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The Chief of the Malaria Section
has the honour to communicate hereunder
the following note:

OBSERVATIONS ON THE BEHAVIOUR OF ANOPHELES FARAUTI
A MALARIA VECTOR IN THE TERRITORY OF PAPUA-NEW GUINEA

by

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A study has been made of certain aspects of the behaviour of Anopheles farauti during three visits to the Territory of Papua-New Guinea made in 1952-1954 at the invitation of the Administration to conduct experiments in village malaria control. This paper contains the results of these observations which were more especially confined to determining the amount of indoor resting of this species in the daytime, examining the outdoor resting places and investigation of its host preferences. Some other observations are included but many aspects of behaviour could not be studied.

It is obviously of importance to determine the behaviour of vector species in this area as the wartime impression gained of the behaviour of the Papua-New Guinea vectors has delayed the adoption of control measures using DDT as a residual insecticide (World Health Organization, 1954).

METHODS

A. farauti resting indoors in the daytime was sought by the light of a torch and resting mosquitos were caught in test tubes. The anophelines were most easily seen when viewed from above with the light shining on their upper surfaces when they appeared like white exclamation marks. Outdoor catches were made at night using native children or adults as bait and the mosquitos were taken in test

tubes. Native children were of great assistance in catching A. farauti resting out of doors once the characteristics of the resting places had been explained to them.

The blood of engorged mosquitos was expressed on to filter papers and the source of the blood meal was determined by precipitin tests made in capillary tubes.

RESULTS

I. DAYTIME RESTING HABITS

(a) Resting Indoors

Catches were made of A. farauti resting indoors in the daytime in a number of localities in Papua-New Guinea. These localities varied in altitude from sea level to 5,100 feet (Minj), and were situated on small islands, the coastal area, and the coastal plain of the mainland, and in the highlands. The map shows the areas in which catches were made.

In addition to A. farauti a smaller number of other species of anophelines and many culicines were captured. Table I shows the details of the anopheline catches in the various areas visited during the period from March to May 1954. The total of 282 anophelines captured resting indoors in the daytime comprised:

232 A. farauti, 35 A. subpictus, 12 A. bancroftii bancroftii, 2 A. punctulatus, 1 A. annulipes. All of these were females. Of a group of 134 A. farauti captured resting indoors in the daytime 128 (96 per cent.) were found to be engorged.

These captures of A. farauti resting indoors in the daytime were made in houses of a variety of styles. Some were built with earth as the floor (Minj, Trobriands, Laloki), others were raised six feet above the ground (Amphletts, Milne Bay). The houses were built from both European and local native materials so that the walls on which A. farauti were found include planks, Masonite (pressed wood), Sizalkraft, corrugated iron, woven bamboo, dry grass, pandanus leaf and woven coconut fronds. The number of rooms in the houses varied from one, as in the Trobriands, to several, as in the European-type houses in the Milne Bay area.

Table I. DETAILS OF CATCHES OF ANOPHELINES RESTING INDOORS IN THE DAYTIME IN PAPUA-NEW GUINEA FROM MARCH TO MAY 1954

Area	Locality	Anophelines
Western Highlands	Minj	15 <u>A. farauti</u>
		12 <u>A. bancroftii</u> <u>bancroftii</u>
		1 <u>A. annulipes</u>
Port Moresby	Laloki R.	6 <u>A. farauti</u> 1 <u>A. punctulatus</u>
Amphlett Is.	Wahea I.	5 <u>A. farauti</u>
Trobriand Is.	13 localities	202 <u>A. farauti</u>
Milne Bay	4 localities	4 <u>A. farauti</u>
		35 <u>A. subpictus</u>
		1 <u>A. punctulatus</u>

A. farauti was found resting up to heights of about four feet on the walls but was usually lower, especially at Minj where it was never found more than seven inches above the ground. This contrasted with the height above the floor at one locality in Milne Bay where a moderately large number of A. subpictus were taken resting indoors. Here this species was found on walls of houses at heights of six feet and more above the floor although many were taken much closer to the floor. The resting site of A. farauti was almost invariably in a shaded part of the house so that a torch was necessary to find the mosquitos, although some could be seen without the torch once they had been located. Most of the anophelines were resting on the walls but a few were found on various objects in the houses such as yams, bottles and string nets. A small number were apparently caught in spider webs. The mosquitos were mainly found in that part of the house used for sleeping and none were found in unoccupied houses. In some areas pigs and dogs

sleep in the houses with their owners (Trobriands, Minj). At Minj there is a definite area in the house for pigs and in this part of the house, as well as in the human sleeping area, captures of resting A. farauti were made in the daytime. This point is referred to again in the description of host preference.

