antilles. — Widespread on all of the inhabited islands all through the year, abundant during and shortly after the rainy season.

A few thousands of adults were caught in houses. Per man-hour the author found 3.7 on an average in houses on Curaçao during dry periods, 12.2 during rainy seasons and 7 during both; 4 on Aruba during both periods; 5.3 on Bonaire during both; 6.5 on all islands of the Curaçao Group together; 4.4 on the St. Martin Group during a dry season; 6.4 on all the Netherlands Antilles together.

The density of larvae varied from one to a few hundreds in one dip.

The number of premises infested with larvae was:

Curaçao	156 out of 606(25.7%)	St. Maarten. . .	10 out of 51(19.6%)
Aruba	52 out of 130(40.0%)	Saba.	7 out of 25(28.0%)
Bonaire	11 out of 50(22.0%)	St. Eustatius . .	10 out of 31(32.3%)
Curaçao Group .	219 out of 786(27.9%)	St. Martin Group	27 out of 107(25.2%)

All of the islands 246 out of 893 (27.5%).

Megarhinus guadeloupensis [Fig. 22]

SABA. Upper Rendez Vous: bromeliad; Sta. 519 July 1949.

Found breeding in *Catopsis nutans*.

The bromeliad contained about 25 ml clear, greenish brown rainwater.

A single larva was found in association with numerous *Culex americanus*. The larva is predacious and cannibalistic; it feeds not only upon larvae of other mosquitoes but also readily attacks larvae of its own species. Hence it is unusual to find more than one *Megarhinus* larva in a breeding place.

The ♀ has a hook-like proboscis and is therefore incapable of biting. The adults of both sexes feed on the nectar of flowers only. They fly by day; the ♂♂ form a stationary swarm on prominent vegetation.

Reported from Guadeloupe, Venezuela and Surinam. — Found only once as a larva at Upper Rendez Vous, Saba.

TABLE 7.

*Chlorine contents and pH values of mosquito-breeding places
on the Netherlands Antilles (averages in italics).*

Species	p H	m g Cl/l (approximate values)
<i>Anopheles pseudopunctipennis</i> . . .	6.5 — 8.3 — 9.6	50 — 800 — 3500
<i>Anopheles albimanus</i>	8.0	350
<i>Aedes taeniorhynchus</i>	7.4 — 7.8 — 8.0	150 — 11000 — 24000
<i>Aedes busckii</i>	6.7	(rainwater)
<i>Aedes aegypti</i>	6.8 — 7.7 — 8.5	traces — 150 — 300
<i>Haemagogus anastasionis</i>	8.0	(rainwater)
<i>Psorophora confinnis</i>	8.1 — 8.5 — 8.6	25 — 950 — 4500
<i>Psorophora pygmaea</i>		1500
<i>Deinocerites cancer</i>	7.2 — 7.6 — 7.9	400 — 15000 — 27000
<i>Culex erraticus</i>	8.1 — 8.5 — 8.8	300 — 400 — 500
<i>Culex americanus</i>	6.5 — 6.7 — 6.8	(rainwater)
<i>Culex bahamensis</i>	7.2 — 8.0 — 8.8	150 — 15000 — 46000
<i>Culex habilityator</i>	7.9	450
<i>Culex maracayensis</i>	6.5 — 7.7 — 8.6	100 — 1200 — 3500
<i>Culex quinquefasciatus</i>	7.2 — 8.0 — 8.5	30 — 1000 — 3000
<i>Megarhinus guadeloupensis</i>		(rainwater)

TABLE 8.

Frequency of breeding of mosquito larvae in association with others.

Species	<i>Anopheles pseudo- punctip.</i>	<i>Aedes aegypti</i>	<i>Culex quinque- fasciatus</i>	<i>Culex nigripal- pus</i>	<i>Deino- cerites cancer</i>	<i>Culex ameri- canus</i>
<i>Culex quinquefasciatus</i> . . .	7 ×	172 ×			1 ×	
<i>Culex maracayensis</i>	29 ×		4 ×			
<i>Psorophora confinnis</i>	12 ×		5 ×	3 ×		
<i>Haemagogus anastasionis</i> . .		1 ×	6 ×			
<i>Culex erraticus</i>	5 ×					
<i>Uranotaenia lowii</i>			1 ×			
<i>Aedes taeniorhynchus</i>	1 ×					
<i>Culex bahamensis</i>			1 ×		1 ×	
<i>Culex habilityator</i>					1 ×	
<i>Megarhinus guadeloupensis</i> .						1 ×
<i>Culex quinq. + Aedes aeg.</i> . .	2 ×					
<i>Culex quinq. + Culex mar.</i> . .	2 ×					
<i>Culex quinq. + Psor. conf.</i> . .		2 ×				
<i>Culex quinq. + Culex err.</i> . .				1 ×		
<i>Culex nigr. + Psor. conf.</i> . .	1 ×					

TABLE 9.

Feeding habits and resting places of adult mosquitoes.

Species	Feeding on author	Resting places				
		House	Animal habitation	Jungle	Grass, weed	Crab hole
<i>Wyeomyia celaenocephala</i> . .	+			+++		
<i>Anopheles pseudopunctipennis</i>	+	once	+		++	
<i>Aedes taeniorhynchus</i>	+			+++		
<i>Aedes aegypti</i>	+	+++	once			
<i>Haemagogus anastasionis</i> . .	+	once		+++		
<i>Psorophora confinnis</i>	+	+			+++	
<i>Deinocerites cancer</i>	—					+++
<i>Culex habilityator</i>	—					+++
<i>Culex quinquefasciatus</i> . . .	+	+++	twice			

TABLE 10.

Distribution and density of the mosquitoes in the Netherlands Antilles.

