An Annotated Checklist and Keys to the Mosquitoes of Samoa and Tonga[1]

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ABSTRACT. An historical review is given of the work done on the mosquitoes of Samoa and Tonga A total of 15 species belonging to the genera *Aedes, Culex, Coquillettidia* and *Toxorhynchites* is known to occur in the area, 13 species in Samoa and 8 in Tonga. Information for each species is provided with respect to the original description, stages described, biology and distribution. Where necessary, a taxonomic discussion is provided. Keys for the identification of adults, male genitalia, pupae and larvae are provided.

INTRODUCTION

The islands of Samoa lie in the South Pacific between latitude 11° and 15° S. and longitude 168° and 173° W. Western Samoa consists of the two large islands, Savaii and Upolu, with the two tiny islands, Manunu and Apolima, situated in the narrow straits between them. About 40 miles southeast is American Samoa consisting of Tutuila, the Manua group, Rose and Swains Islands. The islands of the Kingdom of Tonga lie between latitude 15° and 23° 30' S. and longitude 173° and 177° W. There are about 150 islands in the Kingdom, of which only 36 are inhabited, and the total land area is only 269 square miles. Three main groups of islands are recognized from north to south, the Vavau, Haapai and Tongatabu groups. The southernmost group takes its name from the largest island in the Kingdom, Tongatabu, on which is located Nuku'alofa, the capital of Tonga.

HISTORICAL

SAMOA. The earliest recorded mosquito collection from Samoa was made in November 1904 when J. F. Floyd collected *Aedes (S.) aegypti* in Apia (Howard, Dyar and Knab, 1917:840). In 1913 Gruenberg described *Aedes (F.) samoanus* (as *Finlaya samoana)* from several females collected by K. Friederichs, the Government Zoologist in Apia. Friederichs sent additional material to Theobald (1914) who described *Culex (C.) samoaensis* from a single female and reported *Aedes (S.) aegypti* (as *Stegomyia fasciata), Aedes (S.) polynesiensis* (as *Stegomyia pseudoscutellaris), Culex (C.) quinquefasciatus* (as *Culex fatigans)* and *Mansonia fijiensis* (as *Mansonia,* i.e., *Taeniorhynchus* sp.).

O'Connor (1923) was the first investigator to obtain fundamental information on the mosquitoes of Samoa and to study their relation to the transmission of filariasis. He recorded for the

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first time *Aedes (Aedimorphus) vexans* (as *Ochlerotatus vexans)* and *Culex (C.) annulirostris* (as *Culex jepsoni)* and collected another female of *Culex (C.) samoaensis,* a species not encountered in any subsequent survey. By means of studies on natural and experimental infections on the common man-biting mosquitoes O'Connor demonstrated *Aedes (S.) polynesiensis* (as *Stegomyia pseudoscutellaris)* to be the vector of subperiodic Bancroftian filariasis in Samoa, confirming the earlier findings of Bahr (1912) in Fiji.

Buxton and Hopkins (1927) made extensive studies on the arthropods of medical importance in Samoa, with particular emphasis on the bionomics of mosquitoes. To the species that were already known from Samoa, they added *Culex (C.) sitiens.* Most of their work was done on Upolu, and some on Savaii.

During and after the Second World War, much emphasis was placed in Samoa on the study of filariasis and the mosquitoes that transmitted this disease. Byrd, St. Amant and Bromberg (1945) dissected over 5700 mosquitoes from Tutuila, American Samoa, and confirmed the findings of O'Connor. Bohart and Ingram (1946) included the Samoan mosquitoes in their publication, "Mosquitoes of Okinawa and islands in the Central Pacific." They described the known species and summarized their bionomics. Most of their Samoan material was from the U.S. National Museum, collected primarily by K. L. Knight, W. G. Reddick, E. E. Boyd and P. S. Rossiter. Jachowski and Otto (1952, 1953, 1954) carried out studies in American Samoa on the bionomics of *polynesiensis* and on the density of infection and the sites of transmission of filariasis. Marks (1957) described a new species, *Aedes (S.) upolensis,* from material sent to her from Western Samoa by T. E. Woodward. Among this material was a single adult of *Mansonia fijiensis* (reported as *Mansonia* sp.). Laird, during his studies on "Mosquitoes and freshwater ecology" (1956), made several collections in Samoa and studied the habitats of the immature stages. M. O. T. Iyengar (1955, 1960) made a few collections in Samoa and listed the species. He also studied the extent of transmission of filariasis in Western Samoa (1954). Peterson (1956) gave an account of the introduction of two species of *Toxorhynchites* into American Samoa for the purpose of controlling *Aedes polynesiensis.* Finally Belkin (1962), in his comprehensive work "Mosquitoes of the South Pacific," described in great detail the stages of the known mosquitoes (11 species) and analyzed the relationships of the mosquitoes in the region. He recorded 13 species as occurring in Samoa including a new species, *Aedes (F.) oceanicus.*

TONGA. Only incidental collections of mosquitoes have been made in Tonga in the past. The earliest were made some time prior to 1926 by C. L. Edwards, S. M. Lambert and G. H. E. Hopkins. *Aedes (S.) tongae* (as *variegatus* var. *tongae)* was described from this material by F. W. Edwards (1926). In 1953 Laird (1956) collected in Nuku'alofa and recorded *Culex (C.) quinquefasciatus* (as *Culex pipiens fatigans), Culex (C.) annulirostris, Aedes (Aedimorphus) vexans* (as *vexans nocturnus)* and *Aedes (F.) oceanicus* (as *samoanus).* Iyengar (1955, 1960) collected in Vavau and Nuku'alofa and listed 8 species from Tonga. The Medical Department of Tonga conducted a survey of the mosquitoes of Foa Island in the Haapai group (Halu and Haunga 1952) and listed species from Tonga, with several questionable identifications (1957). Finally Belkin (1962) described in detail the 7 species that were then known from Tonga up to the present time.

Belkin (1962) believed that, despite earlier contributions, the mosquito fauna of both Samoa and Tonga was still poorly known. The author spent 6 months in Samoa and Tonga during 1963, studying the mosquito fauna of these areas and its relationship to Bancroftian filariasis. Parts of this study have been published (Ramalingam and Belkin, 1964, 1965; Ramalingam, 1966, 1968). Despite the long delay, it is felt that the information obtained on the biology and distribution of each species along with the keys would be useful to public health workers in the area.

MATERIAL

Of the six months spent in the area, the months of February, March and July were spent in American Samoa; 1 April to 10 May in W. Samoa and 16 May to 29 June in Tonga. The islands visited were Tutuila, Upolu, Savaii, Tongatabu, Eua, Tofua, Matuku and Nomuka. Mosquitoes examined from the Manua group and Swains Island were collected by Neal Spencer. A total of 368 collections was made for this study in Samoa and Tonga. Over 12,000 specimens were preserved for taxonomic studies, about equally divided between immature stages and adults and including 485 individual rearings from larvae or pupae.

