

INTERNATIONAL COOPERATION ADMINISTRATION

PUBLIC HEALTH DIVISION

WASHINGTON 25, D. C.

MALARIA MANUAL

FOR

U. S. TECHNICAL COOPERATION PROGRAMS

Compiled by Division of International Health  
Public Health Service  
Department of Health, Education, and Welfare  
Washington 25, D. C.

For the Public Health Division,  
International Cooperation Administration

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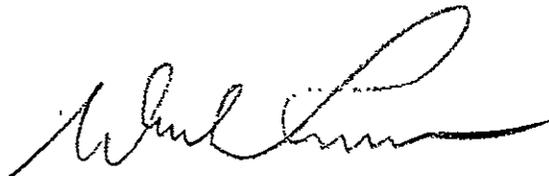
March 5, 1956

TO: Director, U. S. Operations Mission (listed below)  
FROM: Deputy Director for Technical Services, International  
Cooperation Administration  
SUBJECT: Transmittal of Malaria Manual for U.S. Technical  
Cooperation Programs

The attached subject Manual is hereby forwarded to all Operations Missions having public health projects, and is the official basic malaria technical policy document of ICA. In addition to policy guides, it also contains technical information to be used for malaria control or eradication projects supported with ICA funds. One copy of the Manual is to be retained by the Chief of the USOM Public Health Division or Health and Sanitation Field Party, and one copy is to be furnished to each U.S. technician assigned to malaria projects.

Malaria is recognized as a health hazard in many economically less developed countries of the world. Malaria projects in countries having malaria problems should receive high priority among all health projects.

This Manual is the first in a series of technical manuals dealing with various phases of public health projects. It has been prepared in loose-leaf form thereby permitting the addition or substitution of pages or sections in the future. Any suggestions by USOM personnel for revision of this Manual will be welcomed and should be forwarded to PHD/ICA.

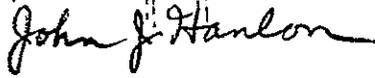


William F. Russell  
Deputy Director for Technical Services

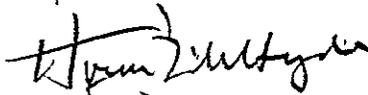
Attachment.

Director, U. S. Operations Mission - 3/5/56

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## I. Introduction

Malaria is the major infectious disease and the leading cause of mortality in many of the economically underdeveloped countries of the world. Programs for controlling this disease have been among the most effective initiated and supported by U. S. Government funds in many of these countries. It has been estimated by the World Health Organization that more than 600,000,000 persons (excluding Communist countries) are living in malarious areas. Approximately 230,000,000 of these now are being protected, thereby leaving an estimated 370,000,000 unprotected against this disease.

During World War II, the U. S. Government was engaged in effective malaria control programs in many areas of the world. These programs were conducted principally by the U. S. Armed Forces, and in some areas the Public Health Service played an important role in these operations.

After World War II, and following the founding of the United Nations, malaria control activities were started under United Nations' auspices through such organizations as the United Nations' Relief and Rehabilitation Administration, World Health Organization (WHO), and United Nations' International Children's Emergency Fund (now designated as United Nations Children's Fund-UNICEF). The programs of these agencies were to some extent a follow-up of the successful malaria control activities of the U. S. Armed Forces during World War II. DDT has proven to be an effective insecticide and it has been shown that wide-scale malaria control operations with residual

DDT were entirely feasible. The Public Health Service (PHS), the Department of Agriculture and other Government agencies have helped develop residual house spraying with DDT and demonstrated the tremendous success of such programs for malaria control purposes. WHO has been able to assist many national programs around the world through international cooperation and demonstrate to officials of many countries the way to malaria-free life through the use of DDT spraying.

Direct malaria control assistance by our Government to the Governments of Liberia, Philippine Islands, and some of the South American countries began during World War II. In Latin America, assistance was administered by the Institute of Inter-American Affairs. After the advent of the Marshall Plan in 1948, Greece and Turkey also received U. S. aid for malaria control. At the present time, 20 countries are receiving U. S. bilateral assistance through the International Cooperation Administration (formerly Foreign Operations Administration - FOA) in malaria control programs. These are in addition to the multilateral aid programs of WHO in which the U. S. participates as a member of that organization.

The U. S. Operations Missions (USOM's) of the International Cooperation Administration (ICA) in 13 countries of Asia and Africa budgeted more than \$8,500,000 for malaria control activities during fiscal year 1955. The total number of persons to be protected in these 13 countries during 1955 has been estimated to be nearly 180,000,000 persons. Attachment 3 lists each country having a U. S.-supported malaria control program.

Member countries of the Pan American Sanitary Bureau (PASB) at the XIVth Pan American Sanitary Conference in Santiago, Chile, in 1954,

adopted a resolution recommending "the intensification and coordination of antimalaria work, with a view to achieving the eradication of this disease in the Western Hemisphere; and that the Member Governments should convert all control programs into eradication campaigns within the shortest possible time, so as to achieve eradication before the appearance of anopheline resistance to insecticides." The PASB, Regional Office for the Americas of the WHO, has established a "Coordination Office for the Malaria Eradication Program" of the Americas with headquarters in Mexico City, to coordinate the total continent-wide malaria eradication program.

The Second Asian Malaria Control Conference in Baguio, Philippines, 1954, recommended "that the ultimate goal of a nationwide malaria control programme be the eradication of the disease." In countries such as Taiwan and Ceylon, eradication programs already are well under way and eradication now is being considered in other countries of Asia.

At the Eighth World Health Assembly which was held in Mexico City during May, 1955, the Assembly authorized WHO to spend an increased amount of funds to assist in various malaria eradication campaigns and requested governments to intensify plans of nationwide malaria control in order to achieve malaria eradication. This resolution was introduced jointly by 28 member countries throughout the world. Attachment 2A is the resolution passed by this Assembly. Attachments 2B-6 were prepared for use at the Assembly as well as at pre-Assembly discussions.

In a conference held on June 3, 1955 at the Division of International Health (INH), a number of experts discussed global malaria

eradication (Attachment 1). Dr. Paul F. Russell emphasized that we are now faced with the "golden moment" and should not miss the opportunity to eradicate malaria where possible. The reasons given were (1) the availability of funds and (2) the susceptibility of anophelines to chlorinated hydrocarbon insecticides. Funds never before available to some economically underdeveloped countries are now allocated for use in many of these areas. Resistance to chlorinated hydrocarbon insecticides is appearing but most anopheline vectors still are susceptible to the residual insecticides. At least seven species<sup>2/</sup> of anophelines have been reported to have developed a physiological resistance to one or more of the chlorinated hydrocarbons. Some species have a behavioristic resistance to one or more of these materials. It is to be expected that additional reports of resistance will be forthcoming in the future. For this reason, no unnecessary delays should be tolerated; instead all control programs should be intensified if possible in order to eliminate malaria while the currently used residual insecticides are yet effective.

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<sup>2/</sup> Anopheles gambiae, A. maculipennis, A. quadrimaculatus,  
A. sacharovi, A. stephensi, A. sundaicus, A. superpictus.

## II. Malaria Policy

### A. Over-all Policy

#### 1. Priority statement as regards malaria projects:

A joint statement (Attachment 10) prepared by the Public Health Division (PHD) of FOA, and PHS and Children's Bureau of the U. S. Department of Health, Education, and Welfare, entitled "Priorities in International Technical Assistance Health Program", emphasizes that a system of priorities in health technical assistance to underdeveloped countries is essential.

In determining the priority of any particular program, the following factors (listed in Attachment 10) are to be considered:

- a. Technical and administrative feasibility.
- b. Early recognizable results.
- c. Results attainable relative to cost.
- d. Take-over ability by host country.
- e. Number of persons affected.

In areas where malaria is a serious health problem, malaria control projects usually will meet all of the above requirements remarkably well and thus can be given a high priority. With modern insecticides and drugs, not only are the projects technically and administratively feasible but the results of control activities at low costs per capita are recognizable soon after initiation. After satisfactory organization of

each program is accomplished, the host country should be able to take it over, contingent upon such factors as the availability of trained personnel and necessary commodities. The number of persons affected is large: millions of persons are protected against a disease which at one time had been thought to be uncontrollable on a mass scale. Therefore, in any country receiving ICA assistance where malaria is a serious health problem, the establishment or continuation of malaria projects should receive careful consideration.

## 2. Technical Assistance.

In most instances U. S. malaria specialists are assigned to malaria projects of the cooperative health programs where U. S. supplied commodities or funds are used for supporting control activities. The procurement of commodities for new projects ordinarily will not be approved unless it can be determined that the project will be administered under competent technical direction. Thus U. S. technical cooperation can be used in developing a sound control or eradication program for which the host government personnel will be given full administrative and technical responsibility at such time as they are able to assume such responsibility. The U. S. specialists should have "counterpart" personnel or "opposite members" assigned to them by the host government. Ordinarily this will result in mutually

beneficial "symbiosis". The U. S. entomologist, for example, can learn more quickly the local species bio-nomics and distribution while the host government counterpart entomologist will be given information re-garding the latest control techniques. In the event that no host government counterpart personnel are avail-able, training of such persons should be initiated as soon as possible in order that the necessary skills are provided for a continued future program. The sending of "participants" abroad is to be encouraged in this regard. Every effort should be made to assist the host government to build its competency and prestige as rapidly as possible.

### 3. Commodity Procurement

Specifications for the following items have been pre-pared for ICA by the Communicable Disease Center (CDC/ PHS) with the assistance of personnel from INH, USCM's, the Department of Agriculture, and other agencies or organizations:

DDT 75%, wettable powder (Attachment 11)

Dieldrin 50%, wettable powder (Attachment 12)

Compression sprayers (Attachment 13)

Whenever the above commodities are to be procured with U. S. funds, the appropriate ICA specification cur-rently in effect is to be used unless strong justifi-cation can be given for doing otherwise. Any suggestions

regarding changes in or additions to these specifications would be welcomed and should be forwarded to PHD/ICA.

B. Program Plans Review

The objective of U. S. aid for malaria programs is the developing or strengthening of host country malaria programs thereby resulting in the control or eradication of malaria. Most of the current USOM malaria projects were started as impact projects designed to initiate the control of malaria. With the wide-scale success of such campaigns, many countries are considering a change from control to eradication operations.<sup>3/</sup> The principle of eradication is sound and it is recommended that USOM's encourage a shift of emphasis from control to eradication wherever the latter appears to be attainable. (See Attachment 3.)

The premature abandonment of malaria control as a USOM project in any particular country may result in increased malaria rates and a loss of previous control efforts. Such abandonment also may have adverse effects upon many other USOM projects if a resurgence of malaria were to occur. Also, such abandonment might result in an almost complete loss of both funds and efforts previously invested in this important public health program. Only when the host government demonstrates its ability and willingness to assume full responsibility for the malaria program on a sound scientific basis,

<sup>3/</sup> For definitions of control and eradication, see Attachment 3.

should consideration be given to shifting USOM emphasis from malaria to other high priority public health projects (Attachment 10).

Although eradication programs initially cost more than the control programs, it is recognized that control operations over an extended period of time will be more costly than concerted eradication programs. As control becomes well organized and effective, apathy of governments may sometimes prevent the necessary intensification of the programs for the achievement of eradication. This means that funds will be diverted to other activities which may seem to be of high priority at that time thereby nullifying many of the previous control efforts. Every effort should be made to obtain malaria eradication within areas delimited by natural barriers such as mountains, large bodies of water or nonmalarious areas. This will permit the establishment of economical surveillance programs in which government malaria surveillance teams are assigned to the task of discovering any primary cases of malaria. Wherever malaria cases are found, immediate elimination of incipient foci should be accomplished by the use of residual insecticides and drugs.

C. Relationship to Malaria Assistance by Other Agencies

The principal agencies presently assisting national governments with malaria control or eradication programs are

ICA, WHO, and UNICEF. The ICA supported programs are granted aid in the form of technical assistance, commodities, and training of host government personnel necessary for wide-scale control activities. WHO is providing many countries with technical assistance and training of host government personnel for malaria programs. UNICEF provides governments with commodities such as insecticides, sprayers, and vehicles for malaria control.

The need for assistance from all of these agencies is great and in a number of countries the above three, and sometimes other international organizations such as the Rockefeller Foundation, are assisting malaria operations. Although ICA should retain its identity in each program in which it is active, these programs provide opportunity for cooperation by USOM personnel. U. S. technicians and commodities are to be used to support directly malaria programs of the host governments. The malaria projects should be considered as integral parts of host government malaria programs, rather than be thought of as "American Programs" or "WHO Programs" in a country.

In countries where other agencies, in addition to ICA, are providing assistance to malaria activities, the following guidelines should be followed:

1. U. S. malaria specialists must establish effective cooperation and close working relationships with the corresponding technicians of the other agencies.

2. Joint planning, implementation, and evaluation of the programs by the host country, USOM, and other active agencies is necessary. The responsibilities of each should be fully coordinated, clearly defined, and agreed upon. Duplication of functions should be avoided, but all should work together to attain the common objectives of strengthening the host country program of malaria control or eradication.
3. A full exchange of information, including direct lines of communication between technicians of the various agencies concerned, is desirable.
4. The assistance provided by U. S. technicians and the use of ICA supplied commodities should be identified as a part of the U. S. aid program to the host country.
5. Close personal relationships should be established between U. S. staff members and those of WHO and other agencies.
6. All informational material released, including scientific publications, should be carefully prepared in order to present the entire situation with proper credit to all agencies or governments involved.

### III. Operations

#### A. Surveys

Whenever personnel are initiating control activities in a previously uncontrolled area, careful malarimetric and entomologic surveys should be made to establish the incidence of the disease and disease vectors, in order to determine the initial problem and to better evaluate the program after control operations have been in effect for sometime. Data from such surveys, obtained before spraying operations are started, are invaluable to all future malaria operations and will be referred to for many years to come. If this data has not been collected, pre-spraying base lines can not be established and evaluation will be difficult. Surveys should be made (1) in the areas to be protected, (2) in the adjacent peripheral areas and (3) in an uncontrolled comparison area, if available, in order to enable effective evaluation of the results obtained by the control measures used.

In addition to the normal malarimetric and entomologic surveys, an economic survey is also advisable. An attempt should be made to determine the adverse effect which malaria has upon the economy of the area. Such data often can be used for justifying the cost of the control operations at a later date, particularly when malaria is nearly eradicated and there is danger that funds will be curtailed to a level precluding the attainment of eradication.

Before initiating any surveys, every effort should be made to obtain all existing information from the pertinent literature, maps and any records available locally. Although such information often may be out of date, it is useful in acquainting the technicians with problems peculiar to the specific areas in which they are to work.

It is not intended to include all the details of surveys here. Instead, refer to some standard text, such as "Malaria, Basic Principles Briefly Stated" by Paul F. Russell. (See Attachment 18 for other references.) However, the following information can be used as general guidelines:

1. Malarimetric surveys: Surveys should be made first in areas where illness suggestive of malaria is highly prevalent in young children. Although spleen surveys are commonly used to provide preliminary indications of the prevalence of malaria, such surveys should be used only to support parasite surveys rather than vice versa.

Splenomegaly may be due to a number of etiological agents and probably is caused by other factors as well in many areas of high malaria endemicity. Particular emphasis should be placed upon the infant parasite rate in infants through the age of 11 months. The initial infant parasite surveys should be made before spraying and should be repeated at yearly intervals thereafter. The infant parasite rate is the best indication of the effectiveness of control measures. In addition, parasite

surveys of other age groups also are useful in determining the percentage of parasite carriers in the older population groups.

2. Entomologic surveys: Both larval and adult anopheline surveys should be made to determine the vector species present and their abundance. Larval surveys will indicate the breeding sites. The adult surveys should include all bionomic data which can be obtained, including information regarding the resting and biting habits of the adult mosquitoes. This is useful in predicting the degree of adult control which may be obtained by using residual insecticides and also will show whether behavioristic changes are being encountered whereby mosquitoes are avoiding the treated surfaces. Additional entomological information to be obtained in the adult studies includes sporozoite and oöcyst indices, density, longevity, and flight range.

The development of mosquito resistance to insecticides also presents an additional survey problem which should be considered. There is a necessity for determining initially the median lethal dosage (LD 50) of the insecticides to the malaria vectors in order to establish base lines of anopheline susceptibility to the insecticides. LD 50 tests are highly desirable, but require special efforts and skills on the part of the entomologists. Several standard tests are available, one of

which is given in the Fifth Report of the Expert Committee on Malaria, WHO Technical Reports Series No. 80, Annex 3, entitled "Techniques for Assessing Susceptibility of Anophelines to Insecticides." A standard field testing kit has been developed by WHO and is available from that organization.<sup>1/</sup> By determining the LD 50 before using insecticides in an area, the proper dosage of residual insecticides can be determined. In addition, the test can be made at periodic intervals, such as once each year, after the initiation of a residual program. This will indicate whether resistance to residual insecticides is developing thereby permitting substitution of other control measures before failure of the program may occur.

3. Economic surveys: It is realized that malaria definitely has adverse effects on the economy of an area, but surprisingly few data have been published to support these contentions. It would be of value to learn the cost of living with malaria versus the economic advantages obtained from control activities.