Smoke in the house did not appear to drive the resting mosquitos from it. Many were caught in houses filled with smoke from fires used either for cooking or for drying copra - the smoke being sufficient to cause lacrymation in the observer.

In coastal areas the resting anophelines were not usually disturbed when the torch was shone upon them but they appeared to be more readily disturbed at Minj and frequently burrowed into the grass walls or flew away. When disturbed during catching some flew for a few inches and rapidly settled again, others flew away and were lost from sight.

The numbers caught in houses varied, of course, with the locality. The greatest density was observed at Kaisiga in the Trobriand Islands where 50 were taken from six square feet of wall of one house. No serial observations were made of day-to-day densities but in this house at Kaisiga just mentioned a catch three days before had only resulted in the capture of six A. farauti. Some search was made of the thatching of roofs but only on the visible under-surface and was not productive of results.

Anophelines caught in mosquito nets have not been mentioned in this description but one catch of 12 engorged females taken in a net in a labour barracks at Kana Kopi Bay (Milne Bay area) comprised four species: 1 A. subpictus, 7 A. farauti, 3 A. punctulatus, and 1 A. koliensis:

(b) Resting out of doors

Catches of A. farauti resting out of doors in the daytime were made at Kaisiga in the Trobriand Islands and at Minj in the Western Highlands of New Guinea. The total catch numbered 234 and comprised: 228 females and 1 male at Kaisiga, and 5 females together with 4 A. bancroftii bancroftii at Minj. Of the total of 233 female A. farauti 178 (76 per cent.) were engorged.

The daytime resting site of A. farauti at Kaisiga was close to the edge of the village and approached to about 40 yards from the nearest house. In this area were growing coconut trees, moss, a lily - Crinum asiaticum (Trobriand: morobau'u) - and ferns both on the ground and on the coconut trees. The ground was damp but at the time there was no surface water in this particular area. The anophelines were found mostly around the shaded roots or stumps of coconut trees; 26 were captured from the roots of one coconut tree. Others were found resting on the trunk of the lily, on grass stems, vine leaves, and the stem of ferns near the ground. The maximum height above ground at which the anophelines were seen resting was two feet but the great majority were found less than one foot from the ground.

At Minj the native people live in small hamlets or single houses built in or close to their gardens. Near one such house in a garden a few A. farauti were found in the shade produced by the low house, banana trees and the leaves of taro. The ground was damp and there was moisture on the moss growing on the ground. The anophelines were found within a few inches of the ground, resting on the dead sodden stem of a taro leaf, a banana trunk, a grass stem, a dead stick and on the outside of the grass wall of the house.

The outdoor resting sites, both at Kaisiga and at Minj, were in shaded areas but the mosquitos were readily seen by daylight. At Kaisiga if resting engorged A. farauti were disturbed they usually settled again rapidly on a place close to the original one, some settled on green jungle boots. Disturbed unengorged A. farauti would often bite man. On a few occasions at Minj disturbed resting anophelines flew away out of sight.

II. BITING HABITS

(a) Biting in the daytime

It has been already mentioned that 4 per cent. of the A. farauti found resting indoors in the daytime were not engorged. On a few occasions, when catches were being made indoors in the daytime, A. farauti was observed biting

man. Presumably these were unengorged females which had been disturbed and found conditions within the house suitable for biting. In one small house two A. farauti were taken biting in the daytime when there was voluminous smoke from a fire used for drying copra.

Biting out of doors in the daytime was observed on several occasions. The biting of man by disturbed unengorged A. farauti in the resting site at Kaisiga has already been described. Also at Kaisiga an attack on man by a moderate number of A. farauti was observed in a shaded area near the breeding grounds. This attack appeared to take place spontaneously - the resting anophelines had not been physically disturbed. At Minj one A. farauti was taken biting man, in the middle of the day, in a garden in the light shade of a casuarina tree. This garden was about 50 yards from two houses and was apparently the resting site for A. farauti.

