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THE MOSQUITOES (DIPTERA, CULICIDAE) OF VANUATU. A FURTHER CONTRIBUTION

M. MAFFI

Additional to a previous contribution (1977) the author reports on the mosquito fauna of the Ripablik Blong Vanuatu, Southwest Pacific. Mainly of aquatic stages, 103 collections, done during a sequence of brief field trips to 7 major islands (Maewo, Ambai, Pentecost, Ambrym, Tongoa, Efate, Erromango) and 2 islets off Efate (Ifira, Iririki), yielded 1.137 specimens, viz 824 larvae, 25 larval pelts, 230 pupae, 27 pupal pelts, 25 female adults and 6 male adults. New first record by island amount to 14. On the specimens of genus *Tripteroides* (2 species known in Vanuatu) will be reported later. Of the remnant 20 mosquito species reported in the past from Vanuatu, 13 were collected: the findings are listed by locality and by species. Some comments on systematics, bionomics and disease relation are added.

INTRODUCTION

Bibliography and information on Vanuatu – former New Hebrides – may be found, up to 1977, in Maffi and Taylor (1977) and in Maffi (1977), and since in *The Culicidae of the Australasian Region* and in the papers by Ratard (1979), Thevasagayam (1980) and Liang (1983). On *An. farauti* No. 1 – the only anopheline in Vanuatu, and the malaria vector – a wealth of indirect evidence is available: from the genetic investigations by Bryan (1970) and Bryan and Coluzzi (1971) on to the papers by Charlwood (1986) and Charlwood & coll. (1984 a, b; 1985 a, b; 1988), mainly on bionomics.

MATERIALE AND METHODS

The collections are reported island-by-island and by species. Each collection has a code number (date/ serial number for that day). Abbreviations for genera and subgenera of mosquito species are as by Reinert (1975), identifications are as in Belkin (1962). Symbols are L = larva, l = larval pelt, P = pupa, p = pupal pelt, f = female adult, m = male adult. When in the field, adults were stored in pill-boxes and later pinned, aquatic stages kept in formalin 4% and later mounted in phenol-balsam, after clarifying in chloral-lactophenol. Imagos are given as: attacking in the open (a.o.); spontaneously

Permanent address: Via Lombardia, 72 16030 CAVI (GE), Italia

emerging (s.e.); individually reared (i.r.). Except for the aquatic specimens of the genus *Tripteroides*, temporarily retained for further study, all the specimens will be deposited with the Bishop Museum, Honolulu, Hawai'i, U.S.A.

COLLECTIONS

A) Island-by-island

MAEWO I. Central western coast. 870103/1, just above Kerepei village, in fresh water canal, slow moving, at grassy edges, sun-shade: *An. (Cel) farauti*, 4 L.; 870104, along field trip inland of Kerepei: /1, between Rongonawo (120)° and Umolongo (140), in bamboo stubbles, foul contents: genus *Tripteroides*, 20 L, 5 P, 2 p, 2 ff (i.r.)°°; /2, at Maeto (370), shallow still water in taro beds, sun-shade, mats of green algae: *Cx. (Cux) starckeae*, 2 L; /3, ibid., id.: *Cx. (Cux) starckeae*, 2L, 2 P; /4, at same place of 870103/1: *An. (Cel) farauti*, 1 P; /5, right bank of T. Kerepei, upstream the village, in abandoned small concrete basin for water reserve, floating leaves: *An. (Cel) farauti*, 13 L.870105, on coastal road to north: /1, inland of Nandunga village, in taro beds, green algae: *An. (Cel) farauti*, 2 L; /2 at Nandunga, id: *An. (Cel) farauti*, 5 L; /3, near house at Titiro village, in shrapnel-shaped concrete water store: *Ae. (Stg) hebrideus*, 3 L, genus *Tripteroides* 1 L, 1 P; /4, south of Naonéoné, in ample shallow ground pools, heavily polluted, sunny, grassy edges: *Cx. (Cux) annulirostris*, 6 L, 1 l, 1 P; /5, ibid, along nearby rivulet, slow waters, mats of green algae: *Cx. (Cux) annulirostris*, 1 L, *Cx. (Cux) starckeae*, 2 L, 4 P; /6, ibid,. ground pool, fairly clear still waters, grassy edges: *An. (Cel.) farauti* 4, L, *Cx. (Cux) quinquefasciatus*, 1 P, *Cx. (Cux) annulirostris*, 2 L; /7, at Vatrowa, in small concrete basin in courtyard, rain-water and leaves: *Ae. (Stg) hebrideus*, 3 L; /8, north of Vatrowa,in coconut husk full of water on the bed of a slow moving small stream: genus *Tripteroides*, 39 L, 7 P; /9, near Vatu Ulowulowanga, shallow still waters, green algae: *Cx. (Cux) quinquefasciatus*, I P, *Cx (Cux) annulirostris* 5 L; /10, south of Naoné, coconut husk, foul waters: *Ae. (Stg) hebrideus*, 1 P, 1 p, genus *Tripteroides*, 28 L, 8 P.

