

**THE MOSQUITOES OF THE SANTA CRUZ FAUNAL SUBAREA
OF THE SOUTHWEST PACIFIC (DIPTERA: CULICIDAE)**

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THE MOSQUITOES OF THE SANTA CRUZ FAUNAL SUBAREA OF THE SOUTHWEST PACIFIC (DIPTERA: CULICIDAE)¹

By Mario Maffi² and Brian Taylor³

Abstract: The Santa Cruz faunal subarea is one of the least known in the South Pacific Region but it forms a major link in a dispersal arc running from New Guinea through the Solomons to the New Hebrides and beyond. Prior to this paper only one series of extensive mosquito collections had been made in the subarea; a summary of this and all other known mosquito collections is given. Our own work, plus a number of other previously unpublished findings, has completed the survey of all the main islands in the subarea. Fourteen definitive species, 2 of which are endemic, and 3 incompletely described endemic forms, are now known from the subarea.

The islands of the Southwest Pacific comprise one of the biologically least known areas of the world and the islands of the Santa Cruz faunal subarea are perhaps the most isolated and least visited in the Southwest Pacific. Politically and administratively known as the Eastern Outer Islands, the islands lie at the extreme eastern end of the 1600 km long Solomon Archipelago. The islands, which have a total land surface of only 836 km², are scattered over a wide area of the Coral Sea (9°30' to 12°30'S and 165°30' to 170°30'E) (FIG. 1). The nearest lands are to the south, the Torres Group of islands at the northern tip of the New Hebrides, over 150 km away; 400 km to the west is San Cristobal in the British Solomon Islands Protectorate. However, the Santa Cruz group is separated from the main Solomons by the Torres trench, over 6000 m deep; apart from the isolated islands of Tikopia, Anuta and Fataka, it lies on the same submarine ridge as the New Hebrides. Belkin (1962) subdivided the South Pacific into 6 faunal areas, of which the Santa Cruz-New Hebrides area is one.

A general historical and geographical description of the Eastern Outer Islands, together with detailed maps, is given by Maffi & McDonnell (1971). The climate has the seasonal characteristics typical of tropical islands lying in the zones of the tradewinds. Rainfall can be considerable, particularly when mountains are present as on Vanikoro.

The population is approximately 9000 (1970 Census, B.S.I.P.) with a predominance of Mel-

anesians on the larger islands and Polynesians on the others. The average density is 10.8 persons per km² with variations from 1.1 on Vanikoro to 201 on Tikopia. Though recent evidence (R. C. Green, pers. commun.) suggests that the movements of populations in the subarea have been quite extensive in the remote past, Tikopia and Anuta have remained relatively isolated, whereas cultural and commercial interchanges seem to have been continuous and active between the Santa Cruz Group, the Reef Islands and the Duff Islands.

According to Belkin (1962: 30) only 4 collections of mosquitoes had been made in the Santa Cruz faunal subarea: in 1926 by A. G. Carment, in 1933 by S. M. Lambert, in 1952 by F. N. Ratcliffe, and in 1956 by D. B. Bonnet of the Robinson-Peabody Museum of Salem Expedition. Our search of both the published literature and unpublished records kept by the Medical Department, B.S.I.P., has revealed a limited amount of additional data for the period prior to 1962: Lambert in 1933 also visited Anuta; Buxton & Hopkins (1927) mentioned that specimens of *Anopheles punctulatus* [undoubtedly *Anopheles (Cellia) farauti*] were received from Vanikoro by Lambert who sent them to Buxton; Lever (1934) commented that *Aedes scutellaris* var. *variegatus* has 2 well-marked varieties, viz., var. *tongae* from Sikaiana and Santa Cruz Is. and var. *hebrideus* from Rennell and Santa Cruz [now known as *Ae. (Stegomyia) varuae* and *Ae. (S.) hebrideus*, respectively], and that the range of *Aedes funereus* var. *ornatus* [now known as *Ae. (Verrallina) lineatus*] extended from Kolombangara to Vanikoro; and S. Tabua, an Assistant Medical Officer of the Medical Department, B.S.I.P., reported *A. farauti* from Tikopia.

In 1964 G. S. Parsonson made collections on several islands, and in 1967 the first collections by personnel associated with the B.S.I.P. national malaria eradication project were made. Limited collections were made in 1968 and 1969 but during 1970 almost all the islands in the subarea were visited. The final collections reported here were made in July 1971.

COLLECTION DATA

We have attempted to gather together details of all mosquito collections in the Santa Cruz faunal

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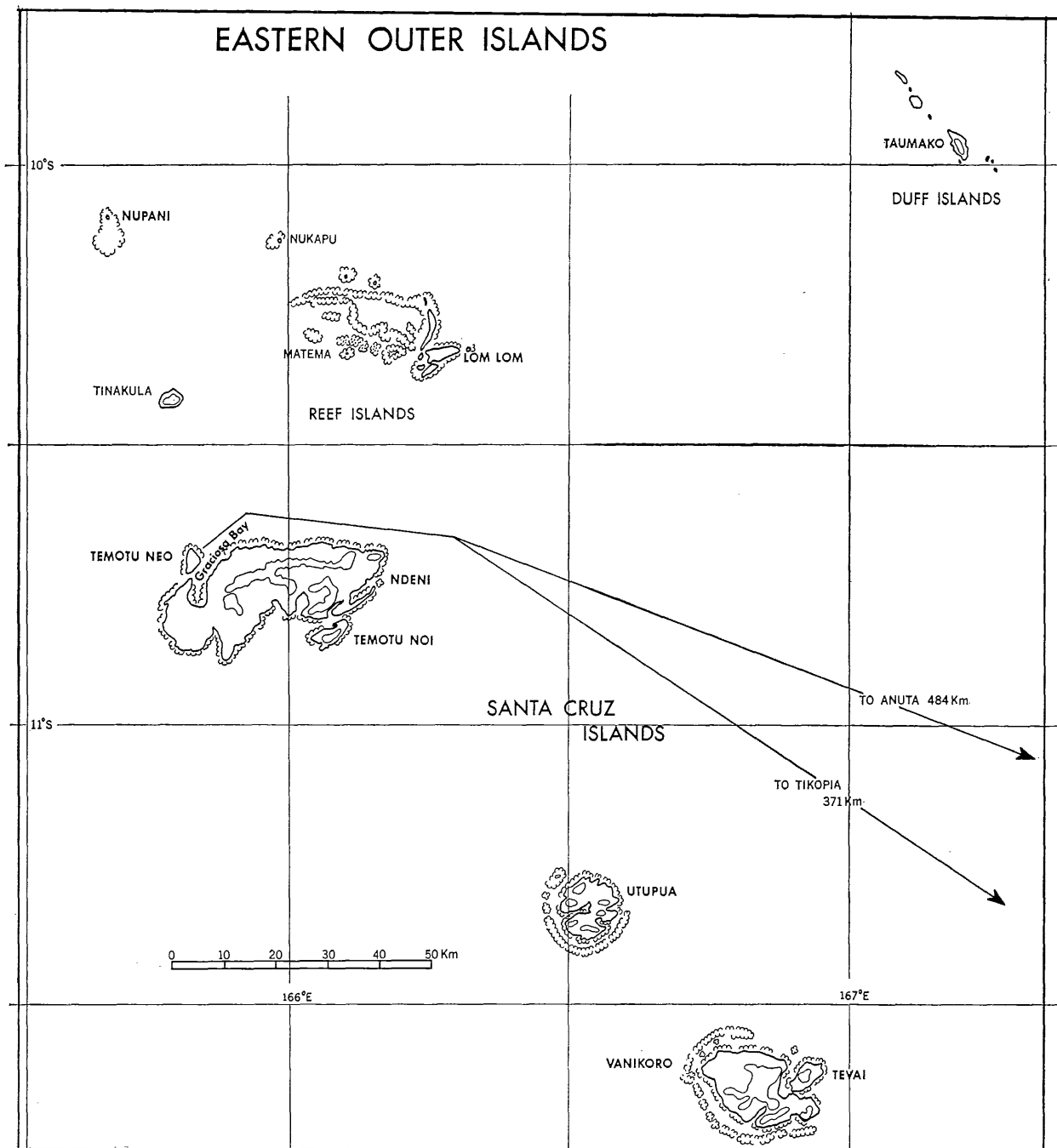


FIG. 1. The Eastern Outer Islands, British Solomon Islands Protectorate (latitude S, longitude E).

subarea. Data on collections prior to 1956 were available in part from published literature (Edwards 1926, Lambert 1934, Belkin 1962, 1965). For additional details we are indebted to correspondents: P. F. Mattingly on the findings of Carment; R. H. Black on the findings of Ratcliffe and Firth; and G. S. Parsonson on his own activities. One of us (B.T.) visited the Johns Hopkins University, Bal-

timore, but Lambert's specimens are apparently no longer there. Other visits were made to the British Museum (Natural History), London, and the School of Public Health & Tropical Medicine, University of Sydney.

Most of the material collected by us and our colleagues since 1967 has been deposited in the Bernice P. Bishop Museum, Honolulu, Hawaii.

Adult specimens were pinned immediately after collection or shortly after emergence in the case of reared specimens. Juvenile stages, including pelts, were preserved in MacGregor solution and mounted in Polyvinyl Lactophenol (Gurr), except for the December 1970 and July 1971 collections which were preserved in 70% alcohol and later mounted in Permount. Identification of specimens was made by us using the keys of Belkin (1962). Dr Belkin's advice was obtained for some of the more unusual specimens.

