A PILOT PROJECT OF RESIDUAL-INSECTICIDE SPRAYING TO CONTROL MALARIA TRANSMITTED BY THE ANOPHELES PUNCTULATUS GROUP IN NETHERLANDS NEW GUINEA *

P. H. VAN THIEL, Ph.D.

*Department of Parasitology, Institute of Tropical Medicine,
Leyden, Netherlands*

D. METSELAAR, M.B., D.T.M. & H.

*Malaria Control Service,
Netherlands New Guinea*

Manuscript received in July 1954

SYNOPSIS

The authors report on preliminary observations carried out in three experimental houses in Netherlands New Guinea, the object of which was to determine whether residual spraying with insecticides might be expected to give good results in the control of malaria transmitted by mosquitos of the *Anopheles punctulatus* group and by *A. karwari*. One house was sprayed with DDT, another with dieldrin, and the third was left unsprayed. From the kills recorded of mosquitos entering these houses at night it is apparent that good results can be anticipated with both insecticides, although dieldrin is the more effective.

Observations made at the same time on the behaviour of these mosquitos indicate that they have greater contact with the inside walls of houses than was previously thought.

The First Asian Malaria Conference, held in Bangkok in 1953, noted that the effectiveness of residual spraying had still to be proved in some areas. Much uncertainty exists whether malaria carried by the *Anopheles punctulatus* group can be controlled by residual spraying. We thought it necessary to make as thorough a study of this problem as possible in order that we might at the same time acquire more information on the bionomics of these anophelines.

In order to achieve this, three houses, similar to each other in every respect, were constructed near Hollandia, Netherlands New Guinea. They were built on piles and were of the same type and material as the native houses in the area. In the eastern wall of each house, two windows,

* An expanded version of this paper will appear in *Documenta de Medicina Geographica et Tropica*.

35 cm × 35 cm, were made, which were closed at sunset by outlet traps. These traps could, if necessary, be replaced during the night; at dawn they were removed. The eaves could be closed by a shutter arrangement, and the floor was covered by sheets of hard board so that the interstices between the planks were closed. A dark cloth hung behind the door inside the houses prevented mosquitos from entering or leaving when the door had to be opened. In each house a boy spent the evening and night acting as bait.

Preliminary observations on the bionomics of the local anophelines—those of the *punctulatus* group (*A. punctulatus*, *A. farauti* and *A. koliensis*) and *A. karwari*—were made in house no. 1.

In seven experiments in which the eaves were kept open until midnight, the specimens entering the house before that time showed a marked tendency to leave it at dawn. In the course of one hour during each period between 7 p.m. and midnight, midnight and 5 a.m., and 5 a.m. and 6 a.m., 9.6%, 20.5%, and 69.9%, respectively, of a total of 302 caught during those hours left the house. The same tendency could be observed when the eaves were kept open during other parts of the night. This means that at night the anophelines have a tendency to stay indoors for a longer period than was previously thought. They could regularly be observed engorged and resting on the walls. This behaviour certainly makes for a favourable prognosis for the control of these mosquitos by residual spraying.

Of 1,053 anophelines which entered the house, 17.6% could be recovered engorged and resting on the walls in the morning after the end of the experiments conducted over 14 nights.

Only 6.1% of 1,396 anophelines caught in the window traps in 25 nights were not engorged; thus the local anophelines generally succeed in biting man, for which purpose they fly into inhabited human dwellings. It is obvious from the foregoing that the engorged specimens are very likely to rest after feeding and are thus the most likely to come into contact with residual insecticides for long enough to acquire a lethal dose.

When the eaves were kept open from 7 p.m. to midnight, 18.7% of 629 anophelines which in the course of the entire night tried to leave the house through the windows entered the window traps during the time when the eaves were open; the corresponding figures when the eaves were open from midnight to 2 a.m. and from 2 a.m. to 4 a.m. are 35.7% of 120 anophelines and 36.8% of 27 anophelines, respectively. These specimens which leave the house soon after entry, either through the windows or through the eaves, would possibly have had too short a contact to obtain a lethal dose had the house been sprayed with insecticide. The same of course applies to mosquitos which left the house through the eaves, but these could not be caught. Survival of a certain percentage of mosquitos after indoor spraying is therefore to be expected.

