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The Secretary of the Expert Committee on Malaria
has the honour to communicate hereunder
the following note:

IS IT NECESSARY TO CONTINUE INDEFINITELY
DDT RESIDUAL SPRAYING PROGRAMMES?

Relevant observations made in Greece

by

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After the spectacular decline of malaria in many areas of the world as a result of the use of residual-action insecticides, and especially of DDT,¹⁴ the question obviously arises whether the maintenance of the results obtained requires the continued application of insecticides, or whether it would be possible, without dire consequences, to suspend their application even temporarily.

This paper briefly describes observations made recently in Greece, which might contribute to the solution of a problem which is so important, especially from an economic standpoint.

The exceedingly satisfactory results obtained in 1945 from the experimental application in Greek rural areas of DDT residual spray^{3,9,11} suggested a radical modification of the malaria control programme then being carried out in Greece.² Accordingly, in the succeeding year (1946) the new method was put into practice throughout the malaria-stricken rural areas.^{4,7}

During the five-year period 1946-50, systematic spraying with 2.0 g pure DDT per m² was carried out once a year in all premises of 5,067 villages and small towns with a population of 3,420,738 (average 1946-50); protection from malaria

was thus provided for the total population of endemic rural areas.

During the same period, larvicidal measures with DDT were also undertaken, both from the ground and the air. Ground larvicidal spraying was carried out systematically in malaria-stricken urban areas, where house-spraying would have been very costly; air spraying, which presented psychological difficulties, was applied irregularly in some large, swampy areas.

This anti-malaria campaign resulted in a steady disappearance of anopheline vectors and other household pests from sprayed quarters, and in the rapid decline of malaria to a state where its transmission was almost completely checked.^{8,12}

The infant parasite rates, estimated in the autumn of each year in a number of villages considered representative of each district, were reduced to zero from the first year of the nation-wide spraying programme (1946), and remained at this level until the end of the five-year period in 1950.^{5,6}

The annual school-age parasite rates estimated under the same conditions showed a rapid fall towards zero at the close of this period; the general school-age parasite rates for 1949 and 1950 were 0.04% and 0.03% respectively.

The malaria splenomegalies so often occurring in this country during the pre-DDT period¹³ now remained merely a historical recollection. A great number of hospital beds, formerly frequently occupied by severe malaria cases, became available for other purposes.

Rice cultivation, which only a few years previously was carried out under severe restrictions on account of the malaria hazard, has been rapidly extending during recent years, so that the production of rice during 1952 will more than cover the country's requirements. The Greek farmer's standard of living has risen appreciably. Finally, the consumption of quinine and synthetic anti-malarial drugs has gradually become insignificant.⁵

In the spring of 1951, certain difficulties in obtaining insecticides, together with other concurrent reasons, suggested a reduction of the extended spraying programme which had been applied during the preceding five-year period. It was

therefore decided to exclude tentatively for that year two districts, namely, the island of Crete (total population 465,453) and Peloponnese (total population 1,127,467). In addition, it was decided to reduce the number of villages to be sprayed in the rest of the country by selecting for spraying those which in the past had shown higher malaria rates. Further, the lower part of inner wall surfaces was excluded from the scheme for residual spraying.

In the districts eliminated from the residual spraying project, however, a systematic epidemiological investigation was carried out by specialized workers throughout the malaria season, in accordance with our carefully planned programme, for the purpose of discovering in good time any possible alarming phenomena (e.g., rise of anopheline rates beyond certain limits, occurrence of positive malaria cases, etc.). In such instances, immediate repressive measures were applied - namely, residual spraying with DDT, and treatment of all positive cases detected.

The following facts emerged from the results collected towards the end of the 1951 malaria season.

(1) In Crete, where in the previous five-year period an average of 856 villages and towns, with a population of 306,767 and an annual consumption of 34,538 kg of pure DDT, had been sprayed yearly, no case requiring the application of repressive measures appeared during the respective malaria seasons. The 1951 autumn infant parasite rates and the school-age parasite rates were nil. No positive case was detected.

(2) In Peloponnese, where an average of 995 villages and towns (total population 602,588) were sprayed annually during the previous five-year period at a consumption of 44,780 kg of pure DDT, there were cases necessitating the residual spraying of 31 villages with a population of approximately 16,456, and the consumption of 1,040 kg pure DDT.

Out of these 31 villages, 27 were sprayed following the appearance of a high anopheles density, and the other four because microscopically positive malaria cases had occurred (6 cases in all, vivax only). By the end of the year, in addition to these 6 cases, 34 others were found in the Peloponnese distributed

among 21 villages, which had not been sprayed in 1951 (31 vivax and 3 falciparum).

The 1951 autumn infant parasite rates were found to be nil, and the school-age parasites rates remained at the same low level of the previous year (0.1%). In no area was any outbreak of malaria observed, and the total number of positive cases detected by the epidemiological investigation carried out during the 1951 malaria season until the end of December amounted to 40, of which 3 were falciparum and 37 vivax.