The collection data have been primarily collated island by island and are presented in chronological order for each island. As far as possible the locality, collector, collection number, bionomics, species and number of specimens of each life stage are given.

The following abbreviations are used for the names of collectors:

AC, A. G. Carment—data originally reported by Edwards (1926) and confirmed by Mattingly (pers. commun.). Belkin (1962: 447) expresses doubts as to the existence of a Tulagi Hospital on Santa Cruz Is. Reliable local sources confirm that there were no medical services on the island prior to 1930.

BS, A. T. C. Bourke & R. Slooff—entomologists attached to the B.S.I.P./W.H.O. malaria eradication project. Data from detailed unpublished internal report in B.S.I.P. Medical Department files. Slooff (1972) gives no details.

BT, B. Taylor.

DB, David D. Bonnet—collector on the Robinson-Peabody Museum of Salem Expedition to the Southwest Pacific, 1956. Originally reported by Belkin (1965).

GP, G. S. Parsonson—previously unpublished data given to us by the collector. Identifications by J. S. Pillai.

JA, J. G. Avery—malariaologist, B.S.I.P. Data from unpublished internal B.S.I.P. Medical Department report. Anophelines only were collected and identified but not preserved.

MM, M. Maffi.

MT, M. Maffi & B. Taylor.

RF, R. Firth—specimens identified by F. N. Ratcliffe, who was incorrectly named as the collector by Belkin (1962) (R. H. Black, pers. commun.).

RS, R. Slooff—details in unpublished internal report in B.S.I.P. Medical Department files. Mentioned without details by Slooff (1972).

SH, S. Horoto—Senior Malaria Technician (Entomology) of the B.S.I.P. malaria eradication

project.

SL, S. M. Lambert—specimens sent to Johns Hopkins University (Belkin 1962: 30) and identified by F. M. Root. Some information was published by Lambert (1934: 82, 137–38) but most of the entomological data are contained in an unpublished report (A Health Survey of the B.S.I.P., 1933) submitted to the High Commissioner for the Western Pacific.

ST, S. Tabua—Assistant Medical Officer, B.S.I.P. Data from unpublished internal report in B.S.I.P. Medical Department files.

YP, Y. H. Paik—W.H.O. malariaologist attached to the B.S.I.P. malaria eradication project.

In the collection lists, the following symbols are used: ♀, ♂, L = whole larva, l = larval pelt, P = whole pupa, p = pupal pelt.

For our own results collection numbers are also given, for example, (T/0156) = code number for each adult deposited in the Bishop Museum; T/E0I.1 = code number for slide mounts of juvenile stages deposited in the Bishop Museum.

COLLECTIONS FROM THE SANTA CRUZ FAUNAL SUBAREA

The island-by-island list is arranged in the grouping used by Belkin (1962: 29–30). Thus there are 2 major groups—the high volcanic islands of the Santa Cruz Group (Ndeni or Santa Cruz proper, with its adjacent islands of Temotu Neo and Temotu Noi, Tinakula, Utupua and Vanikoro), and the coral islands of the Reef Islands Group (FIG. 2 gives details of the innermost islands). The remaining islands, the Duff Islands, Tikopia and Anuta, are much more isolated and are considered as separate entities. The only remaining island, Fataka, is uninhabited and unvisited, apart from seasonal bird-nesting forays by the people of Anuta. Brief geographical details are given for each island immediately prior to the relevant chronological list of findings.

Santa Cruz Group

Santa Cruz Islands: Total population 3433, nearly all Melanesians. Ndeni (Ndende or Santa Cruz) is the main fairly large island (518 km²), with an extensive coral plateau in the western part, the remainder being volcanic basalt rising to over 300 m. The island is densely wooded, with a good network of rivers and creeks. The coast is mainly rocky but there are beaches along the western part while mangroves are common in the bays and lagoons of the central and eastern portions of the southern coast. With the opening of a District sub-station and airfield at Graciosa Bay in 1970,

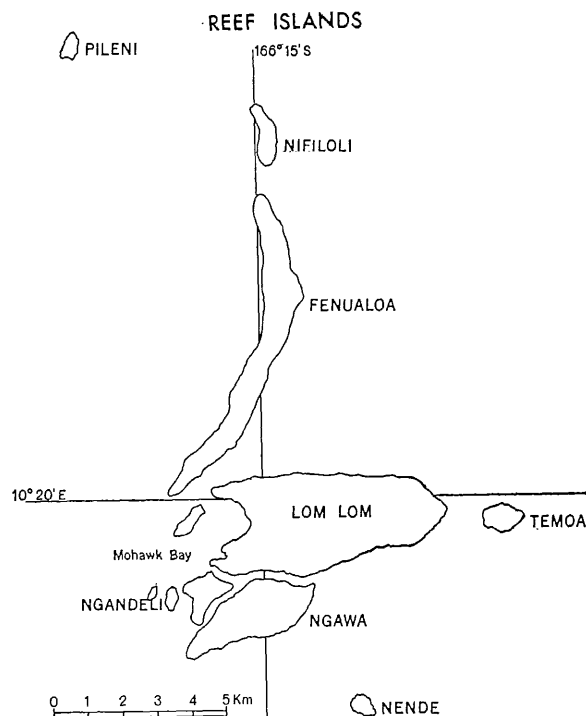


FIG. 2. The Reef Islands group.

communications with the main Solomons have greatly improved.

Temotu Neo and Temotu Noi are smaller islands lying adjacent to Ndeni on the northwest and southeast sides, respectively.

Ndeni

I.1926. Near Tulagi Hospital, AC, *Anopheles (C.) farauti*, 2 ♀♀; *Aedes (S.) tulagiensis*, 2 ♀♀.

? I.1926. Graciosa Bay, AC, on schooner, *Culex (Loph.)* sp., 2 ♀♀; *Anopheles (C.) farauti*, 2 ♀♀.

30.VIII.1956. Graciosa Bay, Lawai (=Lwowa), DB 71, near hospital, half coconut, partial shade, *Aedes (S.) varuae*, 2 ♂♂, 1 P. DB 74, ground well, *Anopheles (C.) farauti*, 1 ♀, 5 L, 2 P; *Culex (Loph.)* sp. Santa Cruz forms, 15 ♂♂, 2 L. DB 76, rain barrel near hospital, *Culex (Loph.)* sp. Santa Cruz forms, 11 L; *Aedes (S.) hebrideus*, 2 ♂♂, 1 ♀, 10 L; *Aedes (S.) varuae*, 11 L, 5 P. DB 77, shaded area near gardens behind hospital, leaf axil of "Spiny Palm," *Aedes (S.) tulagiensis*, 13 L.

12-13.VIII.1964. Graciosa Bay, GP, in artificial ditch, near the stream at the head of the bay, *Anopheles (C.) farauti*, 4 L. Larvae in dugout canoe, in the bay, *Culex (C.) sitiens*, 1 ♀, 79 L. Larvae in rain water in dugout canoe; adults biting in bush, *Aedes (S.) hebrideus*, 9 ♀♀, 55 L. In dugout canoe, *Tripteroides (T.) bonneti*, 31 L. Nemya I., GP, larvae in barrel; adults biting at dusk, *Aedes (S.) hebrideus*, 3 ♀♀, 10 L.

9.XI.1967. Graciosa Bay, Lwowa, MM (identifications tentative, specimens damaged), *Aedes (S.) hebrideus*, inland limit of the beach, rain water in dugout canoe.

20.XI.1967. Luesalemba School, MM, caught on ship, anchored 200 m offshore, biting man at 0700, *Anopheles (C.) farauti*.

19.II.1968. Graciosa Bay, Palo, BS, night man-biting, *Anopheles (C.) farauti*, 31 ♀♀.

20.II.1968. Nebo River, BS, in canoe, *Aedes (S.) hebrideus*, 10 L.

1.III.1968. Nanggu, BS, indoor day-resting, *Anopheles (C.) farauti*, 4 ♀♀. Utongo, BS, night man-biting, *Anopheles (C.) farauti*, 5 ♀♀.

28.VII.1968. Bonembwe School, RS, night man-biting, *Anopheles (C.) farauti*, 1 ♀.

29.VII.1968. Graciosa Bay, Lwowa Hospital, RS, night man-biting, *Anopheles (C.) farauti*, 4 ♀♀.

7.XI.1969. Graciosa Bay, Palo, JA, indoor day-resting, *Anopheles (C.) farauti*, 1 ♀. Night man-biting and indoor night-resting, *Anopheles (C.) farauti*, 6 ♀♀.

8.XI.1969. Nanggu, JA, night man-biting and indoor night-resting, *Anopheles (C.) farauti*, 24 ♀♀.

6.VII.1970. Luesalemba School, MT 1, coconut grove, rain water in small artificial container, *Aedes (S.) varuae* (T/0156), 1 ♀, 4 L, 1 P. Graciosa Bay, S. Cruz Sub-Station, MT 2-5, muddy wheel tracks, with grassy edges, sun-shade, *Anopheles (C.) farauti*, 31 L, 4 P. MT 6, rain water collected in groove in trunk of fallen tree, polluted, decomposing leaves, *Aedes (S.) varuae* (T/0152-55), 4 ♂♂, 21 L, 47 p. Along road from airstrip to Uta village, MT 7, wheel track with muddy water, *Anopheles (C.) farauti*, 10 L. Graciosa Bay, Lwowa, MT, night man-biting, *Anopheles (C.) farauti* (T/0149), 1 ♀; *Armigeres (A.) breinli* (T/0150-1), 2 ♀♀.

