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The Secretary of the Expert Committee on Malaria
has the honour to transmit hereunder a

NOTE ON SOME RESIDUAL INSECTICIDE TRIALS FOR
MALARIA CONTROL IN EAST AFRICA

(Section 3.3.1 of the Agenda)

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On the request of the Colonial Office, London, I visited certain places in East Africa from May to August 1950 in order to assess the amount of malaria remaining in populations which had been subjected to experiments in malaria control by residual spraying of their houses. These experiments were either under the direct charge of the Colonial Insecticides Research team or had been devised with the help of this organization. Mr. C.B.Symes, O.B.E. of the C.I.R. was the scientist in charge of the operations which he had largely planned himself.

I visited (a) part of Kericho district, (b) the township of Mbale and (c) the Kasanje rural area. I took thick and thin blood films of the children and examined the abdomens for enlargement of the spleen. I paid most attention to the children who had been born since the experiments began, that is to say, to children who presumably had lived their whole domestic life in an insectized environment. The blood films were stained with Giemsa's stain and were examined by me either in East Africa or on my return to England. Parasite density was noted but in this instance was of little significance.

Kericho District. About 3,000 African dwellings in this highland area of Kenya have been impregnated once or twice a year since 1946 with DDT, originally

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in oil solution but since 1949 with a 50 per cent dispersible powder. This work was undertaken by officers of the Kenya Government with the advice and help of the C.I.R. A report on the first year's results was issued by the Inter-Departmental Insecticide Committees, and indicated that transmission of malaria had been approximately halved. The population was examined in July this year but owing to the complete failure of the 1950 epidemic, no results of any value were obtainable. This unfortunately is always liable to happen in regions where malaria not only is of the epidemic variety, but does not recur of necessity every year.

Mbale Township. Mbale is a small town near Mount Elgon in Uganda and is one of the most malarious places in the country. All the dwellings (about a thousand) were treated with DDT dispersible powder (about 150 mgms. per sq. ft.) in January, 1949, again in July 1949 and lastly in January and February, 1950. In June I examined children who were said to have lived constantly in the treated area since the beginning of the experiment. (One can take none of the local statements for granted; on one morning a large number of children were collected and vouched for by the local authorities - for some reason I was suspicious and insisted on several children taking me to their actual homes. These proved to be outside the sprayed area and quite a large proportion of the gathering was found to be similarly unsuitable.)

133 African children were eventually examined and 110 showed malaria parasites in the blood (parasite rate of 83%). 34 infants under 18 months were included in this group; their rate was 85%. Plasmodium falciparum was the dominant parasite, P. malariae was found in 6 children and P. vivax in 3. Crescents were found 30 times and this high proportion suggests that active transmission was going on.

This treatment of houses in Mbale has obviously failed to protect the occupants from malaria; a more clear cut result could hardly have been obtained and I had no hesitation in recommending the cessation of the experiment. A similar trial (D.B. Wilson & C.B. Symes) in the town of Jinja in Uganda was equally unsuccessful.

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Kasanje. Kasanje consists of a number of peninsulars jutting out into Lake Victoria a few miles from Entebbe. They are fairly isolated from each other, though they are joined together on the land side. Six of these areas (each about 10 square miles and containing 500 huts) were chosen for trying the effect of different formulations of residual insecticides. Also there were two untreated controls, the second of which was not started until 2 or 3 years after the experiment began. The first spraying was done in May 1946 and it has been repeated twice a year since. My observations on Kasanje were made in June, July and August. The parasite rates are summarized below:-

Place	Insecticide	Total Children	P A R A S I T E R A T E S		
			Rate	Children under 5	Rate
Mumuaka	DDT	156	22%	36	36%
Musale	DDT	74	32%	40	40%
Mutuba III	DDT	63	40%	38	47%
Sabagate	DDT	71	27%	22	41%
TOTAL	DDT	364	28%	136	41%
Sabawali	BHC	128	18%	54	22%
Mutuba II	BHC	45	9%	23	0%
TOTAL	BHC	173	16%	77	16%
Sabadu	Control	88	23%	44	11%
Busi	Control	104	70%	52	75%

The dominant organism was Plasmodium falciparum. Quartan parasites were found 7 times in the DDT area, once in the BHC and 10 times in the control; benign tertian was found twice in the DDT, twice in the BHC and once in the control.

A study of the above figures reveals at once that (a) this rural area, with the possible exception of Busi, is not subject to hyperendemic malaria and (b) there is some variation from one district to another, particularly in the controls. It follows therefore, that (1) no sensational drop in the incidence of malaria

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could be expected and (2) some of the results might be difficult to interpret. There is another difficulty also; although since the scheme began, parasite rates have been determined twice yearly, these have been done by African staff largely unsupervised by C.I.R. Fortunately two important surveys of 1946 were carried out under the direct supervision of Mr. Symes and Dr. Hadaway and their figures are available for comparison. I have had to ignore the remainder.