In order to obtain the type of data necessary, a suggested economic survey form has been prepared (Attachment 14). If at all possible, USOM's are urged to initiate surveys in which the data could be obtained. The ideal method to collect such data is to have surveys made under the supervision of an economist. In the event that an economist is not available from the USOM staff,

<sup>1/</sup> A similar kit for testing resistance currently is being assembled by PHS and may be requested by USOMs through PHO/ICA.

it may be possible to interest the host government in providing a qualified person. As an alternative the data can be collected by the malaria personnel, but great care must be exercised in the interpretation of the results in order to avoid faulty conclusions. The results of such surveys carefully conducted over a period of several years should prove to be invaluable, particularly when justifying the existence of control or eradication programs to government officials responsible for approving expenditure of the necessary funds for program continuation. Efforts should be made to demonstrate that funds used for malaria programs are capital investments which will continue to pay dividends for many years to come.

B. Planning of Operation Program

When staff members plan operations, they first should prepare a careful analysis of survey data in order to indicate what action is required and where initial operations should be started. It is better to plan a program covering one of several large continuous controlled areas, rather than many small areas, thereby providing a maximum number of people with protection. Infected mosquitoes from unsprayed areas sometimes may infect persons living in sprayed areas but near the periphery of such areas. For this reason, the controlled area should be as extensive as possible or be bounded by nonmalarious areas. The prime emphasis in malaria

control or eradication operations at present is on the use of residual insecticides applied to inside wall surfaces of buildings. Although antilarval measures such as drainage and landfill are of value in any permanent malaria program, the dramatic and rapid results obtained with residual insecticides usually have not been forthcoming in an antilarval program alone. However, such measures should not be overlooked. When assisting a host government with a long-range program, efforts should be made to avoid the creation of new breeding problems which can be avoided by proper engineering techniques. Program operations should include the use of antimalarial drugs when feasible. Chemotherapy is a valuable tool and will be of ever-increasing importance as the goal of eradication is approached. The combination of antimalarial drugs and residual insecticides makes this goal foreseeable in the near future in many areas.

It is important to correlate the malaria program with other public health programs and with programs of agriculture, industry, public works, etc. Too often malaria control planning has been incomplete in that these other programs have been disregarded. An example of this would be the relationship between irrigation practices of agricultural communities and malaria prevalence. Mutually beneficial programs may result from joint planning between malaria control personnel and those responsible for control of irrigation water on agricultural land.

1. Insecticides:

Chlorinated hydrocarbon insecticides, particularly DDT and dieldrin, currently are recommended for adult anopheline control. DDT and dieldrin are used as residual adulticides applied to walls and other resting places of the anophelines. Larvicides are not used in many programs, but if such treatment is necessary, chlorinated hydrocarbon insecticides should not be employed if any chlorinated hydrocarbons are being used for house spraying. Observation of this precaution has been recommended by many entomologists as a possible aid in retarding the rate of development of resistance to these materials.

Both DDT and dieldrin are used more commonly in the malaria program as wettable powder (also indicated as "water wettable") formulations. In a few instances in the past, difficulties have been experienced with certain formulations of wettable powders. Although it is believed that the present specifications will result in high quality wettable powders, technicians must be alert particularly to the possibility of poor suspensibility. Several rapid tests have been developed to determine the suspensibility of wettable powders in water. The following rapid test, modified from one developed by the Malaria Institute of India for DDT 75% wettable powder, is cited as an example:

Weigh 3.3 gm. of the sample and mix with hard water<sup>4/</sup> (or with water representative of that used in spray operations) to make 100 c.c. of mixture in a 100 c.c. graduated cylinder. Invert the cylinder 30 times to mix thoroughly and allow to stand. If more than 4 c.c. of solid material settles out after 15 minutes of standing, the sample probably has unsatisfactory suspensibility. This may be checked more conclusively by using the suspensibility test described in Attachment 11.

If any material is suspected to be below standard, samples from individual drums should be taken and completely identified as to name of manufacturer, contract number, batch or lot number, date of arrival in country, name of ship, dates of sampling and testing, and any other pertinent information including adverse storage conditions, such as excessively high temperatures or exposure to moisture. Several fully labelled one-pound representative samples unsatisfactory material, from separate batches, plus one sample of satisfactory material, if any, from the same shipment should be sent by air pouch to PHD/ICA, Washington. An official complaint should be made to PHD/ICA regarding any defective

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<sup>4/</sup> Calcium chloride, anhydrous - 0.304 gm.  
 Magnesium chloride, hexahydrate - 0.139 gm.  
 Distilled water to make - 1.000 liter

materials. It is important to include full details including the data listed above and the amount of both defective and satisfactory material received in any questionable shipments.

Any samples returned to PHD/ICA will be tested and a report will be made to the USOM. The submission of official complaints, comments, and samples will contribute toward the continued development of improved quality of wettable powder insecticides.

Careful attention should be given to the method of application of residual materials. All houses should be sprayed thoroughly, using the recommended dosages. Some entomologists believe that resistance to insecticides may result partially from improper spraying. Incomplete DDT coverage of potential mosquito-resting surfaces may result in the development of either behavioristic or physiological resistance to this material. This, however, is a controversial matter at the present time. When using either DDT or dieldrin, sublethal dosages should be avoided. There is some evidence, on the other hand, that complete wall coverage is not needed when using dieldrin. The so-called "strip method" is an example of incomplete coverage and consists of spraying one spray pattern width with dieldrin and leaving every alternate strip unsprayed. When this or similar methods of incomplete application are used, results should be watched with utmost care.

Regardless of the insecticide being used, technicians should always be alert to the possibility of the development of resistance. Any reports of unsatisfactory control should be thoroughly investigated and appropriate studies made.

In order to determine the amount of insecticide needed for a program, it will be necessary to calculate the average amount needed per dwelling and the average number of inhabitants per dwelling. Population figures for the area to be treated will then determine the total requirement. Dosage rates per unit of wall surface for both DDT and dieldrin are given below.

a. Use of DDT:

75% wettable powder is mixed with water to produce a 5% DDT mixture.<sup>5/</sup> Use approximately 252 gm. of 75% DDT mixed with water to a total volume of one U. S. gallon (3.785 liters). Metal containers such as empty milk cans can be calibrated to provide spray crews with standard measures for preparing the mixtures, rather than weighing the necessary amount each time.

The DDT-water mixture should be strained through a fine mesh screen (preferably of noncorrosive metal) into clean sprayers. A metal screen

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<sup>5/</sup> This is the standard mixture used in most countries. However, lower percentage mixtures are used in certain areas.

can be soldered into a funnel thereby providing a strainer-funnel combination for filling the spray tanks. After the sprayman pumps and vigorously shakes the sprayer, the mixture is sprayed on wall and ceiling surfaces at the rate of two grams of technical DDT per square meter or approximately 214 gm. per square foot (40 c.c. of 5% mixture per square meter). Although this dosage has been effective in many areas when applied once each year, it is sometimes used at smaller dosages applied two or three times per year for a cumulative total of two grams, particularly if local customs include frequent replastering, painting or cleaning the wall surfaces. In areas where mud wall surfaces are encountered, the possibility of deactivation of DDT by iron ions should be considered. If an analytical chemistry laboratory is available, it may be possible to confirm suspected degradation of the material. Substitution of dieldrin for DDT may solve this problem.

CDC recommends the following precautions in regard to DDT:

"In view of its extensive usage without harmful effects on humans, DDT apparently is a relatively safe insecticide, particularly from the standpoint of acute toxicity. However, it is known to be toxic to fish and has killed various species of mammals exposed to large dosages of DDT. In using DDT reasonable

precautions should be taken to avoid breathing the dusts, mists, or powders, and to avoid direct skin contact with the chemical in any form. Contaminated skin areas should be washed with soap and water and excessively contaminated clothing should not be worn."

b. Use of dieldrin:

Dieldrin 50%, wettable powder, is mixed with water to prepare a 0.625% mixture, or mixtures containing as much as 1.30% dieldrin. To prepare a 0.625% mixture, use approximately 47 gm. of 50% dieldrin mixed with water to a total volume of one U. S. gallon (use 95 gm. if preparing a 1.30% mixture). See above DDT suggestions for information regarding measuring and straining.

Dieldrin has been used effectively in many countries and has several advantages. Anophelines resistant to DDT may be susceptible to dieldrin, as has been the case with Anopheles sundsi in Indonesia. Some species of adult anophelines are less irritated or repelled by dieldrin than by DDT. Another advantage is that less material need be transported as compared to DDT because of the lower required dosage of dieldrin per unit area treated. A 75% dieldrin wettable powder currently is being tested experimentally and will be useful particularly in areas where transportation of commodities to inaccessible areas presents difficulties.

Less use experience has been obtained with dieldrin for malaria control than with DDT and, therefore, the optimum dosage has not been determined in some areas. Mixtures containing as high as 1.30% dieldrin have been used effectively in field programs. Using 40 c.c. of 0.625% dieldrin per square meter will provide a theoretical residual deposit of 250 mg. per square meter (approximately 23 mg. per square foot). The 1.30% mixture provides 500 mg. per square meter (approximately 46 mg. per square foot).

Research is in progress in several countries at present to learn the optimum dosage to be recommended, but this will vary from one area to another as well as from one species to another. It is recommended that LD 50 laboratory tests as well as field biological tests, both conducted over a 12 months or longer period of time, be made to determine the optimum dosage necessary in any area where the dosage rate for this material has not been established. The dieldrin 500 mg. dosage appears to be more effective than a 2 gm. DDT dosage for a longer period of time but the lower effective limits for dieldrin have not been determined. It is doubtful whether the minimum annual dosage would be less than 250 mg. per square meter.

CDC recommends the following precautions in regard to dieldrin:

"Investigations indicate that the acute toxicity of dieldrin is about four or five times that of DDT to mammals. Users should exercise particular care in handling concentrated formulations.<sup>6/</sup> For maximum safety, workers handling technical dieldrin or dieldrin concentrates should wear waterproof, xylene-resistant gloves and suitable protective clothing. Where workers are exposed continually to appreciable contamination in handling technical dieldrin, dieldrin dusts or wetttable powders, or in applying dieldrin formulations, respirators should be employed. With the dilute formulations<sup>6/</sup> (1.25 percent or less) precautions similar to those appropriate for other chlorinated hydrocarbon insecticides should be used; i.e. adequate care should be taken to avoid the breathing of dieldrin dusts or sprays, and to avoid skin contamination with dieldrin in any form; contaminated skin areas should be washed immediately with soap and water; and grossly contaminated clothing and shoes should not be worn."

2. Equipment:

a. Sprayers:

The application equipment most commonly used in residual programs consists of hand operated cylindrical compression sprayers of approximately three-gallon total capacity. Where preferred, stirrup pumps are acceptable. Power application equipment

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<sup>6/</sup> Underlining added by editors. Field use experience with dieldrin has thus far shown that dieldrin can be employed safely in malaria operations. No fatalities have been reported and only a few cases of poisoning have occurred. The latter were a result of gross misuse of the material, i.e. daily exposure to heavy dosages, no change of clothing, and no daily washing of exposed body parts, over a period of 3-9 months before toxic symptoms were manifested.

requires special attention and in many countries servicing is unavailable. For this reason the hand operated equipment is preferable.

Stainless steel nozzle tips; capable of producing a flat fan shaped spray angle of 80° and a discharge rate of 0.2 gallons per minute at 40 p.s.i. currently are recommended for the compression sprayers. Tips producing higher discharge rates may be specified if be desired. Constant pressure valves are available but must be specifically requested by the USOM's. In several countries, difficulties have been experienced with these valves in field operations and although the use of constant pressures is a progressive development in spraying operations, such valves are not generally recommended at present unless the technicians in charge of control activities feel that they are required and can be serviced properly. Commercial manufacturers of spraying equipment for the malaria programs are engaged in research which eventually may result in improved and effective constant pressure valves which can be serviced and adjusted readily by field personnel. When U. S. technicians are ordering compression sprayers to conform to ICA specifications, optional items such as liquid capacity of tank, and whether or not constant pressure valves and pressure gauges are to be included

should be specified. The list of spare parts included in the specification should be checked to determine whether it is satisfactory for the anticipated program.

After careful planning of the control program, the number of sprayers required can be estimated. Spraymen using compression sprayers ordinarily are able to apply 10 to 20 pounds of DDT 75% wettable powder, in water mixture per day, depending upon the country, area, and conditions. Using these figures, the number of sprayers needed can be calculated after the program plans are determined. In some countries where the spray crews work throughout most of the year, one compression sprayer is estimated to apply 2,000 pounds of DDT 75% wettable powder in one year. If all spraying is to be done within a period of several months or other conditions so dictate, it may be necessary to procure two or more sprayers per 2,000 pounds.

b. Vehicles:

Vehicle requirements will vary greatly from one country to another. However, the lack of vehicles has hampered spraying and survey activities in many areas. The types ordered will depend upon the local requirements, condition of roads or trails, and availability of local servicing and spare parts.

In most areas, four-wheel drive vehicles are most desirable. Trailers are used in some areas and if so, vehicles should be ordered to be equipped with proper trailer hitches.

The possibility of using bicycles in lieu of motor vehicles should not be overlooked. It is undesirable to procure more motor vehicles than are absolutely necessary for the success of the programs. Where bicycles can be used to attain the desired objective it may be possible to procure them with host government funds.

c. Laboratory and survey equipment:

Laboratory supplies and survey equipment are vital to any carefully planned program. Each technician should determine his particular requirements in this regard and order the equipment through normal channels as quickly as possible in order to obtain the supplies when needed. Certain items such as rearing cages, larval pans, flashlights, etc. perhaps may be constructed or already may be available in the host country and, therefore, should not be purchased with U. S. funds.

Care should be taken to give as complete a description as possible of each item, along with name and number of catalogue and number of item in the catalogue. Neglecting to do this may result in

unavoidable delay by procurement personnel in ordering the supplies. Further information regarding procurement procedures is included in Attachment 17.

3. Chemotherapy: Research with modern antimalarial drugs has been in progress in the United States and other countries for a number of years. Many malariologists feel that use of chemotherapy has been neglected in malaria control programs. With the gradual change of emphasis to malaria eradication, it is believed that antimalarial drugs will play an ever increasing important role in the programs (Attachment 9). Consideration should be given to combining the use of antimalarial drugs, particularly chloroquine and pyrimethamine with the residual insecticide program. The mass use of drugs definitely is indicated when administration of such a program is feasible. The following drugs and dosages are those most commonly recommended for use:

- a. Pyrimethamine (synonyms: Daraprim, Malocide, BW 50-63)
- (1) Suppressive dosage: 25 mg. as single weekly dose -- preferably taken on same day each week.
  - (2) Therapeutic dosage: not recommended for treatment of acute cases because action is too slow for rapid termination of fever and parasitemia.
- b. Chloroquine (synonyms: Aralen, Avloclor, Nivaquine B, resoquin, SN 7618, et al.)

- (1) Suppressive dosage: 300 mg. base (500 mg. salt) taken as a single dose weekly, preferably on same day each week.
- (2) Therapeutic dosage: 1,500 mg. base (2.5 grams salt) in 3 days as follows: (a) initial dose, 600 mg. base, (b) followed in 6 hours by 300 mg. base, (c) single dose of 300 mg. base on second day, (d) single dose of 300 mg. base on third day.

For all practical purposes, amodiaquine (synonyms: CAM-AQI, Cam-aqi, camoquin, SN 10751, et al.) is equally effective either as a suppressant or as a therapeutic agent; dosages exactly as recommended for chloroquine.

c. Primaquine (synonyms: SN 13272)

- (1) Suppressive dosage: not recommended.
- (2) Therapeutic dosage: 15 mg. single dose daily for 14 days. (Low activity against asexual blood parasites; highly effective (curative) against tissue parasites responsible for relapse (P. vivax). During acute attack (P. vivax) may be given concomitantly with chloroquine or by itself during latency.)

d. Proguanil (synonyms: Bigumal, chlorguanide, Drinupal, Paludrine, et al.)

- (1) Suppressive dosage: 100 mg. (salt) daily to people with little immunity, 300 mg. (salt)

single dose weekly to people in endemic areas.

(Least toxic of antimalarials; can be placed in hands of laymen with minimum risk of all effect.)

- (2) Therapeutic dosage: not recommended for treatment of acute malaria because of slow action, unless supported by such drugs as chloroquine, mepacrine, or quinine.

e. Mepacrine (synonyms: Atabrine, quinacrine, et al.)

- (1) Suppressive dosage: 100 mg. (salt) daily.

- (2) Therapeutic dosage: 2.8 grams (salt) in 7 days as follows:

(a) 200 mg. (salt) 5 times on day 1 (every 6 hours), then

(b) 100 mg. (salt) 3 times daily for 6 days.

Use of the drug will produce a yellow discoloration of the skin and conjunctivae; not a toxic manifestation, however.

#### 4. Personnel:

There is no set pattern of organization which can be followed for each country. However, the central organization responsible for the over-all malaria program should include the following professional skills: medical, entomological, parasitological and sanitary engineering.

Every effort should be made to utilize technical support available within the host government. For

example, malaria education programs can be sponsored by health educators (if any exist) within the government ministry or department of health, with the assistance of the malaria personnel, as a part of the government over-all health education program. Similarly, certain necessary chemical analyses perhaps can be made by chemists employed within other government agencies or other organizations such as universities. The central professional malaria staff should be strong but not completely independent of other existing facilities.

The field control programs can be administered directly by the central government malaria organization, or they can be decentralized and administered through the existing provincial, district, or state health organizations. In any event, close supervision of the spray crews is necessary. A spray team or unit usually consists of one foreman, three to five spray men, and a helper. The spray teams are immediately under the jurisdiction of a supervisory field worker who should have a staff capable of making the necessary mosquito and malarimetric surveys.