Species	Widespread		Limited dis- tribution	Abundant		Scarce
	Permanent	After rains		Permanent	After rains	
<i>Wyeomyia celaenocephala</i> . .			+		+	
<i>Anopheles pseudopunctipennis</i>		+			±	
<i>Anopheles albimanus</i>			+			+
<i>Uranotaenia lowii</i>			+			+
<i>Aedes taeniorhynchus</i>			+		±	
<i>Aedes busckii</i>			+			+
<i>Aedes aegypti</i>	+	++		+	++	
<i>Haemagogus anastasionis</i> . .		±				+
<i>Psorophora cyanescens</i>			+			+
<i>Psorophora confinnis</i>		+			+	
<i>Psorophora pygmaea</i>			+		±	
<i>Deinocerites cancer</i>	+	++			±	
<i>Culex erraticus</i>			+			+
<i>Culex americanus</i>	+	++			+	
<i>Culex bahamensis</i>			+		±	
<i>Culex habilityator</i>			+			+
<i>Culex maracayensis</i>		+			+	
<i>Culex nigripalpus</i>			+			+
<i>Culex quinquefasciatus</i> . . .	+	++		+	++	
<i>Megarthinus guadeloupensis</i> .			+			+

HYGIENIC IMPORTANCE

MOSQUITO-BORNE DISEASES

Some mosquitoes are vectors of dreadful diseases, other may be serious pests of man and animal.

MALARIA

The following authors reported that malaria was not autochthonous on some or on all of the islands: FRIEDMANN (1861), FERGUSON (1913), WATERMAN (1917, 1918, 1919a, 1946), VAN KOL (1919), LENS (1928), LAMPE (1936), VERWEY (1937), WINCKEL (1939), BONNE (1940-1942), VAN DER KUYP (1941, 1941a, 1947, 1948a, 1948b, 1949a, 1950), PHILIPSZON (1942), HENDERSON (1945), SWELLENGREBEL & WINCKEL (1947), SCHOENLEBER (1949) and VAN DER SAR (1951).

This fact was also mentioned in many Colonial reports (Curaçao reports) and Annual reports of the Public Health Service of Curaçao.

Some of the older people of St. Eustatius recall an epidemic of tertian fever which occurred at the beginning of this century. However, there was no physician on the island at that time (VAN DER KUYP, 1947, 1948a).

VAN KOL (1904) stated that the Government physician C. A. SHAW reported an autochthonous (introduced) case of malaria in a boy on Saba in 1902 after his father returned from Santo Domingo suffering from malaria. However, there were no data concerning blood examination and no malaria mosquitoes were found.

Many patients with malaria returned to the Netherlands Antilles after having worked in Colombia, Venezuela, Cuba, Santo Domingo, Guadeloupe and other regions, or after a vacation trip elsewhere. VERSLUYS (1908) reported that early in 1905 about 400 inhabitants of the Netherlands Antilles were working at the railroad construction in the interior of Surinam (Dutch Guiana). Within a month 20 per cent had malaria and afterwards 50 per cent. After some 15 had died they returned to Curaçao. In September of the same year all had left Surinam. In 1919 261 patients on Aruba (2.9 per cent of the population), suffering from malaria had worked in Venezuela.

In 1946 the author found a spleen index of 1.7 per cent in 1,071 children from rural regions on Curaçao. In none of the children with enlarged spleen malaria parasites were found (VAN DER KUYP, 1947, 1949a).

At the authors' request the Government physician, G. F. LUBLIEK, determined the spleen index in children between the ages of 3 and 15 years on St. Eustatius in 1947. The index proved to be 1.2 per cent in 255 children; none of the three children with enlarged spleen showed malaria parasites in their blood. Enlarged spleens are rarely found on St. Maarten and Saba, according to Government physicians, H. C. TJON SIE FAT and J. M. CHOCOLAAD (VAN DER KUYP, 1947, 1948a).

WATERMAN (1946) collected a few Anophelines on Curaçao in 1919. BERGMAN (1924) stated that a few Anophelines were seen on Curaçao at the end of 1924. EMANUELS (1947) caught an *Anopheles "tarsimaculatus"* on French St. Martin between 1923 and 1927. One larva of *Anopheles albimanus* was collected by HUMMELINCK in Cul de Sac on Netherlands St. Maarten in May 1949. This mosquito is an efficient vector of malaria.

From 1941–1947 *Anopheles pseudopunctipennis pseudopunctipennis* was found on Curaçao, usually in very small numbers, but widespread after heavy rains (VAN DER KUYP, 1941–1945, 1947, 1941a–1945a, 1947a, 1949a, 1950, 1953). Larvae of this species were collected by HUMMELINCK at Rooi Prins on Aruba in January 1937.

This mosquito has been reported from the U.S.A. to Chile and Argentina. It is the principal malaria vector in northern Argentina. It is also a vector in Guatemala and in the highlands of Mexico, but it is harmless in other countries. In some regions it feeds on man, but in other, it ignores man and is attracted to animals.

It is harmless on Curaçao and Aruba because of the following reasons:

1. It is a very poor vector of malaria in adjacent Caribbean regions.
2. It is more attracted to animals than to man on Curaçao.
3. It has a very low density, due to the low number of suitable breeding places as the rainfall is usually very poor.
4. The different distribution of patients and vector. Patients suffering from malaria coming to Curaçao and Aruba are usually treated in the hospitals in the vicinity of which no *Anophelines* are found.
5. There are no chronic malarial patients on the islands. Patients suffering from malaria are medically well cared for.

A few wild females were caught and dissected, but did not show oöcysts or sporozoites.

WUCHERERIASIS (Filariasis)

VAN KOL (1919), VERWEY (1937) and SWELLENGREBEL & WINCKEL (1947) stated that filariasis is rare in the Netherlands Antilles. The same statement was made repeatedly in the Colonial reports of Curaçao (Curaçao reports) and in the Annual reports of the Public Health Service of Curaçao.