Of the 12 species definitely known from the area prior to this survey all were found except *Culex (C.) samoaensis* and *Mansonia fijiensis.* In addition 2 new endemic species were found, *Aedes (F.) tutuilae* and *Aedes (S.) tabu* (Ramalingam and Belkin, 1965). A species of *Toxorhynchites* introduced into American Samoa was recovered and was shown to have been misidentified in the past. The previously undescribed larva and pupa of *Aedes (F.) samoanus* were also discovered and reared individually. Considerable additional data on the bionomics of immature stages (breeding sites, association with other species) and adults (biting activity) were obtained for nearly every species collected.

Table I summarizes the current information on the distribution of all 15 species definitely known to occur in the Samoa-Tonga area, based on this survey as well as on previous records. In the following paragraphs the mosquito fauna of each island group is discussed briefly.

MOSQUITO FAUNA OF SAMOA

The known mosquito fauna of Samoa consists of 13 species belonging to the 4 genera, *Culex, Aedes, Coquillettidia* and *Toxorhynchites.*

The genus *Culex* is represented by 4 species, only one of which, *samoaensis*, is endemic. *Culex samoaensis* is an exceedingly rare species which has been collected only twice and is now known by only 2 specimens (Belkin 1962:212). Despite careful search for this species in suitable situations no specimens of *samoaensis* were found during this survey. *Culex quinquefasciatus* is undoubtedly an introduced species, having arrived in the South Pacific during the period of exploration, probably as breeding populations on sailing vessels. It is extremely common in and around the larger settlements in American Samoa and Western Samoa. The other 2 species, *annulirostris* and *sitiens,* are probably indigenous in Samoa as in many other islands in the South Pacific. Of the 2, *sitiens* is much more common in Samoa.

The record of *Mansonia fijiensis* from Samoa was based on a single male from Moata'a swamp on Upolu examined by Belkin (1962:309). Theobald (1914:37) reported the presence of a species of *Mansonia* found by Friederichs on Upolu but this material has never been located. Belkin (1962, loc. cit.) indicated the possibility that this may be a species different from true *fijiensis* which is common in the Fiji Islands. Special efforts were made to obtain this species in Moata'a swamp but no specimens were found. Stone (1966) described this *Mansonia* as a new species, *Coquillettidia (C.) samoaensis,* from 2 specimens collected in the Manua group and from the single male from Moata swamp, Upolu.

Aedes is the dominant mosquito genus in Samoa and is represented by 3 endemic or indigenous species in the Kochi Group of the subgenus *Finlaya,* 2 endemic or indigenous species of the Scutellaris Group and the introduced *aegypti* in the subgenus *Stegomyia* and a representative of the subgenus *Aedimorphus, vexans,* which may be indigenous or introduced. The species of the subgenera *Finlaya* and *Stegomyia* are breeders in container habitats, those of *Finlaya* primarily in the leaf axils

of monocotyledonous plants (primarily Araceae and Pandanaceae) and those of *Stegomyia* primarily in treeholes, plant parts on the ground (coconut shells, husks, spathes, etc.) and artificial containers.

Toxorhynchites amboinensis was introduced into American Samoa for the control of *Aedes (S.) polynesiensis* and is now well established in Tutuila.

Four other species have been reported from Samoa in the past. *Culex (C.) litoralis* Bohart, 1946 was reported by Iyengar (1955:33,46; 1960:77,101). Belkin (1962:27) regarded this record as most unlikely but considered the possibility that a relative of *C. (C.) roseni* Belkin, 1962 could occur in Samoa. During this survey 49 collections were made in seaside rockpools, the reported breeding sites of *litoralis* and only *C. (C.) sitiens* was found. It appears therefore that the record of *litoralis* is erroneous. Another species which should be dropped from the list of Samoan mosquitoes is *Tripteroides (T.) purpuratus* (Edwards, 1921). Belkin (1962:37,500) mentions 4 larvae of this species labelled American Samoa (Otto) and suggests that this material was erroneously labelled and that it actually came from Fiji where *purpuratus* is common. The other possibility suggested by Belkin that a relative of *purpuratus* may be present in Samoa must be discarded since in some 100 treehole collections during this survey no species of *Tripteroides* was found. Finally the report of the introduction of *Toxorhynchites (T.) brevipalpis* and *T. splendens* (Peterson 1956; Belkin 1962:37,531,533) should be clarified. Neither species was found during this survey in American Samoa. It is evident that one of the species introduced was actually *T. amboinensis* (misidentified as *splendens).* This species is now firmly established in Tutuila. On the other hand it appears that the introduction of *brevipalpis* was not successful (Ramalingam and Belkin, 1976).

MOSQUITO FAUNA OF TONGA

The known mosquito fauna of Tonga consists of 8 species belonging to the genera *Culex* (3 species) and *Aedes* (5 species). In the genus *Culex,* 2 species are probably indigenous, *annulirostris* and *sitiens,* and the third is the ubiquitous introduced *quinquefasciatus.* In the genus *Aedes,* the subgenus *Finlaya* is represented by an introduced species, *oceanicus,* of the Kochi Group, the subgenus *Stegomyia* by 2 endemic species, *tabu* and *tongae,* of the Scutellaris Group and the introduced *aegypti* and finally the subgenus *Aedimorphus* by *vexans* which was probably introduced by the natives. A redescription of the adult male and female of *tongae* was made by Huang (1972).

There are records of 3 additional species which are probably based on either misidentifications: *Culex (C.) albinervis* and *Aedes (S.) horrescens* reported by the Tonga Medical Department (1952, 1957) or an error in labelling, *Culex (C.) roseni* (Belkin, 1962:204).

The current knowledge of the mosquito fauna of Tonga is extremely fragmentary as only a few of the more than 150 islands have been surveyed. In view of the presence of 2 endemic species of the Scutellaris Group it is probable that with more intensive surveys additional endemic species will be found, particularly on the more remote and isolated islands.

CONSIDERATION OF SPECIES

1. Aedes (Finlaya) samoanus (Gruenberg)

1913. Entomol. Rundschau 30:130-131 (as *Finlaya samoana).* Apia, Upolu Island, Samoa (BERLIN, destroyed ?).

STAGES DESCRIBED. M*, F, P*, L* (Stone and Bohart, 1944:212, M*, L; Marks, 1947:32, M, F, L; Belkin, 1962:379, M*, F; Ramalingam, 1965:P*, L*; Ramalingam and Belkin, 1976:P*, L*).

DISCUSSION. This mosquito was undoubtedly confused in the past with the other members of the Kochi Group as it was the only species known to occur in Samoa prior to 1962. In that year Belkin (1962) described a new species, *oceanicus*, and a third species of the group, *tutuilae*, was described from material collected during this survey (Ramalingam and Belkin, 1965). Associated rearings of the immature stages of *samoanus* were obtained for the first time during this survey but their descriptions were not published until this year (Ramalingam and Belkin, 1976) although they were originally prepared more than 12 years ago (Ramalingam, 1965). Previous published descriptions of the immature stages (P, L) actually pertain to *A. oceanicus*. *Aedes samoanus* can be readily distinguished from *oceanicus* and *tutuilae* in all the stages except for the females which resemble those of *tutuilae* very closely and cannot be separated from that species with certainty (Ramalingam and Belkin, 1965).