## IV. Research:

Although it is not the function of USOM technical assistance to engage in malaria research per se, it is recognized that frequently certain field studies are necessary in order to maintain the high degree of malaria control desired. In many cases it is necessary to test various control procedures under field conditions if difficulties are being experienced with the standard control recommendations. It should be kept in mind that all such studies as those mentioned here should be done with the objective of strengthening the malaria programs rather than at their expense.

Studies regarding anopheline resistance to insecticides are needed. The following recommendation was approved by the FOA Health Committee on June 9, 1955:

"FOA should take the initiative in stimulating basic research on the problem of insect resistance in general by whatever agencies might be concerned."

At this same meeting a discussion regarding "Overseas Action Research" resulted in the following recommendation:

"FOA should encourage and sponsor action research and to this end should examine each project to determine the maximum research potential contained therein. In addition, development of maximum research potential of the individual countries should be an objective of FOA. It is only through research activities that continuing progress will be made in the free countries. The health and economic problems are so interrelated that sustained progress in one is dependent on progress in the other.

"Action research should be interpreted to include not only conventional research in the natural sciences, but also the search for basic regularities which appear to underlie the processes of economic and social change through which countries are passing; it should include as well, continuing program analysis and evaluation with the view to maintaining optimum efficiency in FOA health programs. Much of action

research will obviously benefit many countries and hence can justifiably be financed by regional or area funds. The research potential of a project should be judged by (a) applicable value of the potential yield, (b) the prospect of productive results, (c) the research capacity of the area and of personnel involved, including both FOA staff and local personnel, (d) the value of the project in further development of research personnel."

If basic research beyond necessary field studies appears to be indicated as pertinent to any particular malaria program, the problem should be clearly stated along with the proposed research needed and submitted officially to PHD/ICA, Washington.

V. Reporting:

The Project Proposal and Approval (PPA) is the most important document or report prepared by the USOM's in regard to the malaria projects. Utmost care should be used in the preparation of the PPA. The Taiwan PPA for FY 1956 (Attachment 16) illustrates the type of information which should be included in a PPA.

An outline for a semiannual report of malaria, filariasis and other vector-borne diseases presently is under consideration by ICA. Pending receipt of future instructions from ICA, the attached outline (Attachment 15) is included as a guide which may be used for preparation of reports. Although the preparation of reports is tedious, it is one way that PHD/ICA and INH/PHS are able to be cognizant of the progress of the programs and be able to render assistance to the programs. Duplicate copies of all reports should be sent to INH/PHS.

All reports or other correspondence regarding malaria programs should be routed through official channels to ICA/Washington.

## VI. Evaluation

There have been instances in which malaria control programs have become established in areas and have been looked upon as "permanent" projects with no periodic attempt being made to determine what achievements have been accomplished. Care must be taken to evaluate the progress of the programs periodically in order to strengthen the development of sound practices.

The following criteria can be used for evaluation:

- A. People's acceptance of the program: Statements of the village people, press publicity, resolutions or letters from officials or groups or persons, etc. should be collected.
- B. Malaria incidence: Obtain periodically all data available regarding malaria incidence from local doctors, hospitals, health officials and malaria teams. The results of malariometric surveys would also be included here.
- C. Anopheline vector incidence: Summaries of anopheline data should be included. Evaluation of malariometric data should always be made in conjunction with evaluation of vector incidence data.
- D. Economic implications: All economic data referred to in Attachment 14 give further indication of the value of these programs. Specific data should be included to illustrate the favorable economic impact of malaria control.

VII. Attachments

- Attachment 1: Minutes of June 3, 1955 INH meeting for Discussion of Global Malaria Eradication.
- Attachment 2A: Resolutions of the World Health Assembly, Malaria Eradication, WHA 8.30, 26 May 1955.
- Attachment 2B: Excerpt from UNICEF-WHO Joint Committee on Health Policy, May 6, 1955.
- Attachment 3: Global Malaria Eradication, INH, May 4, 1955.
- Attachment 4: Malaria Eradication, Proposal by Director-General, WHO A8/P&B/10, 3 May 1955.
- Attachment 5: Malaria Eradication, JC8/UNICEF WHO/1, 19 April 1955.
- Attachment 6: Malaria Eradication. Note by Executive Director of UNICEF JC8/UNICEF-WHO/3, 12 April 1955.
- Attachment 7: Notes on Malaria Control in the Americas (1954), PASB, 24 March 1955.
- Attachment 8: Hemisphere-wide Malaria Eradication by Fred L. Soper, PASB, 14 February 1955.
- Attachment 9: The Present Status of the Anti-Malarial Drug Chloroquine, Pyrimethamine (Daraprim), and Primaquine by G. Robert Coatney, Industry and Tropical Health, 2nd Conference, 1955.
- Attachment 10: Priorities in International Technical Assistance Health Programs. Joint Statement by PHD/FOA and PHS and Children's Bureau.
- Attachment 11: DDT 75%, Wettable Powder Specification.

Attachment 12: Dieldrin 50%, Wettable Powder Specification.

Attachment 13: Compression Sprayer Specification.

Attachment 14: Economic Surveys for Malaria Programs.

Attachment 15: Outline for Semiannual Report of Malaria Pro-  
jects.

Attachment 16: PPA, Taiwan.

Attachment 17: ICA Procurement Policies.

Attachment 18: Bibliography.

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Dr. Justin M. Andrews, Associate Chief for Program, Bureau of State Services, Public Health Service, Washington, D. C.

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Dr. G. Robert Coatney, Acting Assistant to the Chief, Laboratory of Tropical Diseases, National Institutes of Health, Bethesda, Maryland

Dr. Willard H. Wright, Chief, Laboratory of Tropical Diseases, National Institute of Health, Bethesda, Maryland

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UNITED STATES DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE  
PUBLIC HEALTH SERVICE

DIVISION OF INTERNATIONAL HEALTH

Minutes of Meeting for Discussion of Global Malaria Eradication

A meeting was held in Dr. Hyde's office in the afternoon of June 3, 1955 to discuss world malaria problems and the feasibility of developing a global eradication program. The following were present.

Dr. H. van Zile Hyde - PHS  
 Dr. Paul F. Russell - Rockefeller Foundation; Consultant, WHO  
 Dr. Carlos Luis Gonzales - Secretary, PASB  
 Dr. Carlos Alvarado - Coordination Office for Malaria Eradication Program, PASB  
 Dr. L. L. Williams, Jr. - Special Consultant, PASB  
 Dr. Arunaldo Gabaldon - Chief, Malaria Institute, Maracay, Venezuela  
 Dr. Manual Ferriera - Brazil  
 Dr. John J. Hanlon - FOA  
 Dr. Lewis C. Robbins - FOA  
 Mr. Richard Parsons - FOA  
 Mr. Abraham Fuchs - FOA  
 Mr. E. K. G. Borjesson - FOA  
 Dr. Justin M. Andrews - PHS  
 Dr. George H. Bradley - PHS  
 Dr. William W. Wright - PHS  
 Dr. Fred J. Brady - PHS  
 Dr. Howard Kline - PHS  
 Dr. Paul Q. Peterson - PHS  
 Dr. E. F. Warner - PHS  
 Mr. Hershel Engler - PHS  
 Mr. Donald R. Johnson - PHS

Dr. Hyde opened the meeting with a short discussion of the multilateral and bilateral malaria control programs.

Dr. Hanlon raised two questions for consideration during the course of the discussions: (1) the relationship of malaria control and the overpopulation problem; (2) the relationship between malaria control and other mosquito borne diseases such as dengue and yellow fever. As an example, what will wide-spread malaria control do in controlling Aedes aegypti in India?

Dr. Hyde introduced the principal speaker of the afternoon, Dr. Paul F. Russell.

Dr. Russell: There has been tremendous acceleration in the world attack on malaria; particularly in the past year or so. He

attributes this to four underlying factors:

(1) Work of the Public Health Service and the Rockefeller Foundation in assisting in the basic understanding of the epidemiology of malaria through attack on the mosquito vector;

(2) DDT has made it economically feasible for the first time to attack rural malaria. Paris green previously cost approximately \$4.00 a year per capita thereby being uneconomical in rural areas;

(3) Various governments, bilateral programs and multilateral programs have made monies available for the programs;

(4) WHO influence in arousing interest, providing technical help, and stimulating the programs.

It is now proper to use the term "eradication" of malaria. Nationwide eradication programs are possible but world-wide eradication is still far off. It is possible to speak of eradication in the Western Hemisphere. At Baguio, Philippines, nation-wide eradication programs were discussed. Health departments in various countries of the world should now investigate eradication possibilities.

We do not know how long present circumstances favorable to the eradication of malaria will last. These circumstances are (1) susceptibility of the vectors to presently used insecticides and (2) the availability of funds. We can expect that it will take from six to ten years for resistance to insecticides to develop after the initiation of widespread insecticidal operations. In many areas resistance to DDT has developed and in some areas, dieldrin resistance is also encountered. The principal resistance is now found in Greece with Anopheles sacharovi. In Lebanon, Anopheles sacharovi is also showing resistance to DDT. In Java, Anopheles sundaicus is found to be resistant to DDT in two areas. Dr. Richard Baggy has reported in a letter to Dr. Pampana that Anopheles stephensi is resistant to DDT in Saudi Arabia. Dr. Trapido has reported Anopheles albimanus behavioristic resistance to DDT in Panama.

Therefore, it is not known how long before the chlorinated hydrocarbon insecticides may become useless. Also it is not known how long the necessary funds will be available for these programs. Therefore, now is the time to strive for world-wide eradication. There can be eradication from the Americas. No malaria should be present in Europe. The same is true of Turkey, Iran, Iraq and parts of the Far East. In Indochina and Indonesia, the political situation may prevent the present attainment of malaria eradication. Africa is not yet ready for many nation-wide eradication programs except in certain areas of North Africa. Also, South Africa may be able to go ahead with eradication programs. The east and west coast areas of Africa will be most difficult.

The stage is now ready in many countries for such programs. The money must be made available and the help of international agencies is necessary. We are now faced with the "golden moment" and should not miss this opportunity to eradicate malaria where possible. The WHO Director has been given increased authority to assert more leadership in the World-wide malaria program. An eradication program is a reasonable plan.

Thailand has eliminated the vector in certain areas. Ceylon has been able to stop spraying in some areas and has established vigilance squads. These squads visit each hospital and dispensary once a fortnight. Also, blood slides are made on each suspicious patient and each case of malaria is followed up closely. All remaining pockets of malaria are to be cleaned out. It has been possible to resettle 1,000,000 Ceylonese as a result of malaria eradication and the rice crop has been doubled.

It is not necessary to eradicate malaria from all of India within six to seven years. Instead one large area should be selected as a pilot eradication area. It can then be demonstrated whether or not eradication is feasible. At the present time some persons only see the vastness of the problem:

Dr. Hyde then introduced Dr. Alvarado to discuss the eradication plan for the Americas.

Dr. Alvarado: A brief summary of the present status of malaria in the Western Hemisphere was presented. Of the 135,000,000 persons who lived in malarious areas, 60,000,000 are now in eradication zones, 45,000,000 in control zones and the remaining 30,000,000 are without protection. Therefore it would be necessary that 75,000,000 be included in the anticipated program.

No physiological resistance to insecticides has yet developed in the anophelines of the Western Hemisphere. Behavioristic resistance has been shown in A. albimanus in Panama and A. darlingi in Brazil.

At the 14th Pan American Sanitary Conference in Santiago, a resolution was passed to promote eradication programs. A special office has been set up in Mexico City to study all of the anopheline programs of the Hemisphere. The following points are considered for each program: (1) what is the capacity of the central malaria service of each country to undertake such a program; (2) what are the deficits in each country in the way of funds and administration.

The No. 1 priority of the Americas is Mexico. More than 50% of the unprotected persons are in Mexico. This program is to be developed with the help of WHO, PASB and a loan from the U. S. Government. All countries of the Americas realize the problem and are eager to undertake the eradication program.

Dr. Russell: In reference to Mexico, a staff of many qualified persons is needed to undertake such a program. In Venezuela and Brazil, an excellent training program is being undertaken. WHO can help other countries in the Americas with necessary training of personnel. WHO initiated pilot control projects in countries of Africa and in the Philippine Islands. In the latter, it was shown in the Island of Mindoro that A. minimus flavirostris can be controlled with DDT residual spraying. WHO can also appraise the various malaria programs to evaluate their effectiveness.

A country should not receive international monies for malaria programs unless an agreement between the host country and the international agency is made as to the exact program of control with a detailed method of operation clearly outlined.

The financing of malaria eradication should be looked upon as capital investment in order to make additional monies available for the programs.

Dr. Hyde: Malaria eradication is a capital investment. It should not be looked upon as a give-away program. However, help is needed to convince the International Bank of the desirability of making funds available for malaria eradication on the basis of this being a capital investment.

Dr. Russell: Qualified economists need to be convinced of this. Many examples could be cited to them such as the Ceylon resettlement and subsequent doubling of the rice yield.

Dr. Hyde: During the road program in the Philippine Islands, bids by construction companies were cut in half as a result of the assurance that malaria would be controlled. All such instances should be compiled into one paper which would be available to anyone.

Dr. Russell: It is important that we obtain base lines now before the malaria problem is removed. After control operations are put into effect, it would be impossible to know what the problem was before control unless some studies had been made.

Dr. Andrews: Perhaps some university would be interested in exploring this project further. Dr. Hyde said that this should be an independent investigation and not one by WHO or any other health agency. In this way, impartial, unbiased studies could be made.

Dr. Russell: Research must be continued. In some areas, house spraying is not feasible. Perhaps anti-malarial drugs could be used in these areas such as has been done in Brazil by adding the drug to table salt. As residual control continues, malarial drugs will be used more and more. Previously the cost was too high but as the number of cases becomes fewer, use of anti-malarials becomes more practical.

ICA policy requires that all transactions and offers in connection with any purchase transaction over \$1,000 normally be in writing.

It is ICA policy that negotiated procurement take place only as an exceptional practice for emergency or small value procurement.

(17) Publicity Concerning Awards

ICA considers as public information data concerning awards that have been concluded re suppliers, commodities, prices, and buyers on all transactions that the agency finances.

(18) Specifications

The only mandatory specifications, at this time, are for compression sprayers, 75% DDT water-dispersible powder, and dieldrin 50% wettable powder.

(b) Procurement with other than Dollar Exchange

In those instances where it is desirable to procure quantities of commodities for nondollar currencies (e.g. with the foreign exchange realized from sale of surplus agricultural commodities), the policies which have been described above as governing dollar procurement are modified only to the extent necessary for each foreign currency procurement.

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Additional studies are also needed on the Anopheles mosquitoes. This is particularly true in regard to resistance studies. For instance, after the development of chlorinated hydrocarbon insecticide resistance, will these materials again become effective after a three to four-year layoff during which time the materials are not used. The answer is not known at present.

Because of the absence of malaria, malaria research can not be done in the United States at present, which is somewhat distressing. It is as important to the United States as ever and the United States must do more research in this regard. Dr. Coatney's studies of Daraprim is an example.

Dr. Williams: More than \$8,000,000 is being spent by the U.S. Government bilateral malaria programs in 15 countries of the world. Why is NIH not doing more research on malaria? Dr. Wright said that space and personnel are not available for such studies at present. Polio preempts the possibility at the National Institutes of Health. Dr. Hyde suggested that studies be made by CDC.

Dr. Hyde introduced Dr. Gabaldon of Venezuela who was the Chairman of the first WHO Expert Committee on Malaria.

Dr. Gabaldon: The present program in Venezuela was started in 1945. By 1950 eradication had been obtained in certain areas of the country. At present it is hoped that the eradication areas can be coalesced and thereby obtain country-wide eradication.

More information on the capital investment gains which are available from malaria control activities, would be most helpful. At the present time the budget in Venezuela is frozen for malaria control activities. People forget quickly what malaria means after control is attained. However, many examples of the benefits of malaria control can be cited. For instance, a 120,000-hectare irrigation project in the center of a formerly malarious area was impossible to establish until malaria was controlled.

Dr. Ferriera: Initially it was easy to obtain dramatic reduction of malaria by the use of DDT and everyone was happy. At a certain point, however, cuts are made in budgets because such reductions appear to be necessary. Therefore, this is the "golden moment". In order to obtain eradication, we must do a complete job or else we may have to go back to the old days of other methods of control if further resistance develops. It is important that all nations cooperate on this program.

There was a dramatic situation in Brazil recently. A shortage of dollars for various projects precipitated a round table meeting in Brazil to discuss budgets. \$1,500,000 was needed for insecticides. The Director of the Pan American Sanitary Bureau learned of the situation and sent a cable to the President of Brazil showing the importance of the malaria program. The money was granted to the malaria program. This illustrates the importance of the bilateral and multi-lateral programs which can be used to build up the position of malaria services in various countries which have been declining in importance.

We are all together in one boat in the malaria programs.

Dr. Hyde: The cost of control per capita increases as the malaria instance decreases. This makes it difficult to obtain the necessary funds as the problem decreases.

Dr. Russell: Control is often initiated in the areas of easiest access first. This also tends to increase the cost later on when the more difficult areas must be brought into the program.