AMBAI I. (formerly Aoba I.) *Eastern end.* 870102 and 870106. Strikingly different from past experience (Maffi, 1977: 710714/5 and 710706/3-/8) repeated dippings in Lake Waï Lambutaga and Lake Waï Méméa – now teaming with larvivorous Gambusia fishes – yielded negative results. 870106/1, at the forested fringe of Lake Waï Méméa, attacking at 10 a.m., *Ae. (Stg) aobae*, 1 f, *Ae. (Stg) hebrideus* 4 ff. 870107/1, at Vureas School, in small superficial well dug into rock near sea, abandoned, scarce water (brackish?): *An. (Cel) farauti*, 4 L, *Cx. (Cux) quinquefasciatus*, 16 L, 1 l, 12 P; /2, ibid., in shrapnel- shaped water tank (similar to 870105/3) near house: *Ae. (Stg) hebrideus*, 1 L, 1 l, 1 P, genus *Tripteroides*, 2 L; /3 *Northern coast, eastern half, inland,* near Lolovinué (300), in forest, in large treehole, 50 cm above ground, clear rain-water, leaves: genus *Tripteorides*, 6 L; /4 Eastern end, below Torgil School (locality Tumisiro), in forested area inland of coastal dune, in shallow ample ground collections, brackish?, shaded, leaves: *Cx. (Cux) annulirostris*, 1 L, *Ae. (Ver) lineatus*, 6 P, *Ae. (Adm) nocturnus* 6 L, 7 P, 1 p; /5, ibid., id.: *An. (Cel) farauti*, 5 L, *Cx. (Cux) annulirostris*, 3 L, *Ae. (Adm) nocturnus*, 6 L, 4 P; /6, ibid., id: *An. (Cel) farauti*, 3 L, *Cx. (Cux) quinquefasciatus*, 1 L, *Ae. (Adm) nocturnus* 2 L; /7, ibid., id.: *An. (Cel) farauti*, 9 L, *Cx. (Cux) annulirostris*, 3 L, *Ae. (Ver) lineatus*, 6 P, *Ae. (Adm) nocturnus*, 7 L, 5 P; /8, ibid., id.: *An. (Cel) farauti*, 3 L, *Cx. (Cux) quinquefasciatus*, 1 p, 1 f (i.r), *Cx. (Cux)* unspecified, 1 f (s.e.)°, *Ae. (Ver) lineatus*, 7 P, *Ae. (Adm) nocturnus*, 7 L, 5 P; /9, ibid., id.: *An. (Cel) farauti*, 1 L, *Cx. (Cux) quinquefasciatus*, 1 L, *Cx. (Cux) annulirostris*, 1 L, *Cx. (Cux)* unspecified, 1 f (s.e.)°°, *Ae. (Ver) lineatus*, 1 L, 1 P, *Ae. (Adm) nocturnus*, 4 L, 3 P; /10, ibid., attacking viciously in shaded forest, at 3 p.m.: *Ae. (Ver) lineatus*, 1 f, Aedes, subgenus undet., 3 ff°°°. 870108/1, Loloway, raniwater in stranded boat, leaves: *Cx. (Cux) pacificus*, 2 L, *Cx. (Cux) quinquefasciatus*, 9 L 1 P, *Cx. (Cux) annulirostris*, 1 L, 1 p, *Ae. (Stg) hebrideus*, 5 L, 1 P, 5 p.