BIOLOGY. In American Samoa the immature stages of *samoanus* were found commonly in the leaf axils of *Freycinetia* sp., a forest creeper belonging to the family Pandanaceae. In numerous collections made in the axils of taro *(Colocasia)* and screwpine (*Pandanus* sp) in American Samoa, *samoanus* was never recovered and was found only once in the leaf axil of the giant taro ("ta'amu", *Alocasia indica*). In Western Samoa heavy breeding of *samoanus* occurred in the leaf axils of *Freycinetia* sp as well as in *Pandanus*. In one collection a single larva of *samoanus* was found in the leaf axil of giant taro. The difference in the 2 populations of *samoanus*, as regards the choice of breeding places, is puzzling since morphologically the 2 populations are very similar in all the stages. In American Samoa no other species of mosquito breeds in the axils of *Freycinetia* and hence *samoanus* did not occur in association with any other species of mosquito. In Western Samoa *samoanus* occurred in the same collection with *oceanicus, tutuilae* and *polynesiensis*, in the leaf axils of *Pandanus*. The adults of *samoanus* are nocturnal in habit, becoming active after sunset and reaching a peak of activity at 11:00 p.m. They rest primarily outdoors and only a few were collected in "fales" during the day.

In American Samoa this mosquito is exceedingly abundant in the interior villages and in those coastal villages that are closely surrounded by virgin forest. In Western Samoa, because of breeding in the leaf axils of *Pandanus, samoanus* is abundant in all villages and especially in the interior. This is highly important in the epidemiology of subperiodic Bancroftian filariasis, since it has been shown that *samoanus* is an efficient vector of this disease (Ramalingam and Belkin, 1964; Ramalingam, 1968).

DISTRIBUTION. **Western Samoa**: *Savaii* (Aopo, Asau). *Upolu* (Afiamalu, Aleisa, Fagali'i, Lanuto'o, Luatuanu'u, Mafa Pass, Manunu, Moata'a Stream or Swamp, Solosolo, Tuanai, Vavau). **American Samoa**: *Tutuila* (Aasu, Amouli Ridge, Aoa, Aoloau, Iliili, Leloaloa, Mapusaga).

Not known elsewhere.

2. Aedes (Finlaya) tutuilae Ramalingam and Belkin

1965. Am. Entomol. Inst., Contrib. 1(4):3-7. Aoloau, Tutuila, American Samoa (USNM).

STAGES DESCRIBED. M*, F, P*, L* (Ramalingam and Belkin, 1965).

BIOLOGY. *Aedes tutuilae* breeds almost exclusively in the leaf axils of *Pandanus*. In Samoa, 32 collections were made in the leaf axils of taro, 38 in *Pandanus* leaf axils and 6 in the leaf axils of *Freycinetia* sp. Each collection was made at a different location and generally included several plants. Thus the mosquito larvae and pupae of a collection came from many leaf axils and even from several plants of the same species. They were obtained from the leaf axils of *Pandanus* in 24 collections, near sea level on the coast to elevations of 460 meters in the interior.

The immature stages of *Aedes tutuilae* occurred in association with the following species: *oceanicus* (in 16 collections), *samoanus* (4) and *polynesiensis* (2). In each of these collections the immature stages were recovered from more than one axil, therefore it is not known definitely if *tutuilae* is ever found in association with another species in the same plant axil.

As females of *tutuilae* cannot be differentiated with certainty from those of *samoanus* little can be said about their biting habits. Undoubtedly the adults are nocturnal as in the case of *samoanus*. Several unusually dark specimens of the *samoanus/tutuilae* type were collected biting man on several occasions and it is probable that they were *tutuilae*. It is possible that the two specimens of *Aedes (Finlaya)* South Pacific species 25 (UCLA) reported by Ramalingam and Belkin (1964) as being naturally infected with *Wuchereria bancrofti* were also *tutuilae* as originally surmised. However, this cannot be definitely determined and the relation of *tutuilae* to filariasis is uncertain.

DISTRIBUTION. **Western Samoa**: *Savaii* (Asau, Paia, Saleia). *Upolu* (Afiamalu, Manunu, Moata'a Swamp, Tuanai). **American Samoa**: *Tutuila* (Aasu, Aoloau, Fagasa, Fighter Strip, Masefau, Agriculture Farm). *Manua* Group (Ofu, Amouli Ridge).

Not known elsewhere.

3. Aedes (Finlaya) oceanicus Belkin

1962. Mosq. South Pac. 377-379. Amouli, Tutuila, American Samoa (USNM). This species was confused with *samoanus* by workers prior to 1962 (see under *samoanus*).

STAGES DESCRIBED. M*, F, P*, L* (Belkin, 1962).

BIOLOGY. The immature stages of *oceanicus* are found most frequently in the leaf axils of taro, giant taro and *Pandanus*. In Samoa especially, extensive breeding takes place in the leaf axils of taro. On several occasions, nearly every plant examined in a taro patch contained numerous immature stages. They were also plentiful in the leaf axils of *Pandanus*, but as *Pandanus* is not cultivated as much as taro, the leaf axils of the latter account for the major breeding site of this species. In Tutuila a few larvae were collected in the leaf axils of pineapple and Neal Spencer also found *oceanicus* in the leaf axils of the Sago palm. Two collections of *oceanicus*, one each from Tutuila and Upolu, were obtained from small holes in coconut trees. Two collections of this species were also made in rockholes; in both these cases the rockholes were in plantations, in partial shade; the water was clear with a little organic debris at the bottom. Finally 2 larvae of *oceanicus* were recorded from a collection in a coconut shell together with the immature stages of *polynesiensis*. The collection immediately before this one was made in taro leaf axils and it is possible that these 2 larvae were accidentally carried over from one collection to the other in the bulb of the pipette. Buxton and Hopkins (1927) observed that the eggs of this species are laid in strings just above the water level in the leaf bases of *Colocasia*.

Aedes oceanicus was found in association with the following species in collections of immature stages: *Aedes tutuilae, A. samoanus, A. polynesiensis, A. tabu, A. tongae* and *Toxorhynchites amboinensis*.

The adults of *oceanicus* are crepuscular and nocturnal. Although they enter "fales" at night, their density there is very low when compared to what one would expect from the profusion of breeding that occurs close by. *A. oceanicus* does not rest in "fales" during the day and is not a vector of filariasis.