It was noted that *A. karwari* behaved in very much the same way as the *A. punctulatus* group.

A long period of drought such as is seldom experienced in Netherlands New Guinea caused a considerable decrease in the number of anophelines and prevented these experiments from being performed on a larger scale. However, when a sufficient increase in the number of anophelines had occurred, the walls, roof, door, and door-cloth of house no. 1 were sprayed with a suspension of 5% DDT water-dispersible powder (2 g per m²) and of house no. 2 with a 1.25% dieldrin emulsion ^a (500 mg per m²). House no. 3 was left unsprayed, and the anophelines caught in the traps placed in it were used for comparison with those surviving in the traps of the two sprayed houses.

The following results were obtained during the period from 9 February 1954 (the date of spraying) to 21 March 1954 (the date on which the first-named author left, although the observations in these houses are continuing) :

House no. 1 (sprayed with DDT)

On 20 mornings after the eaves had been left open throughout the evening and night, 66% of 502 anophelines were found dead on a sheet spread on the floor and 13.5% dead in the traps. Another 13.5% died 12-24 hours after contact with the insecticide. An average of 6% survived 48 hours or longer; these specimens had therefore had no contact with the DDT.

When, in two experiments, the eaves and windows were kept open throughout the evening and night, 35 anophelines were found dead on the floor.

In these various experiments, specimens of all the local vectors of malaria were found dead on the floor and in the cages, and both engorged (*A. punctulatus*, 83%; *A. farauti*, 73%; *A. koliensis*, 67%; *A. karwari*, 61%) and unfed. Specimens both engorged and unfed were also found among the survivors, but the state of engorgement could not always be determined.

House no. 2 (sprayed with dieldrin)

On 20 mornings after the eaves had been left open throughout the evening and night, 61% of 181 anophelines found were dead on the sheet on the floor and 35% dead in the cages. Only 4% were still alive in the cages, and these died within 12 hours. The dieldrin effect was therefore 100%.

When, in two experiments, both the eaves and the windows were kept open throughout the evening and night, 17 anophelines were found dead on the floor.

^a We wish to thank the Shell Co., Singapore, for making a quantity of dieldrin emulsion (Dieldrin 15) freely available to us.

In this house as well, specimens of all the local vectors of malaria were found dead on the floor and in the cages, and both engorged (*A. punctulatus*, 82%; *A. farauti*, 82%; *A. koliensis*, 78%; *A. karwari*, 67%) and unfed. Among the survivors, some were engorged and some not.

House no. 3 (unsprayed)

Of 141 anophelines caught in the traps, 87% survived 48 hours or longer.

From these experiments it is apparent that a favourable prognosis may be made for the control of malaria transmitted by the *A. punctulatus* group and by *A. karwari* through indoor residual-spraying with DDT. Moreover, with the dosages used, dieldrin had an even more toxic effect on the anophelines than DDT.

RÉSUMÉ

Au cours de la Première Conférence asienne du Paludisme, à Bangkok en 1953, on avait relevé que, dans certaines régions, l'efficacité des pulvérisations à effet rémanent restait encore à prouver. On ignorait en particulier si le groupe *A. punctulatus* (*A. punctulatus*, *A. farauti* et *A. koliensis*) était sensible aux pulvérisations. Cette question a été étudiée par les auteurs en Nouvelle Guinée Hollandaise. Près de Hollandia, trois maisons ont été construites, à titre expérimental, avec les matériaux utilisés habituellement dans le pays, et pourvues de petites trappes-fenêtres. Les parois intérieures de la première de ces maisons ont été traitées par une poudre mouillable de DDT, à raison de 2 g/m², et celles de la deuxième par une émulsion de dieldrine à 12,5% (0,50 g/m²) ; la troisième, non traitée, servait de témoin. Le contrôle des moustiques — dont la biologie et les mœurs purent être précisées à cette occasion — a montré que dans le local traité au DDT, 93% des insectes étaient morts dans les 24 heures après leur contact avec l'insecticide. Cette proportion s'élevait à 100% dans le local traité à la dieldrine. Il semble donc que les pulvérisations d'insecticides à effet rémanent peuvent donner de bons résultats dans la lutte contre les anophèles du groupe *A. punctulatus* et contre *A. karwari*, vecteurs du paludisme dans la région en cause.