PENTECOST. I. West coast, central part. 870109/1, south of Vanu village, along the coastal road,

° Figures in brackets give the altitude above sea level, in metres.
°° 18 (see B. Taylor, 1989).

°, °°, °°° Respectively 30, 31 and 33 ii-iv (see B. Taylor, 1989).

in treehole: *Ae. (Stg) aobae*, 15 L, *Ae. (Stg) hebrideus*, 9 L, 2 l, 3 P, *Ae. (Stg) pernotatus*, 3 L; /2, ibid., at grassy edges of flowing rivulet, sun-shade: *An. (Cel.) farauti*, 11 L, 1 P, *Cx. (Cux) annulirostris*, 8 L. 870110/1, along partially dry bed of steep small stream south of Ranmawat Hospital, in residual rocky pools. abundant leaves at bottom: *An. (Cel) farauti*, 15 L, 4 P, *Cx. (Cux) annulirostris*, 3 L, 2 P; /2-/5, during a field trip upstream the Malsisi T. and its valley, viz: /2, in dried bamboo stubbles (150): *Ae. (Stg) hebrideus*, 1 L, *Ae. (Stg) pernotatus*, 1 L, genus *Tripteroides*, 6 L, 1 P; /3, above Policarpe's taro gardens (250), in ample pool below cascade, in running clear cold waters, amongst rocks in the sun, a few algae: *Cx. (Eum) femineus*, 3 L, 1 P; /4, at 240, below Salwol village (280), in coconut shell, foul water and decaying meat: *Cx. (Cux) pacificus*. 4 L, *Ae. (Stg) hebrideus*, 1 L, genus *Tripteroides*, 1 L; /5, nearby, id: *Cx. (Cux) pacificus*, 10 L, 2 P, *Ae. (Stg) hebrideus*, 1 L, genus *Tripteroides*, 3 L. 870111/1, in Vanu (see 870109/2), upstream, in lateral shallow pools, grassy edges, leaves at bottom, sun-shade: *An. (Cel) farauti*, 1 L, 2 l, 4 P; /2, at inland fringe of the beach, along the coastal road, below Ranwadi School (Church of Christ), in stranded boat residual rain-waters, abundant leaves at bottom: *Cx. (Cux) pacificus*, 7 L, *Cx. (Cux) quinquefasciatus*, 5 L, *Ae. (Stg) hebrideus*, 7 P; /3, ibid., in other boat, id.: *Cx. (Cux) quinquefasciatus*, 5 L, *Ae. (Stg) hebrideus*, 12 L, 5 P. 870112/1-/4., along coastal road from Ranmawat to Baravet village, viz: /1, south of Levsendam village, in slow flowing clear waters of taro creek crossing the road, sun-shade, algae: *An. (Cel) farauti*, 8 L, 3 l, 3 P; /2, south 1 km, in swampy area inland the coastal dune, with slow moving waters, mainly shade, with taro and/or pandanus: *An. (Cel) farauti*, 5 L; /3, inland of coastal dune near Whitewater, in residual still water of a nearby dry stream, sun, green algae: *An. (Cel) farauti*, 4 L; /4, south of Suu, not far form the sea, in ample, shallow ground pool (for watering cattle?), grassy edges, green algae, sun-shade: *An. (Cel) farauti*, 14 L, *Cx. (Cux) annulirostris*, 4 L; /5, at Ranmawat Hospital, near guests' building, in concrete cylinder for water storage, lid missing, cool waters: *Ae. (Stg) hebrideus*, 26 L. 870113/1-/6, on western coastal road, southern section, viz: /1, south of Wali, along T. Walap, near to the sea, in still sun-shaded water collection on the right bank, muddy bottom with leaves: *An. (Cel) farauti*, 1 L, 1 P, *Cx. (Cux) annulirostris*. 6 L, 2 l; /2, attacking in the open at 10 a.m.: *Ae. (Ver) lineatus*, 2 ff; /3, upstream small creeck north of Arangamaot village, above native garden (30), in bamboo stubbles: genus *Tripteroides*, 3 L; /4, north of Pamharar village, along T. Wawol, near to the sea and inland of the coastal dune, in still shallow waters of lateral ground pools, grass and dead leaves, sun-shade: *An. (Cel) farauti*, 10 L; /5: nearby, attacking in the shade at 12 a.m.: *Ae. (Stg) hebrideus* 1 f; /6 near Rabsubmel village, in ample ground pool for watering cattle, still shallow unclean waters, grass and dead leaves, sun-shade: *An. (Cel) farauti*, 5 L. 870114/1, Ranmawat Hospital, as in 870112/5: *Ae. (Stg) hebrideus*, 5 L; /2, below Ranmawat Hospital, inland of coastal road just south, in caves, attacking at 9 a.m. almost in darkness: *Ae. (Stg) aobae*, 1 f; /3, just outside the caves, in garden, at 10 a.m.: *Ae. (Stg) aobae*, 4 ff.