WATERMAN (1946) informed the author that he found one autochthonous case of filariasis on Curaçao between 1916 and 1919.

ROBLES (1941) told the author that in about 1928 he found microfilariae in the blood of a woman in the third district of Curaçao who had never left the island.

HENRIQUEZ (1946) said that in about 1936 he found an autochthonous case of filariasis in a child at Punda, Willemstad, Curaçao.

HARTZ (1940) stated that filaria was found in histological material of two persons who had been only in Curaçao and Europe, which proved that this disease is autochthonous on Curaçao. However, these two persons came by ship to Curaçao. They might have been infested in ports of call, especially in the West Indies.

VAN DER KUYP (1941) reported 2–3 per cent of *Microfilaria bancrofti* in a few hundreds of persons on Curaçao.

From 1941–1944 the author made blood smears at night of 1,027 inhabitants of the Curaçao Group. *Wuchereria bancrofti* was found in 43 persons (4.2 per cent) of whom 6 were foreigners and 10 were natives who had visited a foreign country for a period ranging from a few days to a few years. At least 27 cases (2.7 per cent) were therefore autochthonous. However, 6 cases concerned housemates of carriers (VAN DER KUYP, 1949a).

Filariasis is very rare on Aruba, but constitutes a potential danger, in that immigrants from endemic areas are present together with a known vector (VAN DER KUYP, 1944, 1948b).

Filariasis and elephantiasis have been reported from the St. Martin Group, but

there is no evidence that they were autochthonous cases. However, from 1941-1943 the author examined 34 adults and 5 children on Curaçao, born on one of these islands. Four persons carried *Wuchereria bancrofti*. One child who had arrived only ten days previously was found infested; she had never left St. Martin before. Furthermore, one of the three adults found infested, had never been off St. Martin before his arrival 20 days earlier on Curaçao; the second adult had been only on St. Martin, Saba and Curaçao, while the third had visited Guadeloupe. At least two of these four persons, therefore, must have been infested in the St. Martin Group (VAN DER KUYP, 1947, 1948a).

Culex quinquefasciatus, an efficient vector of wuchereriosis, is a common house mosquito in all of the inhabited Netherlands Antilles. It has been reported in all tropical parts of the world. Many *Culex quinquefasciatus* caught in a boarding-school at Scherpenheuvel, Curaçao, in August 1947, were examined. One was found infested.

It has often been said that filariasis on the Curaçao Group is not indigenous (not normal or natural locally), but imported and rarely introduced (contracted locally from imported cases). People are too often inclined to accuse another population of the spread of dreadful diseases. It is true that a great portion of the population consisting of immigrants from known endemic areas of filariasis, are undoubtedly sources of infection. In 1943, for example, 24.8 per cent of the population of the Netherlands Antilles were not born in one of the islands. This figure includes 3.0 per cent of persons born in Surinam and 3.4 per cent born in Venezuela. *Wuchereria bancrofti* is the most widespread *Filariidae* and prevails in nearly all warm countries. In America it has been found from Charleston (U.S.A.) to Argentina. It is common in the Greater and Lesser Antilles. Then why should it be absent in the Netherlands Antilles while:

1. the same kind of people settled there as elsewhere in tropical America,
2. an efficient vector is present,
3. no measures are taken against the worm nor against the vector, for example, the inhabitants hardly ever use mosquito bednets.

The low rate of wuchereriosis may be explained by the relatively low density of *Culex quinquefasciatus*, as compared with other tropical areas, because of the small number of ground pools due to the scanty rainfall.

Elephantiasis is very rare on the Curaçao Group. This may be due to:

1. the low rate of filariasis,
2. the scarcity of purulent infections of the lower limbs, because of the absence of *Tunga penetrans* (syn. *Sarcopsylla p.*) and as people do not walk barefooted.

YELLOW FEVER

According to the Colonial reports of Curaçao several cases of yellow fever occurred in this century; on Curaçao: 1 in 1900, about 7 in 1901 (3 patients died), 1 in 1902 (died), 1 imported case in 1904, 1 on a steamship in 1905, 1 imported case in 1908, 1 in 1909 and 1 in 1914 (died); on Bonaire: 1 in 1902 and 1 in 1903 (both died). The last case in St. Maarten was reported in 1879. Some cases of jaundice, especially the sporadic ones in later years may have been erroneously diagnosed as yellow fever.

In 1941 and 1942 blood samples of 20 coloured inhabitants of Curaçao, 8 males and 12 females, were examined by Dr J. C. BUGHER in the "Instituto de Estudios Especiales (Carlos Finlay)" in Bogotá, Colombia, with the following results.

10 negative: 20, 20, 24, 32, 39, 50, 58, 60, 63 and 65 years old;

1 inconclusive-negative: 27 years old;

2 inconclusive-inconclusive: 20 and 48 years old;

7 positive: 48, 50, 52, 54, 57, 69 and 70 years old.

Thus all the persons with positive mouse protection tests were born before the major epidemic of 1901.

Unfortunately this survey has not been repeated on a large scale, nor have blood samples of young people been included in sufficient numbers.

The yellow fever mosquito, *Aedes aegypti*, is the most prevalent mosquito in all of the inhabited islands. It is widespread all through the year and abundant during the rainy season.

Some species of the genus *Haemagogus* are vectors of the jungle yellow fever. *Haemagogus anastasionis* was found on Curaçao and Aruba. Fortunately it has not been incriminated as a vector. Besides there are no monkeys which serve as reservoirs of the yellow fever virus in the sparse jungle of the Curaçao Group.