DISTRIBUTION. **Western Samoa**: *Savaii* (Aopo, Asau, Paia, Saleia, Samauga, Sale'aula). *Upolu* (Afiamalu, Aleisa, Mafa Pass, Malua, Manunu, Moata'a Stream or Swamp, Luatuanu'u, Solosolo, Puipa'a, Tuanai, Vaiusu, Vavau). **American Samoa**: *Tutuila* (Aasu, Agriculture Farm, Alofau, Amalvia, Aoa, Aoloau, Amouli Ridge, Fagasa, Faleniu, Fagaalu, Fighter Strip, Laloaloa, Malaeloa, Mapusaga, Masemau, Old Aoloau, Pavaiai, Vatia). *Manua* Group (Ofu). *Swains.* **Tonga**: *Tongatabu* (Hofoa, Houma, Matahau, Pea, Tofua, Nuku'alofa, Havelu). *Eua* (Futu, Government Farm, Ohonua, Petani, Reichlemann Estate, Government Saw Mill, Tongamama'o). *Matuku. Tofua.*

Also reported from *Wallis* Island and questionably from *Futuna* Islands (Alofi) by Belkin (1962).

4. Aedes (Stegomyia) aegypti (Linnaeus)

1762. *In* Hasselquist, Reise nach Palaestina, 470 (as *Culex aegypti).* Egypt (Neotype, BMNH).

STAGES DESCRIBED. M*, F*, P*, L* (Carpenter and LaCasse, 1955:261-262; Christophers, 1960; Belkin, 1962:442).

BIOLOGY. The immature stages were found only in artificial containers, the typical breeding sites of *aegypti* in the South Pacific. In Tonga, *aegypti* was found breeding in association once each with *A. tabu* and *C. quinquefasciatus.* No *aegypti* was collected in Tutuila during the survey in 1963 but it was subsequently reported in Pago Pago (Hitchcock, personal communications, 1969). In Western Samoa and Tonga *aegypti* was collected in the larger villages and in the towns of Apia and Nuku'alofa where the adults were present in a high enough density to be considered a nuisance.

DISTRIBUTION. **Western Samoa**: *Upolu* (Apia, Aleisa). **Tonga**: *Tongatabu* (Nuku'alofa, Hogoa, Matahau). *Haapai* (Belkin, 1962).

Reported widely from many other islands in the South Pacific and throughout the tropical regions of the world.

5. Aedes (Stegomyia) polynesiensis Marks

1951. Ann. Trop. Med. Parasitol. 45:138. Ura, Taveuni, Fiji (BMNH). Prior to 1951 this species was referred to as *pseudoscutellaris.*

STAGES DESCRIBED. M*, F, P*, L* (Marks 1954:383, M*, F*; Rosen and Rozeboom, 1954: 531, L*; Belkin, 1962:466, M*, F, P*, L*).

BIOLOGY. Since *polynesiensis* is the principal vector of subperiodic Bancroftian filariasis and of Dengue over a wide area of the South Pacific, it has attracted much notice. Several workers have studied its biology, notably O'Connor (1923), Buxton and Hopkins (1927), Jachowski (1954), Bonnet and Chapman (1958), Ramalingam (1968) and Suzuki and Sone (1973). A very brief review of the biology is given below.

Aedes polynesiensis is the predominant species in Samoa and the immature stages were obtained in 55 collections. It shows a great deal of plasticity in the selection of the breeding places and will breed in treeholes, rockholes, coconut shells, artificial containers, cocoa pods, banana stumps and leaves, crabholes and leaf axils of *Pandanus.* In most of the breeding sites it occurred alone but on rare occasions it was found breeding in association with *Toxorhynchites amboinensis, Culex quinquefasciatus, C. sitiens, Aedes oceanicus, A. tutuilae* and *A. samoanus.*

Although the biting activity of *polynesiensis* is largely diurnal some females bite at night, both in "fales" and in the bush. *Aedes polynesiensis* is diurnally active, with two peaks of activity, a

lesser one in the morning and a greater one in the afternoon. It does not rest in houses except on rare occasions. Man is the principal host for *polynesiensis* although this species will also feed on pigs, horses and dogs. The seasonal periodicity of *polynesiensis* shows the species to be present throughout the year with a peak in March and its lowest density in September.

DISTRIBUTION. **Western Samoa**: *Savaii* (Aopo, Asau, Falealupo, Matavai, Saleia, Vaisala). *Upolu* (Afiamalu, Aleisa, Faleolo, Mafa Pass, Malua, Manunu, Moata'a Stream or Swamp, Mulifanuai, Paepaeala, Puipa'a, Satepuala, Solosolo, Vaiusu, Vavau). **American Samoa**: *Tutuila* (Aasu, Amouli, Amanave, Aoa, Aoloau, Breakers Point, Coconut Point, Fagasa, Fagasa Pass, Fighter Strip, Futigo, Malaeloa, Masefau, Old Aoloau, Pago Pago, Tafuna, Vatia). *Ofu. Swains.*

Also occurs in the following island groups or islands in the South Pacific: *Fiji, Horne, Wallis, Ellice, Tokelau, Cook* (Northern and Southern), *Austral, Marquesas, Tuamotu, Pitcairn, Society Islands.*

6. Aedes (Stegomyia) upolensis Marks

1957. Ann. Trop Med. Parasitol. 51:51-57. Afiamalu, Upolu, Samoa (BMNH).

STAGES DESCRIBED. M*, F, P*, L* (Marks, 1957:51, M*, F, P, L; Belkin, 1962:477, M*, F, P*, L*).

DISCUSSION. *Aedes (A.) upolensis* can be distinguished from *polynesiensis*, the only other member of the Scutellaris Group in Samoa, by the following characters. (1) In the adults, the lower mesepimeral patch of scales is either missing or consists of 3 or fewer scales. (2) The female has a complete or almost complete subbasal band on tergite VII. (3) The male has stout specialized setae on the claspette of the genitalia. (4) The larva has an incomplete saddle; prothoracic hair 13 is present; and the upper and lower pairs of gills are approximately equal in length.

BIOLOGY. The immature stages of *upolensis* were obtained in only 2 collections, one in a forest tree trunk at the edge of the rain forest in Tofuna, Tutuila and the other in a fern tree stump in Afiamalu, Upolu. Females were also obtained in several biting collections. This species can be described as a truly forest mosquito. The adults were obtained on several occasions, but always in dense bush. They do occur at the edge of some villages where the virgin forest borders the village. They feed readily on man and eggs were obtained from several females. Like *polynesiensis*, this species is diurnal but because it is not abundant no opportunity arose to make detailed observations on biting habits, resting places or even breeding sites. *Aedes upolensis* is a minor vector of *Wuchereria bancrofti.*

DISTRIBUTION. **Western Samoa**: *Savaii* (Aopo). *Upolu* (Afiamalu, Aleisa, Manunu, Solosolo). **American Samoa**: *Tutuila* (Aasu, Aoloau, Tofuna). *Manua* (island not specified, Belkin, 1962).

7. Aedes (Stegomyia) tongae Edwards

1926. Bull. Entomol. Res. 17:103 (as *Aedes (Stegomyia) variegatus* var. *tongae).* Haapai, Tonga (BMNH).

STAGES DESCRIBED. M*, F (Edwards, 1926, M*, F; Marks, 1954, M*, F*; Belkin, 1962: 475, M*, F, the immature stages of Belkin pertain to *Aedes tabu*; Huang, 1972:338, M*, F).