AMBRYM I. Southeastern part. 870114/4, coastal part west of Utas village, in clear slow moving waters of a small stream (= Vanueimamelit): *Cx. (Eum) femineus*, 4 L, 1 P; /5, ibid. but nearer to the sea, in ample ground pooling – with shallow still waters and leaves at bottom – of another stream (Bwalsalwei): *An. (Cel) farauti*, 1 L, *Cx. (Cux) annulirostris*, 2 L, 8 P, 1 m (i.r.). 870115/1-/15, on the *southern coast, west of Pawé village*, upstream the T. Erate for about 2 km, starting from the estuary, viz: /1, 100 m inland the coastal dune, on black ashy ground, in a sunny tiny pool, some couch: *An. (Cel) farauti*, 1 L; /2, 100 m upstream, small shallow sunny pool on black-reddish ashes, submerged and floating leaves: *An. (Cel) farauti*, 7 L, 5 P; /3, small pool on reddish clay ground, adjacent to the rocky bank, shaded: *An. (Cel) farauti*, 1 L, *Cx. (Cux) annulirostris*, 2 L; /4, as /3, but wider and deeper, submerged and floating leaves and debris: *An. (Cel) farauti*, 4 L, 1 l, 6 P; /5, at 300 m from /1, similar to /4 but larger and deeper, abundant floating leaves: *An. (Cel) farauti*, 1 L, 3 P, *Cx. (Cux) quinquefasciatus*, 1 P, *Cx. (Cux) annulirostris*, 3 L, 1 l, 8 P; /6, ground pool 2 m x 1 m, on sandy-rocky ground, 0,5 deep, sun-shaded, submerged and floating leaves: *An. (Cel) farauti*, 8 L, 3 P; /7, divided from /6 by basaltic diaphragm but similar: *An. (Cel) farauti*, 3 L; /8, farher upstream, in forested gully south of coastal road, in coconut husk, clear yellowish water: *Cx. (Cux) pacificus*, 9 L, genus *Tripteroides*, 9 L; /9, ibid. farther up, id.: *Cx. (Cux) pacificus*, 3 L, 1 P, genus *Tripteroides*, 11 L; /10, ibid. just below coastal road, id.: *Cx. (Cux) pacificus*, 3 L, 13 P, *Ae. (Stg) hebrideus*, 1 P, genus *Tripteroides*, 1 L; /11, upstream of coastal road (30), along dry bed of torrent, on basaltic rocks emerging from ashy ground, in a small pool, sun-shade, submerged and/or floating leaves: *An. (Cel)*

