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THE CHALLENGE OF GLOBAL MALARIA ERADICATION

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During the past ten years, many nations of the world have initiated or expanded malaria control campaigns because of the effective control made possible by the development of DDT and related materials. Residual insecticides applied to the inside wall surfaces of dwellings provided control that previously appeared impossible. Even though these materials are effective and economical, many governments have insufficient means to carry out the necessary programs.

In order to assist countries otherwise unable to establish and maintain anti-malaria campaigns, vector control specialists and commodities have been provided by the coordinated action of the World Health Organization (WHO), the United Nations Children's Fund (UNICEF), the U. S. International Cooperation Administration (ICA) and other organizations. At the present time it is estimated that of

the approximately 600,000,000 persons living in areas requiring malaria protection outside of communist countries, more than 260,000,000 are receiving such protection (4). Our government through ICA is providing direct support to 20 countries of the free world for malaria programs in which it is estimated that more than 175,000,000 persons are receiving protection. The most extensive campaign is in India where 136,000,000 persons already are within the program. In addition, the Philippines, Taiwan (Formosa), Vietnam, Cambodia, Laos, Indonesia, Thailand, Pakistan, Nepal, Iran, Jordan, Ethiopia, Liberia, Mexico, Honduras, Colombia, Peru, Haiti, and Ecuador are receiving aid. WHO and UNICEF also provide assistance to some of these and other countries. The Pan American Sanitary Bureau (PASB), which is the Regional Office for the Western Hemisphere for WHO, is taking an active lead in many of the programs in Latin America.

The tremendous success of malaria con-

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tol operations throughout the world has encouraged governments and international organizations to endorse and promote a change from control of malaria to eradication of malaria. At the Eighth World Health Assembly held in Mexico City in May, 1955, a resolution was approved by the official delegates of 46 nations recommending that governments intensify plans of nation-wide malaria control in order to achieve eradication before the anopheline vectors are no longer susceptible to control by the residual insecticides. The Assembly also authorized the Director-General of WHO to request governments of countries where malaria still exists to give priority to malaria eradication projects in their requests for assistance under the United Nations Expanded Programme of Technical Assistance.

The eradication concept is under intense consideration in many countries at present. Taiwan and Ceylon have nearly attained this goal and others are proceeding with eradication programs. Mexico has an ambitious five-year program in which the elimination of malaria from 17,000,000 persons is planned. The Philippines, Iran, Thailand, Jordan, and Haiti are examples of countries receiving U. S. aid where eradication is being stressed.

Even though governments have the best of intentions to eradicate this mosquito borne disease, many difficulties lie ahead. The most important of these are as follows:

1. ANOPHELINE RESISTANCE TO INSECTICIDES: DDT has been the principal insecticide used for residual applications and has made possible the tremendous success of malaria programs. However, after several years of use, anopheline mosquitoes have been shown in some areas to be resistant to DDT. The resistance of *Anopheles sacharovi* to DDT in Greece was suspected first in 1951 (2). In 1954 Crandell (1) reported the resistance of *A. sudaicus* to DDT in Indonesia. Dieldrin is now being used effectively in Indonesia to control the DDT resistant *A. sudaicus* adults but it is not known

how long before they will develop dieldrin resistance. Other reports indicate chlorinated hydrocarbon resistance in several other species of anophelines elsewhere. The most recent report was given at the WHO Conference on Malaria in Africa, held in Nigeria, November 28-December 6, 1955. It was reported by Elliott and Ramakrishna (3) that in Western Sokoto (Nigeria) *A. gambiae* has developed an increased specific resistance to dieldrin with an evident though less marked resistance to DDT. Despite these alarming reports, DDT and dieldrin continue to be the insecticides of choice in most areas of the world. Resistance generally is localized but can be expected to spread. It is hoped that resistance will not become too widespread before eradication is attained in many areas.

The development of this physiological resistance by mosquitoes to the chlorinated hydrocarbon insecticides generally is given as the principal reason for the present emphasis on a shift from control to eradication programs. Resistance, of course, makes control more difficult. It may be necessary to substitute other insecticides such as organic phosphate compounds, increase the use of antimalarial drugs, or return to the use of antilarval measures. In any event, the development of resistance is not a hopeless problem.