DISCUSSION. Until 1965 *Aedes (S.) tongae* was the only member of the Scutellaris Group known from the islands of Tonga. It had been raised to full specific rank by Farner and Bohart (1945). A second member of the Scutellaris Group was described from Tonga by Ramalingam and Belkin (1965). These studies indicated that *tongae* was actually restricted to the Haapai and Vavau groups where it was the dominant species. It does not occur in the Tongatabu group where *Aedes tabu* is the dominant form. Both species occur in the Haapai group but only *Aedes tongae* is present in the Vavau group. *Aedes tongae* resembles *Aedes cooki* Belkin, 1962 from Niue Island closely but due to insufficient material it is not possible to establish if *cooki* is in fact synonymous with *tongae* at this time.

BIOLOGY. Ten collections of immature stages of *tongae* were made in treeholes. These were mostly in coconut trees and included the large "tree wells" used for collecting rainwater for domestic purposes. One of the treeholes was in a fern tree and another in a rotting papaya stump. The organic content of the latter was very high, resulting in a foul odor. Three collections were obtained from coconut shells and 3 from the leaf axils of *Pandanus*. *Aedes tongae* was found to breed in association with *Aedes (S.) tabu* in 3 collections from treeholes and with *Aedes (F.) oceanicus* in 2 collections from the leaf axils of *Pandanus*. Nothing is known about the bionomics of the adults except that the females bite during the day. As it is the dominant member of the Scutellaris Group in the Vavau and Haapai groups it probably acts as the vector of filariasis in these areas.

DISTRIBUTION. Tonga: Haapai group *(Matuku, Tofua)*. Vavau Group *(Vavau)*. Not known elsewhere.

8. Aedes (Stegomyia) tabu Ramalingam and Belkin

1965. Am. Entomol. Inst., Contrib. 1(4):1-3. Eua Island, Tonga (USNM).

STAGES DESCRIBED. M*, F, P, L (Ramalingam and Belkin, 1965).

DISCUSSION. Prior to 1965 this species was not separated from *tongae* by Edwards (1932: 165); Taylor (1934:20); Farner and Bohart (1945:44-45); Marks (1954:352); Iyengar (1955:29; 1960:60); Laird (1956:80); Stone, Knight and Starcke (1959); Belkin (1962:475-476) and Stone (1963:129).

BIOLOGY. The breeding places of *Aedes tabu* in order of importance are: (1) treeholes, (2) artificial containers, (3) coconut shells and spathes and (4) leaf axils of taro. As most of the islands in Tonga are elevated coral islands or coral atolls , rockholes are very scarce. Thus a breeding place of some importance to members of the Scutellaris Group in the Society Islands, Samoa and Fiji is of little consequence here. The hairy form of *tabu* was obtained in 4 collections, 2 in treeholes and 2 in artificial containers. *Aedes tabu* was found to breed in the leaf axils of taro in 9 collections but was not recovered from the leaf axils of *Pandanus*. *A. tongae*, on the other hand, was found in the leaf axils of *Pandanus*, among other plants, but never in taro. All the breeding places of *tabu* were situated in partial or deep shade. The water ranged from clear to very turbid, the latter being more frequent in the case of treeholes. *Aedes tabu* was found to breed in association with the following species: *Aedes aegypti* (1), *Aedes tongae* (3), *Aedes oceanicus* (9), *Culex (C.) annulirostris* (1) and *Culex (C.) quinquefasciatus* (2). *Aedes tabu* is a semidomestic species but it is primarily a bush mosquito that bites out-of-doors and does not rest in houses during the day. It is most abundant in plantations but also occurs in shady areas in villages.

DISTRIBUTION. **Tonga**: *Tongatabu* (Havelu, Hofoa, Houma, Matahau, Nuku'alofa, Tofoa). *Eua* (Government Farm, Chonua, Petani, Reichlemann Estate, Government Saw Mill). *Matuku. Tofua.*

Not known elsewhere.

9. Aedes (Aedimorphus) vexans vexans (Meigen)

1830. Syst. Beschr. Zweifl. Insekt. 6:241; near Berlin, Germany (MNHP).

DISCUSSION. This species was referred to in the past as *Aedes (Aedimorphus) vexans* (Edwards, 1924:372, 1932:170-171; Buxton and Hopkins, 1927:91-95; Taylor, 1934:20; Paine, 1935, 1943:22-23; Lee, 1944:72; Knight, Bohart and Bohart, 1944:35-36; and Perry 1946) and as *Aedes (Aedimorphus) vexans nocturnus* (Bohart and Ingram, 1946:15-17; Knight and Hull, 1953:460-463; Iyengar, 1955:30; Laird, 1956; Rageau, 1958:3-4; Stone, Knight and Starcke, 1959). Belkin (1962:427) treated it as *A. nocturnus* and Reinert (1973) synonymized *nocturnus* with *vexans vexans.*

STAGES DESCRIBED. M*, F, P*, L* (Bohart and Ingram, 1946:15, M*, F, P*, L*; Yamaguti and LaCasse, 1950:73, M*, F*, L*; Knight and Hull, 1953:460, M*, F, L; Belkin, 1962:427, M*, F, P*, L*; Reinert, 1973:66, M*, F*, P*, L*).

BIOLOGY. Six collections were made of *vexans* in American Samoa, Western Samoa and Tonga, all in shallow ground pools, often with a lot of grass and other vegetation. The species did not occur in large numbers. The adults are nocturnally active and will occasionally bite man. Four females of *vexans* were collected indoors in Tongatabu.

DISTRIBUTION. **Western Samoa**: *Savaii* (Aasu). *Upolu* (Apia, Manunu, Paepaeala). **American Samoa**: *Tutuila* (Malaeloa). *Olosega.* **Tonga**: *Tongatabu* (Hofoa, Tofoa). *Tofua.*

Widely distributed in the South Pacific, and Eurasia and North America.

10. Culex (Culex) pipiens quinquefasciatus Say

1823. Acad. Nat. Sci. Phila., J. 3:10. New Orleans, LA, U.S.A. (NE).

DISCUSSION. This species was introduced into the South Pacific during the days of the sailing ships. Known in the Commonwealth and Europe as *Culex pipiens fatigans* (Wiedemann).

STAGES DESCRIBED. M*, F*, P*, L* (Belkin, 1962:195, M*, F, P*, L*; Bram, 1967:192, M*, F*, P*, L*).

BIOLOGY. This species breeds in polluted to relatively clean waters in cement drains, cisterns and other artificial containers. Females are nocturnally active and will rest in houses during the day. It is not important as a vector of filariasis in the South Pacific.