(b) Biting at night

Most observations on night-time biting were made at the edge of village squares (Trobriands, Milne Bay) or just outside isolated houses (Minj) using native children as bait. With the children standing, the great majority of A. farauti sought their blood meals from the toes, feet, ankles and lower legs, although the upper legs, trunk and arms were exposed. Children in the Trobriand Islands were well aware that they were being bitten; indeed, at Kaisiga where the anopheline population was large, they were somewhat exasperated by the relatively slow method of catching in test tubes. Additional evidence of the irritation by the bite of A. farauti was provided by the marks of scratching on the legs of children used as bait. At East Cape (Milne Bay area) adult male natives were used as bait and most of the anophelines had to be caught by regular inspection as the adults did not appear to be aware that they were being bitten. A. farauti can, however, be a pest mosquito for adult natives - this was seen at Kaisiga. In two Europeans, bites by A. farauti were followed by the formation of papules with some surrounding erythema.

When night catches were being made, using native children as bait, it appeared that some children were much more attractive for A. farauti than were

the majority of the group. No comparison was made between the relative attraction of white and dark skins. To do this an adequate sample from each group would be necessary to compensate for individual differences in both groups.

During the act of probing, A. farauti was often disturbed by the light of a torch and flew away. A similar reaction was obtained when the mosquito was fully engorged with blood dripping from the anus. However, when actively feeding A. farauti was on most occasions dislodged only with difficulty by means of a test tube in the bright light of a torch. Light rain and a light breeze did not appear to deter A. farauti from biting out of doors at night.

Biting indoors at night in rooms lit by kerosene pressure lamps was observed on several occasions. Here A. farauti bit on a shaded exposed part of the body.

(c) Comparison of night catches with numbers found resting indoors in the daytime

In Table II are presented the results of night catches in three areas (Trobriands, Milne Bay, Minj) along with the results of house searches in the daytime. A few conclusions only can be drawn from this comparison. Where the night catches were small (Kavataria, Waga Waga) few or no A. farauti were taken resting indoors in the daytime. The large indoor catch at Kaisiga was associated with a large population biting out of doors at night. However, the moderately large night catch at East Cape was coupled with the finding of no A. farauti resting indoors in the daytime. It should be mentioned here that when the search of houses was made at East Cape a brisk south-east trade wind was blowing. At Waga Waga in the Milne Bay area one A. subpictus was found resting indoors in the daytime but none of this species was taken in the night catch which comprised 4 A. farauti and 3 A. longirostris. However, these two catches were made at opposite ends of the village which extends for several hundreds of yards along the shore. At Minj moderately large night catches were associated with few mosquitos resting indoors in the daytime. In this area the days are comparatively dry, the mean relative humidity at midday varying between 44 per cent. and 53 per cent. throughout the year. In addition, the small number of houses in hamlets contrasts with the larger number in village groups in other areas.

Table II. COMPARISON OF NIGHT CATCHES OF A. FARAUTI WITH THE NUMBER TAKEN RESTING INDOORS IN THE DAYTIME

Area and Locality	Night Catch				Resting Indoors		
	Number	Catchers	Hours	Bait	Number	Catchers	Hours
Trobriand Is.							
Kavataria	7	1	1	10	3	1	1
Kaisiga	79	2	1/2	18	92	1	1-1/2
Milne Bay							
East Cape	52	2	1	10	0	2	1/2
Waga Waga	4	2	1	10	0	2	1
Minj							
Dimbina	61	4	1-1/2	4	4	3	-
Kolia	22	4	1-1/2	3-6	0	1	-

(d) Host preference

Observations on A. farauti biting animals other than man were limited to an occasion on which one was seen to bite the foot pad of a recumbent dog at night in an area of high anopheline density. However, blood spots were made from adult females captured resting indoors and out of doors at Kaisiga (Trobriand Islands). At this village there are many domestic pigs and dogs but no cats or poultry. There are scrub turkey nests near the village. Blood spots were also made from anophelines captured resting indoors and out of doors in the daytime at Minj. Here there are pigs in the houses but very few dogs and hens.

The results of these tests are not yet available.