In regard to Dr. Hanlon's questions on the relationship between malaria control and other mosquito borne diseases such as dengue and yellow fever, we must have a clean, sharp focus on malaria eradication and not attempt to do two or three things at one time. We may obtain side benefits. The first stage is to obtain malaria eradication and the second is control over other mosquito borne diseases. We should not expect to do both at the same time. It is not possible to tell whether there will be any control obtained other than malaria control.

The other question of Dr. Hanlon in regard to population pressure Dr. Russell answered by pointing out that some persons have asked "Is it better to die of starvation than to die of malaria?" Good health is a sound population policy. We can not have good health in a malarious population. A good malaria program has a sound impact on the people and it goes down to the grass roots.

Dr. Warner briefly discussed the India malaria control program which is now in its third year. Malaria is the No. 1 disease of India and it has a definite relationship to the economic development of the country. The economy of India has suffered greatly from the presence of malaria.

WHO initially had four demonstration areas with a total population of 1,000,000 persons. Malaria control was shown to be economical in these areas. The Rockefeller Foundation handled the Mysore program and did an amazing job of control there.

Favorable conditions were to be found in India for initiating the present malaria control program. These were as follows: (1) the Malaria Institute was available for supervision of the program; (2) many qualified malariologists were available in India; (3) it was known what measures should be taken to control malaria; (4) a massive attack was required: with support of FOA, WHO, and the Rockefeller Foundation insecticides and equipment were made available.

The first year the program was in operation, 75,000,000 persons were included. This was expanded to 90,000,000. During the present year 136,000,000 are to be included.

Delays in obtaining of equipment and other commodities delayed the control activities. India is not yet ready for complete eradication but it should be possible to have areas of eradication. People like the program. It is necessary to have further evaluation to determine the contribution of malaria control to the country's total economy. It is realized that malaria is a large factor but the portion is not known.

Dr. Russell: In India there has been no insecticide resistance demonstrated up to the present time.

Dr. Hyde: In summarization, some basic documents are needed to study the economics for malaria control or eradication in order to educate persons controlling the budgets. It will also be necessary to salvage research for malaria problems.

Dr. Williams: The phrase "This is the golden moment" was reiterated. Rather than state the cost to control the limited cases of malaria, we should show how many persons are protected with a certain amount of money. The technical assistance personnel of FOA can be used in many cases to convert the control programs to eradication programs. We should advertise to the U. S. congressmen the economy of eradication versus control.

There is a lack of research in the United States on malaria. Work is being done on other things instead of on malaria. FOA should go into practical field research such as the use of insecticides versus the use of chemotherapy. If it takes three years for the plasmodia to die in the body, why not use chemotherapy along with insecticides? In this way the plasmodia may be eliminated in from one to two years. This may save the cost of heavy spraying in the third year. We now have the necessary drugs and should use them in the program.

Dr. Wright: Daraprim should be tested on large populations. The resistance of Plasmodium falciparum to the drug may present an obstacle in some cases. There is practically no malaria research now being done by NIH. Perhaps WHO could make field trials with Daraprim and chloroquin. We need to know more about these materials and this can be done by carefully controlled field tests. We should use the drugs in field programs where DDT spraying has been done.

Dr. Andrews: The lack of malaria research is not due to reluctance on the part of Dr. Wright and others. Federal budgets remain static or else are reduced. Encouragement from people outside the Public Health Service would help. A new item in a budget means that an old item must be eliminated.

Dr. Hanlon: Research must be encouraged. Perhaps an epidemiology research center could be started in some tropical country. However, it is difficult for FOA to engage in research. Research

properly belongs within the Public Health Service. He suggested that a national institute of "geo-medicine" be established. The initial steps to demonstrate the value and need of such an institute must be promoted by those of us who are in international health. This institute could act as a research center. Many U. S. Government agencies are affected by international health problems such as malaria.

Dr. Gonzales: We should go ahead and help countries if they commit themselves to eradication programs.

Dr. Brady: The attitude of this group at this meeting should be made known to higher echelons. This group is the one which is the most cognizant of the need for malaria eradication and it behooves us to make this attitude known.

Dr. Bradley: At present we do not have the wherewithal to do additional research work in this country on malaria control.

After a few additional miscellaneous remarks, the meeting was adjourned.

World Health  
Organization

Organisation Mondiale  
De La Sante

Resolutions  
of the  
World Health Assembly

Eighth World Health Assembly

WHA8.30  
26 May 1955

ORIGINAL: ENGLISH

MALARIA ERADICATION

The Eighth World Health Assembly,

Having considered the comprehensive report and proposal on malaria eradication submitted by the Director-General,<sup>1</sup>

Having examined the recommendations of the XIV Pan American Sanitary Conference in Santiago, Chile in October, 1954 and of the Malaria Conference for the Western Pacific and South-East Asia Regions in Baguio, Philippines, in November, 1954, concerning the danger constituted by the potential development of anopheline resistance to insecticides and concerning measures to obviate that danger,

Considering resolution EB15.R67,<sup>2</sup> adopted by the Executive Board at its fifteenth session after a study of the reports available up to that time,

Considering that the ultimate goal of malaria control programmes should be the eradication of the disease,

<sup>1</sup> Document A8/P&B/10

<sup>2</sup> Off. Rec. Wld Hlth Org. 60, 27

- I. 1. REQUESTS governments to intensify plans of nation-wide malaria control so that malaria eradication may be achieved and the regular insecticide-spraying campaigns safely terminated before the potential danger of a development of resistance to insecticides in anopheline vector species materializes;
2. AUTHORIZES the Director-General to request those governments in whose countries malaria still exists to give priority to malaria eradication projects in their requests for assistance under the United Nations Expanded Programme of Technical Assistance, and to provide the locally available resources which are required to achieve malaria eradication;
- II. DECIDES that the World Health Organization should take the initiative, provide technical advice, and encourage research and co-ordination of resources in the implementation of a programme having as its ultimate objective the world-wide eradication of malaria;
- III. 1. AUTHORIZES the Director-General to obtain financial contributions for malaria eradication from governmental and private sources;
2. ESTABLISHES, under Financial Regulations 6.6 and 6.7, a Malaria Eradication Special Account, which shall be subject to the following rules:
- (1) The Special Account shall be credited with voluntary contribution received in any usable currency and shall also be credited with the value of contributions in kind, whether in the form of services or supplies and equipment;
  - (2) The resources in the Special Account shall be available for incurring obligations for the purposes set out in (3) below, the unexpended balances of the Account being carried forward from one financial year to the next;
  - (3) The Special Account shall be used for the purpose of meeting the costs of:
    - (a) research;
    - (b) such supplies and equipment, apart from minimal requirements to be provided from Regular and Technical Assistance funds, as are necessary for the effective implementation of the programme in individual countries; and
    - (c) such services as may be required in individual countries and as cannot be made available by the governments of such countries;
  - (4) The operations planned to be financed from the Special Account shall be presented separately in the annual programme

and budget estimates, this presentation to include an indication as to whether the resources required are known to be available in the Special Account or from another source;

(5) In accordance with Financial Regulations 6.6 and 11.3, the Special Account shall be maintained as a separate account, and its operations shall be presented separately in the Director-General's annual financial report;

IV. AUTHORIZES the Executive Board or a committee of the Board to which it may delegate authority to act between sessions of the Board to carry out the following functions:

(1) to accept contributions to the Special Account as provided under Article 57 of the Constitution, and

(2) to advise the Director-General from time to time on any questions of policy relating to the administration of the Special Account or to the implementation of the programme.

Ninth plenary meeting  
26 May 1955, A8/VR/9.



Excerpt from: UNICEF-WHO Joint Committee on Health  
Policy Report of the Eighth Session Held at  
U.N. Headquarters, New York, 6 May 1955

### Malaria Eradication

5. The Committee recognized two outstanding recent developments in the fight against malaria. In the first place, it has been shown that it is technically and financially feasible to eradicate malaria in large areas, regardless of latitude, primarily by using residual insecticides. In the second place, it has now become apparent that there may be a time-limit beyond which the insecticides no longer kill the mosquitoes that carry malaria owing to the development of resistance in the mosquito vector or to changes in its behavior.
6. Resistance to chlorinated hydrocarbon insecticides has appeared in several species of anopheline malaria vectors after some six years of residual spraying programmes. As the Committee believes that it is possible in most circumstances, with proper planning and organization of the programme, to eradicate malaria before this time-limit, it recommends that nationwide and regional malaria eradication projects be encouraged and that present malaria control plans be converted into eradication plans as soon as possible.
7. The Committee recognizes the advantage of discontinuing residual insecticide spraying while the insecticide is still fully active against the mosquitoes. Such discontinuation is not possible in the usual malaria control programmes where no end of the spraying can be visualized, and it is only feasible in eradication plans.
8. The Committee understands by "malaria eradication" the elimination of malaria from a given area as an endemic disease. By definition, malaria is no longer endemic when there has been no new autochthonous case for three consecutive years (unless contracted from an imported case) provided that there is no adequate search for such cases. The term "Malaria Eradication Programme," as currently used by WHO means: (a) the systematic elimination of malaria from an entire country or group of countries within a given number of years, and (b) provision for preventing reinfestation. The achievement of malaria eradication requires total control in all areas where transmission of malaria occurs. In some countries a Malaria Eradication Programme may be so planned as to achieve eradication in successive stages, area by area, and eventually to cover the entire country.
9. The Committee understands that, while the objective of malaria eradication schemes is the elimination of malaria as an endemic disease, the objective of malaria control is only an amelioration of the endemic situation with the hope that, in time, the maintenance of effective measures might result in the disappearance of malaria--a hope that has been rarely fulfilled.

10. The Committee believes that new anti-malaria projects should aim at eradication and that the requesting countries should be expected to have, or to establish, for such period as may be necessary, an adequate central anti-malaria organization for the implementation, coordination and guidance of the national programme; should promote the necessary supporting legislation; and should pledge their financial support for the duration of the programme. UNICEF, on the other hand, should endeavour to continue its assistance till the termination of the programme.

11. The Committee recommends that UNICEF give highest priority to the support of malaria eradication programmes.

12. The Committee recommends that in special areas in which, for technical reasons, eradication programmes would be premature, support to control programmes could be considered.

13. The Committee recommends that UNICEF and WHO use their full influence to convert presently supported malaria control programmes into eradication programmes as rapidly as possible.

GLOBAL MALARIA ERADICATION

INTRODUCTION: The following material was prepared for the United States Delegate to the 8th World Health Assembly as a guide for Assembly discussions regarding malaria eradication programs.

1. The United States should support the principle of ultimate global eradication of malaria.

2. The United States should support eradication now in countries, regions, or areas where eradication is feasible. This should include support of the proposals as set forth in Documents 1 and 3 below which are considered to be feasible.

3. The United States should support active well-planned control programs in countries, regions or areas where eradication is not feasible at this time. These control programs should be planned in such a way that they can develop into area eradication programs which will expand until by coalescence of area programs, country-wide or regional eradication is attained.

4. The United States should urge that all available techniques be utilized in anti-malaria programs, with primary dependence upon residual insecticides and chemotherapy.

5. The United States should support research projects in special control methods.

BACKGROUND INFORMATION:

The following Documents deal with malaria eradication proposals:

1. "Notes on Malaria Control in the Americas (1954) with Estimates on Cost of Eradication." PASB, 24 March 1955.
2. "Malaria Eradication" note by Executive Director of UNICEF (JC8/UNICEF-WHO/3) 12 April 1955.
3. "Malaria Eradication" (JC8/UNICEF-WHO/1) 19 April 1955.

Summary of DocumentsDocument 1

Resistance to DDT and the urgency for malaria eradication is discussed with reference to the XIV Pan American Sanitary Conference. The status of malaria control programs in each of the countries of the Western Hemisphere is included. Two tables show the estimated

costs of malaria eradication along with other data for each of the countries in the Western Hemisphere.

### Document 2

This note from UNICEF discusses the proposition that UNICEF provide increased aid to governments in order to achieve malaria eradication. A number of technical and policy questions raised by the UNICEF board are included. (These questions are dealt with below). An annex to Document 2 contains excerpts from the March 1955 section of the UNICEF Executive Board regarding increased UNICEF aid for malaria eradication.

### Document 3

The present status of malaria eradication in many countries of the world is discussed with brief summaries of some of the more successful malaria programs. The history of the development of resistance to insecticides is briefly stated. "A Scheme of the Sequence of Events in Malaria Eradication Programmes" is included. This scheme sets up a 10-year program for such eradication. A number of the questions which are raised in Document 2 are answered in Document 3. In Annex 1 to this Document is included "A Tentative Programme Toward World-wide Malaria Eradication." This includes a per capita cost per year for each of the WHO regions and the total populations living in malarious areas. A 10-year schedule for each of the regions is also proposed with the total cost of spraying operations for each region.

### Terms

The term "Malaria control" as used herein means the purposeful reduction of human malaria prevalence to low levels of occurrence though transmission still takes place frequently enough to prevent its permanent disappearance.

"Malaria eradication" means the total elimination or extermination of human malaria parasites within a specified area. Document 3 states that the term "implies the planned elimination of the disease from an entire country within a period of 10 years or less."

### Feasibility of Eradication

When determining the feasibility of eradication in any area, country, or region, the following factors should be considered:

1. Availability of qualified professional personnel.
2. The willingness of countries to participate in eradication programs and to what extent, particularly when cost per capita increases as disease incidence decreases.

3. Susceptibility of malaria vectors to control measures being used at present.
4. Inaccessibility of areas because of geographical obstacles or political unrest.
5. Human behavior characteristics such as nomadic habits, population sleeping out-of-doors, and opposition to spraying activities.

Global eradication of malaria may eventually be possible but it is not yet feasible as a tightly scheduled program. The proposals set forth in Documents 1 and 3 above should be supported but recognition should be given to special regional considerations which are listed below. It is to be noted that according to Document 3, some 600,000,000 persons are exposed to malaria and of these, 230,000,000 are protected against the disease, leaving 370,000,000 still unprotected. The eradication of malaria from these 370,000,000 should be accomplished.

#### Special Regional Considerations

The program for the Western Hemisphere as proposed in Document 1 should be implemented as soon as possible. Special consideration must be given to the inaccessibility of certain areas such as are found in jungles of South and Central America. The hostility of certain tribes living in malarious areas must be also overcome before eradication can be completed in the Western Hemisphere. Although availability of funds may be a limiting factor in these programs, it has been demonstrated in Mexico that the necessary monies can be obtained.

In the Western Pacific Region some areas are still inaccessible, i.e. the interior of New Guinea. Political unrest is prevalent in places such as Vietnam and Laos, thereby making country-wide implementation of the programs more difficult. The shortage of professional personnel also presents an obstacle in many areas of this region. The feasibility of eradication in this region may be demonstrated first in Taiwan where an attempt is being made in this direction.

In the Southeast Asia Region some similar problems occur. The inaccessibility of sections of Nepal and Kalimantan (Indonesian Borneo) are examples. Professional personnel are in short supply in most of these countries (Nepal, Burma, Indonesia). DDT resistance has appeared in this region in Anopheles sundaicus on the island of Java. The largest national program is found in this region where more than 110,000,000 persons are already protected in India.

In the Eastern Mediterranean Region, the habits of the people may sometimes make eradication difficult. The nomads of Iran are

an example. Their constant moving from place to place hinders fulfillment of certain control methods but the utilization of chemotherapeutic measures could be increased. The size of the areas in relation to government facilities and personnel precludes operations at the moment in places such as Saudi Arabia. Many of the countries have a serious shortage of trained personnel (Yemen, Pakistan). Where there is weak coordination between the central and local governments, implementation of the program is hindered (Pakistan).

In the African Region, inaccessibility of certain areas is a serious obstacle (Ethiopia). The vastness of Africa in relation to population and government facilities precludes any immediate malaria programs in many areas. Human behavior such as sleeping out-of-doors and opposition to spraying makes control difficult (Liberia). The behavior of carriers such as Anopheles gambiae melas, which often do not rest on the insecticide treated wall surfaces, may necessitate the use of control measures other than residual insecticidal treatment.

The European Region has the problem of mosquito resistance to insecticides (Greece) but, generally speaking, eradication should be possible in most countries in the near future.

The Soviet Countries and Communist China present special problems at present. Little is known of the present status of malaria control or future projects there.

#### Comment on UNICEF Document (No. 2 above)

In Document 2 a number of technical and policy questions are raised. Many of these questions are answered by Document 3. Although concurrence is given to these answers, further elaboration is as follows:

##### 1) Inter-Country Coordination

(a) It is not sound and feasible, from a technical point of view, to plan and carry out, at the present stage, malaria eradication in all regions or continents. However, carefully planned programs should be promoted in every area where it is possible to do so. The impossibility of doing this in all areas should not deter anyone from going ahead in other areas. Area-wide eradication programs can be developed and expanded until they coalesce with each other to form country-wide, regional-wide, hemisphere-wide, and eventually world-wide eradication.

(b) The answer to (a) is yes for the Americas. The programs proposed in Documents 1 and 3 should be followed. Although a 10-year schedule as proposed in Document 3 is desirable, it need not necessarily be followed. It should be re-emphasized here, however, that the sooner the program is accomplished, the less likelihood

there is that resistant strains of mosquitoes will be encountered.

(c) If the scheme does not go according to plan, there are corrective measures which can be taken. Allocation of additional funds by international agencies may be necessary. The time period can be extended if it appears that satisfactory progress is being made.