DISTRIBUTION. **Western Samoa**: *Upolu* (Afiamalu, Apia, Asau, Manunu, Satepuala, Solosolo, Vaiusu, Fagali'i). **American Samoa**: *Tutuila* (Aoloau, Breakers Point, Fagaalu, Fagatogo, Futigo, Leloaloa, Mapusaga, Pago Pago, Tofuna, Malaeloa). **Tonga**: *Tongatabu* (Havelu, Hofoa, Matahau, Nuku'alofa).

Widely distributed elsewhere in the South Pacific and throughout the tropical, subtropical and warm temperate regions of the world.

11. Culex (Culex) annulirostris Skuse

1889. Linn. Soc. N. S. W., Proc. 2(3):1737-1738. Blue Mountains and Berowra, New South Wales, Australia (MM).

STAGES DESCRIBED. M*, F, P*, L* (Knight and Hurlbut, 1949:30, M*, F, P, L*; Bohart, 1957:80, M*, F, L*; Belkin, 1962:207, M*, F, P*, L*).

BIOLOGY. In Samoa and Tonga this species was most frequently collected in ground pools and several times in large artificial containers. The latter resembled ground pools since they contained considerable amounts of mud and organic debris. This species was found more frequently in Upolu, Savaii, Tongatabu and Eua than in Tutuila. *Culex annulirostris* occurred in association with *Aedes polynesiensis* and with *Aedes tabu* in artificial containers. It was also associated once with *Aedes vexans vexans* and several times with *Culex quinquefasciatus.*

Culex annulirostris is a serious pest mosquito in the Solomons and in the New Hebrides. This is not the case in Samoa and Tonga where it bites man only occasionally.

DISTRIBUTION. **Western Samoa**: *Savaii* (Falealupo, Sasina, Vaisala). *Upolu* (Apia, Faleolo, Mulifanuai, Paepaeala, Satepuala). **American Samoa**: *Tutuila* (Fagasa Pass, Fatatogo, Futigo). **Tonga**: *Tongatabu* (Hofoa, Matahau, Nuku'alofa, Pea, Tonga College). *Eua* (Ohoniva, Reichlemann Estate, Tongamamao). *Nomuka. Tofua.*

Widely distributed elsewhere in the Pacific and in the Indomalayan region.

12. Culex (Culex) sitiens Wiedemann

1828. Aussereurop. Zweifl. Insekt. 1:542. Sumatra (ZMC).

STAGES DESCRIBED. M*, F*, P*, L* (Bohart and Ingram, 1946:18, M*, L*; Yamaguti and LaCasse, 1950:30, M*, F*, L*; Belkin, 1962:205-206, M*, F, P*, L*).

BIOLOGY. This species was especially abundant in Tutuila and was collected only occasionally in Upolu. It has been reported from Tongatabu in the past (Iyengar, 1960; Belkin, 1962) but only a single aberrant female was collected during this survey. The immature stages were collected many times in shallow rockpools close to the sea and once in a coconut shell. The water temperature in these pools rose considerably during the afternoon owing to direct exposure to the sun. The salinity in the pools varied considerably and sometimes approached that of seawater. *C. sitiens* was found in association with *A. polynesiensis* several times.

DISTRIBUTION. **Western Samoa**: *Upolu* (Manunu, Solosolo). **American Samoa**: *Tutuila* (Alofau, Breakers Point, Laloae, Laulii). **Tonga**: *Tongatabu* (Havelu, Hofoa, Matahau, Nuku'alofa).

This species is widely distributed in the South Pacific and occurs in the Ethiopian and Oriental Regions.

13. Culex (Culex) samoaensis Edwards

1914. Entomologist 47:36-37. Apia, Samoa (BMNH).

STAGES DESCRIBED. F (Edwards, 1914:36; Belkin, 1962:211-212).

BIOLOGY. Only 3 females are known of this species, 2 of these collected in a latrine. Rare.

DISTRIBUTION. **Western Samoa**: *Upolu* (Apia).
Not known elsewhere.

14. Coquillettidia (Coquillettidia) samoaensis Stone

1966. Entomol. Soc. Wash., Proc. 68:331-333. Tau Island, Manua Group, American Samoa (USNM).

DISCUSSION. Belkin (1962:309) examined a single male from Upolu and provisionally included it with *fijiensis*. Stone (1966) obtained 2 additional specimens from the Manua group and described them as a new species. Not collected during the survey.

STAGES DESCRIBED. M*, F (Stone, 1966:331).

BIOLOGY. A very rare species. Only 3 adults obtained so far from the localities indicated.

DISTRIBUTION. **Western Samoa**: *Upolu* (Moata'a Stream). **American Samoa**: Manua Group: *Tau* Island.
Not known elsewhere.

15. Toxorhynchites (Toxorhynchites) amboinensis (Doleschall)

1857. Natuurkd. Tijdschr. Ned.-Ind. 14:381-382. Amboina, Moluccas, Indonesia (NMW).

DISCUSSION. This species was introduced into American Samoa in 1955 mistakenly as *splendens* for the purpose of controlling *Aedes polynesiensis* (Peterson, 1956). As in most other species of *Toxorhynchites* there is marked sexual dimorphism in the adults of *amboinensis*. This has undoubtedly led to misidentifications of the males and females as two different species. The female of *amboinensis* resembles *splendens* quite closely, actually *inornatus* even more. The male, on the other hand, is superficially quite similar to that of *brevipalpis* except for the dark scale tuft of abdominal segment VIII.

STAGES DESCRIBED. M*, F*, P*, L* (Doleschall, 1857:381, adults; Banks, 1906, M*, F*; Ramalingam, 1965, P*, L*; Steffan, 1968:150,310, M*, F*, P*, L*).

BIOLOGY. Immature stages of *amboinensis* were found on Tutuila in leaf axils of *Colocasia, Alocasia* and *Pandanus,* in treeholes, a bamboo stump and a rockhole. The principal breeding sites for this species are the leaf axils of *Colocasia*. Adult females were collected twice, on one occasion resting on a tree trunk and on another just after oviposition. Oviposition took place around 1200 hrs. on an overcast day in a large cavity filled with water on a fallen tree trunk. The female was observed to move up and down (dance) over the treehole water a distance of about 0.6 m, starting from a height of about 1 m and gradually approaching the water surface. When the movements came to about 10 cm the female would strike the water surface and deposit an egg.

DISTRIBUTION. **American Samoa**: *Tutuila* (Aasu, Agriculture Farm, Aoloau, Masefau, Tofuna, Vatia, Fighter Strip).
Occurs naturally in Southeast Asia; introduced and established in Hawaii and from there to Samoa.

KEYS TO THE MOSQUITOES OF SAMOA AND TONGA

There are no published keys to the mosquitoes of Samoa and Tonga. The only available recent keys are those of Belkin (1962) and these include the entire mosquito fauna of the South Pacific. Keys to the adults, pupae and larvae of the mosquitoes of Samoa and Tonga are given below.