DENGUE

This disease has been mentioned in several Colonial reports of Curaçao, in several Annual reports of the Public Health Service of Curaçao, in some monthly and annual reports of the Government physicians, by WATERMAN (1919a, 1946), WINCKEL (1939), VAN DER SAR (1941, 1942), VAN DER KUYP (1941, 1949a), and on St. Maarten and Saba by EMANUELS (1947).

Dengue is very common on Curaçao in newcomers, especially in Europeans and Americans. Several epidemics occurred in European and American quarters, for example at Mundo Nobo, Van Engelen, Emmastad, Julianadorp, Suffisant (American soldiers). It is called "vijfdaagse" (five days' fever).

The author examined 33 Europeans. The majority had shown clear clinical signs: fever, usually lasting till the fifth day, sometimes till the seventh (in 19 per cent), severe headache (91 per cent), pain behind the eyeballs (88 per cent), sharp rheumatic-like articular pains (68 per cent), rash (50 per cent), leucopenia (even reaching 1,600 leucocytes), conjunctival congestion, albuminuria, etc. A second attack was very rare and, if occurring, very mild as compared with the first.

The author never found this syndrome in natives, not even in children, though it may be suggested that many cases of fever of unknown cause or "cold" in children might actually have been dengue.

Dengue is transmitted by *Aedes aegypti* (see yellow fever).

Other specific diseases transmitted by mosquitoes have not been reported from the Netherlands Antilles. The cause and the vector of encephalitis have not yet been studied.

OTHER EFFECTS OF MOSQUITO PEST

The bite of mosquitoes causes irritation, but this varies in degree with different people and with different species. Some persons do not even notice the bite, others suffer severely. The irritation may be so bad that the exposed part of the body becomes red and swollen, sometimes with impairment of the function of the joints and sleeplessness. Secondary infection whether or not with serious results may develop, but this is caused by scratching.

The bite is especially troublesome to babies and newcomers. A relative immunity will develop after some time, if a species abounds, and so people will get

used to the bite of their native species. This immunity is specific and does not hold for other species. Therefore, when visiting a foreign place people often complain of the mosquitoes there, while their own mosquito pest may be worse.

Mosquitoes also annoy by their "singing", causing sleeplessness, especially in nervous persons.

Some mosquitoes are great pests of animals. In some foreign areas their attacks cause great losses of livestock.

Aedes aegypti and *Culex quinquefasciatus* are common and serious house pests in the Netherlands Antilles. *Psorophora confinnis* is troublesome outdoors, and may invade houses. Severe biters outdoors are also *Aedes taeniorhynchus*, *Haemagogus anastasionis* and *Wyeomyia celaenocephala*. The bite of *Anopheles pseudopunctipennis* is painful. The author was not attacked by the other mosquitoes.

MOSQUITOES AND TRAFFIC

Air planes

In 1931 the airport Hato (Plesman Airport since Jan. 1954) on Curaçao, was ready for use; in 1935 the airfield Dakota on Aruba, and in 1943 the Prinses Juliana airfield on St. Maarten.

Eight of the mosquito species, out of 11 found on Curaçao, were caught near the Hato airport. Two, *Culex erraticus* and *Culex nigripalpus*, were found solely in this locality.

In two airplanes from Surinam-Trinidad-Curaçao *Aedes aegypti* were found (Dec. 1942, Jan. 1943).

From 1940-1943 1,595 planes from foreign airports were sprayed at Hato. "Mosquitoes" were reported in 102 cases (6.4%). (Ann. reports Publ. Health Serv. Cur.). However, it may be suggested that the native word "muskita" (housefly) used by the sanitary labourer at Hato had been misinterpreted, as afterwards mainly houseflies were found in the airplanes.

In 1946 2,670 airplanes directly from foreign airports were examined at Hato. Live insects were found in 114 (4.3%): in 105 from Venezuela (7.4% of all planes from Venezuela) and 9 via or directly from Santo Domingo (2.4% of all planes from Santo Domingo); see Table 11. The majority of the insects were *Musca domestica*. Other insects were *Stomoxys calcitrans*, *Decadiomus bahamicus*, *Euxesta quaternaria*, *E. notata*, *Swammerdamella brevicornis*, etc.

On January 23, 1947, four mosquitoes were found in three airplanes of the P.A.A. from La Guaira. They were in such a poor state however, that they could not be identified.

Automobiles

The author found in cars on Curaçao and St. Martin *Aedes aegypti* and on Curaçao *Culex quinquefasciatus* and *Psorophora confinnis*.

Schooners

From May 1945-August 1947 the author examined at random 388 schooners in the port of Willemstad, Curaçao. *Aedes aegypti* larvae and sometimes pupae were found on 14 (3.6%): once in a galvanized cistern, once in 5 barrels and 12 times in one barrel. Six of these schooners came from Santo Domingo, 3 from Venezuela, 2 from Aruba, one from Trinidad, one from Surinam and one from Colombia. *Culex quinquefasciatus* larvae were taken in a barrel on another schooner from Santo Domingo. *Aedes aegypti* larvae and pupae were collected in a barrel on a schooner

which was already 20 days at Willemstad. An engorged adult *Culex quinquefasciatus* was caught on another which was already 10 days at Willemstad.

Where did the mosquitoes get on these schooners which regularly sailed from and to Curaçao? There are several possibilities. The eggs might have been laid by mosquitoes on Curaçao or in a foreign port, because the majority of the receptacles were accessible to mosquitoes, but eggs or larvae might have been taken with water from Curaçao or another harbour.

However it may be, mosquitoes may be transported by ships from and to the Netherlands Antilles.

THE ROLE OF THE VARIOUS WATER COLLECTIONS

To the data given in the chapter "Biology" as regards the finding places, and in Table 12 the following remarks may be added.