farauti, 7 L, 1 P, *Cx. (Cux) annulirostris*, 13 L; /12, farther but similar: *An. (Cel) farauti*, 3 L, *Cx. (Cux) annulirostris*, 8 L, 1 l, 1 P; /13, farther up (50), similar: *An. (Cel) farauti*, 4 L, 1 P, *Cx. (Cux) annulirostris*, 4 L, 2 l, 6 P; /14. up (70), similar but clearer waters, shaded: *Cx. (Eum) femineus*, 5 L, 1 P; /15, at (80), similar: *An. (Cel) farauti*, 6 L, 1 P, *Cx. (Eum) femineus*, 5 L, 5 P. 870116/1-/5, at the *southeastern tip of the island* viz: /1 south of Pamal village, from coastal road upstream T. Pamal, in gnawed coconut, foul water: genus *Tripteroides*, 35 L, 1 P, 1 p; /2, farther up, id.: *Ae. (Stg) hebrideus*, 1 P, 1 p, genus *Tripteroides*, 20 L; /3, farther up, id.: genus *Tripteroides*, 25 L; /4, on left bank, near uninhabited country house, in jerrican with clear water: *Ae. (Stg) hebrideus*, 2 L, 1 p, genus *Tripteroides*, 5 L, 1 P; /5, at Pamal village's beach, residual rain-water in canoe: *Ae. (Stg) hebrideus*, 12 L.

TONGOA I. Western part. 870121/1, below Lupaléa village, along the steep T. Narivavanga, basin in concrete (6 m x 2 x 0,3 – present water level –) for catching water, open, submerged and floating leaves, green algae: *Cx. (Cux) annulirostris*, 2 L, 1 P; /2, in tiny basin hewn in tufa wall, shaded, in locality Maturuturu (near /1): *Cx. (Cux) pacificus*, 1 L, *Cx. (Cux) sitiens*, 1 L; /3, S of Panita village, at inner fringe of beach, in clear water into a drum dug into the sand: *Cx. (Cux) quinquefasciatus*, 1 L, 1 P, *Cx. (Cux) annulirostris*, 7 L; /4, on the beach of Lambukuti village, brackish water in stranded canoe: *Cx. (Cux) sitiens*, 11 L, *Cx. (Cux) annulirostris*, 1 L. 870122. On the southern slopes of Mt. Mbutumbutu: /1 in tiny clear, shaded, dripping water collection hewn on tufa wall, at Viradoni (250): *Cx. (Cux) annulirostris*, 1 P; /2, at Siminatom (220), in open ground pool, clear waters, submerged and floating leaves, shaded in part: *Cx. (Cux) quinquefasciatus*, 1 P, *Cx. (Cux) annulirostris*, 7 L, 1 P; /3, at Simbiit (165), open pool as /2: *Cx. (Cux) annulirostris*, 13 L, 2 P, 1 p; /4, at Bongabonga village (*southwestern end* of island), in ground water-tank: *Ae. (Stg) aegypti*, 3 L; /5, at Simat campement (*southeastern part*), clear water in jerrican: *Ae. (Stg) hebrideus* 1 L; /6, at Alolo, near Eré village (*western coast*), in bamboo stubbles: genus*Tripteroides*, 5 L. 870123/1, after a field trip on the steep northern slopes of Mt. Tafa Ni Urata – *centre* of Tongoa I. – and its water collections yielded negative results, at Pélé village (50), east of airport, in a 170-litre drum, clear cool rain-water: *Ae. (Stg) aegypti*, 5 L, 1 l, 1 p.

EFATE I. Area of Port Vila. 870118/1, at Malapoa Promontory, Black Sands, along the right bank of T. Tagabé mouth, light forest, in crabholes, brackish? *Cx. (Cux) quinquefasciatus* 1 p, 1 f (i.r.), *Cx. (Cux) sitiens*, 1 P; 870126/1, on left bank of T. Tagabé, downstream of pumping station (Ohlen), in shallow, sun-shade, taro ground pools: *An. (Cel) farauti*, 3 L, *Cx. (Cux) annulirostris*. 5 L.