17.VII.1970. Southern Coast, Utongo, MT 1, village well, *Anopheles (C.) farauti*, 3 L, 1 P. Southeast Coast, Kaita, MT 2, rat-gnawed coconut husk, with foul contents, *Aedes (S.) varuae*, 6 L. MT 3, coconut fresh husk, rat-gnawed with clear contents, *Aedes (S.) varuae* (T/0311-4), 1 ♂, 3 ♀♀, 2 L, 2 P, 8 p. MT 4, small collection, brackish, on a groove on a branch of a *Calophyllum inophyllum* L. protruding on the beach, *Aedes (S.) varuae* (T/0328), 1 ♀, 1 L. Southern Coast, Ndendu, MT, day man-biting, in semi-shade, under coconut palms, *Armigeres (A.) breinli* (T/0315), 1 ♀. In mangrove area, day man-biting, in shade, *Aedes (L.) dasyorhynchus* (T/0316), 1 ♀. Treehole, *Aedes (S.) varuae* (T/0309), 1 ♂. Coconut husk, *Aedes (S.) varuae* (T/0310), 1 ♂.

18.VII.1970. Graciosa Bay, Lwowa, MT, night

man-biting, *Anopheles* (C.) *farauti* (T/0317), 1 ♀; *Aedes* (S.) *hebrideus* (T/0319-21), 3 ♀♀; *Armigeres* (A.) *breinli* (T/0318), 1 ♀.

25.IX.1970. Northern Coast, Noluta, SH 09, coconut shell with foul contents, in the sun, *Armigeres* (A.) *breinli*, 8 L. SH 10, sunny, muddy, running creek, floating material, *Anopheles* (C.) *farauti*, 3 L; *Uranotaenia barnesi*, 1 L. SH 11, fresh water in a new canoe, shaded, *Aedes* (S.) *hebrideus*, 1 L; *Aedes* (S.) *varuae*, 11 L.

26.IX.1970. Southwest Coast, Nea, SH 12, coconut shell with foul contents, *Aedes* (S.) *hebrideus*, 2 L; *Armigeres* (A.) *breinli*, 2 L. SH 13, coconut shell with foul contents, *Armigeres* (A.) *breinli*, 4 L. Southwest Coast, Menjembelo, SH 14, rain water in 167-liter (44-gal.) drum for drinking, under coconut palms, *Aedes* (S.) *tulagiensis*, 6 L; *Aedes* (S.) *hebrideus*, 2 L. SH 15-16, bionomics unknown, *Aedes* (S.) *hebrideus* (T/0333-5), 1 ♂, 1 ♀, 2 L; *Aedes* (S.) *varuae*, 1 L. SH 17, coconut shell with dirty contents, *Aedes* (S.) *hebrideus*, 11 L.

27.IX.1970. Western Coast, Nemboi, SH 18, dirty water in shaded treehole on *Pometia pinnata* Forst, *Culex* (Loph.) sp. Santa Cruz forms, 4 L.

28.IX.1970. Southern Coast, Utongo, SH 19, dirty water in treehole, 100 m from the village, *Aedes* (S.) *tulagiensis*, 5 L. SH 20, rain water in new canoe, *Aedes* (S.) *varuae*, 3 L. SH 21, coconut husk with foul water, *Armigeres* (A.) *breinli*, 3 L.

29.IX.1970. Southeast Coast, Neki River, SH 23, hole in *Calophyllum inophyllum* L., near to the sea, *Aedes* (L.) *dasyorrrhus*, 7 L. Southeast Coast, Akamboi, SH 24, coconut shell, *Aedes* (S.) *varuae*, 7 L. Southeast Coast, Kaita, SH 25, clear water, for cooking, in 167-liter (44-gal.) drum, *Aedes* (S.) *varuae* (T/0338), 1 ♀, 4 L. Northern Coast, Taepe, SH 26, dirty water in wooden pig bowl, *Aedes* (S.) *hebrideus* (T/0340), 1 ♀, 10 L; *Aedes* (S.) *varuae*, 4 L; *Armigeres* (A.) *breinli* (T/0339), 1 ♂.

30.IX.1970. Graciosa Bay, Palo, SH ?, near the water pump, on a rain-filled trailer, *Armigeres* (A.) *breinli* (T/0341), 1 ♀, 1 p. SH 27, coconut husk with foul content, *Armigeres* (A.) *breinli*, 4 L.

25.VII.1971. Graciosa Bay, S. Cruz Sub-station, BT, day-flying. *Aedes* (S.) *hebrideus* (T/0650), 1 ♂. T/E0I.5, coconut with small hole, *Armigeres* (A.) *breinli* (T/0651), 1 ♀, 1 p. Graciosa Bay, Airfield (near), BT, T/E0I.6, treehole, *Tripteroides* (R.) *melanesiensis* (T/0652-5), 2 ♂♂, 2 ♀♀, 3 l, 6 p; *Tripteroides* (R.) *melanesiensis* (T/0707), 1 ♀, 1 l, 1 p (individual rearing). T/E0I.6, *Aedes* (S.) *varuae*, 1 l, 1 P. Graciosa Bay, Airfield, north side, BT, T/E0I.7, large grassy surface pool exposed to sun, *Anopheles* (C.) *farauti* (T/0669-71), 1 ♂, 2 ♀♀, 8 L,

2 p; *Culex* (C.) *sitiens*, 5 L.

26.VII.1971. Graciosa Bay, near Uta, BT, T/E0I.8, beach, hole on fallen tree, *Aedes* (S.) *hebrideus* (T/0665-8), 1 ♂, 3 ♀♀, 2 L, 2 l, 7 p. Graciosa Bay, hillside below S. Cruz Sub-station, BT, T/E0I.9, small treehole, *Aedes* (S.) *varuae* (T/0656-8), 2 ♂♂, 1 ♀, 2 p. *Tripteroides* (R.) *melanesiensis*, (T/0708), 1 ♀, 1 l, 1 p. Stump of papaya tree, *Aedes* (S.) *varuae* (T/0660-1), 2 ♀♀. Predusk man-biting, *Aedes* (S.) *hebrideus*, (T/0662), 1 ♀. *Armigeres* (A.) *breinli* (T/0663-4), 2 ♀♀.

27.VII.1971. Graciosa Bay, Lwowa, BT, T/E0I.10, hole on log, *Aedes* (S.) *hebrideus* (T/0679), 1 ♀; *Aedes* (S.) *varuae* (T/0678), 1 ♀, 1 p. Graciosa Bay, S. Cruz Sub-station, BT, T/E0I.11, water on top of 167-liter (44-gal.) drum, *Aedes* (S.) *hebrideus* (T/0680-5), 1 ♂, 4 ♀♀, 2 p. Graciosa Bay, Balo, BT, T/E0I.12, canoe under construction, *Aedes* (S.) *hebrideus* (T/0672-5), 2 ♂♂, 2 ♀♀; *Aedes* (S.) *varuae* (T/0676-7), 2 ♂♂, 1 l, 1 p. Graciosa Bay, Palo (near), BT, T/E0I.13, treehole, *Aedes* (S.) sp. *edwardsi* group (T/0699; T/0702-3), 1 ♂, 2 ♀♀, 2 L, 4 l, 2 P, 4 p; *Aedes* (S.) *hebrideus*, 2 L, 1 p; *Aedes* (S.) *varuae* (T/0695-7; T/0700-1), 2 ♂♂, 3 ♀♀, 4 l, 1 P, 6 p; *Tripteroides* (R.) *melanesiensis* (T/0698), 1 ♂, 3 L, 2 p. Graciosa Bay, Airfield (near), BT, night man-biting (2100-2200), *Anopheles* (C.) *farauti* (T/0689-92), 4 ♀♀ (plus 22 specimens unmounted); *Culex* (C.) *sitiens* (T/0686-7), 2 ♀♀; *Armigeres* (A.) *breinli* (T/0688), 1 ♀.

28.VII.1971. Graciosa Bay, S. Cruz Sub-station, BT, day man-biting, *Aedes* (S.) *hebrideus* (T/0693), 1 ♀; *Armigeres* (A.) *breinli* (T/0694), 1 ♀.

Temotu Neo

29.VIII.1956. Malo, DB 65, near village, Tridacna shell in full sunlight, *Anopheles* (C.) *farauti*, 1 ♀, 1 P; *Aedes* (S.) *varuae*, 5 ♂♂, 1 ♀. DB 67, taken while biting man in partial shade at 1715, *Armigeres* (A.) *breinli*, 2 ♀♀. DB 69, U.S. airplane wing tank used to catch rain water, in shade, *Tripteroides* (T.) *bonneti*, 1 ♂, 1 P. DB 70, shallow ground well, full sun, no vegetation, *Anopheles* (C.) *farauti*, 2 ♂♂, 1 ♀, 4 L, 2 P. DB 72, treehole near village, *Aedes* (S.) *hebrideus*, 2 L. DB 73, rain barrel in village, full sunlight, *Aedes* (S.) *hebrideus*, 1 ♀, 1 L, 1 P.

24.IX.1970. Neo, SH 07, at the seashore, polluted water in canoe, *Aedes* (S.) *hebrideus* (T/0330), 1 ♂, 5 L. SH 08, polluted rain water in Tridacna shell, full sunlight, *Culex* (C.) *sitiens* (T/0331-2), 2 ♀♀, 26 L.

Temotu Noi

1.III.1968. Banoimba, BS, indoor day-resting,

Anopheles (C.) farauti, 1 ♀. Bimba, BS, indoor day-resting, *Anopheles (C.) farauti*, 1 ♀.