If one or more countries neglect to prosecute eradication measures for various reasons, it may be possible to extend additional financial assistance if desirable. If not, it may be possible to establish malaria barrier zones and initiate quarantines to protect areas where eradication has been achieved. The barriers can consist of natural geographic features such as bodies of water, mountain ranges, or deserts. Man-made barriers can consist of protective zones of land at the periphery of eradication areas, from which all Anopheles carriers of malaria are controlled. Surveillance programs in the barrier and eradication zones must be carefully maintained to prevent the re-establishment of the disease.

If it proved impossible to execute the entire scheme on schedule it is doubtful whether there would be any loss of investments. The development of resistance could be a result but this could be dealt with by using anti-malarial drugs and other mosquito control methods.

(d) There is the possibility of a breakdown of the regional scheme for technical reasons but as discussed in (c) above such situations can be remedied. The use of anti-malarial drugs, insecticides other than those to which resistance may have developed, and drainage, are possible solutions to technical breakdown.

In the event that the Fund is unable to fulfill completely its moral commitment to assist campaigns, whatever funds are available should be used to encourage the continuation of projects.

It has been predicted that a population once protected against malaria will be subject to epidemics if the protection were removed. However, this has not been demonstrated since the advent of the newer insecticides and drugs. Such possibilities should not discourage anyone from promoting such programs. As a general rule, the development of malaria programs by international agencies strengthens the national control organizations and makes the public more cognizant of improved public health. The investments of governments and the Fund will continue to pay dividends for many years to come and it appears that all monies spent for malaria programs are wise investments.

2) Effective Planning and Implementation in the Individual Country

(e) Conditions necessary in order to make an eradication

campaign effective are stated in Annex, paragraph 51 of Document 2. Several other points can be added as follows:

(1) Personnel. Malariologists, entomologists, sanitary engineers, and other professional persons must be trained or made available as soon as possible. Activities of both national and international agencies to make such training possible should be intensified.

(2) Commodities. Ideally, the approach to eradication should be by the use of a combination of both anti-anopheline and anti-malarial measures. This combination compounds the effect of both methods of control. At present, most control programs do not utilize chemotherapy to any great extent. However, increased emphasis should be placed on adding chemotherapy, particularly when ultimate eradication is the goal. Drugs such as chloroquin and pyrimethamine (Daraprim) are valuable tools in such programs. The elimination of gametocyte carriers dramatically reduces the malaria potential. The drugs also are useful for treating persons entering eradication zones from malarious areas and for treating stubborn "pockets" of residual malaria. In the time of mass movements of populations, their utilization must not be overlooked.

(3) Research. The research proposed in Document 3, pages 10, 11 (study of resistance to insecticides and preparation of staple food items containing anti-malarial drugs) should be implemented. Studies are also needed to develop other insecticides or new formulations of presently used materials which are effective when present residual control is unsatisfactory. Combinations of DDT or dieldrin with the newer organic phosphate compounds deserve careful study as does the development of formulations of these materials which will remain active for one year or longer on all types of wall surfaces. Mass treatments of populations with the better anti-malarial drugs including chloroquin and pyrimethamine should be treated. Additional research regarding the bionomics and ecology of the vector species of mosquitoes is also necessary in order to control certain species such as A. gambiae melas more effectively.

(4) Additional considerations. Malaria eradication raises economic and social problems such as increased populations in areas where these programs are successful. Theoretically, the additional mouths to feed will be compensated for by an increased amount of productive labor available for agricultural and industrial uses. In the absence of malaria, children will be more

receptive to formal education and absenteeism of both laborers from factories and children from schools will be reduced drastically (already demonstrated in Indonesia). Coordinated development of malaria programs with programs in the fields of agriculture, industry and education, therefore, should be encouraged. Malaria control should not be delayed if such coordination cannot be developed formally. Malaria eradication will so improve the health and well-being of the people that their economic and social status will be raised, and higher standards of living will result.

(f) UNICEF raises the point whether a period of three years' operation in any given area will achieve eradication. It is unrealistic to expect to achieve eradication within three years in any given area. The more logical programs would be those proposed in Document 3, page 6, whereby a 10-year period is established for eradication activities. Programs based on three or four years' intensive control activities, using both anti-anopheline and anti-parasite measures coupled with subsequent permanent surveillance activities, are realistic and should be encouraged.

SUMMARY OF 1955 MALARIA CONTROL ACTIVITIES  
IN COUNTRIES RECEIVING FCA ASSISTANCE 1/

Country	U. S. Contribution FY 1955	Estimated Goal to be Attained in 1955 (Population Protected)
Philippines	\$ 443,000	6,300,000
Taiwan	592,000	5,500,000
Vietnam, Cambodia, Laos	300,000	3,000,000
Indonesia	1,400,000	12,300,000
Thailand	123,500	6,000,000
Pakistan	213,500	6-8,000,000
Nepal	71,000	225,000
India	4,700,000	136,000,000
Iran	545,647	4,500,000
Ethiopia	50,000	Survey only 65,000
Liberia	73,200	
<u>(Total houses to be sprayed '55-'58)</u>		
Honduras	Infinitesimal (not known)	(71,000)
Ecuador	"	(312,000)
Colombia	"	(1,277,000)
Mexico	Services of one entomologist (FY '56)	(2,972,000)
<hr/>		
Totals (excluding Western Hemisphere)	8,511,847	179,890,000 persons

(Compiled May 4, 1955)

1/ The following countries have initiated USOM malaria projects since this document was prepared: Peru, Haiti, Jordan.

United Nations

Nations Unies

World Health  
Organization

Organisation Mondiale  
De La Sante

Eighth World Health Assembly

A8/P&B/10  
3 May 1955

ORIGINAL: ENGLISH

MALARIA ERADICATION

Proposal by the Director-General

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PART I: THE PUBLIC HEALTH PROBLEM - WHAT HAS BEEN ACCOMPLISHED - WHAT REMAINS TO BE ACCOMPLISHED - PROPOSAL FOR SOLVING THE PROBLEM

Introduction

1. The eradication of malaria from the world as a public health problem is a basic objective of WHO. Thanks to the remarkable properties of DDT, a number of national health departments, often assisted by WHO, UNICEF or USA bilateral aid programmes, have made truly amazing progress towards this objective. Until recently the goal had seemed to become increasingly attainable. However, it has now become apparent that there may be a time limit beyond which the new insecticides, which have made nation-wide malaria eradication projects financially feasible, may no longer kill the mosquitos that carry malaria. Resistance to DDT has appeared in several species of Anopheles malaria vectors after some six years of exposure. Hence the present concern of WHO that nation-wide malaria eradication projects be pushed ahead with the utmost speed and vigour.

Present status of malaria eradication

2. Today certain wide areas in the Americas, Europe and Asia have been cleared of malaria by DDT residual spraying. Nation-wide malaria control projects are well advanced in Argentina, Brazil, the British and French Guianas, Ecuador, Nicaragua, the United States and Venezuela; in Cyprus, Greece, Italy, Turkey and Yugoslavia; in Ceylon, India, Iran, Lebanon, the Philippines, Taiwan and Thailand; in Madagascar, Mauritius and the Union of South Africa. In a total world population of just over 2.5 billions, some 600 millions<sup>1</sup> are exposed to malaria, but of these, some 230 millions<sup>1</sup> either have been freed from malaria or are now being protected, chiefly by residual DDT spraying. Nevertheless, with an estimated 370 millions still unprotected against malaria it is obvious that world-wide malaria eradication remains a great task. The important point to be emphasized is that, excepting only tropical Africa, there are now in each continent malaria-cleared areas that demonstrate beyond doubt the economic and technical feasibility of malaria eradication by residual spraying. Four outstanding examples may be mentioned briefly:

Venezuela. In 1945 Venezuela set up the first national project that, from its inception, was designed to eradicate malaria from an entire country by DDT spraying. The latest report describes an area of some 180,000 square kilometres, with a population of nearly 2.5 million (50 per cent. of the nation's population) that is now malaria-free. The vector

<sup>1</sup> These figures do not take into account the Union of Soviet Socialist Republics, the People's Republic of China and a few other countries, for which adequate data are not available.

mosquitos, Anopheles albimanus and A. darlingi, as late as 1941 were responsible for malaria death rates ranging from 531 to 1125 per 100 000. Anopheles darlingi has disappeared, but albimanus remains, harmless, of course, in the absence of human infections. This proves that (a) malaria eradication by residual spraying is possible without mosquito vector eradication; and that (b) sometimes residual spraying by itself will result in the eradication of some vector species as an extra dividend.

Italy. In 1946 Italy announced a nation-wide malaria eradication plan by residual spraying with DDT without larviciding or anti-vector drainage. The island of Sardinia was reserved for a special experiment in which there was to be not only house spraying but also larviciding and drainage to attempt to eradicate the vector mosquito as well as malaria. Italy had been malarious for centuries, and in spite of many years of control by drugs, drainage and larviciding, there were still some 55 455 cases of malaria in 1939, with 627 deaths. This was a notable decline from the 129 482 cases, with 2045 deaths, in 1914 prior to World War I, but it was still an active enough seed-bed that when control measures slackened and drainage was sabotaged during World War II the number of malaria cases rose to over 411 602 in 1945, with 386 deaths. (Mepacrine greatly reduced rate but not the morbidity.)

Italy is now practically malaria-free. The residual spraying has been so successful that only seven new cases of malaria were reported in 1953 and only five in 1954 in the entire country, including Sicily and Sardinia, with a total population of 47 millions. In the latter island the attempt to eliminate the vector failed, but malaria was eradicated.

Mauritius. Malaria appeared in Mauritius first about the middle of the 19th century, and the disease became highly prevalent, remaining so until recently. In 1948 a nation-wide malaria eradication programme was begun, and the result has been that today malaria is rare. Malaria notifications dropped from 46 395 in 1948 to only 23 in 1952. Here, as in Venezuela, there were two principal vectors; one, A. gambiae, remains in large numbers, the other, A. funestus, has disappeared like A. darlingi as a result of the house spraying.

Ceylon. Malaria was a major health problem in Ceylon for centuries. It was highly endemic in many areas and from time to time, as in 1934, became disastrously epidemic. In 1936, not an epidemic year, there were some 2.9 million cases in a population of 5.6 million, a morbidity rate of 523 per thousand of population. A nation-wide residual spraying project was started in 1946-47, the results of which have been excellent. Whereas there were 2.8 million cases of malaria in 1946 - a morbidity rate per thousand of 413 - in 1954 there were only 29 650 cases (diagnosed clinically without

blood examinations) in a population of 8.3 million, a rate of only 3.5 per thousand. Ceylon has now increased its rice crop by 50 per cent. and has resettled over a million people in fertile areas previously uninhabitable because of malaria. Large areas inhabited by some 600 000 people are now virtually free of the disease, and here spraying has been stopped. These areas are patrolled by Vigilance Units, searching for cases, which are promptly dealt with.

#### Development of resistance to insecticides

3. In 1947 DDT-resistance in house-flies was first reported in certain areas that had been sprayed for two years. Such resistance is now widespread and is so strongly developed against not only DDT but also against the related BHC, chlordane and dieldrin, that in many localities house-flies can no longer be controlled with these insecticides. Similar resistance was noted about the same time in certain pest Culex mosquitos but not in the Anopheles vectors of malaria until 1951. In that year it appeared in A. sacharovi in Greece, after six years of exposure to DDT. This resistance has steadily become more marked so that in numerous areas of Greece today malaria control by DDT residual spraying is not possible. Such resistance has extended to related insecticides and has appeared in other Anopheles species. It has also appeared in A. sacharovi in two villages of Lebanon and in A. sundaicus in two small areas of Java.

4. Another disconcerting phenomenon is the behaviour of A. albimanus in Panama. These mosquitos, after some six years of exposure to DDT, began in significant numbers in one area to avoid treated surfaces. Such a behaviour characteristic, if widespread, would, of course, make DDT useless for malaria control. This is because DDT residual spraying in practice only kills an insect that rests on a treated surface long enough to take up a lethal amount of DDT: the resting time required may be about 15 minutes or more. In an area of South Java A. sundaicus also avoids DDT-treated surfaces to some extent.

5. Elsewhere, malaria vectors remain fully susceptible to DDT, in some cases after ten years of exposure to it. For example, in Venezuela, Italy, India and Ceylon there is so far no evidence of any resistance or any behaviour change in any malaria vector. Thus, on the evidence, one can reasonably expect in most areas that DDT residual spraying will effectively kill malaria mosquitos of a given community season after season for at least six years. There is also reason to fear that sooner or later repeated exposure of a community of Anopheles mosquitos to DDT or related insecticides will result in the development of strains which will either not be poisoned, or else will avoid contact with treated surfaces.

Malaria eradication

6. The term "malaria eradication" should not be confused with the expression "vector eradication"; the latter implies complete extirpation of the malaria-carrying species of Anopheles from a given area. This is neither economically feasible nor technically possible except under unusual conditions. Well-implemented attempts in Cyprus and Sardinia to eradicate Anopheles mosquitos failed, although in each case malaria was eradicated. The per capita cost in Sardinia was four times greater than that of equally complete malaria eradication on the Italian mainland.
7. Malaria eradication, possible today by DDT residual spraying, implies the planned elimination of the disease from an entire country within a period of ten years or less. Planning further implies that by regional and inter-regional co-operation, neighbouring countries will co-ordinate their programmes so that a cleared area will not be threatened by one where malaria is still endemic. The plan should ensure that no given area would be exposed to residual insecticides for more than six years.
8. Such a bold concept is not considered to be unrealistic by those best qualified to judge. For example, the XIVth Pan American Sanitary Conference, in October 1954, resolved, as regards malaria: "that the Member Governments should convert all control programmes into eradication campaigns within the shortest possible time, so as to achieve eradication before the appearance of anopheline resistance to insecticides..." Also the WHO Malaria Conference for the Western Pacific and South-East Asia Regions, in November 1954, in Baguio: "having reviewed the evidence that it is possible by DDT residual spraying to terminate malaria transmission over wide areas, recommends that the ultimate goal of a nation-wide malaria control programme be the eradication of the disease".
9. In practice, when all factors are favourable, experience shows that one year's spraying with residual DDT will stop malaria transmission in a given area (see Table I). However, unless this freedom from transmission is actively maintained for three years, the reservoir of infection in the human population will not die out. Since there are often unfavourable factors, and because a margin of safety is required, it is now generally considered that routine spraying will be necessary for four years. If there is then adequate evidence that transmission has been completely blocked, spraying may be terminated provided that the area is kept under strict surveillance by trained vigilance teams. All cases of fever must be investigated, residual pockets of malaria must be eliminated by adequate therapeutic measures, and, if necessary, spraying must be re-instituted where evidence indicates that renewed transmission is likely or is taking place.

TABLE I

SCHEME OF THE SEQUENCE OF EVENTS IN MALARIA ERADICATION PROGRAMMES

YEARS	-1	1	2	3	4	5	6	7	8	9	10
(a) Exceptionally favourable conditions: Infant Parasite Rate negative after first, spr											
P H A S E	SURVEY	ATTACK	CONSOLIDA-TION		M A I N T E N A N C E						
Spraying opera-tions (on a total coverage base)		XXXXXXXXXXXXXXXXXXXX			No more spraying except for special interven-tions						
Infant parasite rate	+++	-	-	-							
Epidemiological surveillance: new malaria cases traced	(?)	(?)	(?)	+	-	-	-				////
Protection from reintroduction of: a) DDT-resis-tant mosquitos	→										
b) malaria car-riers	→										
(b) Average conditions: Infant Parasite Rate negative after second year of spraying											
P H A S E	SURVEY	ATTACK	CONSOLIDA-TION		M A I N T E N A N C E						
Spraying opera-tions (on a total coverage base)		XXXXXXXXXXXXXXXXXXXX			No more spraying except for special interventions						
Infant parasite rate	+++	+	-	-	-						
Epidemiological surveillance: new malaria cases traced	(?)	(?)	(?)	(?)	+	+	-	-	-		////
Protection from reintroduction of: a) DDT-resis-tant mosquitos	→										
b) malaria car-riers	→										

Note: Interruption of spraying; when infant parasite rate has been negative for three years.

Malaria is no longer endemic when epidemiological surveillance has failed to trace new malaria cases, presumably infected (for three consecutive years) in the area of eradication.

10. While it is generally not economically or socially feasible to use antimalaria drugs to eradicate the disease when it is widely prevalent, their use may be indicated in the later stages of a nation-wide malaria eradication plan, when small foci of malaria are being found and dealt with by vigilance teams. However, in some areas, it may be found advisable to make use of drugs as a supplementary measure at an earlier stage.

11. By definition, when in a given area there has been no locally contracted case of malaria for a period of three years as determined by adequate surveillance, then the disease is no longer endemic (see Table I). At this point the special malaria eradication organization can safely leave an area, and the local health department can take over the responsibility for detecting and dealing with any reappearance of malaria. Thus, in planning nation-wide malaria eradication, it is usually necessary to visualize four years of residual spraying followed by at least three more of special surveillance. As, under average conditions, some areas will always lag behind others, the special organization for nation-wide malaria eradication should probably be planned for a period of ten years. Thereafter, the specially trained personnel will be available to attack other health problems.

#### Costs

12. From reports submitted to WHO, it appears that the annual cost of malaria eradication by DDT residual spraying varies from an average of 11 cents in South-East Asia to 46 cents in the Americas per capita of those protected. About 48 per cent. of the cost of operations goes for insecticide, spraying equipment and transport. Expenditure will decline when spraying is interrupted, as maintenance costs will be notably less than those of active eradication procedures. However, an accelerated and complete eradication programme which must clear the last possible focus of infection promptly may cost some 10 per cent. more than a less exacting programme (see Annex 1).