The above results, and the continued difficulties in obtaining insecticides, led to the decision to continue during 1952 the programme applied in Peloponnese and Crete in the preceding year, as well as to expand it, with certain slight modifications, to the remaining part of the country. The changes in the 1952 programme consisted in preventive house spraying of 31 villages in Peloponnese where repressive measures had been required during the previous year, and, in the remaining country, of 269 villages selected from the most malarious ones. In all other respects, the procedure followed in Peloponnese and Crete was continued.

A summary of the results so far collected is as follows:

1. In Crete, during this second year of the suspension of the spraying programme, no suppressive interference was required. Moreover, anopheline rates for the island during the year remained low, and no positive case of infection was detected.

2. In the Peloponnese, after a two-year suspension of the regular spraying programme, i.e. in 1952, a total of 69 villages, with a population of 51,731, were sprayed as against an average of 995 villages with a population of 602,588 sprayed during the 1946-50 period. Out of these 69 villages, 31 had been sprayed for preventive reasons and 38 as a "repressive" measure. The criterion for the application of such repressive measures was either the finding of an increased anopheline density (noted in 29 villages), or the finding of microscopically positive malaria cases (noted in 9 villages). The total number of the cases detected in these 9 villages was 29, all vivax and of these 29, 20 were concentrated in two villages only. In the whole district the total of microscopically positive

malaria cases found was 41 (38 vivax, 2 falciparum, 1 malariae). It should be added that in an area (Scala-Iaconia) of the same district where experimental DDT residual spraying in 1952 did not seriously affect the anopheline density because of the resistance developed by the local vector (A. sacharovi)¹⁰, there was no indication whatever of a recurrence of the endemy.

3. In the rest of Greece, in addition to the 269 villages where preventive spraying had been carried out, there were cases requiring repressive action in 51 villages. Thus, of an average 3,400 villages sprayed annually in this part of the country during the 1946-50 period, and 1,930 villages sprayed in 1951, the number of sprayed villages during 1952 amounted to 327 (see table I).

It follows that the suspension of the regular spraying programme for two years (1951-2) in Greece and Peloponnese and for one year (1952) in the remaining country (table I) resulted in no serious reversal of the balance achieved. In Crete, it seems that we are in sight of the actual eradication of malaria, and the maintenance of anophelism at low levels (moderate anophelism without malaria). In various areas of Peloponnese, however, especially where rice cultivation has been rapidly extending, anophelism has shown an upward tendency towards levels prevailing during the pre-DDT period. In spite of this, even in these areas there was no significant increase in malaria incidence after the two years' suspension of the DDT residual-spraying programme. The positive cases detected during the malaria season were very few and sporadic, representing high anophelism with insignificant malaria incidence.

An explanation of the above phenomena should be sought in the complete, or almost complete, eradication of parasite species which resulted from the nationwide spraying programme applied during the preceding five-year period. In spite of the occasional increases in anopheline density observed during the two-year period of suspension of spraying, the campaign seriously interfered with the revival of the transmission cycle of the disease.

It is obvious that this situation cannot be expected to last, and armed vigilance is therefore required in the future. We have, however, considered it

advisable to make our observations known, since the advantages resulting from even a temporary suspension of the spraying programme are very apparent, provided the maintenance of the balance achieved is assured.

Apart from the by no means insignificant saving, suspension offers the possibility of preventing the building-up of resistance to the insecticides by local vectors. The opportunity of keeping valuable insecticides in reserve for a longer period constitutes a considerable profit. On the other hand, any objection that might be raised in regard to the necessity of destroying other domestic pests is disposed of, when it is considered that observations of the development by these insects of resistance to synthetic insecticides are daily increasing.¹

At any rate, the evaluation of conditions which may allow of a temporary suspension of spraying programmes or the spacing of their periodicity, should be made with care by responsible experts.

TABLE I. PROGRAMME OF HOUSESPRAYING IN GREECE, 1946-52

	Number of villages sprayed	Population protected by residual spraying	Quantity of DDT consumed (Kg.)
<u>CRETE</u>			
1946-1950 (annual average)	856	306,767	34,538
1951	0	0	0
1952	0	0	0
<u>PELOPONNESE</u>			
1946-1950 (annual average)	995	602,588	44,780
1951	31	16,456	1,040
1952	69	51,731	3,228
<u>REMAINING COUNTRY</u>			
1946-1950 (annual average)	3,215	2,511,383	182,986
1951	1,930	1,291,100	62,650
1952	327	240,938	12,783
<u>TOTAL</u>			
1946-1950 (annual average)	5,067	3,420,738	262,304
1951	1,961	1,307,556	63,690
1952	396	292,669	16,011

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