28.IX.1970. Bimba, SH 22, fresh water in 167-liter (44-gal.) drum, in the shade, *Aedes (S.) varuae* (T/0336-7), 1 ♂, 1 ♀, 4 L.

Tinakula

An active volcanic cone, rising to a height of over 700 m. There is only 1 small village, which is visited periodically by the people of the outer Reef Islands (Nupani, Nukapu) for gardening. The upper slopes are barren but the lower ones are quite densely wooded, with deep gullies from top to bottom. In late 1971 the volcano erupted and the village was evacuated.

11.XII.1970. YP, T/E01.1, treehole, *Aedes (S.) hebrideus*, 3 L.

Vanikoro

A moderate sized island (156 km²) of volcanic origin rising to nearly 1000 m. It is heavily wooded and has a very high rainfall, with an average of over 5000 mm. A great part of the coast is covered by mangroves. There is a small (163) Melanesian population restricted to 1 large village, Buma, on Tevai Island, and to 3 small villages: Lale, Emua and Lataka. The former government and timber company station at Peu has been deserted since 1965.

11.VIII.1956. Peu, DB 32, water in iron frame of old steam boiler, partial shade, *Culex (Lophoceraomyia)* sp. Santa Cruz forms, 15 L. DB 33, 208-liter (55-gal.) iron drum rain barrel in open sun, *Aedes (S.) varuae*, 15 L; *Tripteroides (R.) melanesiensis*, 1 L. DB 34, 208-liter (55-gal.) iron drum rain barrel in open sun, *Culex (C.) quinquefasciatus*, 3 ♂♂, 4 ♀♀, 8 L, 7 P. DB 35, 19-liter (5-gal.) kerosene tin, filled with rain water from corrugated iron roof, *Culex (C.) quinquefasciatus*, 1 ♂, 7 ♀♀, 10 L, 11 P. DB 36, 208-liter (55-gal.) drum rain barrel, shaded, *Aedes (V.) lineatus*, 1 ♂, 4 ♀♀, 11 L, 4 P. Pathway to Government House, DB 37, biting man in daytime, partial shade, *Aedes (V.) lineatus*, 1 ♀. Pathway towards Government House, DB 38, tree fern stump with water in center, *Aedes (S.) robinsoni*, 1 ♂, 1 P; *Aedes (S.) varuae*, 1 L; *Tripteroides (R.) melanesiensis*, 3 ♂♂, 1 ♀, 50 L, 2 P. Hillside near Government House, DB 40, large treehole in Flame tree (*Poinciana*), *Aedes (S.) robinsoni*, 3 ♂♂, 9 L, 7 P; *Tripteroides (R.) melanesiensis*, 8 ♂♂, 4 ♀♀, 39 L, 12 P. Tractor ruts in swampy area of timber trail below Government House toward river, full sunlight, water very warm, DB 41, *Anopheles (C.) farauti*, 12 L, 1 P; *Culex (C.) annulirostris*, 1 ♂, 2 ♀♀, 6 L, 3 P.

VIII.1964. Peu and Emoa, GP, larvae in open,

shallow, muddy pools, high temperatures, at Peu on road; in running water in taro swamp at Emoa, emergent vegetation; adults biting in early evening; many more taken, notably in damaged mosquito nets in labor lines, *Anopheles (C.) farauti*, 16 ♀♀, 50 L. Larvae in overflowing sewage from cesspool, ditches, rain barrels, ♀♀ biting fiercely, in bush taken at random, and in open after 1600, *Culex (C.) quinquefasciatus*, 11 ♂♂, 32 ♀♀, 60 L. Larvae in barrels; adults biting at dusk, *Aedes (S.) hebrideus*, 10 ♀♀, 10 L. Larvae in half coconuts; adults taken while biting, *Aedes (S.) varuae*, 33 ♀♀, 50 L.

11.XI.1967. Tevai I., Buma, MM, wild taro (*Cyrtosperma*) swamp behind the village, shallow water, semi-shade, *Anopheles (C.) farauti*, 4 L; *Culex (C.) annulirostris*, 3 L; *Uranotaenia barnesi*, 2 L. One of the larvae of *C. (C.) annulirostris* was infected with *Coelomomyces* sp. First record for the Santa Cruz-New Hebrides area, and 1st for the species.

23.II.1968. Tevai I., Buma, BS, clear pool, *Anopheles (C.) farauti*, ? L. Wild taro swamp, *Anopheles (C.) farauti*, ? L; *Uranotaenia barnesi*, ? L. Indoor day-resting, *Anopheles (C.) farauti*, 10 ♀♀.

24.II.1968. Nambuko School, BS, sunlit pool, *Anopheles (C.) farauti*, ? L. Indoor day-resting, *Anopheles (C.) farauti*, 2 ♀♀. Night man-biting and indoor night-resting, *Anopheles (C.) farauti*, 12 ♀♀.

26.II.1968. Nambuko School, BS, night man-biting and indoor night-resting, *Anopheles (C.) farauti*, 5 ♀♀ (after DDT residual spraying).

10.XI.1969. Tevai I., Buma, JA, night man-biting and indoor night-resting, *Anopheles (C.) farauti*, 22 ♀♀.

14.VII.1970. Tevai I., Buma, MT, indoor day-resting, *Anopheles (C.) farauti* (T/0262-6), 5 ♀♀. MT 1, large treehole shaded; decomposing leaves and floating debris, *Tripteroides (T.) bonneti* (T/0270-2), 3 ♀♀, 2 L, 2 p; *Tripteroides (R.) melanesiensis* (T/0273; T/0322-23), 2 ♂♂, 1 ♀, 39 L, 3 p. Tree stump, *Aedes (S.) varuae* (T/0269), 1 ♂; *Tripteroides (R.) melanesiensis* (T/0267-8), 1 ♂, 1 ♀. MT 2, wild taro swamp behind village, *Anopheles (C.) farauti*, 1 L, 1 P. Southeast coast, Mabale Garden House, MT 3, wild taro shallow swamp, with muddy bottom, semi-shade, *Uranotaenia barnesi*, 1 L. Emua, MT 4, creek bordering the village, *Anopheles (C.) farauti*, 12 L.

15.VII.1970. Northwest coast, Lale, MT 1, coconut shell, *Aedes (S.) robinsoni*, 1 L; *Aedes (S.) varuae* (T/0274), 1 ♀, 5 L, 3 P. MT 2, rain water in 167-liter (44-gal.) drum, *Aedes (S.) robinsoni*, 2 L; *Aedes (S.) varuae* (T/0275-7), 1 ♂, 2 ♀♀, 22 L, 2 P, 8 p; *Tripteroides (R.) melanesiensis*, 1 L.

Utupua

A moderate sized island (78 km²) of volcanic origin, rising to 400 m, densely wooded and surrounded by an extensive coral reef. A small (232) Melanesian population is distributed among several small villages and 2 larger ones, Old and New Nembao.

11.VIII.1964. GP, biting indiscriminately, *Culex* (*C.*) *quinquefasciatus*, 6 ♀♀ [given as *C. (C.) fatigans*]. Biting at dusk, one 46 m (50 yards) offshore, *Aedes* (*S.*) *varuae*, 12 ♀♀.

27.II.1968. Nembao, BS, local creek, *Anopheles* (*C.*) *farauti*, ? L.

28.II.1968. Nembao, BS, indoor day-resting, *Anopheles* (*C.*) *farauti*, 9 ♀♀. Night man-biting, *Anopheles* (*C.*) *farauti*, 1 ♀.

20.VII.1968. Nembao, RS, night man-biting, *Anopheles* (*C.*) *farauti*, ? ♀.

15.VII.1970. Nembao, MT, day man-biting in semi-shade, ♂♂ resting on man, *Aedes* (*S.*) *hebrideus* (T/0278-85), 2 ♂♂, 8 ♀♀. MT 3, rocky ground, coconut spathe, *Aedes* (*S.*) *hebrideus*, 3 L, 3P; *Tripteroides* (*R.*) *melanesiensis*, 2 P. Night man-biting, *Anopheles* (*C.*) *farauti* (T/0286-90), 5 ♀♀.

16.VII.1970. Asumbao, MT 1, coconut shell, *Aedes* (*S.*) *hebrideus* (T/0296-9, T/0324, T/0326, T/0705-6), 5 ♂♂, 3 ♀♀, 15 L, 7 P, 9 p; *Aedes* (*S.*) sp. *scutellaris* group (T/0300-1, T/0325, T/0327, T/0704), 3 ♂♂, 2 ♀♀. Under coconut palms, day man-biting in semi-shade, *Aedes* (*S.*) *hebrideus* (T/0293-5), 3 ♀♀; *Aedes* (*S.*) sp. *scutellaris* group (T/0291-2), 2 ♀♀. Nembao, MT 2, rock pool with fresh water, *Aedes* (*S.*) *hebrideus* (T/0302-5), 2 ♂♂, 2 ♀♀, 4 L, 5 P, 5 p. MT 8, shallow well, *Anopheles* (*C.*) *farauti*, 10 L, 1 P. Aboke Creek (along the coast, north of Nembao), MT 7, small, sunny, water almost still, grass at edges, *Anopheles* (*C.*) *farauti*, 1 L. Alangua Point (along the coast, north of Nembao), MT 3, big boulder at fringe of narrow beach, semi-shaded, ample collection on boulder; salinity higher than sea water (108‰), *Anopheles* (*C.*) *farauti*, 4 L; *Culex* (*C.*) *sitiens* (T/0308), 1 ♀, 4 L, 1 p; *Aedes* (*S.*) *hebrideus* (T/0306-7), 1 ♂, 1 ♀, 3 L, 2 P, 2 p. Northwest Coast, Aweta, MT 4, rat-gnawed coconut husk, *Aedes* (*S.*) *robinsoni*, 3 L, 1 P; *Tripteroides* (*R.*) *melanesiensis*, 1 L. Northwest Coast, Arolu, MT 5, thin layer of water on muddy ground at inner fringe of forest, *Uranotaenia barnesi*, 1 L. MT 6, in village, in the open, 1/2 of glass fishing ball filled with rain water, *Aedes* (*S.*) *hebrideus*, 5 L.