Earth-lined breeding places

Ground pools were found in gardens, yards, in and along roads and beside springs and tanks. They were stagnant or very slowly streaming; a few were permanent, the majority temporary and containing rainwater. A few hundreds contained *Psorophora confinnis*, many of them *Culex quinquefasciatus* (in 44), 17 held *Anopheles pseudopunctipennis* and 17 *C. maracayensis*.

A few ponds were permanent, but the majority contained rainwater temporarily; the sizes varied with the rainfall, the diameter ranging from 4–60 m. The author examined 71 ponds of which 44% contained mosquitoes, mostly *An. pseud.* (26) and *C. mar.* (19).

Swamps were exclusively temporary after heavy rains. All contained larvae, chiefly of *An. pseud.* and *Ps. conf.* The same holds true for boggy lands whether or not with foot or hoof prints. They contained mainly *An. pseud.*

Ditches were located in gardens and along the roads; the greater portion contained rainwater. The most common larvae being those of *An. pseud.* (taken in 9) and of *Ps. conf.* (in 6).

In 10 stagnant beach pools *Aedes taeniorhynchus* was taken.

No larvae were caught in rock holes containing salt water, but those with rainwater were suitable breeding places, for example, *Ps. conf.* was found breeding in hundreds of rock holes on Aruba during a rainy period.

Numerous crab holes along the shores yielded *Deinocerites cancer*.

In 12 out of 15 wells larvae were sampled, mostly *An. pseud.* and *C. quinq.* (in 6).

Small streams were found after heavy rains. *An. pseud.* was collected in 8, *C. mar.* in 3.

Vegetable breeding places

Several bromeliads contained *Wyeomyia celaenocephala* on the Christoffelberg, a steep hill on Curaçao, and *Culex americanus*, in the St. Martin Group. Bromeliads were found in small numbers in other localities on Curaçao, but without larvae. — Bromeliads were attached to trees at Hato, and filled with water regularly, but no larvae were found.

In 7 tree holes on Curaçao and Aruba *Haemagogus anastasionis* was found.

Numerous coconut shells were examined on several islands, the majority did not contain water; three shells on Curaçao held *C. quinquefasciatus*. Leaf axillae of several plants, calabashes and bamboo stumps were examined with negative results.

Man-made receptacles

The following towns and settlements have tapwater: Willemstad and vicinity, Emmastad, Julianadorp, Caracasbaai, and Bullenbaai on Curaçao; Oranjestad, Arend Refinery, Noord, Santa Cruz, St. Nicolaas, Lago Heights and Lago Colony on Aruba; Kralendijk and Rincón on Bonaire.

In other areas people use cisterns, concrete tanks, wells, barrels, drums and other receptacles. But these are also found in towns, except for those of the oil companies, as tapwater is expensive and not always sufficient and adequate. In 1945 rainwater was used as drinking water in 20.8% of 7,560 premises in Willemstad on Curaçao, artesian well water in 37.5% and tapwater in 41.7%, of which 37.0% had taps of the Government water supply and in 4.7% tapwater was bought from neighbours. In 1944 32.9% of 1,195 premises in Oranjestad and St. Nicolaas on Aruba visited by sanitary inspectors had no taps of the Government waterworks, in 1945 21.7% of 1,296.

Water that is needed in the household is collected in various receptacles, but there are also containers thrown away carelessly in the yards which may serve as breeding places of mosquitoes. The receptacles are made of cement and concrete, wood, metal, glass and enamel, stoneware, etc. They contain mainly the two domestic mosquitoes: *Aedes aegypti* and *Culex quinquefasciatus* (see Table 12).

The most important receptacles are mentioned in Table 15. Only the concrete cisterns, concrete tanks and troughs, drums, barrels, stoneware jars and storm-water catch basins in the streets are important when taking into consideration their sizes and numbers and the density of the larvae. Sewage disposal systems in Willemstad, Oranjestad and St. Nicolaas are in the process of installation; if not built adequately, they may be prolific breeding places of *C. quinq.*

In 1945 there were cisterns in 1,285 of 7,560 premises (17.0%) in Willemstad, and barrels and/or drums in 4,759 (62.9%). In 16.5% of the premises drums or barrels were uncovered. — Concrete cisterns with rainwater were found everywhere; their sizes ranging from 2×2 — 5×15 m with varying depths. — Concrete tanks in the gardens contained artesian well water. Their sizes ranged from $1\frac{1}{4} \times 1\frac{1}{4}$ — 10×10 m, usually 3×3 — 6×6 m; depth of water from almost 0 — 3 m. — The concrete troughs served as drinking troughs, aquaria in the gardens and containers of waste water under the taps; $\frac{1}{2} \times \frac{1}{20}$ — 5×2 m, water depth almost 0 — 1 m.

Storm-water catch basins in the streets contained innumerable *C. quinq.* larvae and pupae. HENRIQUEZ (1932) reported that 89% of 541 catch basins in the streets of Willemstad contained mosquito larvae. — There are only few concrete bathing pools, but they sometimes hold a huge number of larvae.

61% of the drums and 66% of the barrels held solely *A. aeg.*, 6% of the drums and 7% of the barrels solely *C. quinq.*, and 10% of the drums and 9% of the barrels contained both. Drums (14%) and barrels (25%) were often placed in the kitchens; they contained water bought from water vendors. Few were screened or covered adequately, the majority was accessible to mosquitoes.

Small tins and broken bottles in the yards are not important on the Curaçao Group, because of the scanty rainfall. 47% of 38 tins with water contained larvae. — Larger tins, such as kerosine tins, are somewhat more important, as water needed in the household is kept within. The same holds true for buckets, basins, washing-bowls, water-pitchers, etc. — Stoneware jars were found mainly on St. Martin and St. Eustatius.

TABLE 11.

Percentage of airplanes with live insects; Hato Airport, 1946.