III. MITE INFESTATIONS OF ADULT A. FARAUTI

In seven localities in the Trobriand Islands and also at Minj in the Western Highlands, hydrachnid mites were found on A. farauti adults. The greatest

proportion of A. farauti found carrying these parasites was at Kaisiga where the anopheline density was high. Of 112 A. farauti captured resting indoors in the daytime 56 (50 per cent.) carried mites; of 79 taken biting in the village square at night 38 (48 per cent.) were infested; and of 172 resting out of doors in the daytime 65 (38 per cent.) bore mites. Of the mosquitos caught biting in the village square and resting out of doors in the daytime, the proportion bearing mites was significantly different ($X^2 = 4.13$, p 0.05). The number of mites carried by the anophelines varied from 1 to 12.

IV. BREEDING SITES

The water collections chosen by A. farauti for oviposition are well known as being ubiquitous and diverse. On the Trobriand Islands, which are of coral origin, where most of the larval collections were made, A. farauti larvae were found in roadside (wartime) borrow pits, shallow wells, water pools reached by the higher tides, swamps behind the crest of the beach, pools of water impounded for drinking, depressions containing rain water, pig wallows, a cement drip trap beneath a tap, 44 gallon drums sunk in the earth, natural holes in the coral, permanent inland swamps especially where shallow wells had been dug at the edges, and impounded water used as a duck pond. In the Amphlett Group larval A. farauti were found in a pig wallow hole in a seepage area at the foot of one of the steep mountains. At Minj A. farauti larvae were taken in seepage areas amongst the kunai grass and in a blocked drain.

Some of these breeding sites were perennial while others were temporary and seasonal. Many of those near the sea contained brackish water. When the larvae were found in clear water there was usually some light shade or perhaps shelter available even though this was merely due to dead leaves on the surface, grass growing in the water, or to the raised edge of the pool or drain. The larvae were found in turbid water pools which were completely unshaded. These observations on the slight shading of breeding sites did not always apply as one pool of impounded clear water was completely unshaded and contained numerous larvae.

No larvae were found in densely shaded pools, or in recently opened coconut shells. In one swamp on the Trobriand Islands, which depended to a large extent on continued rain for its persistence, numerous A. farauti larvae were found. As the swamp dried out the larvae remained in the water caught in old coconut shells lying in the swamp bed. They were also found to have retreated down into large crab holes which still contained water. When the swamp filled again the larvae migrated from these retreats into the general swamp area.

V. SPECIES OF ANOPHELINES ENCOUNTERED AT THE LOCALITIES VISITED

The species encountered are listed briefly:

Trobriand Islands: A. farauti, A. longirostris

Amphlett Islands: A. farauti

Milne Bay: A. farauti, A. punctulatus, A. koliensis, A. subpictus,
A. longirostris

Laloki River: A. farauti, A. punctulatus

Minj: A. farauti, A. annulipes, A. bancroftii bancroftii,
A. punctulatus

DISCUSSION

Indoor resting in the daytime has been frequently observed with A. farauti in the other malarious territories of Melanesea: in the New Hebrides: Belkin et al. (1945), Black (1954,a), Cheesman (1932), Daggy (1945), Herivaux et al (1939); Solomon Islands: Belkin et al. (1945), Perry (1950); Netherlands New Guinea: Black (1954,b), de Rook (1935), van Theil (1954). In Papua-New Guinea Heydon (1923) reported the finding of both A. farauti and A. punctulatus resting indoors in the daytime at Rabaul (New Britain): in hospital wards, his own bungalow, and native quarters and houses. He found them chiefly in the wet season. They were located on the walls chiefly near the ground, on undersides of beds and in sheltered and dark situations. Backhouse (1954) said that he was unable to find

A. farauti resting indoors in the daytime when he was at Rabaul. At Lalapipi (Papuan Gulf) Atherton and Lemerle (1943) found that a minority of A. farauti remained in dwellings during the day in cool dark corners, under the thatch and in generally sheltered positions. English (1943) stated that A. punctulatus (punctulatus and farauti) did not harbour by day in huts or tents unless present in enormous numbers. Mackerras and Aberdeen (1946) were unable to find a single resting anopheline by day in huts near Wewak (Hwain River) where a night catch of 483 (98 per cent. A. farauti) had been made in eight hours. They concluded that this species was essentially a house visitor and not a house dweller. Bang et al. (1947) reported A. farauti resting indoors at Lalapipi (Papuan Gulf), Nadzab and Salamaua (New Guinea mainland) and in the Admiralty Islands. Roberts and O'Sullivan (1948) reported that A. punctulatus (farauti, punctulatus, and koliensis) were rarely found resting indoors in any numbers at Salamaua and Mirivasi (Papuan Gulf). However, on one occasion, they found large numbers by day in huts of a native compound at Nadzab, near Lae. Here engorged females, chiefly A. farauti, were found resting in moist holes in the ground, inside boxes and on the walls and roof.