Reef Islands Group

Total population 4053 (3353 Melanesians and 691 Polynesians). The outer islands, Nupani,

Nukapu, Matema and Pileni, with Polynesian populations of 150 to 200 in each case, are low-lying coral islands not exceeding 10 m above sea level. There is no surface water except for brackish wells and damp, possibly swampy areas, at least on Nupani. The inner islands, Nifiloli, Fenualoa, Temoa, Nende, Ngandeli, Lom Lom (or Naelo) and Ngawa are slightly raised, up to 20 m, coral islands with a very extensive shallow reef area on the western side edged by mangrove swamp. There is little or no surface fresh water except on Ngawa, where *A. farauti* larvae have been collected.

*Outer Islands**Nupani*

8.V.1933. SL, daytime collections, *Aedes* (*V.*) *lineatus*, 1 ♂, 30 ♀♀, [as *Aedes* (*A.*) *funereus* var. *ornatus*]; *Aedes* (*S.*) *hebrideus*, 1 ♂ [as *Aedes* (*S.*) *variegatus* var. *hebrideus*]. *Aedes* (*S.*) *varuae*, 1 ♂ [as *Aedes* (*S.*) *variegatus* var. *tongae*]; *Aedes* (*S.*) *variegatus*, 4 ♀♀ (current name undeterminable).

5.IX.1956. DB 92, treehole in shade near village, *Aedes* (*S.*) *tulagiensis*, 1 ♂, 1 ♀, 75 L, 12 P; *Tripteroides* (*R.*) *melanesiensis*, 1 ♀, 1 P. DB 95, taken while biting man in daylight, semi-shade, *Aedes* (*S.*) *hebrideus*, 2 ♀♀; *Armigeres* (*A.*) *breinli*, 5 ♀♀. DB 96, treehole in shade in forest area, *Aedes* (*S.*) *hebrideus*, 1 ♀. DB 97, taken while biting man, deep shade in bush, *Aedes* (*S.*) *hebrideus*, 1 ♀; *Armigeres* (*A.*) *breinli*, 2 ♀♀.

7.VII.1970. Near Matalele, MT 1-2, coconut husk with foul contents, *Armigeres* (*A.*) *breinli*, 10 L, 9 P. MT 3, abandoned dugout canoe, filled with polluted water and decomposing leaves, *Aedes* (*S.*) *hebrideus*, 5 P. Near Tekainga, MT 4, dried half coconut shell, filled with clear rain water, *Aedes* (*S.*) *hebrideus*, 17 L, 1 p (1 larva infected with *Coelomomyces* sp. First record for the Santa Cruz-New Hebrides area, and 2nd for the species.) Northeastern forested part, MT 5, treehole in *Barringtonia asiatica* (L.) Kurz, *Aedes* (*S.*) *tulagiensis*, 8 L, 2 P. Northeastern beach, MT 6, rain water on small groove in trunk of fallen tree, sunny, *Aedes* (*S.*) *hebrideus*, 7 L.

8.VII.1970. MT, day man-biting in semi-shade, ♂♂ resting on man, *Aedes* (*V.*) *lineatus* (T/0167-80), 14 ♀♀; *Aedes* (*S.*) *hebrideus* (T/0161-66), 2 ♂♂, 5 ♀♀; *Armigeres* (*A.*) *breinli* (T/0157-9), 3 ♀♀.

11.XII.1970. YP, T/E01.2, coconut shell, *Aedes* (*S.*) *hebrideus*, 6 L; *Aedes* (*S.*) *varuae*, 3 L.

Nukapu

22.IX.1970. SH 01, treehole on *Inocarpus fagiferus* (Park) Fosb., *Aedes* (*S.*) *tulagiensis*, 3 L. SH 02, treehole on *Burckella obovata* (Forst.) Pierre, *Aedes*

(*S.*) *varuae*, 10 L, 1 P. SH, day man-biting, *Armigeres* (*A.*) *breinli*.

Pileni

15.VIII.1964. GP, taken at bottom of deep well, some biting, *Aedes* (*S.*) *varuae*, 5 ♀♀.

22.IX.1970. SH 03, drinking ground well in the village, semi-shade, *Aedes* (*S.*) *hebrideus*, 3 L.

Matema

IX.1970. SH, collections negative.

Inner Islands

Nifiloli

1.X.1970. Along the trail to Leveia, SH 28, treehole, *Aedes* (*S.*) *hebrideus*, 1 L. Leveia, SH 29, clear, fresh cooking water in 167-liter (44-gal.) drum, *Aedes* (*S.*) *hebrideus*, 4 L.

Fenualoa

3.IX.1956. DB 91, treehole in shade, *Tripteroides* (*R.*) *melanesiensis*, 1 ♀, 1 P. No village names are given. Collections ERP 82, 84, 87, 88, 89, and 90 from Fenualoa were negative.

23.XI.1967. Tuwo, MM, larvae in coconut half shell near pig sty, along the beach; adults biting at 0800, *Armigeres* (*A.*) *breinli*, 2 ♀♀, 8 L.

1.X.1970. Malapu, SH 30, dugout canoe, fresh water, floating material, *Aedes* (*S.*) *hebrideus*?, 4 L (2nd stage). SH 31, near a house, under pandanus, in abandoned plastic bowl, *Aedes* (*S.*) *hebrideus*, 1 L. SH 32, water for cooking in 167-liter (44-gal.) drum, *Aedes* (*S.*) *tulagiensis*, 8 L; *Aedes* (*S.*) *hebrideus*, 2 L. Tanga, SH 33, water for cooking in 167-liter (44-gal.) drum, *Aedes* (*S.*) *tulagiensis* (T/0342-3), 1 ♂, 1 ♀, 2 L; *Aedes* (*S.*) *varuae*, 1 L. Malombu, SH 34, dirty water for cooking in 167-liter (44-gal.) drum, *Aedes* (*S.*) *hebrideus*, 1 L.

Temoa

23.IX.1970. SH 04, drinking rain water in 167-liter (44-gal.) drum, shade, *Aedes* (*S.*) *tulagiensis*, 4 L; *Aedes* (*S.*) *varuae*, 2 L. SH 05, drinking rain water in 167-liter (44-gal.) drum, shade, *Aedes* (*S.*) *tulagiensis*, 3 L; *Aedes* (*S.*) *varuae*, 1 L; *Tripteroides* (*R.*) *melanesiensis* (T/0329), 1 ♂, 6 L.

Nende

23.IX.1970. SH 06, treehole on *Pometia pinnata* Forst. *Aedes* (*S.*) *tulagiensis*, 12 L.

Ngandeli

2.X.1970. SH 35, clear water for drinking in 167-liter (44-gal.) drum, *Aedes* (*S.*) *hebrideus*, 1 L.

Lom Lom

9.VII.1933. Mohawk Bay, SL, daytime collection, *Aedes* (*S.*) *hebrideus* [as *Aedes* (*S.*) *variegatus*], 8 ♀♀.

31.VIII.1956. Naelo, DB 78, rain water collected in groove in trunk of fallen tree, full sun, *Culex* (*Loph.*) sp. Santa Cruz forms, 8 L; *Aedes* (*S.*) *hebrideus*, 3 L; *Aedes* (*S.*) *varuae*, 3 L. DB 79, treehole in shade near hospital, *Aedes* (*S.*) *tulagiensis*, 7 L. DB 80, ♀ mosquito captured while laying eggs at DB 78, *Aedes* (*S.*) *varuae*, 1 ♀. DB 81, treehole in shade, *Tripteroides* (*R.*) *melanesiensis*, 20 L. DB 83, treehole near hospital, shade, *Tripteroides* (*R.*) *melanesiensis*, 6 L.

1.IX.1956. Naelo, DB 85, leaf axil of "Spiny Palm," shaded, *Aedes* (*S.*) *tulagiensis*, 25 L. DB 86, hole in side of coconut tree cut to collect rain water on trail to hospital, *Tripteroides* (*R.*) *melanesiensis*, 4 L.

17.XI.1969. JA, along the Ngamanie-Otelo trail, fresh-water well, *Anopheles* (*C.*) *farauti*, ? L.

Ngawa

8.VII.1970. Nenumbo, MT 1, rain water on groove in trunk of fallen tree, *Aedes* (*S.*) *hebrideus*, 12 L. MT 2, village well and small creek with sandy bed, sun-shade, *Anopheles* (*C.*) *farauti*, 9 L. MT 3, along trail from Nenumbo to Manuopo, coconut husk with semi-foul contents, *Armigeres* (*A.*) *breinli*, 7 L, 1 P. MT 4, small ground collection of brackish water in buttresses of *Intsia bijuga* (Colebr.), *Culex* (*C.*) *sitiens*, 10 L; *Aedes* (*L.*) *dasyorrrhus* (T/0182-4), 2 ♂♂, 1 ♀, 2 p. Nenumbo, MT 5, rain water in a dugout canoe on beach, *Culex* (*C.*) *sitiens* (T/0181), 1 ♂, 1 p.

