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The Secretary of the Expert Committee on Malaria has the honour to circulate herewith an extract of an unpublished report by Dr. D.K. VISWANATHAN (Member of the Expert Committee on Malaria of the WHO.IC) and T. RAMACHANDRA RAO, on

✓ CONTROL OF RURAL MALARIA
IN KANARA AND DHARWAR DISTRICTS, BOMBAY PROVINCE
WITH DDT INDOOR RESIDUAL SPRAYS

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FIRST YEAR'S RESULTS

The activities and results recorded in this paper mark the end of one phase and the beginning of another in the evolution of the Bombay Provincial Malaria Organisation. It is also a record of the largest rural malaria control project undertaken in India harnessing the war-time discovery and the war-time use of DDT on a mass scale. These activities are looked upon as of a pioneer nature with fruitful facilities for extension or similar lines all over the province on the completion of malaria surveys now in progress in representative areas and indeed for similar adoption in the rest of the country as well.

In the first five year period since the creation of the Malaria Organisation in 1942 investigations and experimental control measures revealed that anti-larval work in fluviatilis transmitted malarious localities was only possible where there was much concentration of human population, that paddy fields which were previously reckoned as unimportant breeding grounds will have to be included in a programme of anti-larval control (Ramachandra Rao, 1945) and that for smaller communities such a programme was not economical. It was also established that cleanweeding of hill-streams and channels, the most favoured breeding grounds for fluviatilis, was not adequate for complete malaria control on account of the paddy fields also breeding fluviatilis and besides repeated cleanweeding over a number of years tended to scour the bed and sides of channels during the monsoon on account of the removal of vegetation. In certain areas a judicious combination of anti-larval measures combined with spraying with pyrethrum twice a week in the peripheral inhabited areas gave fairly satisfactory results at a cost of Re.1/- per capita per annum. In smaller communities spraying with pyrethrum had to be carried out on a spaced programme of two consecutive days of spraying separated by one and two sprayless days alternately every week. This method also costs about Re. 1/- per head per annum. This rational spacing of spray killing was necessitated by the outdoor resting habits of the vector species.

The advent of DDT and the pilot experiments carried out in 1945 rendered malaria control in rural areas much more economically feasible with the result that the conclusions derived from the activities of the first five-year period were no longer operative.

(1) This paper will appear in full in the Indian Journal of Malariology.

While in the first five year phase only experimental control schemes were undertaken in a few selected centres, the present scheme operates in 2 out of the 20 districts of the Province and benefits roughly ten per cent of the total provincial population. The effects both by way of reduced malarial prevalence and appreciation by the public as well as by the state are of far-reaching value in the rapid expansion of similar schemes throughout the Province. The Government of Bombay has sanctioned five malaria squads which are now engaged in carrying out surveys in the districts of Bijapur, Sholapur, Ahmedabad, Kaira and Nasik. A survey has already been completed in Thana District and a district-wide comprehensive scheme of malaria control is now engaging the attention of the Government of Bombay. When the survey in all the districts mentioned above is completed and schemes are submitted and sanctioned by Government, 8 out of the 20 districts of the Province will have the benefit of a complete programme of rural malaria control. It is gratifying to record that the programme of activities of the Malaria Organisation of this Province has been cited as a model for other Provinces to follow.

As regards anophelis densities there is a reduction of about 90 per cent in fluviatilis in Kanara District and of 70 to 80 per cent of culicifacies in Dharwar District. Both these reductions effectively keep down the density of the vector species in each area below the assumed critical threshold of transmission of 4 per 10 manhours in the case of fluviatilis and 5 per manhours in the case of culicifacies. In assessing the utility of the scheme from anophelis densities recorded indoor resting places the points to be borne in mind are :

- (a) Does the indoor density in sprayed dwellings represent the true proportions which escape destructions?
- (b) If the answer is in the negative is it correct to use the indoor density figures for such assessment?

Recent work of Kennedy (1947) and Muirhead Thomson (1947) has shown that spraying with DDT may have a repellent effect on anophelines in that the individual mosquitoes which enter houses for the purpose of feeding and get a momentary contact with the sprayed surface have a tendency to fly away quickly and that the dose received is not adequate to destroy them. It is therefore possible that specimens of the vector species might take the bee-line to the host of predilection at night, complete feeding and move outdoors immediately thereafter. If they come in contact with the sprayed surface prior to feeding they may immediately move out without either getting infected or transmitting infection. If they come in contact after completion of feeding they still escape destruction but they would have either got infected or transmitted the infection. If such is proved to be the general experience application of DDT as an indoor residual spray will have no practical effect whatever and low densities of anophelines recorded from indoor resting places are no clues whatever to the quantum of malaria transmission. On the other hand, on theoretical grounds even if a large number of insects is caught after DDT spray it may only be a reflection of heavy breeding and such a record may still be consistent with effective reduction in malaria transmission so long as their longevity is reduced well below the period necessary for the development of the parasites in the insects. A true assessment therefore will have to include both the basic field studies (see, e.g. Muirhead Thomson) as well as epidemiological data which measures the incidence of malaria in a community. Judged from the latter

standard the reduction in the transmission of malaria in the scheme area under report is undoubted and one may therefore indirectly conclude that with respect to the vector species in this area viz., fluviatilis and culicifacies DDT is effective as an indoor residual spray in the dosage in which it is now applied. Repeated night collections in the scheme area have failed to detect fluviatilis in Kanara District. But this work has to be carried out on a more extended basis both in Kanara and in Dharwar Districts.