It is apparent from these reports that different observers have obtained different results and that even the same observer has had varying results in different localities. It has been noted during the work reported in this paper that catchers vary in their ability to locate resting anophelines. It has also been noted that the numbers resting indoors in the same house on different days varies greatly (Kaisiga). It is suggested that those who have failed to find any A. farauti resting indoors on a particular occasion have made their search when conditions have not been suitable for A. farauti to rest indoors.

Shade is the only factor common to these reports of indoor resting in the daytime. Moisture, sheltered situation and coolness are also mentioned. It is unfortunate that there have been no serial observations in Papua-New Guinea made over a prolonged period of time and correlated with climatic and other data. Atherton (1944,b) pointed out that the number of female A. farauti entering living quarters varied considerably from one evening to another, even when the same number

of occupants was present. The variation was quite closely correlated with the weather. At Minj, where the days are relatively dry, A. farauti is only found within a few inches of the ground indoors. On the coast where the atmosphere is more humid A. farauti is often found at higher levels indoors. It would appear that this species only remains indoors when the day comes if there is sufficient moisture. Other factors may operate to drive it out of the house, smoke does not, however, appear to be one of these. In some native houses the sleeping rugs are rolled up against the walls and it is apparent that there is much disturbance in the house each morning. Light airy houses may not be attractive for daytime resting. On the other hand, factors may operate to persuade it to remain in the house during the day, such as wind and rain in the early morning.

There have been numerous observations of A. farauti resting indoors at night in Papua-New Guinea: Atherton and Lemerle (1943) and Waterhouse (1943) at Lalapipi, Atherton (1944, a; 1944, b) in the Ramu Valley, Roberts (1944) at Salamaua, Mackerras and Aberdeen (1946) at Wewak, Bang et al. (1947), Roberts and O'Sullivan (1948) at Salamaua and Mirivasi. Both fed and unfed females have been observed resting indoors at night, for periods in excess of an hour, on walls of huts and tents, roofs as high as one can reach, furniture, beds and mosquito nets. The stimulus to leave the dwelling remains uncertain. The results presented here show that of those A. farauti remaining in the houses during the day only 4 per cent. are unfed. Atherton and Lemerle (1943) suggested that some A. farauti remained in houses because they had not had a blood meal or were interrupted when partly fed. At Hollandia (Netherlands New Guinea) van Thiel (1954) suggested that the light of dawn provided the stimulus for A. farauti to leave houses in which it had lingered during the night. It is suggested that if this be so those nesting in shaded places do not receive the stimulus and remain indoors if other conditions such as humidity and freedom from disturbance are suitable. This would explain why the daytime resting sites indoors are not the same as those where A. farauti has been observed resting at night.

The search for A. farauti resting out of doors has usually been more successful in Papua-New Guinea than the search indoors in the daytime. Outdoor resting places

for this species have been described by Atherton and Lemerle (1943), Atherton (1944), Horsfall and Porter (1946), Bang et al. (1947), Waterhouse and Atherton (1947), Roberts and O'Sullivan (1948) and Laird (1952) from widespread areas in Papua-New Guinea. The characteristics of these resting places are that they are moist, shaded, cool, close to the ground and are not far away from the source of the blood meal. The observations presented in this paper add to the list of vegetation types which provide these suitable conditions. It should be noted that outdoor resting sites are generally much more moist than those indoors but the amount of light present is much greater. This may support the suggestion that the amount of moisture indoors determines, to some degree, whether A. farauti will remain indoors in the daytime.

The considerably lower percentage of engorged A. farauti (76 per cent.) compared with those found resting indoors (96 per cent.) is of interest ($\chi^2 = 15.1$, p 0.001). The unengorged A. farauti presumably were unable to secure a meal on the previous night or their flight only brought them as far as the daytime resting sites.