Duff Islands

A compact chain of small islands of volcanic origin. The main island, Taumako, rises to about 400 m. A Polynesian population of about 200 resides mainly on an artificial island, Tahua, some 200 m offshore within a shallow reef.

There is only 1 other small village, Kahula, on the eastern side of Taumako Island, and 1 family resides on Treasurers' Island. The islands are wooded, the rainfall is high, and there are several swampy areas, the largest one being on Taumako opposite Tahua.

16-18.VIII.1964. Taumako I., GP, larvae in dark swamp, heavily contaminated, on mainland, next to temporary village; adults (missing) taken on the beach opposite Tahua village, *Anopheles* (*C.*) *farauti*, 3 L; *Culex* (*C.*) *annulirostris*, 36 L. *Culex* (*Loph.*) sp. (L missing) Santa Cruz forms [formerly identified as *C. (C.) australicus* (Parsonson, see introduction)]. *Aedes* (*S.*) *hebrideus* L (missing). Larvae in Tridacna shell in pig sty on the shore; adults (missing) taken on the beach opposite Tahua village, *Aedes* (*S.*) *varuae*, 6 L. *Tripteroides* subg., L (missing).

16.XI.1967. Taumako I., MM, along the Vai

Nata stream on the mainland opposite Tahua, attacking man at 1100, *Armigeres* (A.) *breinli*, 1 ♀ (specimen damaged, identification tentative).

15.XI.1969. Taumako I., JA, stagnant pool on the mainland; near the mouth of the Vai Nata, *Anopheles* (C.) *farauti*, ? L. Tahua, JA, indoor day-resting, *Anopheles* (C.) *farauti*, 5 ♀♀. Night man-biting and indoor night-resting, *Anopheles* (C.) *farauti*, 27 ♀♀.

10.VII.1970. Taumako I., near Vanua Garden huts, MT 1, coconut husk, *Aedes* (S.) *varuae*, 13 L, 1 P. Near the mouth of the Vai Nata, MT 2, stagnant pool, sunny; clear water, vertical vegetation along edges, *Anopheles* (C.) *farauti*, 10 L. Along the seashore, northwest, MT 3, treehole, *Tripteroides* (T.) *bonneti* (T/0204), 1 ♀, 10 L, 1 P, 1 p. MT 4, in the gardens inland of the southeastern beach, rat-gnawed coconut husk, with foul contents, *Aedes* (S.) *varuae* (T/0198), 1 ♀, 6 L, 1 p; *Armigeres* (A.) *breinli* (T/0195-7), 1 ♂, 2 ♀♀, 4 L, 6 p; *Tripteroides* (T.) *bonneti*, 7 L. South of the above locality, MT 5, coconut spathe, in a garden, *Aedes* (S.) *varuae* (T/0199-200), 1 ♂, 1 ♀, 4 L, 9 P, 6 p; *Tripteroides* (T.) *bonneti*, 3 L. MT 6, as above, but more in forest, dried half coconut shell, with yellowish contents and green algae, *Aedes* (A.) *varuae*, 5 L; *Armigeres* (A.) *breinli*, 1 p. On the beach, opposite Tahua, MT 7, rat-gnawed coconut husk, with foul contents, *Aedes* (S.) *varuae*, 5 L; *Armigeres* (A.) *breinli*, 4 L, 6 p; *Tripteroides* (T.) *bonneti*, 1 L. Near Kahula village, MT 8, rat-gnawed coconut husk, with foul contents, *Aedes* (S.) *varuae* (T/0201-3), 1 ♂, 2 ♀♀, 5 L, 2 p; *Armigeres* (A.) *breinli*, 6 p. North of Kahula village, MT 9, at edge of flooded area in the bush, shallow waters, with decomposing material, shade, *Aedes* (V.) *lineatus*, 19 L. On the hill's saddle, along shortcut between Kahula and Tahua, MT 10, in a dugout log in the forest full of rain water, with green algae and decomposing leaves, *Culex* (C.) *annulirostris* (T/0205-8), 1 ♂, 3 ♀♀, 7 L, 1 P, 5 p; *Culex* (Loph.) sp. Santa Cruz forms, 2 L. In gardens bordering the beach opposite Tahua, MT, day man-biting in shade, under coconut palms, *Aedes* (V.) *lineatus* (T/0191-4), 4 ♀♀; *Armigeres* (A.) *breinli* (T/0185-90), 6 ♀♀. Tahua Artif I., MT, night man-biting and indoor night-resting, *Anopheles* (C.) *farauti* (T/0209-15), 7 ♀♀ (51 specimens collected in all).

Tikopia

A small (5 km²) island of volcanic origin rising to about 400 m. It is densely populated with 1040 Polynesians in several villages on the low-lying southwestern and southern flat areas. Gardens and coconuts extend high on the slopes. A fresh-

water crater lake, opening to the sea, occupies much of the eastern 1/2 of the island and is surrounded by swampy land.

1952. Ravenga, RF, *Culex* (C.) *annulirostris*, 60 ♀♀; *Aedes* (S.) *hebrideus*, 2 ♀♀ [as *Aedes* (S.) *quasiscutellaris*].

IX.1955. Lake Terota, ST, *Anopheles* (C.) *farauti*.

8.VIII.1956. Matautu, along trail to Lake Terota, DB 22, biting man in daytime, in the open, partial shade, adjacent to DB 31, *Aedes* (S.) *hebrideus*, 3 ♀♀. DB 23, treehole, in shade, *Tripteroides* (R.) *melanesiensis*, 1 ♀. Teifi, nr. trail to Lake Terota, DB 25, coconut shell, in shaded bush, *Aedes* (S.) *hebrideus*, 4 ♂♂, 1 ♀, 18 L, 4 P. Along trail to Ravenga, DB 26, treehole in papaya tree, full sun, *Aedes* (S.) *hebrideus*, 3 ♂♂, 1 ♀, 4 L, 2 P. On trail to Matautu, DB 30, biting man in daytime, partial shade, *Aedes* (S.) *hebrideus*, 2 ♀♀. DB 31, treehole, shade, *Aedes* (S.) *hebrideus*, 2 ♂♂, 3 ♀♀, 8 L, 5 P; *Tripteroides* (R.) *melanesiensis*, 4 ♂♂, 5 ♀♀, 41 L, 4 P. DB 31a, no collection data but presumably Tikopia, *Aedes* (S.) *hebrideus*, 1 ♂, 5 ♀♀, 4 P. Lake Terota, in bull rushes and water lilies on edge of lake, DB 27, *Anopheles* (C.) *farauti*, 1 ♀, 4 L; *Culex* (C.) *annulirostris*, 1 ♂, 3 ♀♀, 10 L, 2 P; *Tripteroides* (R.) *melanesiensis*, 1 P (Belkin 1965: 13, lists as probable erroneous record). Kafika, DB 29, outrigger canoe on beach of village, partial shade, *Aedes* (S.) *hebrideus*, 25 L.

13.XI.1967. Matautu, MM, near the hospital, coconut shell, *Aedes* (S.) *hebrideus*, 3 L. Along the lower course of the Wai Teputa water, treehole in forested garden, *Tripteroides* subg., 5 L., identification tentative, larvae damaged. Poti Mua, MM, behind the village; seepage and small creek, slow running water, *Aedes* (S.) *hebrideus* (identification tentative, larvae damaged), 1 L.

14.XI.1967. Lake Terota, MM, wild taro, swampy edge of the lake, attacking at 1600, *Culex* (C.) *annulirostris*, 6 ♀♀. Potusataumako, MM, near the village, coconut shell, *Aedes* (S.) *hebrideus*, 5 L.

13.VII.1970. Nuku, MT 1, treehole, *Tripteroides* (R.) *melanesiensis*, 18 L. Lake Terota, MT 2, edge of the lake, swampy area, covered with wild taro, *Culex* (C.) *annulirostris*, 9 L; *Aedes* (V.) *lineatus* (T/0256-61), 4 ♂♂, 2 ♀♀, 8 L. Eastern slopes, at mid hill (180 m), MT 3, coconut plantations in forest clearing, coconut half husk, rat-gnawed, with foul contents, *Aedes* (S.) *hebrideus*, 7 L; *Tripteroides* (R.) *melanesiensis*, 2 L. Matautu, behind the hospital, MT 4, very small rainpans on sandy soil; debris, shade, *Aedes* (S.) *hebrideus*, 17 L, 2 P, 2 p; *Tripteroides* (R.) *melanesiensis*, 1 L. MT 5, coconut shell, *Aedes*

(*S.*) *hebrideus* (T/0249-51), 1 ♂, 2 ♀♀, 5 p. Near Matautu, along the trail to Potimoa, MT 6, small rain-water collection in groove on trunk of fallen tree, *Aedes* (*S.*) *hebrideus* (T/0252-5), 4 ♂♂, 11 L. Lake Terota, at lake side, MT, day man-biting in shade, *Aedes* (*V.*) *lineatus* (T/0238-42), 5 ♀♀; *Aedes* (*S.*) *hebrideus* (T/0237), 1 ♀. Western slopes, on the saddle along the shortcut from KoroKoro to the lake, (100 m), MT, day man-biting in shade, *Aedes* (*V.*) *lineatus* (T/0243-4), 2 ♀♀. Aramera, MT, at sea level, near water tank; day man-biting, ♂♂ resting on man, *Aedes* (*V.*) *lineatus* (T/0245), 1 ♀; *Aedes* (*S.*) *hebrideus* (T/0246-8), 1 ♂, 2 ♀♀.