#### Benefits

13. The benefits of substituting malaria eradication programmes for routine malaria control derive from the fact that the former will be self-limiting, whereas the latter has no discernible end. Italy had thousands of cases of malaria in 1939 after many years of classical malaria control by drugs, drainage and larviciding. Vigorous malaria control of a similar type was carried out at enormous cost in the United States from about 1915 through 1945, but the country remained malarious - highly so in some countries. The cost of the accelerated programme with DDT residual spraying, which virtually eradicated malaria from the United States in the years from 1946 to 1952, was a good investment.

14. There can be no doubt about the general economic and social benefits that malaria eradication brings to the countries cleared of the disease (see WHO Chronicle, Vol. 9, No. 2-3). As regards non-malarious countries, obviously they too will share in the benefits if they have import or export business with countries once malarious and now freed of this burden!

#### Conclusion

15. The reasons for an accelerated programme are to be found in the fact that the mosquito vector may become resistant to DDT if the attack is prolonged and that eradication thereafter would be unreasonably costly and often impossible. There is therefore today no other logical choice: malaria eradication is clearly indicated, presents a unique opportunity and should be implemented as rapidly as possible. Time is of the essence.

#### International implications of a world-wide malaria eradication programme.

16. An important international implication of malaria eradication derives from the fact that infective Anopheles mosquitoes or insecticide-resistant strains of vector mosquitoes or human malaria carriers infective to mosquitoes can easily cross national boundaries. Such as interchange of mosquitoes and malaria parasites between countries may have little importance if the countries are malarious, but in some cases the investment made by a country in eradicating its malaria may be jeopardized by a neighbouring country which has not taken similar measures. The spread of DDT-resistant strains of malaria mosquitoes might be particularly dangerous. Also, it is quite possible for imported infective mosquitoes or infective human carriers to start the transmission anew in a country where such transmission had been interrupted. Hence the importance of regional and inter-regional programmes and the special significance of plans such as that to eradicate malaria from all the Americas. There is urgent need for full international co-operation and co-ordination as well as international assistance in malaria eradication programmes.

17. Another international implication of malaria eradication is that today there are several agencies dispensing money for social and economic improvement of underdeveloped countries. These agencies are greatly interested in practical projects that promise important gains at reasonable cost. Malaria eradication by residual spraying is now a thoroughly practical proposition in many areas and is thus receiving considerable financial support. But once Anopheles resistance to insecticides develops, the costs of control are apt to become so much higher that questions of economic feasibility will arise.

18. Moneys for international aid have great importance in assisting countries to carry out malaria eradication programmes; in fact, without this aid some countries would find it impossible to adopt such programmes and would thus remain malaria foci dangerous to surrounding countries.

19. Adequate planning is of great importance in connexion with international assistance, and such planning must include the national and international aspects of malaria eradication. Total coverage, which is essential, may in some cases be unusually expensive. Hence, in some countries it may be necessary for the central government to provide increased financial support to the local authorities for the implementation of the eradication programme. Sometimes it will be necessary for countries to merge a part of their programme into an inter-country programme so that contiguous areas will receive simultaneous and thorough treatment. Regional Offices of WHO can be of great assistance in drawing up and promoting such inter-country plans and agreements.

20. While a continental plan of eradication has great advantages and seems possible now in the Americas, such a plan may not be feasible on every continent. In some cases eradication will have to proceed by areas, which should be chosen on the basis of (1) a topographical configuration or other conditions that can provide barriers so that after the area has been cleared of malaria, spraying can be safely discontinued; and (2) the willingness and ability of the country concerned to carry out the programme. Co-ordination of programmes in time and in efficiency as well as in topography is indispensable.

21. As already noted, all national malaria control programmes should aim at malaria eradication. It seems feasible to plan continent-wide programmes for the Americas and Europe and large sub-continental programmes in the Eastern Mediterranean, the South-East Asia and Western Pacific Regions. On the African continent south of the Sahara, since there have not yet been demonstrations of any wide areas being cleared of malaria by residual spraying, it seems premature to plan in terms of continent-wide eradication. The problem of finding an effective and economical method of eradicating malaria in tropical Africa has not yet been solved. Pilot projects are being carried out, and these require increased emphasis and assistance in order that a solution may be obtained as quickly as possible.

22. In the planning and implementation of world-wide malaria eradication, WHO will be expected to give technical advice and co-ordinate the necessary resources. It should therefore be provided with the means of fulfilling the following functions:

(1) Technical advice

1.1 Exchange of information and provision of facilities to make quickly available to all malaria services of governments such technical data as are of value to their programmes.

1.2 Organization of malaria conferences, study groups, and meetings of chiefs of malaria services.

1.3 Supply of malaria advisory teams on the request of countries to help in solving particular problems, to provide independent assessment as to progress of efficiency of operations, or to suggest such modifications in planning of operations as might be indicated.

1.4 Advisory services of highly experienced malariologists of international reputation as requested.

1.5 The provision of training facilities through fellowships, study tours, and malaria courses.

(2) Co-ordination of research

There is still urgent need for co-ordination of research in connexion with malaria eradication. The two most immediate research projects would appear to be:

2.1 Experimental study of the development of resistance in anopheline vector species to the several chlorinated hydrocarbon insecticides and the possibility of the loss of such resistance when the insecticide is withheld.

2.2 The preparation of a staple food item containing an anti-malarial drug - for example, chloriquinized salt as used by Pinotti in the Amazon area - which could be distributed to a population living under conditions where residual spraying is not practicable and where routine administration of drugs as such would be impossible.

(3) Co-ordination of resources

As regards the provision of equipment, transport and supplies, or even, in some cases, of financial help for local expenses, WHO might well be given authority to co-ordinate and stimulate appropriations from various agencies or non-governmental bodies.

PART II: RESOURCES OUTSIDE WHO WHICH SHOULD BE DEVELOPED TO  
SUPPORT THE PROGRAMME OF MALARIA ERADICATION

23. As indicated in Part I of this document, there are today several sources of funds for social and economic improvement of the so-called under-developed countries. Other specialized agencies of the United Nations, like FAO, for instance, and the United Nations Expanded Programme of Technical Assistance, UNICEF, the Colombo Plan, the United States of America's International Co-operation Administration and other agencies have an interest in eradicating malaria from the world. The governments of countries where malaria continues to be a problem should be encouraged to provide the necessary resources to the extent possible for eradication of malaria in their own countries. Furthermore, there may be sources of contributions from private concerns interested in offering services or funds to the programme.

24. Under the new programming procedures for the Technical Assistance Programme, the responsibility for assigning priorities to projects to be financed under that programme rests with individual governments within the country ceilings established by the Technical Assistance Board for all participating organizations. The Director-General therefore proposes to invite all governments participating in the proposed world-wide malaria eradication programme to request that priority be given to appropriate projects in their country programmes to be financed from Technical Assistance funds.

25. As will be seen from the attached extract from the report of the UNICEF Executive Board on its March 1955 meeting, E/ICEF/294 (Annex 2), that Board endorsed "the general proposition that UNICEF provide increased aid to enable governments to intensify their control programmes in order to achieve malaria eradication". Accordingly, it requested the Executive Director to continue to prepare requests on the same UNICEF principles as in the past "but at the increased tempo which governments may desire". Nevertheless, in view of the seriousness of the obligations proposed to be undertaken by UNICEF, and in recognition of the urgency of the matter, the Board proposed that a special meeting of the UNICEF/WHO Joint Committee on Health Policy be convened in the near future "for the purpose of clarifying the relevant technical and policy aspects of malaria eradication programmes and, in particular, indicating to UNICEF the areas in which such programmes might usefully be undertaken in the near future." It was hoped that the report of the Committee would become available to the Board at its September session and serve, in the meantime, as a guide to the UNICEF administration in bringing forward requests to its September session.

26. In expressing its readiness to co-operate in the proposed world-wide malaria eradication, subject to the conclusions of the Joint Committee on Health Policy on the various aspects of UNICEF aid to large-scale malaria eradication programmes as well as the

areas where such programmes should be undertaken, the Board wished to be assured that it would not be called upon to contribute toward the cost of the international health personnel required.

27. In view of the magnitude of the programme and the need for assistance from many sources, the Director-General recommends that he be authorized to seek the active co-operation and assistance of other appropriate bilateral and multilateral governmental agencies including the United States International Co-operation Administration, the Colombo Plan and others, as well as non-governmental organizations and private concerns. It is envisaged that contributions in any usable currencies, or in services, supplies and equipment should be accepted for use in the programme.

### PART III: IMPLICATIONS FOR WHO

#### General

28. The World Health Organization, in exercising its constitutional function "to act as the directing and co-ordinating authority on international health world;" should take the initiative and assume full responsibility for technical advice, co-ordination of research and co-ordination of resources in the implementation of such a world-wide programme, as outlined in Part I of this document. In order to carry out these functions, the Organization needs the means with which it can make available appropriate advice to governments, assist in providing training facilities for staff and stimulate and co-ordinate research to achieve complete success and to guide the total programme. The Organization should also take the responsibility for co-ordinating other international, bilateral or multi-lateral resources which can be made available to meet the costs of the large quantities of supplies and equipment without which the effective implementation of the programme is not possible.

29. It will be recalled that the Executive Board, at its fifteenth session, adopted resolution EB15.R67,<sup>1</sup> calling attention to the urgency of malaria eradication.

30. The Director-General urges the Health Assembly to give favourable consideration to this vital undertaking, in which it is now planned that WHO will play an important role, taking due account of the importance of timing and the opportunity which is now available to improve the health of the peoples in vast areas of the world.

31. There are set out below the detailed proposals which the Director-General is submitting to this Assembly in relation to the budgetary and financial implications of the proposal for the Organization.

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<sup>1</sup> Off. Rec. Wld Hlth Org. 60

Implications on the Regular Budget of the Organization

32. The greatest possible security of financing of those basic activities which will fall under the responsibility of the Organization is necessary. Having regard also to the size of the additional amount needed, it is proposed that the basic minimum requirements for the Organization's co-ordinating activities be financed from its regular budget. The Director-General calls attention to the fact that it is undesirable to distort the total health programme under the regular budget for the purpose of financing malaria eradication. It should be emphasized that the orderly implementation of all the other activities included in the Proposed Programme and Budget Estimates for 1956 should not be affected, and the Director-General would urge that these other activities should not suffer a reduction in favour of a concentration on the malaria eradication programme.

33. There are attached, as Annex 3 and Annex 4, descriptive material and the estimated additional costs for the minimum requirements which it is proposed should be met from regular funds for this programme. The information contained in the annexes has been presented in a form similar to the one used in Official Records No. 58. It will be noted that the estimated total additional expenditure in 1956 amounts to \$309 484, of which \$306 484 refers to Appropriation Section 5 and \$3000 to Appropriation Section 7. Annex 4 shows also the amounts already provided in the Proposed 1956 Programme and Budget Estimates for malaria work under all funds, in order that the Health Assembly may know the total estimated costs of this programme in 1956 under Regular, Technical Assistance and Pan American Sanitary Bureau funds.

34. The supplementary estimates of \$309 484 are based on the assumption that approximately the same level of provision for malaria work will be maintained under Technical Assistance funds as shown in the 1956 estimates. It is also expected that an amount approximately equal to the supplementary 1956 estimates will be required, at least for the first four to six years of the period of implementation, although the precise requirements will have to be calculated for each individual year and included in the Director-General's annual estimates.

35. The Director-General recommends that this additional provision be included in the amounts to be voted by the Assembly for Appropriation Sections 5 and 7, and that the \$309 484 be financed by using an equivalent amount which is available in the increased casual income. This would avoid an increase in assessments on Members over the amount shown in Official Records 58 and would not disturb the orderly implementation of the activities planned and provided for in the Proposed Programme and Budget Estimates for 1956.

36. The Committee on Programme and Budget, in reviewing the Proposed Programme and Budget Estimates for 1956, will wish to examine

these additional estimates before the budgetary calling for 1956 is determined.

#### Malaria Eradication Special Account

37. As indicated in Part II of this document, it is proposed that the resources expected to be made available under the regular budget and from bilateral and multilateral sources be augmented by direct contributions from governments and from private sources, to be paid into a Malaria Eradication Special Account. The Eighth World Health Assembly may therefore wish to authorize the Director-General to address appropriate appeals for this purpose to governmental and private sources.
38. Should the Health Assembly approve the proposals, the Director-General recommends that the Special Account to be established should be used specifically for the purpose of meeting the cost of:
- (a) such supplies and equipment, apart from minimal requirements to be provided from Regular and Technical Assistance funds, as are necessary for the effective implementation of the programme in individual countries, to the extent that such supplies and equipment cannot be provided by the governments of the countries concerned from local resources, by bilateral or multilateral agencies including UNICEF.
  - (b) such services as may be required in individual countries and as cannot be made available by the governments of such countries or by bilateral or multilateral agencies.
39. It is proposed that the Special Account should be credited with contributions received in any usable currency from whatever source, and reflect contributions in kind, whether in the form of services or supplies and equipment.
40. In accordance with financial regulations 6.6 and 11.3, it is recommended that the proposed Malaria Eradication Special Account be maintained as a separate account and the operations of the account be reported to the Executive Board and the World Health Assembly.
41. Financial regulation 6.7 requires, *inter alia*, that unless otherwise provided by the Health Assembly, special accounts shall be administered "in accordance with the present regulations". It is recommended that recorded obligations against the Special Account shall be maintained as such until discharged, regardless of the duration of the programme, and that the unexpended balances of the Account be carried forward from year to year until the programme is terminated.

42. Activities under the Special Account will be included in the Director-General's annual financial report.

Action to be requested of the Executive Board

43. Article 57 of the Constitution authorizes the Health Assembly or the Board acting on behalf of the Health Assembly to accept and administer gifts and bequests made to the Organization. The Health Assembly may wish to request the Board to establish a committee:

- (a) to accept contributions between sessions of the Board, and
- (b) to advise the Director-General from time to time on any questions of policy relating to the administration of the Special Account or to the implementation of the programme.

PART IV: SUMMARY OF RECOMMENDATIONS ON MALARIA ERADICATION

44. There follows a summary of recommendations submitted for the consideration of the Eighth World Health Assembly:

- (1) That a world-wide malaria eradication programme be immediately undertaken, with WHO providing technical advice, co-ordination of research and co-ordination of resources.
- (2) That the Director-General be authorized to request those governments in whose countries malaria still exists to give priority to malaria eradication projects in their requests for assistance under the United Nations Expanded Programme of Technical Assistance and to provide the resources locally available which are required to achieve malaria eradication.
- (3) That the amount of \$309 484 required for the programme in 1956 be added to the appropriation for that year, and that it be financed from the additional casual income which has become available.
- (4) That the Director-General be authorized to address appropriate appeals for assistance in malaria eradication to governmental and private sources.
- (5) That a Malaria Eradication Special Account be established for the purposes and with the composition set forth in Part III of this document.
- (6) That the Executive Board be requested to establish a committee to accept contributions to the Special Account and to advise the Director-General on policy questions relating to the implementation of the programme and to the administration of the Special Account.

## A TENTATIVE PROGRAMME TOWARDS WORLD-WIDE MALARIA ERADICATION

The calculations given in the following table are rough estimates. The rate of annual increase in the number of protected people for each region varies owing to variations that can be foreseen for the development of the different national programmes.

- (1) In general it has been assumed that only in 1955 will the programme reach total coverage of areas aiming at malaria eradication.
- (2) It has also been assumed that full interruption of transmission will be achieved usually only during the second year of total coverage spraying and that therefore house-spraying might be withheld in any suitable area that has been completely sprayed for at least four years, provided that by the fourth year appropriate surveillance and treatment of traced cases is undertaken, and provided that the infant parasite rate has been negative in the second, third and fourth years.
- (3) It has been estimated that the per capita cost per year of active surveillance and treatment of cases will amount to 40 per cent. of the cost of active protection by spraying.
- (4) The duration of "epidemiological surveillance", as mentioned above, has been foreseen for five years, after which maintenance could be entrusted to the general health services and would no longer need to be the concern of the special antimalaria organization.
- (5) The total per capita cost per year of the residual spraying campaign given in tables (c) and (d) has been calculated on the basis of the following averages for each region:

Americas	\$0.455 (in 1958; \$0.42 in 1955)
South-East Asia	\$0.11
Eastern Mediterranean	\$0.20
Western Pacific	\$0.175
Europe	\$0.20
Africa	\$0.41

To the above figures 10 per cent. has been added to cover the increased cost of eradication as compared with the cost of subtotal control (table (d)).

- (6) As the American Region has supplied corrected data, no attempt has been made to apply the considerations and calculations mentioned in paragraphs 1, 4 and 5 above for that region.

(7) It may be noted that as a world average the cost of supplies, transport and equipment amounts to some 48 per cent. of the total cost of spraying operations (without the 10 per cent. supplement mentioned in paragraph 5). This percentage is based on an average requirement per million population to be protected of 100 tons DDT 75 per cent. wettable powder, 250 sprayers, and 20 vehicles, applied to the proportion of population belonging to the various regions in the programme foreseen for 1958.