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The frequency of spray once in two months in the case of fluviatilis and once in six weeks in the case of culicifacies was evolved as a result of pilot experiments and judging from present data this frequency seems to be adequate for the dosage now practiced. The dosage also was determined from the pilot experiments and while any lessening of the dosage has been found to bring about the early reappearance of the vector species increased dosage is not also considered necessary in view of the various factors prevailing in rural areas under the housing conditions described previously and it will not be possible to expect any prolongation of the period of residual toxicity beyond two months. While in order to ensure economy of material used a working speed for labour has been determined and enforced for the reasons already stated by Wiswanathan and Parikh (loc. cit.) it is not considered strictly necessary to enforce a very uniform spread of the spraying mixture.

Various formulations of DDT have been tried such as DDT suspension powder containing 50 per cent DDT and emulsion containing 20 per cent DDT concentrate (Torch Brand) diluted with water to a final concentration of one per cent of DDT. Best results continue to be achieved by the use of a 5 per cent emulsion of DDT made out of a DDT concentrate in Medium Kerosine Extract and applied in a dosage of 60 milligrams per square foot. Amidst the dark clouds of malarial hyperendemy in the scheme area there was the silver ray that one half the area had its season in one half of the year and the other in the other half, thus making it possible to employ trained staff all the year round. But this circumstance is not likely to be available elsewhere and the seasonal employment of trained labour will be inevitable. But there is no question about the need to keep the trained higher personnel in service all the year round. Indeed one visualises with the advent of DDT the possibility of calling the Squads public health squads and not merely malaria squads. So that provision may be found for their suitable employment all the year round.

The working cost of 6 annas per head per annum of the scheme is the lowest on record for rural malaria control in an area where the malaria season extends for at least 6 months in the year, especially at the present high levels of price of materials and wages for labour. There is no more ground for the tilt of the administrator "If malaria is preventable, why not prevented?", since not only is it feasible for the state to provide the funds but for public health departments to demonstrate tangible results in vast rural areas. Indeed, expression may be given to what is not more than an impression at present, that DDT indoor residual spray will not only control malaria but possibly also minimise fly-borne diseases and the incidence of human plague. While the insufflation of rat-burrows with DDT may effectively control an epizootic of plague and consequently plague amongst humans as well

without affecting the rat-population, DDT indoor residual spray will not help in the prevention of the epizootic but may prevent human plague. In fact, the occurrence of rat-falls in not a few villages in the present scheme area without any case of human plague tends to offer a pointed evidence towards such a hypothesis. The experience, however, will have to be watched over a series of years. If this is confirmed two diseases can be effectively controlled by a single measure provided the seasons coincide.

It is often suggested that the advent of DDT has rendered species sanitation obsolete and obviated the need for detailed entomological surveys and investigations. This is indeed a misconception. The frequency of spraying is dependent on the species. Its daily output, its resting habits and its vulnerability to DDT all play a significant part in the determination of frequency dosage and quantities consumed which affect costs. The total omission of cattle-sheds from spraying as well as its restriction to not more than 10 feet height in Kanara is an instance of the application of the principle of species sanitation based on the habits of the local vector fluviatilis.

Finally it has to be recorded that during more than a year's continuous spraying no evil effects have been observed either among men and domestic animals or among the labour employed.

SUMMARY

The first year's results of a large rural malaria control project in Kanara and Dharwar Districts of the Bombay Province, India, with DDT indoor residual sprays, together with the details of the area and topography, population involved, epidemiological features, type of organisation, methods and cost; are described.

Anopheles fluviatilis and A. culicifacies are the vectors and the seasons of transmission are July to November in one section and December to June in another.

Nearly a population of a million living in an area of 8,486 square miles derived the benefits of the scheme at an average cost of 6 annas per capita per annum.

The staff was divided into five units each in charge of a trained medical officer.

The formulation of DDT used was the DDT - Medium Kerosine Extract-Soap formula devised by the Malaria Institute of India. The stock emulsion containing 25 per cent DDT was diluted in the field to give a final 5 per cent mixture. The dosage adopted was approximately 56 milligrams per square foot, and the spraying frequency was once in two months during the transmission season. Depending upon the bionomics of the vector species, all human, mixed and animal dwellings in Dharwar District and only human dwellings in Kanara were sprayed.

An average reduction of 90 per cent of A. fluviatilis in the sprayed structures in Kanara and of 70 to 80 per cent of A. culicifacies in Dharwar was noticed.

The cumulative spleen rates in the sprayed and unsprayed villages in Kanara were 14.4 and 72.2 per cent respectively; in Dharwar they were 19.6 and 28.3 respectively. The parasite rates were 3.8 and 14.6 respectively in Kanara and 4.4 and 7.5 respectively in Dharwar.

Infant parasites were 0.8 per cent in the sprayed villages and 13.3 per cent in the unsprayed ones in Kanara and were 0.0 per cent and 2.1 per cent respectively in Dharwar.

The relations with the public in the implementation of the scheme are discussed.

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