15.XII.1970. YP, T/E0I.3, coconut shell, *Aedes* (*S.*) *hebrideus*, 1 L. YP, T/E0I.4, treehole, *Aedes* (*S.*) *hebrideus*, 3 L.

Anuta

A very small (2.6 km²) island of volcanic origin rising to about 70 m. A population of 157 Polynesians lives in 2 villages on the low-lying southern end. Some swampy areas are maintained for taro growing. There is interesting terraced gardening to the summit of the island with many breadfruit pits containing fresh to extremely foul water.

16.VII.1933. SL, daytime collection, *Aedes* (*S.*) *hebrideus* [as *Aedes* (*S.*) *variegatus*], 22 ♀♀. Night collection, *Culex* (*C.*) *annulirostris*, 5 ♀♀.

18.VII.1933. SL, daytime collection, *Aedes* (*S.*) *hebrideus* [as *Aedes* (*S.*) *variegatus*], 21 ♀♀.

12.VII.1970. Vatsiana, MT 1, 2, coconut shell, *Aedes* (*S.*) *hebrideus* (T/0225-7), 3 ♂♂, 27 L, 3 P. Mid-hill, in gardens, MT 3, small breadfruit pit with fairly clean water, *Culex* (*C.*) *annulirostris* (T/0234-6), 1 ♂, 2 ♀♀, 12 L, 1 P; *Aedes* (*S.*) *hebrideus* (T/0232-3), 1 ♂, 1 ♀, 3 L, 4 P, 6 p. Top of hill, in gardens, MT 4, 4 breadfruit pits, with foul water, *Culex* (*C.*) *annulirostris*, 2 L; *Aedes* (*S.*) *hebrideus* (T/0230-1), 2 ♂♂, 9 L, 2 p. Forested center of the island, MT 5, small, polluted rain-water collection on a stump of *Bisonia grandis* Coppet., *Aedes* (*S.*) *hebrideus* (T/0228-9), 2 ♀♀, 18 L. Day man-biting in shade, ♂♂ resting on man, *Aedes* (*S.*) *hebrideus* (T/0216-23), 2 ♂♂, 6 ♀♀.

NOTES ON SPECIES—TAXONOMY, BIONOMICS AND DISTRIBUTION

Prior to this paper the only summary of the distribution of the various species has been that of Belkin (1962). His summary covered the following islands: Ndeni, Temotu Neo, Vanikoro, Nupani, Fenualoa, Lom Lom and Tikopia. Every one of the major islands has now been visited with the exception of Fataka. To Belkin's list of 12 species we have added 3 definitive species, *Uranotaenia barnesi*, *Culex* (*C.*) *sitiens* and *Aedes* (*Lorrainea*) *dasyor-rhus*. Two possibly new species have also been found [*Aedes* (*Stegomyia*) sp. of the *edwardsi* group and *Aedes* (*S.*) sp. of the *scutellaris* group]. The conspectus (TABLE 1) summarizes the findings in

TABLE 1. Conspectus of the mosquitoes of the Santa Cruz faunal subarea.*

SPECIES	SANTA CRUZ GP.							REEF ISLANDS GROUP												
	SANTA CRUZ IS.							OUTER							INNER					
	Ndeni	Temotu Neo	Temotu Noi	Tinakula	Vanikoro	Utupua	Nupani	Nukapu	Pileni	Matema	Nifiloli	Fenualoa	Temoa	Nende	Ngandli	Lom Lom	Ngawa	Duff Islands	Tikopia	Anuta
<i>Anopheles</i> (<i>Cellia</i>) <i>farauti</i>	+	+	+		+	+										+	+	+	+	
<i>Uranotaenia barnesi</i>	+				+	+														
<i>Culex</i> (<i>C.</i>) <i>quinquefasciatus</i>					+	+														
<i>Culex</i> (<i>C.</i>) <i>sitiens</i>	+	+				+											+			
<i>Culex</i> (<i>C.</i>) <i>annulirostris</i>					+													+	+	+
<i>Culex</i> (<i>Lophoceraomyia</i>) sp.	+				+											+		+		
Santa Cruz forms																				
<i>Aedes</i> (<i>Verrallina</i>) <i>lineatus</i>					+		+											+	+	
<i>Aedes</i> (<i>Lorrainea</i>) <i>dasyor-rhus</i>	+																+			
<i>Aedes</i> (<i>Stegomyia</i>) <i>tulagiensis</i>	+											+	+	+		+				
<i>Aedes</i> (<i>Stegomyia</i>) <i>robinsoni</i>					+	+		+	+							+				
<i>Aedes</i> (<i>Stegomyia</i>) <i>hebrideus</i>	+	+		+		+	+		+		+	+				+	+	+	+	+
<i>Aedes</i> (<i>Stegomyia</i>) <i>varuae</i>	+	+	+		+	+	+	+	+			+	+		+	+		+		
<i>Armigeres</i> (<i>A.</i>) <i>breinli</i>	+	+					+	+				+				+	+			
<i>Tripteroides</i> (<i>T.</i>) <i>bonneti</i>	+	+			+													+		
<i>Tript.</i> (<i>Rachionotomyia</i>) <i>melanesiensis</i>	+				+	+	+					+	+			+		+		
Total no. of species	15	11	6	2	1	10	8	6	3	2	0	1	5	3	1	1	6	5	8	2

*The 2 undescribed *Aedes* (*Stegomyia*) species are not included.

the subarea between 1926 and 1971, [with the exception of the 2 undescribed *Ae. (S.)* species].

Anopheles (*Cellia*) *farauti* Laveran, 1902

With the exception of the Inner Reef Islands, Ngawa and Lom Lom, this species is restricted to the volcanic islands of the subarea which are obviously higher and wetter than the coral atolls. The only volcanic islands on which the species has not been found are Tinakula and Anuta. The 1955 and 1956 findings of *An. farauti* on Tikopia coincided with what appear to be the first outbreaks of malaria on the island (Maffi & McDonnell 1971). Repeated and careful searches in 1967 (Maffi), 1969 (Avery), and 1970 (Maffi & Taylor, Paik) have failed to locate *An. farauti* larvae or adults and this, combined with an apparent decline in the human malaria parasite rate, suggests that the species may have disappeared from the island.

Morphologically the specimens all agree with the description of *An. farauti* from the Solomons proper with no more than the usual variation. The breeding sites were generally typical of those described for the species. In 1 case, on Utupua, 16.VII.1970, we found larvae, in association with *C. sitiens* and *Ae. hebrideus*, in a water collection on a large boulder. The chloride concentration in this water was 108% that of sea water. This was in spite of there being more usual breeding sites (Aboke Creek) only a short distance away where *An. farauti* was also found breeding.

Uranotaenia *barnesi* Belkin, 1953

The discovery of this species on Ndeni, Vanikoro and Utupua fills the gap in the known distribution (Belkin 1962) between the Solomons proper and the New Hebrides. The breeding sites were typical, being in fresh-water jungle (taro) swamps and shallow layers of shaded water on peat soil at the edge of the jungle.

Culex (*Culex*) *quinquefasciatus* Say, 1823

The main findings of this species have been at the now-abandoned timber camp of Peuo on Vanikoro, by Bonnet in 1956 and by Parsonson in 1964. This was the only place where overseas shipping regularly called and the occurrence of *C. quinquefasciatus* there is not surprising. More unexpected is the report by Parsonson in 1964 of the species on Utupua. It is not clear from Parsonson's letter to us whether this was on board ship (he notes collecting *An. farauti* biting 46 m, i.e., 50 yards, offshore) or ashore. Our findings (BT) are that this species is not uncommon on board the small ships of the Solomons. We did not find this species on Utupua.

Culex (*Culex*) *sitiens* Wiedemann, 1828

The presence of *C. sitiens*, here reported for the first time in the subarea, is not surprising since the species is extremely widespread in Old World tropical regions and through much of the South Pacific area as far east as Tonga. The finding of larvae in a rock pool with a very high salinity, as commented on above for *An. farauti*, confirms Lever's note (1944b in Belkin 1962) of larvae developing to maturity in undiluted sea water. It is perhaps worth noting that 3rd-instar larvae of *C. sitiens* can be misidentified as *Culex (C.) roseni*, a species known only from the Society Islands (Belkin 1962). Both J. S. Pillai, in identifying Parsonson's 1964 collections, and one of us on initially identifying the 1970 collections, appear to have erred in the same way. Belkin (pers. commun.) expressed the view that the *C. roseni* identifications were 3rd-instar *C. sitiens*. The July 1971 collection (BT) from Santa Cruz airfield, north side, was carefully examined with Belkin's view in mind and, although the 3rd-instar larvae show several of the characters of *C. roseni* as illustrated by Belkin (1962), the 4th-instar larvae are all of the *C. sitiens* type. The larvae previously identified as *C. roseni* were all associated with *C. sitiens* larvae.

Culex (*Culex*) *annulirostris* Skuse, 1889

This is a very widespread species throughout the South Pacific but the findings in the Santa Cruz subarea are only from the most eastern islands, viz., the Duffs, Vanikoro, Tikopia and Anuta. The larval habitats are quite typical, varying from the fresh to brackish waters of Lake Terota on Tikopia and the fresh to foul water of the breadfruit pits on Anuta to a semi-built dugout canoe, full of rain water with decomposing leaves, on Taumako (Duff Is.). Among the larvae collected at Buma, Vanikoro (MM) in 1967, was one infested with *Coelomomyces* sp. (Maffi & Genga 1970). This was the first known finding of this type of parasite in mosquito larvae in the Santa Cruz-New Hebrides area.