IFIRA I. Port Vila Bay, Efate I. 870125/1, Nokosake village, in 170-litre drum, clean shaded fresh water: *Cx. (Cux) quinquefasciatus*, 1 L, *Ae. (Stg) aegypti*, 5 L, 6 p, 2 mm (1 s.e., 1 i.r.); /2, locality Tasilapa (used for dumping), in tin: genus *Tripteroides* 5 L, 2 P; /3, ibid., in discarded paper-box, clear water, shade: *Ae. (Stg) hebrideus*, 5 L, 3 P, 1 p, 1 m (i.r.), *Ae. (Stg) pernotatus*, 1 L.

IRIRIKI I. Port Vila Bay, Efate I. 870117/1, at sea landing spot, at beach's inland fringe, in discarted tin, rain- water, leaves: *Ae. (Stg) hebrideus*, 10 L, 6 p, 1 m (s.e).

ERROMANGO I. Southeastern coast. 870127/1, at Melvi hamlet, north of Ipota village, in discarded tin, dirty rain- water: genus *Tripteroides*, 1 L; /2, Ipota, near river's estuary, in discarded well, foul, brackish?, debris: *Cx. (Cux) sitiens*, 3 L, *Cx. (Cux) annulirostris*, 4 L, 1 P. *Southwest coast*, 870129/1, Pongkil village, in huge treehole 1 m from ground, foul water and submerged leaves: genus *Tripteroides*, 1 L; *Central west coast*, upstream William R., /1, east of Unpongkor village, upstream of small concrete dam, clear water gently moving, sun: *An. (Cel) farauti*, 11 L, 2 l, 2 P; /2 near /1 but shaded by water-lilies: *An. (Cel) farauti* 2 L, 1 l, *Cx. (Cux) annulirostris*, 6 L; /3, right bank of river, in ample pools, shaded at grassy edges: *Cx. (Cux) annulirostris*, 5 L; /4, ibid., id. but small and *Pistia*: *Cx. (Cux) annulirostris*, 3 L; /5, ibid., id. but larger, floating debris: *Cx. (Cux) annulirostris*, 4 L; /6, locality Unwatson, right bank of slow moving waters, abundant mats of submerged and floating brownish algae and weeds: *An. (Cel) farauti*, 19 L, 4 l, 4 P; /7, river crossing at Salipuni, still waters, grassy edges: *An. (Cel) farauti*, 1 L, 1 l, 2 P; /8, upstream T. Nuitnaiwumen (local name) – right affluent of R. William – in still waters with water-lilies: *Cx. (Cux) annulirostris*, 4 L. 870131/1, near Unpongkor village, in *Poinciana* treehole, clear contents, leaves: *Ae. (Stg) aegypti*, 4 P, 1 p, *Ae. (Stg) pernotatus*, 2 L.

B) By species

Anopheles (Cellia) farauti Laveran 1902.

In the unusual climatic conditions of a long dry spell prevailing in January 1987, the species – considered *farauti* No. 1 (Bryan, 1981) – was showing the wide adaptability of its aquatic stages to varied breeding places. Never in containers. Often associated with other species, mainly culicine.

The species appears widespread on coastal areas. Considering Buxton's difficulties in finding it (1927: 67,68) it can well be assumed that the growing presene of man and cattle, and the related changing ecologies, have greatly favoured the species. Its altitudinal limits continue to be under 100 metres, the only exceptions in literature being those by Daggy (1945) and Laird (1955).

The fact that in spite of apparently suitable breeding places available the species could not be found in Tongoa I. corroborates the consistently negative results reported by past investigators. Indeed the only exception are the 19 female adults reported in indoor captures by Oddo and Chang (1971).

Culex (Culex) pacificus Edwards 1916

Apparently the species was feeling the impact of the adverse breeding conditions resulting from a long dry spell: aquatic stages were found in unusual places like a stranded canoe (870111/2) or a tiny basin hewn in a tufa wall (070121/2).