Discussion by authors of the host preference of A. farauti in Papua-New Guinea has been based on the wartime precipitin results of Heydon (1944,a; 1944,b) from material collected by army entomologists. Mackerras (1947) reviewed the evidence for host preference gathered during the war years and concluded that A. farauti associates with man and his domestic animals, but has no particular feeding preferences, whereas A. punctulatus (at Milne Bay) is strongly anthropophilic. However, it should be clearly understood that in very many areas of this territory hyperendemic malaria is maintained by A. farauti alone without the aid of A. punctulatus which greatly impressed the observers at Milne Bay in 1942 with its ability as a vector.

The statement made by Mackerras (1947) that "the examination (by the precipitin test) of mosquitos caught in dwellings ... is open to grave suspicion in this region where the Anophelines generally enter dwellings to feed rather than to rest, so that there is a high a priori probability that any found engorged indoors will contain human blood" may have been true when applied to the dwellings of service

personnel. In the civilian population many of the natives keep their pigs, dogs, cats and fowls in their houses at night so that any anopheline entering the house has a choice of animal for its blood meal.

Wharton (1953) has pointed out that A. maculatus in Malaya prefers to feed on cattle but will feed on man even when cattle are present, and is a dangerous vector in that country. It would appear that A. farauti shows similar behaviour and that its attraction towards man is quite sufficient to support high degrees of malarial endemicity even in the presence of other animals.

It was hoped that the significant difference in the degree of hydrachnid infestation in the group of A. farauti resting indoors and out of doors might provide some information about the behaviour of this species. The Sergents (1904) stated that infestation with water mites did not adversely affect the life of anophelines. Banks (1915) said that attachment of a hydrachnid to a mosquito was suicidal on the part of the mite, although Brown (1936) has observed considerable increase in size of mites which had been attached to mosquitos for a few hours. Marshall and Staley (1929) described the formation of serpentiform tubules in the superficial part of the mosquito commencing at the site of attachment of the mite. They did not suggest that this shortened the life of the mosquito.

When the mite-infested A. farauti were collected by means of a sucking bottle it was found that the mites were brushed off the mosquitos. It is possible that the lower infestation rate in the A. farauti taken resting out of doors may be due to the mites having fallen off or being brushed off the mosquito rather than the mites having killed their hosts. Until further observations have been made on the mite-anopheline relationship no definite conclusions can be drawn. The same degree of mite infestation in the group biting near the village square and that resting indoors in the daytime is of interest.

With regard to the breeding sites where A. farauti larvae have been found the only point of interest is the finding of larvae in the crab holes in the bed of a receding swamp. At Rabaul (Territory of New Guinea, 1936) anopheline larvae (probably A. farauti) were found in the innumerable crab holes along the foreshore.

In oiling operations much time was consumed in locating and treating them. Descriptions of breeding sites have been given for Papua-New Guinea by Atherton (1944,a; 1944,b), Heydon (1923), Horsfall and Porter (1946), Laird (1945, 1952), Perry (1950), and Roberts and O'Sullivan (1948).

Daytime biting by A. farauti, indoors and out of doors, has been recorded by several observers in the Solomons and New Hebrides: Belkin et al. (1945), Black (1952, 1954,a), Cheesman (1932), Daggy (1945), and Paine and Edwards (1929). In Papua-New Guinea Atherton (1944,a; 1944,b) and Atherton and Lemerle (1943) have reported A. farauti biting in the daytime in huts and tents and in shaded places out of doors.

When DDT became available to the army during the war, experiments were made on its effect as a residual spray working with A. farauti. Roberts (1944) tested the repellent action of DDT, and Waterhouse (1943) its persistent lethal effects. Bang et al. (1947) sprayed native villages in the Papuan Gulf. This work was done with DDT dissolved in kerosene which has more recently been shown to be an unsuitable prescription for use with houses made of some native materials. Although Bang et al. reported favourable results, in post-war years residual spraying of houses for malaria control was not advocated as a method likely to be of use in Papua-New Guinea despite the numerous wartime observations of A. farauti resting indoors at night and to a limited extent in the daytime. Ford (1950), however, stated that of the newer methods of control, DDT residual spraying appeared to offer most advantages in Papua-New Guinea. The experimental work of van Thiel in Hollandia (1954) has shown that residual spraying offers great promise as a satisfactory method of control of rural malaria in New Guinea. A pilot project using DDT as a residual spray has already been commenced in Netherlands New Guinea and one is being planned for Papua-New Guinea.

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