(8) It should be noted that as eradication from the whole of the African, Eastern Mediterranean and Western Pacific Regions cannot at the moment be envisaged, for the purposes of this tentative programme limited targets have been set for those regions as detailed below:

<u>Region</u>	Population of malarious areas (in Millions)	
	<u>Total</u>	<u>Provisional targets</u>
AMRO	131.5	131.5
SEARO	253.0	253.0
EMRO	50.0	40.0
WPRO	23.0	18.0
EURO	34.0	34.0
AFRO	111.0	10.0
Totals	<u>602.5</u>	<u>486.5</u>

It should also be noted that the above figure for the Americas includes 74.3 million already completely protected.

## TABLES

(a) Millions protected by spraying

<u>Region</u>	or	1953										
		1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964
Americas		25.3	32.0	45.5	54.5	57.2	25.2	11.7	2.7	-	-	-
S.-E. Asia		74	100	150	165	190	105	70	88	63	48	33
E. Mediterranean		14	14	20	25	30	25	20	15	10	.....	
W. Pacific		9.7	10	12	14	15	6	6	4	3	2	.....
Europe		25	25	26	28	5	7	8	6	4	2	
Africa		6.7	7	7.5	8	8.5	2.3	2.5	2	1.5	1	.....
		154.7	189.0	261.0	294.5	305.7	170.5	118.2	117.7	81.5	53	33

(b) Millions protected either by spraying or by surveillance

<u>Region</u>	1953											
	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	
Americas	25.3	32	45.5	54.5	57.2	57.2	57.2	57.2	57.2	-	-	
S.-E. Asia	74	100	150	165	190	205	220	253	253	253	253	
E. Mediterranean	14	15	20	25	30	40	40	40	40	40	.....	
W. Pacific	9.7	10	12	14	15	16	18	18	18	18	.....	
Europe	25	25	26	28	30	32	34	34	34	34	34	
Africa	6.7	7	7.5	8	8.5	9	10	10	10	10	10	
	154.7	189	261	294.5	330.7	359.2	379.2	412.2	412.2	355	297	
1)	4.3	229	263.3	335.3	368.8	405	433.5	453.5	486.5	486.5	486.5	486.5

1) 74.3 million population living in potentially malarious areas in the Americas already completely protected are included in the grand totals for the years 1954 to 1962 inclusive. They are also included in the grand totals for the years 1963 and 1964, together with 57.2 million which will no longer be under surveillance then, and in that for the year 1964, populations in the Eastern Mediterranean and West Pacific Regions which will no longer be under surveillance are also included.

customary in many countries not to spray villages with very low spleen-rates or those that were too remote from the highways. This procedure would jeopardise the possibility of discontinuing the campaign, because it would leave sources of infection within the controlled area.

Secondly, the assessment of results should be so organized as to make it possible to ascertain if and where a total interruption of malaria transmission has been achieved. It is felt that the usual malarimetric survey methods are not sufficiently sensitive for this purpose. As a matter of fact, it might be said that such methods lose much of their utility both where transmission is extremely intense and where it is at vanishing point. In the latter case, infant parasite-rates may have reached zero, though some transmission is still occurring. Therefore, it seems necessary that the localities should be visited regularly and that all subjects having fever or having had fever during the intervals between visits should have their blood examined. This active search for cases, such as is being carried out in Greece, seems necessary; but it should be started at least one year before interruption of the spraying campaign is envisaged, in order to be as sure as possible that such interruption will be applied only where appropriate.

Thirdly, malaria control should be implemented with the greatest technical thoroughness, all at one time and in as large an area as possible, preferably bordered by areas where, naturally or as a result of control, there is also no transmission.

Fourthly, appropriate safeguards, such as those indicated in the fifth report of the Expert Committee on Malaria, should be introduced to ensure rapid detection of any case of malaria and prompt elimination of possible transmission." (Pp. 515-516)

The statement concludes by pointing out:

"It is realized that this new pattern of planning, which must be conceived of in terms of huge areas, of total coverage, of great thoroughness of control, and of a minimum of years, will be difficult and that its implementation will require more funds, more trained personnel, greater efficiency of operations, and better systems of epidemiological surveillance than are necessary now. Further, it may require inter-country coordination of programmes. These difficulties would be compensated for, however, not only by better and quicker results, but also by the hope that after a few years of intense efforts, malaria control would no longer represent an important item in the yearly budget of the health administration. Should this new and bold planning not be adopted, the penalty might vary. In the more favourable cases, house-spraying would remain effective, but would have to be continued year after year; in the

unfortunate cases insecticide resistance would develop, increase, become polyvalent, and the whole programme might ultimately end in failure." (P. 518)

44. Estimates by WHO show that approximately 309 million persons in reporting countries have yet to be protected against malaria. Of this number, the UNICEF Administration estimates that about 135 million are in countries that may request UNICEF aid. During the period 1955-1959, aid may be sought from UNICEF for some 49 million of these, although not more than 40 million would be covered in any one year.

45. The cost of international aid for anti-malaria campaigns has been between 10¢ to 20¢ per person protected per year, with an average of about 12¢. On the basis of these estimates, the cost to UNICEF of aid for malaria eradication would be about \$5 million per year.

46. The Executive Board was impressed with the evidence of the economic importance of the campaigns as called to its attention by the Director of the Pan American Sanitary Bureau/Regional Office for the Americas:

"... In its malignant form, malaria is highly fatal, particularly among the young, and is still one of the world's great killers of children. Although other diseases may decimate, only malaria depopulates. In the past, malaria has caused large areas to be abandoned to the jungle, and the development of enormous fertile tracts has been prevented. Survivors of severe malaria, and of repeated mild infections may suffer the lifelong debilitating effects of chronic infection. Malarious populations tend to live on a bare subsistence basis, contributing nothing to the common good. Even where the incidence of infection is relatively low, there is a surprising inhibition of both mental and physical effort."

"Malaria is a serious burden on the economy of every malarious country. It has been well said that, where malaria fails to kill, it enslaves. It is an economic disease. No infected area may hope to meet the economic competition of non-malarious regions. In agriculture and industry, labour is inefficient and the output is often reduced by one-third to one-half and even more. .. As a primary basis of economic development, malaria must be suppressed." (E/ICEF/282, Paras 7-10)

47. Subject to the provisions set forth in paragraphs 55-56, 61 and 62 below, the Executive Board endorsed the general proposition that UNICEF provide increased aid to enable governments to intensify their control programmes in order to achieve malaria eradication. It requested the Executive Director to continue to prepare requests on the same UNICEF principles as in the past but at the increased

tempo which governments may desire. The Board would continue to receive requests on the same basis from all parts of the world.

48. The Board believes that through this means a very important opportunity is offered UNICEF for a fundamental contribution to welfare of children. The Board expressed its appreciation for the planning reflected in this new approach which, in the longrun view, will be more effective and economical.

49. In order to meet the unusual need for allocations in this field, project allocations would be made annually for one-year periods (instead of for two or three years, as has been the case in the past). At the same time, however, the Board would give approval in principle for its participation in a country programme over a period of years.

50. The Board was conscious that, once full-scale eradication programmes have begun with its aid, UNICEF will bear a heavy responsibility for ensuring that aid is continued until success is achieved.

#### Technical Aspects

51. It is apparent that successful eradication requires planning involving large areas, total coverage, and great thoroughness of control with all that this implies in terms of such elements as the willingness of governments to participate as fully as possible (including governments of countries in which the incidence may not be regarded as serious); prior surveys of the malaria situation; the availability of trained personnel; the development of efficient and economical organization; the assurance of low per caput cost; the formation of better systems of epidemiological surveillance; the degree of inter-country coordination of programmes required, etc.

52. It is the practice of the UNICEF Board not to embark upon large-scale commitments of a long-range nature without a full understanding of how the UNICEF investment would produce desired results both on an over-all basis and in specific country application.

53. The Board was grateful for the technical assurances bearing upon the points which were given by the representatives of WHO at the Board and Programme Committee meetings, including assurances that required technical personnel would be available in the Americas, and that training of the bulk of local personnel need be only of a short-term character. Among those governments in the Americas where discussions of individual country programmes had begun, a full desire to proceed had already been indicated.

54. Nevertheless, in view of the seriousness of the obligations proposed to be undertaken by UNICEF, the Board wished to have greater assurances than could be given at the current Board session that

UNICEF would be taking the proper steps in the proper way, and that these steps were in accordance with an over-all plan for cooperation among countries, as well as effective plans at country operating levels.

55. As a consequence, the Board proposed that a special meeting of the UNICEF/WHO Joint Committee on Health Policy be convened for the purpose of clarifying for UNICEF the relevant technical and policy aspects of malaria eradication programmes and, in particular, indicating to UNICEF the areas in which such programmes might usefully be undertaken in the near future.

56. It was generally recognised that the problem called for urgent action. Therefore, the Board proposed that the special meeting of the JCHP be convened in the near future so that its report will be available to the Board for its September session and can, in the meanwhile, serve as a guide to the UNICEF Administration bringing forward requests to the September session.

#### Effect on UNICEF Aid for Other Types of Programmes and to Geographic Regions

57. The Administration pointed out that during 1954, \$17 million gross was allocated by UNICEF, including \$2 million for malaria work. If it should become necessary to allocate \$5 million for malaria, this could be done without disturbing past patterns if sufficient contributions were obtained to carry allocations to the Board's target level of \$20 million. It was the earnest hope of the Board that governments would increase their contributions to UNICEF so that the \$20 million level would be achieved.

58. Should, however, the level of allocations next year not exceed the 1954 level of \$17 million, the additional \$3 million required annually for malaria (i.e. \$5 million as against \$2 million allocated in 1954) would be obtained, according to estimates by the Administration, by reducing allocations for emergencies by \$1 million (which would be made possible by receiving skim milk free except for ocean freight costs) and by reducing allocations for long-range programmes other than malaria by about \$2 million (from \$9.75 million to \$7.5 million), or about 23 per cent.

59. As far as possible, adjustments would be made on other health programmes, thus maintaining the over-all proportion of aid to long-term nutrition programmes (including the development of new protein sources).

60. The Board recognised that the proposed commitment of \$5 million annually for malaria control would, at best, result in a hold-the-line operation for other types of activities and constitute a departure for UNICEF in its trend of expansion and increasing impact along a variety of lines, some of which hold promise of new and fruitful approaches. Moreover, should the international phase of aid for malaria eradication programmes take longer than anticipated, the disproportion both as between types of programmes and areas would continue.

61. In the light of the above considerations, the Board decided that such disproportion as may result between regions should be regarded as temporary and not as establishing a precedent; and that the Board would, at a later stage in its development of annual target programmes of allocations, give increased attention to the needs of regions to which UNICEF aid had been less as a result of the eradication programmes. In this connection, the Board recognised that target programmes are not regarded as inflexible, but rather as a guide subject to changes by the Board on the basis of new information and experience.

#### Costs of International Project Personnel for Malaria

62. The Board appreciated the assurances that in the Americas the costs for international project personnel in malaria projects would be met in full by WHO and PASB, and that there was no intention to request UNICEF to bear the costs of any of the required international project personnel. The Board wishes to see these assurances firmly spelled out not only for the Americas but for other areas where UNICEF might be giving more aid to malaria projects. (The general question of UNICEF/WHO financial relations is discussed in paras 119-131.)

#### Malaria Eradication in Mexico

63. Mexico has the most serious malaria problem in the Americas. Of a total of 30 million persons in the Americas unprotected against malaria, 19 million live in Mexico. This presents a problem of very large proportions, as the Government wants to mount a four-year eradication programme, 1956-1959. The cost of insecticides, transport and sprayers needed by Mexico for this campaign is estimated to be between \$6 million and \$8 million.

64. The Government of Mexico has indicated its serious interest in prosecuting this programme to its ultimate objective of eradication, and is now in the process of making firm financial arrangements to ensure the availability of funds for the local expenses of the entire campaign.

65. In view of the desire of the Government of Mexico to proceed with the necessary preparatory steps, including financial arrangements and the training of personnel, the Government requested an indication from the Executive Board of UNICEF of its willingness in principle to assist this programme with imported supplies.

66. The Board agreed in principle to participate in the proposed four-year malaria eradication programme. This would be subject to the conclusions of the JCHP on the various aspects of UNICEF aid to large-scale malaria eradication programmes and, as far as Mexico is concerned, the development of detailed plans for effective field operations and the provision of the local financial resources necessary to prosecute the campaign to its full objective.

#### Malaria Eradication in Certain Other Countries

67. In connection with the apportionments made at the present Board session for antimalaria campaigns in Haiti and Trinidad (see paras 183 and 190), it was understood that any relevant recommendations of the JCHP would be applied in the execution of these campaigns.

NARRATIVES TO ESTIMATES FOR MALARIA ERADICATION  
(Appropriation Section 5)

THE AMERICAS

Inter-Country Programmes

Malaria and Insect Control  
Technical Meetings

With the development, in collaboration with the Pan American Sanitary Bureau and other bilateral and multilateral agencies, of malaria eradication programmes in many countries in the Region, it will be necessary to convene meetings, from time to time, of the Chiefs of the Malaria Services to exchange technical information and to facilitate inter-country co-ordination. It is accordingly proposed to convene one such meeting in 1956. The estimated expenditure relates to duty travel.

SOUTH-EAST ASIA

Indonesia

Malaria and Insect Control  
Training Course

There is a special need in Indonesia for assistance in the training of personnel of various categories, such as non-medical malariologists assistant entomologists, sanitarians, laboratory technicians, etc. It is therefore proposed to hold a course, of nine months' duration for the purpose of training several batches of students, to be conducted by a senior consultant malariologist, a consultant sanitarian and a consultant laboratory technician at an estimated cost of \$29 700 in respect of personnel and \$1000 in respect of supplies and equipment. It is proposed that the teaching staff should be assisted by the malariologist and the entomologist assigned to the project "Assistance to Malaria Section Ministry of Health", for which it is expected that the Government will request continuing provision be included under Category I of the Expanded Programme of Technical Assistance

Inter-Country Programmes

Malaria and Insect Control  
Technical Meetings

With the development of malaria eradication programmes in many countries in the Region it will be necessary to convene, from time to time, meetings of the Chiefs of the Malaria Services to exchange technical information and to facilitate inter-country co-ordination. It is accordingly proposed to convene one such meeting in 1956. The estimated expenditure relates to duty travel.

WESTERN PACIFICInter-Country ProgrammesMalaria and Insect ControlTechnical Meetings

With the development of malaria eradication programmes in many countries in the Region it will be necessary to convene, from time to time, meetings of the Chief of the Malaria Services to exchange technical information and to facilitate inter-country co-ordination. It is accordingly proposed to convene one such meeting in 1956. The estimated expenditure relates to duty travel.

REGION UNDESIGNATEDCountries UndesignatedMalaria and Insect ControlInter-Regional Co-ordination

With the expansion of malaria eradication programmes throughout the world there will be wide demands for expert advice which cannot be met from existing resources at Headquarters or in the Regions. It is therefore proposed that provision be made for short-term consultants (36 months) at an estimated cost of \$43 200, to advise on the development of these programmes and to assist governments in the assessment of programmes already undertaken. In addition it is proposed to provide for the appointment of a medical malaria entomologist and a technical assistant with the necessary secretarial assistance, at an estimated cost of \$23 649, including duty travel (5 000), to provide advice and to study problems in this specialized field.

Advisory Teams

In order to assist the governments of requesting countries in the assessment of eradication programmes, to investigate specially difficult problems where eradication may be retarded for technical reasons or, where necessary, to carry out special preoperational surveys and/or training work, it is proposed that provision be made for three advisory teams in 1956 to visit such countries for periods averaging four months in each case. Each team would consist of a malariologist, an entomologist and two laboratory technicians at an estimated cost of \$26 805, plus duty travel and per diem (\$16 800). It would also be necessary to provide for each team laboratory equipment at an estimated cost of \$1 000 and transport (\$3 000).

Grants (Research)

These are two fundamental problems calling for urgent research. The first involves the experimental study of the development of resistance in anopheline vector species to the several chlorinated hydrocarbon insecticides and the possibility of the loss of such resistance when the insecticide is withheld. The second is the preparation of a staple food item containing an anti-malarial drug so that it could be distributed to a population living under conditions where control of malaria by residual

spraying is not practicable and where routine administration of drugs as such would be impossible. Some good field results have been obtained by the distribution of chloroquinized salt in the Amazon area, but before such methods can be advised for general application, it is essential that extensive, carefully controlled studies should be made. Provision is therefore made for grants to suitable institutes for assistance in carrying out these projects.

#### Study Group on International Protection

As countries achieve or approach eradication of malaria, they will be increasingly concerned with the question of protecting themselves from the introduction from outside of infective Anopheles mosquitos or human malaria carriers infective to mosquitos, and particularly from the introduction of insecticide-resistant strains of vector mosquitos. Provision is therefore made for a study group in 1956 (consisting of eight members) to study and make recommendations on the various aspects of this problem.

#### Assistance to Malaria Courses

To meet the anticipated needs for trained workers, particularly at the professional level, provision is made for short-term consultants (twelve consultant months) to assist in training courses to be held in various national institutes or to teach at special courses organized by WHO.

#### Fellowships (Short-term)

Provision is made for twelve short-term fellowships of two months' duration to enable professional workers in the field of malaria control to study malaria control and eradication methods in other countries. Such studies would be of mutual benefit to the fellows and to the countries visited.

(Appropriation Section 7)

### EXPERT COMMITTEES AND CONFERENCES

The last meeting of the Expert Committee on Malaria was held in 1953. In view of the new move towards malaria eradication over wide areas in most WHO Regions, it is considered that advantage should be taken of the presence of a number of members of the Expert Advisory Panel of Malaria in Athens for the European/Eastern Mediterranean Conference, to call a meeting of the Expert Committee in order to advise the Organization in this connexion.