2. AVAILABILITY OF TRAINED PERSONNEL: In most of the countries having a malaria problem, there is a wealth of labor but an acute shortage of trained professional personnel capable of providing the necessary technical leadership for malaria campaigns. However, training programs for professional persons are available in various parts of the world and gradually the number of trained individuals is increasing. Funds are necessary for this training but it appears that there is an awareness of this need and, therefore, funds are being obtained both within countries and from international organizations.

3. HUMAN BEHAVIOR CHARACTERISTICS: Malaria eradication is made more difficult

by the frequent moving of certain peoples from one area to another, carrying malaria with them. Nomadic tribes and persons displaced by wars or political upheavals move from malarious to nonmalarious sections of countries and vice versa. Another problem is that many people sleep out of doors in some countries thereby precluding effective use of residual insecticides inside of dwellings. Antimalarial drug administration may be the solution both to the movement of populations and out-of-door sleeping, provided that such chemotherapy programs can be organized and administered properly.

4. **AREA INACCESSIBILITY:** Ideal malaria eradication programs should include widespread areas, thereby necessitating the crossing of various geographic boundaries. This is not always possible, particularly during present national and international tensions. It is hoped that eventual easing of such tensions will alleviate these situations. Neighboring countries in some instances already are cooperatively combatting malaria along common borders. Cooperative programs are imperative if malaria is to be eradicated.

There is another type of inaccessibility created by geographic obstacles such as mountain ranges. As countries continue to develop, water transport is improved, roads are built, railways are extended, and air fields are constructed. For these reasons geographic obstacles gradually are disappearing. Even so, there are places in the world such as the interior of Africa where it may not be feasible to attempt programs for many years to come.

5. **ATTITUDE OF GOVERNMENTS:** Even though many governments presently are pursuing vigorously malaria eradication programs, there are others showing some apathy toward these campaigns. For success, countries must give wholehearted support to the idea of eradication. Instead of decreasing control activities when eradication is within sight, campaigns must be maintained and extended even to the most remote areas. Usually the areas most difficult of access or where the

population is sparse are left until last. Antimalarial programs leading to eradication are more tedious than normal control operations and per capita annual control costs are higher for several years. However, efforts are being made to demonstrate to government officials that intensified eradication campaigns will be cheaper in the long run and actually can be looked upon as capital investments which will pay for themselves many-fold during years to come.

Even when eradication is attained, an antimalaria organization should be maintained so that cheaper surveillance programs can be put into effect. The surveillance group must be ever alert to reintroduction of malaria and be prepared to take the necessary measures to combat it so that previous efforts will not be lost.

6. **AVAILABILITY OF FUNDS:** As mentioned above, antimalaria operations pay for themselves many-fold. Even so, some governments do not have funds for this type of investment which usually requires foreign exchange and import of experts from abroad. For this reason international organizations have provided generous amounts of funds for commodities and technical assistance. However, there is no assurance that this aid will continue indefinitely. It is hoped that international aid will be continued until countries are financially able to maintain the programs with their own resources.

CONCLUSIONS: Even though there are real obstacles to be overcome, it has been demonstrated that malaria can be eliminated from countries or areas within countries. Insecticides which are effective, comparatively safe, and economical are available. Many organizations now are providing the necessary leadership and funds to assist the less developed countries with their programs. Dr. Paul F. Russell of the Rockefeller Foundation recently expressed this very aptly when he said that these conditions have created the "golden moment" in the history of malaria control and we should not miss the opportunity to eradicate malaria wherever possible.

The members of the American Mosquito Control Association should have a real interest and pride in these programs. Many of the control methods being used so successfully overseas were developed by mosquito control personnel in the United States. Some of our Association members are providing technical direction to the programs in various countries. Insecticides, sprayers and other equipment manufactured in this country are being used to achieve control and eradication. These programs are helping less developed countries of the free world remain free by helping them attain good health and thereby permitting them to progress toward economic self-sufficiency. Global malaria eradication is a stimulating challenge to professional mosquito control personnel everywhere. As members of the Associa-

tion and citizens of the United States, we are helping to meet this challenge and it is hoped that we can continue to do so until malaria is no longer a world-wide threat.

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