Amongst the islands of the southern half of Vanuatu group proper it is only from Tanna that *pacificus* has been reported, up to now. No doubt, more thorough investigation will fill the vacuum.

First record for Tongoa[(o)].

Culex (Culex) quinquefasciatus Say 1823.

Aquatic stages were collected from ground pools and ditches, and from large containers, up to 250 m.a.s.l. (870122/2); unusual breeding in crabhole (870118/1). First record for Maewo, Pentecost, Ambrym, Tongoa and Ifira.

Culex (Culex) sitiens Wiedemann 1828.

Unusual the breeding in a tiny basin hewn in a tufa wall to collect water, on Tongoa (870121/2). First record for Erromango and for Tongoa°.

Culex (Culex) annulirostris Skuse 1889

This ubiquitous species has been found, associated often with other species, in a wide array of breeding sites. Interesting the differences in siphon length. First record for Tongoa, Iririki and Ifira.

Culex (Culex) starckeae Stone & Knight 1958

Findings of aquatic stages of the species on Maewo only – first record –, both at sea level (870105/5) and in the highlands, at 370 m.a.s.l. (870104/2 & /3). Constant presence of mats of filamentous green algae.

Culex (Eumelanomyia) femineus Edwards 1926

With the single exception of a breeding site in still water on a dry basaltic river bed (870115/14 & /15) always collected in running waters.

Aedes (Verrallina) lineatus (Taylor 1914)

Collected only on Ambai (870107/4, /7, /8 & /9), associated with several species. Probably under the pressure of the extended dry season.

° Buxton & Hopkins (1927) clearly refer to two different localities when they relate about malaria on Tongoa I., Shepherd group, (p. 226) and about medical entomology on Tangoa, a small islet off the southern coast of Espiritu Santo (Text-fig. 14, p. 70). Indeed, Rageau & Vervent (1958) relate on Buxton & Hopkins's entomological findings as from Tangoa.

Belkin, however, in his fundamental book (1962), labels (vol. II, p. 24) the island which is usually called Tongoa as Tangoa. In addition, in the text (vol. I), under the heading «Distribution» Belkin consistently refers to Tangoa, and there is no mention at all of a Tongoa.

On the assumption, quite logical, that Belkin's Tangoa is actually Tongoa, my claims of first record – those marked (°) – are null.

Aedes (Aedimorphus) nocturnus (Theobald 1903)

As the previous species, this has been collected only on Ambai, and in the same area, associated with other species (870107/4- /9).

Aedes (Stegomyia) aegypti (Linnaeus 1762)

Typically, the aquatic stages were collected from 170-litre drums, near houses, on Tongoa° and on Ifira; and from a *Poinciana* treehole on Erromango. The spreading of this species continues to be slow, and is probably hampered by the widening use at the village level of the community water-tap, and the consequent discarding of the drums.

Aedes (Stegomyia) aobae Belkin 1962

As in the findings of previous years (Maffi, 1977: 710710/8), aquatic stages of this species were collected along the central part of the western coastal road of Pentecost, in a treehole, associated with *Ae. (Stg) hebrideus* and *Ae. (Stg) pernotatus* (870109/1), and only there.

Aedes (Stegomyia) hebrideus Edwards 1926

Ubiquitous species, rampant all over: with the notable exception of Erromango, up to now. Some aquatic specimens hint at the known possible connections with *Ae. pernotatus* (Belkin, 1962, vol. I: 459, 465). First record for Tongoa[o], Iririki and Ifira.

Aedes (Stegomyia) pernotatus Farner & Bohart 1944

Aquatic stages, in treehole, associated with, *Ae. aobae* and *Ae. hebrideus*, on Pentecost; with *Ae. aegypti*, on Erromango. Associated with *Ae. hebrideus*, in a discarded paper-box, on Ifira. First record for Ifira and for Erromango.