ADULTS

Toxorhynchites

1. Proboscis rigid, apical half sharply recurved and narrower than the basal half; scutellum rounded posteriorly; very large, brilliantly colored species *(Toxorhynchites)* . . . . . ***amboinensis***

Proboscis not rigid, apical half not sharply recurved and about equal in width to basal half; scutellum trilobed posteriorly 2

2(1). Postspiracular bristles absent 3

Postspiracular bristles present *(Aedes)* 7

Coquillettidia

3(2). Dark scaling of abdomen purplish violet, light scaling deep golden *(Coquillettidia)* . . . . . ***samoaensis***

Dark scaling of abdomen brown or blackish, light scaling whitish or yellow *(Culex)* . . 4

Culex

4(3). Labium without distinct complete median light ring; tarsi without distinct basal light markings; 1 or more mesepimeral bristles present . . . . . ***quinquefasciatus***

Labium with a distinct complete light ring; tarsi with distinct basal light markings; lower mesepimeral bristles absent 5

5(4). Abdominal tergites II-VI without any indication of transverse basal pale bands, only indistinct lateral pale spots present . . . . . ***samoaensis***

One or more of abdominal tergites II-VI with more or less complete transverse basal pale bands 6

6(5). Foretibia with a line of small pale spots on anterior surfaee along dorsal row of . . . . . bristles . . . . . ***annulirostris***

Foretibia without any pale spots on anterior surface along dorsal rows of bristles . . . . . ***sitiens***

Aedes

7(2). Wing with conspicuous pattern of dark and light spots or areas *(Finlaya)* 8

Wing without any pattern of dark and light spots or areas, largely dark scaled, sometimes with small basal light spot or some scattered pale scales 9

8(7). Wing predominantly dark, base of vein C largely dark; no accessory subcostal pale area on vein C . . . . . ***oceanicus***

Wing predominantly light, base of vein C largely light; accessory subcostal pale area frequently developed on vein C . . . . . ***samoanus, tutuilae***

9(7). No silvery white scales on mesonotum, pleuron or legs *(Aedimorphus)* . . . . . .
. . . . . ***vexans vexans***
Conspicuous silvery white scales on mesonotum, pleuron and legs *(Stegomyia)* 10

10(9). Mesonotum with lyre-shaped silvery markings; clypeus with a pair of patches of silvery scales . . . . . ***aegypti***
Mesonotum with conspicuous narrow median longitudinal line of silvery scales and a supraalar silvery line on each side; clypeus without silvery markings (Scutellaris Group; key to females only, for males use key to genitalia) 11

11(10). Lower mesepimeral area without silvery scales or at most with 3 scales . . . . . ***upolensis***
Lower mesepimeral area with a conspicuous patch of many silvery scales 12

12(11). Abdominal tergite VII usually with a complete or dotted transverse dorsal silvery band connecting lateral silvery markings; one or more additional tergites usually with complete or dotted transverse silvery bands . . . . . ***tabu***
Abdominal tergite VII with lateral silvery markings not connected by complete or dotted transverse dorsal bands; other tergites usually at most with a few light scales dorsally in middle but without distinct bands 13

13(12). Abdominal tergites usually without pale scales dorsally suggesting transverse bands; hind tarsal segment 4 usually silvery for 0.67 or more . . . . . ***polynesiensis***
Abdominal tergites usually with some pale scales dorsally suggesting transverse bands; hind tarsal segment 4 silvery for about 0.5 . . . . . ***tongae***

MALE GENITALIA

Toxorhynchites

1. Segments VII and VIII with dense lateral tufts of long linear scales; tergite IX long *(Toxorhynchites)* . . . . . ***amboinensis***
Segments VII and VIII without dense lateral tufts of long linear scales; tergite IX varied but never long 2

2(1). Proctiger strongly developed, paraproct with a transverse crown of numerous apical spines, denticles or spicules, nearly always more than 6 and usually very conspicuous; sidepiece with subapical lobe bearing specialized setae; phallosome complex *(Culex)* 3
Proctiger variously developed, paraproct if distinct usually with not more than 5 spines projecting tergally; sidepiece without subapical lobe; phallosome simple 5

Culex

3(2). Inner division of phallosome simple, entirely sternal and sharply bent laterad to form a large acute spine . . . . . ***quinquefasciatus***
Inner division of phallosome complex, with at least some denticles projecting tergally on apex 4

4(3). Basal sternal process of proctiger not developed or inconspicuous, very short or moderately long but weak and poorly pigmented . . . . . ***annulirostris***
Basal sternal process of proctiger very conspicuous, long, curved and darkly pigmented. . . . . ***sitiens***

Coquillettidia

5(2). Paraproct with at least 3 distinct spines *(Coquillettidia)* ..... ***samoaensis***
Paraproct usually with at most 1 distinct spine *(Aedes)* 6

Aedes

6(5). Aedagus without teeth *(Finlaya)* 7
Aedagus with several apical teeth on each side 9

7(6). Specialized basal mesal seta hairlike, slender, smoothly curved, at most slightly flattened distally ..... ***samoanus***
Specialized basal mesal seta not hairlike, distinctly flattened, expanded, widened or angled before apex 8

8(7). Sidepiece with postmedian central mesal patch a dense group of long, pointed, apically curved hairs; a row of 3 to 5 hairs with very broad bladelike or spoonlike apical expansions, extending from the specialized basal mesal seta distad ..... ***tutuilae***
Sidepiece with postmedian central mesal patch absent or with only a few hairs; row of specialized hairs absent ..... ***oceanicus***

9(6). Clasper irregular in shape; spiniform arising from a distinct preapical lobe *(Aedimorphus)* ..... ***vexans vexans***
Clasper more regular in form; spiniform arising apically *(Stegomyia)* 10

10(9). Ninth tergite deeply emarginate in the middle and with very large broadly triangular lateral lobes ..... ***aegypti***
Ninth tergite rounded, truncate or produced into a lobe in the middle and with very small ventrolateral lobes 11

11(10). Claspette with lateral or sternolateral hairs extending almost to point of attachment of lobe to sidepiece ..... ***polynesiensis***
Claspette with lateral or sternolateral hairs extending only about halfway to point of attachment of lobe to sidepiece 12

12(11). Claspette long, apical hairs about as long as lobe ..... ***upolensis***
Claspette short, apical hairs only slightly more than half length of lobe 13

13(12). Apical hairs of claspette extending basad to about 0.25 of entire claspette; average length of specialized setae 0.046 mm ..... ***tongae***
Apical hairs of claspette extending basad to about 0.34 of entire claspette; average length of specialized setae 0.053 mm ..... ***tabu***

PUPAE

Coquillettidia

1. Hair 4-C absent, all cephalothoracic hairs very small; trumpet without pinna, apex specialized for piercing plant tissue ..... ***samoaensis***
Hair 4-C always present, some of the cephalothoracic hairs usually moderately to very strongly developed; trumpet with pinna 2

Toxorhynchites

2(1). Anal segment with conspicuous branched cercal hair (1-X) ..... ***amboinensis***
Anal segment without any cercal hair (1-X) 3