Culex (*Lophoceraomyia*) sp. Santa Cruz forms

These forms remain represented by a comparatively few specimens and we have nothing to add to Belkin's (1962) comments.

Aedes (*Verrallina*) *lineatus* (Taylor, 1914)

This species is an abundant and vicious man-biting species on Nupani, the Duffs and Tikopia. We did not collect it on Vanikoro although Lever (1934) reported it as occurring there and Bonnet found the species breeding in a 208-liter (55-gal.)

water drum. Our findings of larvae were more typically in swampy areas.

Aedes (Lorrainea) dasyorrrhus King & Hoogstraal, 1946

The findings of this species on Ndeni and Ngawa are the first outside the Solomons proper in the South Pacific. Both the larval collections were from holes on trees near to the sea and the 1 adult female was trapped biting in a mangrove area. This female shows lateral tergal abdominal light spots which are noted by Belkin (1962) as being present on New Guinea specimens but not on Solomons specimens.

Aedes (Stegomyia) tulagiensis Edwards, 1926

This species is far more abundant than the earlier records indicate. It has now been found on most of the islands of the Reef group as well as on Ndeni. The 2 adult specimens reared by Horoto agree in all respects with the description by Belkin (1962). Larvae were collected from tree-holes and from rain-water containers such as 208-liter (55-gal.) drums.

Aedes (Stegomyia) robinsoni Belkin, 1962

The finding of this species by Bonnet in 1956 is affirmed by our collections and its range extended both on Utupua and to the sister island of Vanikoro. Larvae were found in a coconut husk in association with *T. melanesiensis*, in a coconut shell in association with *Ae. varuae* and in a 167-liter (44-gal.) drum of rain water in association with *T. melanesiensis* and *Ae. varuae*. The specimens all conform to the description given by Belkin (1962).

Aedes (Stegomyia) sp. in edwardsi group?

Individual rearings of larvae from a large tree-hole at the Graciosa Bay water point (near Palo by BT, 27.VII.1971) indicate a possible 3rd species within the *edwardsi* group. The adults (1 ♂, 2 ♀♀), when compared with specimens of *Ae. tulagiensis* (reared by Horoto from Tonga, Fenualoa, Reef Is., 1.X.1970), have a much smaller median oval patch of narrow silvery white scales on the anterior mesonotum and no whitish or yellowish scales in the supraalar area. In this respect they more closely resemble *Ae. robinsoni* as given by Belkin (1962) but the ♂ genitalia show a strong affinity with those of *Ae. tulagiensis*. One of the 2 ♀♀ shows white basal patches on all fore- and mid-tarsi as well as the usual basal white rings on hind tarsi 1 to 4 with 5 being all white. Other taxonomic characters such as details of the pupal chaetotaxy differ from those of both the recognized species.

Aedes (Stegomyia) hebrideus Edwards, 1926

We have little to add to Belkin's (1962) comments on this species except to note that our findings have added to the list of islands on which the species is known to occur. The finding of specimens in a rock pool with a high salinity appears to be a first record of this type of breeding site, although elsewhere (e.g., Rennell I.) we have found larvae in rock pools containing fresh to slightly brackish water, as did Buxton & Hopkins (1927) in the New Hebrides. On Nupani I. the species was found infected with *Coelomomyces*; this was the 1st record for the area and the 2nd for the species (Genga & Maffi 1973, Laird 1956).

Aedes (Stegomyia) varuae Belkin, 1962

The findings reported in this paper considerably add to the knowledge of the distribution of this species. On 8 islands in the subarea both *Ae. hebrideus* and *Ae. varuae* are found. The 2 species were found breeding in association on 6 occasions. We have taken no specimens of *Ae. varuae* in the act of biting, which is the same as found by Bonnet, although Parsonson says he collected *Ae. varuae* biting on Vanikoro, Utupua, Pileni and the Duffs.

Aedes (Stegomyia) sp. scutellaris group?

Several adults, both captured as imagos and reared from pupae collected from a coconut shell, from Asumbao, Utupua, show constant characters which separate them from the *Ae. hebrideus* and *Ae. varuae*. The main points of difference are as follows: from *Ae. varuae* the ventral surface of the hindfemur is dark for the apical 1/2, from *Ae. hebrideus* the hindtarsus segment 4 is silvery on the basal 0.6 only and segment 5 is dark apically on all surfaces. Other differences, such as a few light scales at the base of foretarsus segment 3 and, on the wing, a conspicuous basal silvery spot at the base of the costa, also separate the species from *Ae. hebrideus* and *Ae. varuae*. Finally a study of the ♂ genitalia shows differences from both the other species, especially in the form of the claspette. The *Ae. scutellaris* complex throughout the South Pacific commonly shows cases of endemic forms limited to only a single island or a very few islands and this form would seem to be an example of endemism.

Armigeres (Armigeres) breinli (Taylor, 1914)

Prior to this paper *Ar. breinli* had been reported only from Temotu Neo and Nupani. Our collections extend the range to several other of the Reef Islands as well as Ndeni (Santa Cruz) and the Duff Islands. As is the case wherever this species is found, the ♀♀ savagely attack man as soon as he

enters shaded areas under coconuts. On only 1 occasion was the species found breeding in anything other than decaying coconuts and this (by Horoto at Taepe, Santa Cruz Is.) was in dirty water in a wooden pig bowl which could be likened to a large rotting coconut.

***Tripteroides (Tripteroides) bonneti* Belkin, 1962**

Prior to this paper *T. bonneti* had been known from only a single ♂ specimen reared from a pupa found on Temotu (Temotu Neo) by Bonnet in 1956. We made collections of what we take to be this species, despite having no rearings of ♂ specimens on Vanikoro, from a large treehole at Buma (larvae, pupae and reared ♀♀), and on Taumako I. (Duff Is.) from a treehole (larvae, pupae and a reared ♀), and from rat-gnawed coconut husks with foul contents (larvae, twice) and a coconut spathe (larvae). Parsonson also reports having collected larvae in a dugout canoe at Graciosa Bay (Santa Cruz I.). It should be pointed out that, as no individual rearings from larvae have been made and as the larva is undescribed, the specimens we collected can only be attributed to this species on the basis of larvae associated with pupae which match Belkin's (1962) description. Belkin has indicated to us (in litt.) that he believes our specimens of *Tripteroides (T.)* from the Duff and Vanikoro are probably *bonneti*. We must point out that our specimens do not fit the diagnostic characters used by Belkin in his key (1962) and they also differ in some ways from his description. However, we are dealing with ♀ specimens only and sexual differences may be expected. It is unlikely that a 2nd species of *Tripteroides (T.)* is present in these isolated islands although such a possibility cannot be ruled out.

***Tripteroides (Rachionotomyia) melanesiensis* Belkin, 1955**

There is little we can add to Belkin's (1962) observations regarding this species. We found it to be present on several islands (Ndeni, Utupua and Temoa) where it had not previously been recorded. The variety of forms presented by the larval stage of this species was first commented on by Buxton & Hopkins (1927) and has been stressed and analyzed, in part, by Belkin (1962, referring to his 1955 paper).

CONCLUSIONS

The Santa Cruz subarea is considered by Belkin (1962) to be possibly the most critical area for an understanding of dispersal of mosquitoes in the

South Pacific.

Of particular note in our collections are the findings of *Aedes (L.) dasyorrrhus* and the possible further endemic forms of the *edwardsi* and *scutellaris* groups of *Aedes (Stegomyia)*. The presence of *Aedes dasyorrrhus* is interesting as the nearest distribution is in the Solomons proper, including Malaita and San Cristobal. This species breeds in treeholes in mangrove swamps and beach areas and it seems possible that dispersal to the Santa Cruz subarea could have been by eggs carried on trees floating from the eastern Solomons. However, the ocean currents in this area of the South Pacific are poorly understood. We can add little to Belkin's comments (1962, 1965) on the *edwardsi* group but the more recent study of the *scutellaris* group in South-east Asia by Huang (1972) shows several species which, particularly in details of the male genitalia, appear to have closer affinities with the Santa Cruz *edwardsi* species than do the South Pacific *scutellaris* group species. Rather than look for an origin of the *edwardsi* group as hybrids between the *albolineatus* and *scutellaris* groups, we feel that the preservation of the *edwardsi* group as relict forms of what may be the ancestral stock of the *scutellaris* group is perhaps more plausible. The absence of any member of the *albolineatus* group from the subarea coupled with the absence of any form resembling the *edwardsi* group in areas where both the *albolineatus* and *scutellaris* groups are present may also be significant.

The number of known forms within the *scutellaris* group continues to increase as more detailed studies of the group on isolated islands are made. The group seems especially prone to endemism with the more widespread species possibly owing their distribution to human migrations particularly among the Polynesian peoples.

Bearing in mind Belkin's puzzlement at the absence of members of the *Aedes (Finlaya) kochi* group from the subarea, since it is well represented in the Solomons and the Fiji-Tonga-Samoa area, we searched pandanus axils on Ndeni but these yielded no mosquito specimens.

There is clearly still scope for mosquito studies in the subarea but, with the exception of Ndeni, where there is now an established Government station and airfield, the islands remain remote and techniques such as individual rearings are difficult to complete under small-ship conditions.

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