Arriving from	Airplanes of the				Total
	K.L.M. ¹⁾	P.A.A. ²⁾	L.A.V. ³⁾	C.D.A. ⁴⁾	
Venezuela	22 of 716 = 3.1%	69 of 644 = 10.7%	14 of 57 = 24.6%	—	105 of 1,417 = 7.4%
Santo Domingo . . .	0 of 10	9 of 367 = 2.5%	—	0 of 4	9 of 381 = 2.4%
Other foreign countries	0 of 593	0 of 277	0 of 2	—	0 of 872
Total	22 of 1,319 = 1.7%	78 of 1,288 = 6.1%	14 of 59 = 23.7%	0 of 4	114 of 2,670 = 4.3%

¹⁾ K.L.M. = Koninklijke Luchtvaart Maatschappij (Royal Dutch Air Lines).²⁾ P.A.A. = Pan American World Airways.³⁾ L.A.V. = Línea Aeropostal Venezolana.⁴⁾ C.D.A. = Compañía Dominicana de Aviación.

CONTROL OF MOSQUITOES AND MOSQUITO-BORNE DISEASES

Quarantine Service

Curaçao and Aruba have port physicians. Ships can be fumigated in both islands. There is a quarantine station at Caracasbaai, Curaçao.

From 1936 all airplanes from foreign airports and from St. Maarten are sprayed on Curaçao and Aruba, but not on St. Maarten where planes arrive not only from Curaçao, but also from neighbouring foreign islands. Planes arriving on Bonaire are not sprayed either, but this island has communication with Curaçao only.

In February 1946 there was reason to suspect that yellow fever occurred in a nearby foreign airport. It was not possible, however, to stop traffic as official reports denied the occurrence of the disease. The author then gave order to spray planes from this port three times: just before the start and half an hour before landing by the steward, and just after landing by the sanitary labourer at the airport. Steamships were sprayed after leaving the suspected port, schooners were sprayed before entering the harbours of the Netherlands Antilles. The crew of ships and airplanes visiting or arriving from the suspected port were vaccinated against yellow fever. Passengers from the port were vaccinated at least ten days before visiting the Netherlands islands.

Breeding places

Breeding places						Species																			
						<i>Wyeomyia celatoccephala</i>	<i>Anopheles pseudopunctipennis</i>	<i>Anopheles alimanus</i>	<i>Uranotaenia lowii</i>	<i>Aedes taeniorhynchus</i>	<i>Aedes busckii</i>	<i>Aedes aegypti</i>	<i>Haemagogus anastasionis</i>	<i>Psorophora confinnis</i>	<i>Psorophora pygmaea</i>	<i>Dinocerites cancer</i>	<i>Culex erraticus</i>	<i>Culex americanus</i>	<i>Culex bahamensis</i>	<i>Culex habitator</i>	<i>Culex maracayensis</i>	<i>Culex nigripalpus</i>	<i>Culex quinquefasciatus</i>	<i>Megarhinus guadeloupensis</i>	
Earth-lined breeding places	Ground pool		+							+															
	Pond		+							+															
	Swamp		+		+					+															
	Ditch		+							+															
	Beach pool									+															
	Rock hole		+	+						+															
	Well									+															
	Crab hole									+															
	Small stream		+									+													
	Boggy land		+															+	+	+	+	+	+	+	
Vegetable breeding places	Bromeliad		+																						
	Tree hole						+																		
	Hollow cactus stump										+														
	Coconut spathe																				+	+	+	+	
	Coconut shell																				+	+	+	+	
Man-made receptacles	Cement, concrete, etc.	Cistern		+						+															
		Tank		+							+														
		Trough		+							+														
		Storm-water catch basin														+									
		Bathing pool									+														
		Floor									+														
		Vessel									+														
	Wood	Bathing tub									+														
		Gutter									+														
		Hollow block									+											+	+	+	+
Metal	Barrel		+							+												+	+	+	
	Tub									+												+	+	+	
	Boat									+												+	+	+	
	Case									+												+	+	+	
	Mortar									+												+	+	+	
	Drum																						+	+	
	Tin		+																				+	+	
	Kerosine tin																						+	+	
	Bucket																						+	+	
	Basin																						+	+	
Glass, enamel	Wheelbarrow									+													+	+	
	Watering can									+													+	+	
	Sugar boiling pan									+													+	+	
	Children's car									+													+	+	
	Flushing toilet tank									+													+	+	
	Roof gutter									+													+	+	
	Vase, glass, bottle																						+	+	
	Empty battery case																						+	+	
	Washing bowl		+																				+	+	
	Toilet bowl																						+	+	
Stone-ware	Bathing tub																						+	+	
	Jar																						+	+	
	Pitcher																						+	+	
Flower pot																							+	+	

TABLE 13.

Density of adult Aedes aegypti in houses.

Island	Period dry or rainy	Average number per single survey per				Percentage of infested habitations	
		man- hour	occupier	house	room	houses	rooms
Curaçao. . .	dry	6.5	0.5	2.4	0.4	68	22
Curaçao. . .	rainy	15	1.6	5.7	1.1	75	26
Curaçao. . .	both	9.7	0.9	3.5	0.7	71	24
Aruba . . .	both	12	0.6	2.5	0.4	60	22
Bonaire . . .	both	14	0.7	2.4	0.5	56	22
Curaçao. . .	both	10.4	0.8	3.2	0.6	65	23
Group							
St. Martin . .	dry	10.9	0.6	1.8	0.4	58	29
Group ¹⁾							
Total	both	10.4	0.8	3.1	0.6	64	24

¹⁾ The houses and rooms in the St. Martin Group are usually smaller than those in the Curaçao Group.

TABLE 14.

Percentage of yards infested with Aedes aegypti larvae.