3(2). Hair 9-VIII usually removed distinctly cephalad from caudolateral angle on sternal surface; paddle usually with both hairs 1,2-P present; hair 1-IX usually present, always a simple bristle ***(Culex)*** 4
Hair 9-VIII usually at caudolateral angle; paddle with only hair 1-P present; hair 1-IX irregular when present ***(Aedes)*** 6

Culex

4(3). Hair 5-IV usually at least 5-branched; 6-V,VI usually at least 4-branched... ***annulirostris***
Hair 5-IV usually double or triple; 6-V,VI usually 2- or 3-branched 5

5(4). Hairs 6-V,VI markedly stronger than 6-IV, usually double ..... ***sitiens***
Hairs 6-V,VI not markedly stronger than 6-IV, double or triple ..... ***quinquefasciatus***

Aedes

6(3). Paddle margins with long fringe of filamentous hairlike spicules (Scutellaris Group) . . 7
Paddle margins without spicules or with short or indistinct spicules 10

7(6). Hair 1-II primarily branched only and with at least 5 branches 8
Hair 1-II secondarily branched or with only 3,4 simple branches 9

8(7). Hair 10-C usually double; hairs 5-II and 5-IV also usually double ..... ***tongae***
Hair 10-C with 3 or more branches; hairs 5-II and 5-IV usually unbranched ..... ***tabu***

9(7). Hairs 9-VI,VII heavy, with barbs or branches ..... ***polynesiensis***
Hairs 9-VI,VII slender, smooth and single ..... ***upolensis***

10(6). Hair 1-C of the same order of magnitude as hairs 2,3-C, smaller or at most 1.5 as long 11
Hair 1-C at least twice as long as hairs 2,3-C; 2-II distinctly mesad of hair 3-II (Kochi Group) 12

11(10). Hair 2-VI distinctly laterad of hair 1-VI ..... ***aegypti***
Hair 2-VI mesad or at level of hair 1-VI ***(Aedimorphus)*** ..... ***vexans vexans***

12(10). Mesonotum with several clear, unpigmented spots; trumpet dark brown and in sharp contrast with the rest of the cephalothorax ..... ***tutuilae***
Mesonotum with one pair of clear, unpigmented spots; trumpet same color as cephalothorax 13

13(12). Metanotum without clear, unpigmented spots ..... ***samoanus***
Metanotum with a pair of clear, unpigmented spots ..... ***oceanicus***

LARVAE

Toxorhynchites

1. Each mouthbrush composed at most of 10 stout rods; abdominal hairs in groups of 3-5 on common basal tubercles ***(Toxorhynchites)*** ..... ***amboinensis***

Each mouthbrush composed of at least 30 slender filaments; abdominal hairs not on common tubercles 2

Coquillettidia

2(1). Valves of siphon serrated, about as long as body of siphon, adapted for piercing plant tissues *(Coquillettidia)* ..... ***samoaensis***
Valves of siphon not serrated, much shorter than body of siphon 6

3(2) Siphon with at least 2 pairs of hair tufts, exclusive of preapical dorsal hairs *(Culex)*. . .4
Siphon with only 1 pair of hair tufts, exclusive of preapical dorsal hairs *(Aedes)* 6

Culex

4(3). Head hair 1-C markedly flattened, its apex rounded or irregular ..... ***sitiens***
Head hair 1-C very slender or moderately thickened, its apex acuminate or filamentous 5

5(4). Head hair 1-C thickened, not filamentous distally, usually very strongly pigmented .... ***annulirostris***
Head hair 1-C very slender, distal part filamentous, sometimes basal part somewhat broadened, usually very lightly pigmented ..... ***quinquefasciatus***

Aedes

6(3). Ventral brush of anal segment with 2 or more detached unpaired proximal hairs not on grid or boss *(Aedimorphus)* ..... ***vexans vexans***
Ventral brush of anal segment with all hairs paired and all on grid or boss 7

7(6). Caudal border of anal saddle with very long marginal spicules; siphon usually spiculate; comb scales in large patch *(Finlaya)* 8
Caudal border of anal saddle with short marginal spicules or none; siphon without distinct spicules; comb scales in a single row *(Stegomyia)* 10

8(7). Head hair 4-C with 2-4 branches, 6-C usually double or triple; spicules of siphon very sparse ..... ***oceanicus***
Head hair 4-C with more than 6 branches; 6-C with 4 or more branches; siphon uniformly covered with spicules 9

9(8). Head hair 4-C with 7-11 branches, 6-C with 4-6 branches; siphon moderately pilose, spicules simple ..... ***tutuilae***
Head hair 4-C with 14-22 branches, 6-C with 9-12 branches; siphon strongly pilose, spicules with 2-4 branches ..... ***samoanus***

10(7). Ventral brush with 5 pairs of hairs; comb scales with short basal denticles .... ***aegypti***
Ventral brush with 4 pairs of hairs; comb scales without basal denticles 11

11(10). Anal segment with saddle incomplete, broadly or narrowly interrupted ventrally .... ***upolensis***
Anal segment with complete saddle 12

12(11). Hair 4a-X single ..... ***tabu***
Hair 4a-X double or triple 13

13(12). Hair 5-M usually double ..... ***tongae***
Hair 5-M usually single ..... ***polynesiensis***

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TABLE

1. Records of Mosquitoes from Individual Islands in Samoa and Tonga

TABLE I: RECORDS OF MOSQUITOES FROM INDIVIDUAL ISLANDS IN SAMOA AND TONGA

MOSQUITO SPECIES	TONGA											SAMOA					
												WESTERN			AMERICAN		
	Entire	Niuafoou	Niuatobutabu	Vava'u Gr.	Ha'apai Gr.	Tofua	Matuku	Nomuku	Tongatabu Gr.	Tongatabu	Eua	Entire	Upolu	Savaii	Tutuila	Manua Gr.	Swains
AEDES																	
Finlaya																	
1. samoanus												●	●	●	●		
2. tutuilae												✱	✱	✱	✱	✱	
3. oceanicus	●			○	✱	✱	✱		●	●	✱	●	●	●	●	✱	✱
Stegomyia																	
4. aegypti	●				○				●	●		●	●	○	○		
5. polynesiensis												●	●	●	●	●	●
6. upolensis												●	●	●	●	●	
7. tongae	●			○	●	✱	✱										
8. tabu	✱				✱	✱	✱		✱	✱	✱						
Aedimorphus																	
9. vexans vexans	●	○	○		✱	✱			●	●		●	●	●	●	●	●
CULEX																	
Culex																	
10. quinquefasciatus	●								●	●		●	●		●		
11. annulirostris	●				✱	✱		✱	●	●	✱	●	●	●	●		
12. sitiens	●								●	●		●	●	●	●	✱	
13. samoaensis												○	○				
COQUILLETTIDIA																	
14. samoaensis												○	○			○	
TOXORHYNCHITES																	
Toxorhynchites																	
15. amboinensis												✱			✱		

✱ Recorded in present survey only. ○ Recorded in other surveys only.

● Recorded in present and other surveys.