Genus *Tripteroides*

The collection, here presented at the generic level, will be discussed at the specific level in a future paper. First record are 2: for Tongoa (870122/6) and for Ifira (870125/2).

Since 1980 *Polylepidomyia* has been resurrected from synonymy as a valid subgenus, and all Australasian species currently included in *Rachionotomyia* have been transferred to it (Mattingly, 1980).

DISCUSSION AND CONCLUSIONS

When investigating about mosquitoes with a practical, medical approach – as is the present case – have to be taken into account the strict and kinetic connections between distribution and bionomics. With the addition of disease relation, when vector mosquito species are involved (Peters, 1965), as in this case.

Reference to distribution, the present collections add little to the data contained in the previous paper on the New Hebrides island group proper (Maffi, 1977): the finding of *Cx. starckeae* on Maewo – also in altitude: a fact evident in New Caledonia also –, the widespread presence of *Cx. quinquefasciatus*, the few oddities of the breeding places, and the addition of some first record for a particular island are the logical result of a more extensive search, favoured by unusually protracted dry climatic conditions. A dry trend which could well become a constant in the future: a reality worth to be considered when planning the activities of the malaria control campaign.

Reference to bionomics, and with particular attention to those of the two indisputable vector mosquito species – *An. farauti* (malaria and filariasis) and *Ae. aegypti* (dengue and haemorrhagic fevers) –, the situation has remarkably changed from that reported ten years ago (Maffi, 1977).

On the one hand the increase in number and the vectorial possibilities of the abovementioned species have been enhanced by the massive occupation by the growing population of Vanuatu – from 90.000 in 1974 to 128.000 in 1984 (Stanley, 1985) – of the coastal areas, coupled with the increase in cattle and in tilled land, thus creating breeding places. An additional negative factor has been the spreading presence of chloroquine- resistant *Pl. falciparum* (Bowden & coll., 1982): a new challenge for the malaria control activities.

On the other hand a few positive assets are gaining momentum in Vanuatu, and their impact may well be decisive. One is the rubber pipe-line: easy to lay down on ground, low in cost, indestructible, it carries to the single water-tap, located at the centre of the village, clear and clean water, coming from a safe source, far away. One of the frequent results of its presence is the disappearance of the 170-litre drum, that ideal breeding place for *Ae. aegypti*. Proper information will cope with the possible danger of a leaking tap creating suitable breeding places for *An. farauti*: the villagers will take care of it.

The second positive factor is the spreading presence on the coastal areas of larvivorous Gambusia fishes into still and slow moving water collections. Brought to Tanna two decades ago, the positive impact of Gambusia in vector control has been reported by Thevasagayam (1980, 1983 a) and by Liang (1983). During the present field visit it has been noted that anywhere the larvivorous fishes were present no mosquito aquatic stage could be found. With proper management, co-operation by the villagers and health education on the matter the larvivorous fishes will pay very good dividends.

The third positive reality, and a fundamental one, is the keen interest shown by the rural community in co-operating in fighting mosquitoes, and consequently malaria. This attitude, which fits perfectly into the programmes considered desirable both in general (Newell, 1975) and for the area (Warren 1983: Thevasagayam, 1983 b), deserves all possible consideration. It is indeed only by the detailed field work, at village level, that more information – at present lacking – can be gathered on the bionomics of Vanuatu mosquito species, the vectors in particular. The guiding lines are already available, thanks to the studies carried out elsewhere on *farauti* No. 1 (Charlwood, and Charlwood & coll., from 1984 to 1988), but the wide array of Vanuatu's natural and/or artificial ecologies deserves local assessment. E.g. it could be worth investigating the practical impact brought by zoophilic diversion – thanks to the abundant cattle at hand – or by preventing contacts between the vector and man (Schreck & Self, 1985; Charlwood, 1986; Majori & coll., 1987; Snow & coll., 1988).

It seems therefore that in Vanuatu entomology – medical, practical, field entomology – could well play an important part in a correct planning of the malaria control campaign and in its implementation.

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