Islands	Yards		
	Number examined	Infested	
		Number	Percentage
Curaçao	606	384	63.4
Aruba	130	83	63.8
Bonaire	50	32	64.0
Curaçao Group	768	499	63.5
St. Maarten	51	41	80.4
Saba	25	20	80.0
St. Eustatius	31	24	77.4
St. Martin Group	107	85	79.4
Netherlands Antilles	893	584	65.4

TABLE 15.

Percentage of receptacles with mosquito larvae.

Receptacles	Number examined	Percentage with						
		larvae	<i>Aedes aegypti</i>	<i>Culex quinquefasciatus</i>	<i>Anopheles pseudopunctipennis</i>	<i>Psorophora confinis</i>	<i>Culex bahamensis</i>	<i>Culex maracayensis</i>
Concrete cisterns . .	62	87	66	18			2	
Concrete tanks . . .	149	36	3	10	18	2		3
Concrete troughs . .	159	44	25	21	4		1.3	4
Drums	627	78	71	17				
Barrels	326	82	75	16	0.6			
Boats	19	21	16	21				
Tins	38	47	45	8	3			
Buckets	37	78	68	54				
Basins	14	57	57	29				
Stoneware jars . .	28	93	71	29				

Mosquito Control

It is no use asking the natives questions about mosquitoes. They always say that there are only a few or none, and usually deny that they store water on their premises. When in spite of their statement receptacles with mosquito larvae are found, they will promptly say that the water is being daily renewed. Therefore only a systematic inspection will give reliable results.

There are well organized sanitary services of the oil companies which prohibit the storage of water in artificial receptacles in their towns and villages. The premises are inspected regularly. Therefore the number of mosquitoes is very small in these areas, for example, 2 *Aedes aegypti* and 1 *Culex quinquefasciatus* were found per man-hour in houses in Emmastad on Curaçao. The corresponding indices for all parts of the Netherlands Antilles were 10.4 and 6.4 respectively (see Table 13).

In 1917 WATERMAN organized an anti-mosquito squad consisting of 6 men. After he left Curaçao nothing was mentioned about this unit.

There is a regulation which prohibits the storage of water in receptacles in Willemstad which are not mosquito-proof. However, people do not obey this regulation. Desperate directors of the Public Health Service sometimes oiled the drinking water after several futile warnings.

The Sanitary Service of Aruba inspected many premises in Oranjestad and St. Nicolaas. Breeding places of mosquitoes were found in 16.2% of 965 premises in 1940, 9.5% of 1,534 in 1941, 14.4% of 1,627 in 1942, 9.2% of 1,195 in 1944, 6.8% of 1,296 in 1945, 3.9% of 1,272 in 1947, 6.2% of 1,540 in 1948, 6.0% of 1,291 in 1949, 6.7% of 1,230 in 1950 and 10.8% of 868 in 1951.

TABLE 16.

Aedes aegypti index before and after control.

Locality	Date	Premises		
		Inspected	Infested ¹⁾	Index (%)
<i>CURAÇAO</i>				
Willemstad	Dec. 1951	8044	4061	50.5
	May 1952	2166	477	22.0
Shell villages	Oct.-Nov. 1951	1317	210	15.9
	Apr.-May 1952	1586	1	0.06
Hato Airport.	Oct. 1951	66	5	7.6
	May 1952	66	1	1.5
Total	before control	9427	4276	45.4
	after control	3818	479	12.6
<i>ARUBA</i>				
Oranjestad	Apr. 1952	2235	499	22.3
	Jul. 1952	2239	126	5.6
San Nicolaas	May 1952	2499	606	24.2
	Jul. 1952	1522	103	6.8
Dakota Airport	Apr. 1952	12	0	0
Total	before control	4746	1105	23.3
	after control	3773	229	6.1

¹⁾ with larvae and/or adults.

The Sanitary Services of Curaçao and Aruba propagate the use of tight covers for barrels and drums, but, if used, these are soon inadequate through wear and tear. Nothing is done, however, to eliminate cisterns which cannot be screened easily. Some taxes are even reduced when one has a cistern. With this the Government tries to encourage the use of cisterns, as the waterworks do not produce sufficient water.

Some houses of Europeans and Americans are screened, for example, those of the Lago Oil Corporation on Aruba, but the majority is not protected.

Usually Europeans strongly favour mosquito bed nets in tropical regions. As malaria is absent and the rate of wuchereriosis is very low, very few Europeans in the Netherlands Antilles use such nets, for example, only 6 of 33 Europeans suffering from dengue (17%), informed the author that they had bed nets, but they did not use these regularly. The natives and the majority of the foreigners complain that it is too hot under a mosquito net. Only babies and some toddlers are protected by these nets.

Household sprays are used when the mosquito nuisance is severe. Some insecticides are made on Curaçao.

Certain anti-mosquito measures were employed on St. Maarten by the Government physician, H. SPITZER, some years ago. Breeding places were screened, if possible, otherwise oiled or stocked with *Gambusia*. Since 1940, however, these measures have been discontinued to a large extent after the departure of SPITZER (VAN DER KUYP, 1947a, 1948a).

On October 24, 1951 an anti-*Aedes aegypti* campaign was initiated on Curaçao and on March 19, 1952 on Aruba.

The staff consists of two supervisors and five inspectors on Curaçao and one supervisor and three inspectors on Aruba. Propaganda is done through press, radio, posters and cinema. A clean-up campaign of tins, bottles, etc. on both islands is on, but progresses slowly.

Residual DDT house spraying and anti-larval work have been carried out on Curaçao in the areas of the oil company and at the airport of Hato and on Aruba at the airport Dakota. In other parts only larviciding has been done by applying $6\frac{2}{3}$ grams of 75 per cent wettable DDT per cubic metre, i.e. 5 parts per million. However, slow progress is made on Curaçao because often 2 grams per cubic metre are used on account of the many complaints of the inhabitants and because many persons refuse to cooperate as there is no adequate legislation.