It was realized during the course of the experiment that the original control - Sabadu - was inadequate because of the low incidence of malaria and a second - Busi - was added. The parasite rates of these two controls are so different that it might be thought that any variations in the treated areas would be of little significance. Fortunately, an examination of the locality shows (a) that Sabadu and Busi are utterly unlike each other, whilst (b) the treated areas are fairly homogenous. The truth of these statements is confirmed by the vector catches in the respective areas.

First using the "under 5" index it will be noted that in the DDT treated district, the parasite rate was 41% as compared with 16% in the BHC districts. In Mutuba II where a BHC wettable powder was in use, there were actually no infections detected in the children under 5. These children were first examined by me 11 weeks after the last impregnation of their dwellings. I repeated the survey a further 10 weeks later in order to see if the apparent protection of the insecticide was still persisting. It was not! The rate now had risen from 0% to 31% (and from 9% in the total children of Mutuba II to 37%). 80% of the infections were accompanied by gametocytes, indicating that the children had been infected not less than 3 weeks before this date (11 days incubation plus 10 days for crescents to develop).

When the general parasite rate of the children is studied, it will be seen that those living in DDT districts had a rate of 28% and in the BHC a rate of 16%. Symes and Hadaway's original pre-treatment figures (May 1946) were 36% and 43%. Eleven weeks after they had first applied insecticide their figures were 39% and 24%.

The vector catches of Kasanje show a negligible number of anopheline adults in both BHC and DDT impregnated houses. Why then should the people living in the

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latter fail to be protected - as they have been elsewhere, e.g. in Mauritius and Kericho? I think the answer is that in these colder places, the mosquito A. gambiae is driven into an inclement exterior where temperatures are too low for the malaria parasite to develop in the insect; in Uganda the exterior is warm enough, development proceeds and the insect bites when it gets the opportunity - probably in the houses. I tried to find out where A. gambiae had taken refuge in Kasanje but had little success. First, were their larvae to be found? Daily searches were carried out in the ideal breeding month of June in selected areas and larvae were collected 13 times in the DDT areas, 14 times in the BHC 24 times in the Busi control and 5 times in the relatively healthy Sabadu control. All this showed was that nothing like eradication of the species had been achieved, even in the BHC area. We then did mass flitting of untreated houses in the treated area and found that a rate of 49.4 adults were caught in the untreated as compared with 3.9 in the treated huts (June 1950). We next turned to night catches in tents, untreated cattle houses and forest. One of these night vigils was abandoned prematurely about midnight because a tropical downpour drove us (and the mosquitoes) away; two others were continued from sunset until after dawn and though other species of mosquitoes were present in hundreds, A. gambiae failed to appear. The density of this species in Kasanje is so low that it was hardly surprising that we were unable to trace it to its outside lair.

Conclusions on the Kasanje experiment. The critical index (i.e. parasite rate of children born since the experiment began) showed that today there is nearly 3 times as much malaria in the DDT as compared with the BHC area. It seems probable that there has been little change in the malaria state of the population living in huts impregnated with DDT for 4 years; whilst in those subjected to BHC the incidence has dropped to nearly a third. A somewhat similar fall occurred 11 weeks after the original treatment with BHC. Soon after 11 weeks, in between this period and a further 7 weeks, the protective effect of the BHC wears off and the population contracts malaria. The widely different rates in the two controls do not invalidate these conclusions; Sabadu originally had an index of 20%, today it is practically the same - 23%.

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To summarize:-

1. Malaria in Kasanje is of the endemic variety.
2. In the DDT area the parasite rate was originally 36%; it is now after 4 years treatment, 28%. In children born since the experiment began the rate is 41%. These figures suggest that little change has occurred.
3. In one BHC area, the parasite rate was originally 43%; it is now 16%. In children born since the experiment began, the rate is also 16%. This suggests that BHC has conferred some protection.
4. In the BHC area 11 weeks after the last treatment, the rate in the younger group of children was nil; the effect of the insecticide then began to wear off and 10 weeks later the rate was 31%.
5. As far as future work under tropical African conditions is concerned, it is suggested that (a) BHC applied at 3-monthly intervals is the residual insecticide of choice and (b) in all such experiments, detailed entomological observations on adult A. gambiae are desirable and the constant presence of a malariologist is necessary to observe at frequent intervals what is happening to the malaria.

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16.10.50.