On Curaçao 2,695 cisterns, 101 tanks and 64 wells were treated. The results are much better on Aruba (see Table 16) as there are less cisterns than on Curaçao, the greater portion of the inhabitants using tap water.

The Government potable water supply on Aruba was treated on July 8, 1952 with DDT (5 parts per million). Besides, 456 cisterns, 158 tanks and 6 wells were treated.

In September 1953 Mr. DENNIS RAUSCH stated in a newspaper of Curaçao that the number of personnel for the *Aedes aegypti* campaign was too small. In the areas of the oil company on Curaçao the *Aedes aegypti* index decreased from 83 to 5 per cent, but in certain sections of the capital the index was 100 per cent.

SUMMARY

The Netherlands Antilles may be divided into:

- (1) The Curaçao Group (or Netherlands Leeward Islands): Curaçao, Aruba and Bonaire.
- (2) The St. Martin Group (or Netherlands Windward Islands): (Netherlands) St. Maarten, Saba and St. Eustatius.

The latter islands are very small, forming together only 8.1 per cent of the total area of the Netherlands Antilles, and 2.2 per cent of its population.

The Curaçao Group often has a desert-like aspect with a "tropical dry-forest" vegetation. Therefore on these islands the mosquito pest is nothing like so bad as it usually is in the tropics. There are few permanent breeding places, except man-made receptacles in and around the houses to store rainwater or well-water in as the Government waterworks do not always produce sufficient and adequate water. The St. Martin Group has a higher rainfall and a more abundant vegetation.

In the preceding pages the morphological characteristics which are of taxonomic value have been described. Keys to the mosquitoes, their classification, their geographical distribution and their biology observed in the Netherlands Antilles have been given.

Mosquitoes may be spread by automobiles, ships and airplanes on the islands. Fortunately, all airplanes from foreign airports and St. Maarten are sprayed on Curaçao and Aruba. Except this measure little was done before 1951 to control mosquitoes, except in the areas occupied by the oil companies. An anti-*Aedes aegypti* campaign was initiated on Curaçao in October 1951 and on Aruba in March 1952 (residual DDT house spraying and larviciding).

Because of the paucity of mosquito records of the Netherlands Antilles a rather thorough survey was made on Curaçao from 1941–1947, while the other islands were visited only for a short time.

At the moment 20 species are known from the Netherlands Antilles.

Anopheles pseudopunctipennis pseudopunctipennis was found on Curaçao and rarely on Aruba, and *An. albimanus* once on St. Maarten, but never an indigenous case of malaria has been reported from the

Netherlands Antilles. The larvae of *An. pseudopunctipennis* were found in earth-lined breeding places, but also frequently in man-made receptacles. Nearly all these breeding places contained clear, fresh or slightly brackish water with green algae; the majority were sunlit. Though the females of *An. pseudopunctipennis* attacked man, they were more attracted to animals.

Culex quinquefasciatus was a common domestic pest mosquito on all of the islands. Though it often bred in earth-lined breeding places, it was found more frequently in man-made receptacles. The water was fresh or slightly brackish and usually polluted. Wuchereriosis bancrofti prevailed at a low rate on the Curaçao Group (4.2%, of which at least 2.7% was indigenous) and at a higher rate on the St. Martin Group (10.3% of which at least 5.1% was autochthonous). Elephantiasis was very rare.

Aedes aegypti was the most common domestic pest mosquito on both groups of islands. It was usually caught in clear, fresh water in man-made receptacles in or around human dwellings. The females bit in the daytime and at night. Several epidemics of yellow fever occurred in the previous century; the last one was on Curaçao in 1901. The last sporadic case occurred on Curaçao in 1914. Dengue was very common in newcomers from non-endemic areas.

Haemagogus anastasionis was collected on Curaçao and rarely on Aruba. The larvae were mainly found in tree holes after occasional rains. All the breeding places contained dark brown rain-water with a layer of humus. The bite of the female is painful. Fortunately it has not been incriminated as a vector of jungle yellow fever. Besides, there are no wild monkeys on the Netherlands Antilles.

Wyeomyia celaenocephala was found in various species of bromeliads on the Christoffelberg on Curaçao. The females will bite fiercely in the jungle.

Uranotaenia lowii was collected from a pond on Bonaire.

Aedes taeniorhynchus was mainly caught in stagnant, sunlit beach pools with clear, dark brown, brackish water on Curaçao, and once in a well on Saba. The females are severe biters.

Aedes busckii was found in a tree hole on St. Eustatius.

Psorophora cyanescens was reported from Aruba only once.

Psorophora confinnis bred in rock holes and other earth-lined breeding places, and rarely in man-made receptacles on the Curaçao Group. The majority of the breeding places were temporary and sunlit, and contained clear or turbid rainwater. The females are fierce biters. They entered houses.

Psorophora pygmaea was collected from a ditch on St. Maarten.

Deinocerites cancer was mainly found in crab holes on both groups of islands. The water of the breeding places was turbid and brackish. Adults lived in the crab holes. Females did not bite the author.

Culex erraticus was caught in clear fresh water near the airport on Curaçao.

Culex americanus was found in various bromeliads on the St. Martin Group.

Culex bahamensis was collected from fresh or brackish water on the St. Martin Group.

Culex habilitator adults and larvae were found in crab holes on St. Maarten.

Culex maracayensis was caught in earth-lined breeding places and sometimes in concrete tanks and troughs on Curaçao. The water was usually clear, shaded and fresh or slightly brackish.

Culex nigripalpus was collected near the airport on Curaçao from a temporary ground pool with rainwater.

Megarhinus guadeloupensis was found once in a bromeliad on Saba.

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