Attachment 4 (copy)  
Annex 4

## SUPPLEMENTARY 1956 ESTIMATES FOR MALARIA ERADICATION

No. of Posts		Estimated Expenditure in 1956		
		Amount al- ready pro- vided for in Off.Rec. No. 58 <sup>1)</sup>	Proposed Additional Provision	Total
		\$	\$	\$
<b>REGULAR BUDGET</b>				
<b>APPROPRIATION SECTION 5</b>				
<u>5</u>	<u>Headquarters</u>	39 674	-	39 674
	<u>Field</u>			
	<u>Africa</u>			
1	Regional Advisers	17 789	-	17 789
1	Country Projects	10 176	-	10 176
-	Inter-country Programmes	7 800	-	7 800
<u>2</u>	<u>Total - Africa</u>	<u>35 765</u>	<u>-</u>	<u>35 765</u>
	<u>Americas</u>			
-	Technical Meetings	-	8 000	8 000
-	Total - Americas	-	8 000	8 000
	<u>South-East Asia</u>			
6	Country Projects	32 217	-	32 217
	Training Course	-	30 700	30 700
	Technical Meetings	-	2 000	2 000
<u>6</u>	<u>Total - South-East Asia</u>	<u>32 217</u>	<u>32 700</u>	<u>64 917</u>
	<u>Eastern Mediterranean</u>			
1	Regional Advisers	12 976	-	12 976
<u>1</u>	<u>Total - Eastern Mediterranean</u>	<u>12 976</u>	<u>-</u>	<u>12 976</u>

1) Adjusted to take account of plus and minus factors relating to staff turnover, delays in effecting replacements and filling new posts, and delays in implementation of new projects, applied in Official Records No. 58.

No. of Posts		Estimated Expenditure in 1956		
		Amount already provided for in Off. Rec. No. 58 <sup>1)</sup>	Proposed Additional Provision	Total
		\$	\$	\$
	<b>Western Pacific</b>			
1	Regional Advisers	19 905	-	19 905
	Technical Meetings	-	2 500	2 500
<u>1</u>				
	<b>Total - Western Pacific</b>	<b>19 905</b>	<b>2 500</b>	<b>22 405</b>
	<b>Region Undesignated</b>			
1	Countries Undesignated	27 005	-	27 005
4	Inter-regional Co-ordination	-	66 849	66 849
12	Advisory Teams	-	142 815	142 815
-	Grants (Research)	-	36 000	36 000
-	Study Group on International Protec/ Assistance to Malaria Courses	-	4 800	4 800
-	Fellowships (Short-term)	-	15 600	15 600
-		-	13 200	13 200
<u>17</u>	<b>Total - Region Undesignated</b>	<b>27 005</b>	<b>279 264</b>	<b>306 269</b>
	<b>Total - Field</b>	<b>127 868</b>	<b>322 464</b>	<b>450 332</b>
	<b>Less: Delays in Implementation of New Projects<sup>2)</sup></b>	<b>-</b>	<b>15 980</b>	<b>15 980</b>
<u>27</u>	<b>Net Total - Field</b>	<b>127 868</b>	<b>306 484</b>	<b>434 352</b>
	<b>Recapitulation</b>			
5	Net Total - Headquarters	39 674	-	39 674
<u>27</u>	" " Field	<u>127 868</u>	<u>306 484</u>	<u>434 352</u>
<u>32</u>	<b>Net Total - Appropriation Section<sup>5</sup></b>	<b>167 542</b>	<b>306 484</b>	<b>474 026</b>

1) Adjusted to take account of plus and minus factors relating to staff turnover, delays in effecting replacements and filling new posts, and delays in implementation of new projects, applied in Official Records No. 58.

2) Average delay factor applied as for all new projects in Official Records No. 58.

No. of Posts		Estimated Expenditure in 1956		
		Amount already provided for in Off. Rec. No. 58	Proposed Additional Provision	Total
		\$	\$	\$
<u>APPROPRIATION SECTION 7</u>				
	Expert Committee on Malaria	-	3 000	3 000
	Total - Appropriation Section 7	-	3 000	3 000
<u>32</u>	<u>Total - Regular Budget</u>	<u>167 542</u>	<u>309 484</u>	<u>477 026</u>
<u>TECHNICAL ASSISTANCE FUNDS</u>				
<u>Field</u>				
<u>Africa</u>				
5	Country Projects	49 729	-	49 729
4	Inter-country Programmes	32 695	-	32 695
<u>9</u>	<u>Total - Africa</u>	<u>82 424</u>	<u>-</u>	<u>82 424</u>
<u>Americas</u>				
8	Country Projects	67 041	-	67 041
10	Inter-country Programmes	108 620	-	108 620
<u>18</u>	<u>Total - Americas</u>	<u>175 661</u>	<u>-</u>	<u>175 661</u>
<u>South-East Asia</u>				
8	Country Projects	62 859	-	62 859
<u>8</u>	<u>Total - South-East Asia</u>	<u>62 859</u>	<u>-</u>	<u>62 859</u>
<u>Eastern Mediterranean</u>				
11	Country Projects	92 234	-	92 234
<u>11</u>	<u>Total - Eastern Mediterranean</u>	<u>92 234</u>	<u>-</u>	<u>92 234</u>
<u>Western Pacific</u>				
8	Country Projects	100 694	-	100 694
<u>8</u>	<u>Total - Western Pacific</u>	<u>100 694</u>	<u>-</u>	<u>100 694</u>
<u>54</u>	<u>Total - Technical Assistance Funds</u>	<u>513 872</u>	<u>-</u>	<u>513 872</u>

1)

Adjusted to take account of plus and minus factors relating to staff turnover, delays in effecting replacements and filling new posts, and delays in implementation of new projects, applied in Official Records No. 58.

No. of Posts		Estimated Expenditure in 1956		
		Amount al- ready pro- vided for in <u>Off. Rec.</u> No. 58 <sup>1)</sup>	Proposed Additional Provision	Total
		\$	\$	\$
<u>PASB FUNDS</u>				
	<u>Field</u>			
	Americas			
4	Country Projects	52 720	-	52 720
1*	Inter-country Programmes	120 481	-	120 481
5	<u>Total - PASB Funds</u>	173 201	-	173 201
91	<u>Total - Regular, Technical Assistance and PASB Funds</u>	854 615	309 484	1 164 099

1) Adjusted to take account of plus and minus factors relating to staff turnover, delays in effecting replacements and filling new posts, and delays in implementation of new projects, applied in Official Records No. 58.

\* Number of posts to be established for the purposes of the intensified malaria eradication programme not yet determined (amount set aside for personnel out of additional \$100 000 is \$50 000).

(c) Cost of spraying operations (without 10 percent. increase)  
in millions of dollars

Region	or	1953										
	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	
Americas <sup>1)</sup>	9.9	13.48	20.4	25.1	26	(11.4)	(5.3)	(1.2)	-	-	-	
S.-E. Asia	8.14	11	16.5	18.15	20.9	11.55	7.7	9.68	6.96	5.28	3.63	
E. Mediterranean	2.8	3	4	5	6	5	4	3	2.....			
W. Pacific	1.7	1.75	2.1	2.45	2.6	1.05	1.05	0.7	0.525	0.35	.....	
Europe	5	5	5.2	5.6	1	1.4	1.6	1.2	0.8	0.4	.....	
Africa	3.015	3.15	3.375	3.6	3.825	1.035	1.125	0.9	0.675	0.45	.....	
	<u>30.55</u>	<u>35.38</u>	<u>51.57</u>	<u>59.9</u>	<u>60.32</u>	<u>31.43</u>	<u>20.77</u>	<u>16.68</u>	<u>10.96</u>	<u>6.48</u>	<u>3.63</u>	

(d) Total cost of operations including 10 per cent. increase of  
spraying operations for eradication, and cost of surveillance  
at 40 per cent. of cost of spraying in millions of dollars

Region	or	1953										
	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	
Americas <sup>1)</sup>	9.9	13.48	20.4	25.1	26	(11.4)	(5.3)	(1.2)	-	-	-	
S.-E. Asia	8.14	12.1	18.15	19.97	22.9	17.11	15.07	17.91	16.02	14.83	9.27	
E. Mediterranean	2.8	3.3	4.4	5.5	6.6	6.7	6	5.3	4.6	3.2	2	
W. Pacific	1.7	1.925	2.31	2.7	2.88	1.85	1.995	1.75	1.63	1.505	0.56	
Europe	5	5.5	5.72	6.16	3.1	3.54	3.84	3.56	3.28	1	0.72	
Africa	3.015	3.465	3.71	4	4.21	2.34	2.59	2.43	2.27	2.115	0.6	
	<u>30.55</u>	<u>39.77</u>	<u>54.69</u>	<u>63.43</u>	<u>65.69</u>	<u>42.94</u>	<u>34.79</u>	<u>32.15</u>	<u>27.80</u>	<u>22.65</u>	<u>13.15</u>	

<sup>1)</sup> Figures in brackets are the assumed figures.

E/2717  
E/ICEF/294EXCERPT FROM REPORT OF THE UNICEF  
EXECUTIVE BOARD, MARCH 1955 SESSIONIncreased UNICEF Aid for Malaria Eradication

41. The question of increased UNICEF aid for malaria eradication was placed before the Executive Board in the Executive Director's General Progress Report (E/ICEF/281, paras 5-18); in an Information Note by the Executive Director on the financial aspects of an increased UNICEF contribution for malaria eradication (E/ICEF/L.755); and in a report by the Director of the Pan American Sanitary Bureau/Regional Office of the World Health Organization on "Malaria Eradication in the Americas" (E/ICEF/282) which includes a request for UNICEF participation in an accelerated regional approach in the Americas. The Board was also asked to express its policy toward a particular case, namely, that involving an eradication programme in Mexico, which contains two-thirds of the unprotected population of the Americas.

42. Following recent experience in several countries, member governments of the World Health Organization have become concerned about the potential danger of development of resistance to DDT by malaria-bearing mosquitoes. Conferences in Asia and the Americas reflecting the collective opinion of responsible public health administrators and malariologists have urged governments to eradicate malaria so that the spraying campaigns can be safely terminated before resistance occurs. Another important factor leading to the new emphasis on malaria eradication (rather than malaria control) is the economic burden of recurrent expenditures for residual spraying under control programmes. Considerable difficulties have been encountered by public health administrations in securing funds for the continuation of a programme, year after year, when the disease is no longer a major cause of sickness. With the possibility of limiting large expenditures to a few years under eradication programmes (leaving only the need for maintenance programmes at a considerably lower level of expenditure), the development of nationwide campaigns would be encouraged.

43. After several years of achieved malaria control, residual spraying can be safely discontinued if proper safeguards have been set and the whole campaign has been planned toward the objective of eradicating malaria. An indication of what is involved in this new approach is contained in the following excerpt from an official statement on the subject by the Chief of the WHO Malaria Section: (WHO Bulletin, Vol. II, No. 4-3, 1954)

"First, within the area to be controlled, every locality where transmission is possible should be under control. It has been

## MALARIA ERADICATION

Introduction:

The eradication of malaria from the world as a public health problem is a basic objective of WHO. Thanks to the remarkable properties of DDT a number of national health departments, often assisted by WHO, UNICEF or USA bilateral aid programmes, have made truly amazing progress towards this objective. Until recently the goal had seemed to become increasingly attainable. However, it has now become apparent that there may be a time limit beyond which the new insecticides, which have made nation-wide malaria eradication projects financially feasible, may no longer kill the mosquitoes that carry malaria. Resistance to DDT has appeared in several species of Anopheles malaria vectors after some six years of exposure. Hence the present concern of WHO that nation-wide malaria eradication projects be pushed ahead with the utmost speed and vigour.

Present Status of Malaria Eradication

Today certain wide areas in the Americas, Europe and Asia have been cleared of malaria by DDT residual spraying. Nation-wide malaria control projects are well advanced in Argentina, Brazil, British and French Guianas, Ecuador, Nicaragua, the United States and Venezuela; in Cyprus, Greece, Italy, Turkey and Yugoslavia; in Ceylon, India, Iran, Lebanon, the Philippines, Taiwan and Thailand; in Madagascar, Mauritius and the Union of South Africa. In a total world population of just over 2.5 billions, some 600 millions<sup>1</sup> are exposed to malaria, but of these, some 230 millions<sup>1</sup> either have been freed from malaria or are now being protected, chiefly by residual DDT spraying. Nevertheless, with an estimated 270 millions still unprotected against malaria it is obvious that world-wide malaria eradication remains a great task. The important point to be emphasized is that, excepting only tropical Africa, there are now in each continent malaria-cleared areas that demonstrate beyond doubt the economic and technical feasibility of malaria eradication by residual spraying. Four outstanding examples may be mentioned briefly:

<sup>1</sup> These figures do not take into account the Union of Soviet Socialist Republics, the People's Republic of China and a few other countries for which adequate data are not available.

Venezuela. In 1945 Venezuela set up the first national project that, from its inception, was designed to eradicate malaria from an entire country by DDT spraying. The latest report describes an area of some 180,000 square kilometers, with a population of nearly 2.5 million (50 percent, of the nation's population) that is now malaria-free. The vector mosquitoes, Anopheles albimanus and A. darlingi, as late as 1941 were responsible for malaria death rates ranging from 531 to 1125 per 100,000. Anopheles darlingi has disappeared but albimanus remains, harmless, of course, in the absence of human infections. This proves that (a) malaria eradication by residual spraying is possible without mosquito vector eradication; and (b) that sometimes residual spraying by itself will result in the eradication of some vector species as an extra dividend.

Italy. In 1946, Italy announced a nation-wide malaria eradication plan by residual spraying with DDT without larviciding or anti-vector drainage. The island of Sardinia was reserved for a special experiment in which there was to be not only house spraying but also larviciding and drainage to attempt to eradicate the vector mosquito as well as malaria. Italy had been malarious for centuries and in spite of many years of control by drugs, drainage and larviciding, there was still some 55,455 cases of malaria in 1939 with 627 deaths. This was a notable decline from the 129,482 cases, with 2045 deaths in 1914 prior to World War I but it was still a sufficient active seed-bed so that when control measures slackened and drainage was sabotaged during World War II the number of malaria cases rose to over 411,602 in 1945 with 386 deaths (Mepacrine greatly reduced the death rate but not the morbidity).

Italy is now practically malaria-free. The residual spraying has been so successful that only seven new cases of malaria were reported in 1953 and only five in 1954 in the entire country, including Sicily and Sardinia, with a total population of 47 millions. In the latter island, the attempt to eliminate the vector failed but malaria was eradicated.

Mauritius. Malaria appeared in Mauritius first about the middle of the 19th century and the disease became highly prevalent, remaining so until recently. In 1948 a nation-wide malaria eradication programme was begun and the result has been that today malaria is rare in Mauritius. Malaria notifications dropped from 46,395 in 1948 to only 23 in 1952. Here, as in Venezuela, there were two principle vectors: one, A. gambiae, remains in large numbers, the other, A. funestus, has disappeared like A. darlingi as a result of the house spraying.

Ceylon. Malaria was a major health problem in Ceylon for centuries. It was highly endemic in many areas and from time to time, as in 1934, it became disastrously epidemic. In 1936, not an epidemic year, there were some 2.9 million cases in a population of 5.6 million, a morbidity rate of 523 per thousand of population. A nation-wide residual spraying project was started in 1946-47 and the results have been excellent. Whereas there were 2.8 million cases of malaria in 1946, a morbidity rate per thousand of 413, in 1954 there were only 29,650 cases (diagnosed clinically without blood examinations) in a population of 8.3 million, a rate of only 3.5 per thousand. Ceylon has now increased its rice crop by 50 per cent, and has resettled over a million people in fertile areas previously uninhabitable because of malaria. Large areas inhabited by some 600,000 people are not virtually free of the disease and here spraying has been stopped. These areas are patrolled by Vigilance Units searching for cases which are promptly dealt with.

#### Development of resistance to insecticides

In 1947 DDT-resistance in house-flies was first reported in certain areas that had been sprayed for two years. Such resistance is now widespread and is so strongly developed against not only DDT but also against the related BHC, chlordane and dieldrin, that house-flies can no longer be controlled with these insecticides in many localities. Similar resistance was noted in certain pest Culex mosquitoes about the same time but not in the Anopheles vectors of malaria until 1951. In that year it appeared in A. sacharovi in Greece after six years of exposure to DDT. This resistance has steadily become more marked so that in numerous areas of Greece today malaria control is not possible by DDT residual spraying. Such resistance has extended to related insecticides and has appeared in other Anopheles species. It has also appeared in A. sacharovi in two villages of Lebanon and in A. sundaicus in two small areas of Java.

Another disconcerting phenomenon is the behaviour of A. albimanus in Panama. This mosquito, after some six years of exposure to DDT, began in significant numbers in one area to avoid treated surfaces. Such a behaviour characteristic, if widespread, would, of course, make DDT useless for malaria control. This is because DDT residual spraying in practice only kills an insect that rests on a treated surface long enough to take up a lethal amount of DDT; the resting time required may be about 15 minutes or more. In an area of South Java A. sundaicus also to some extent avoids DDT-treated surfaces.

Elsewhere malaria vectors remain fully susceptible to DDT, in some cases after 10 years of exposure to it. For example, in Venezuela, Italy, India and Ceylon there is so far no evidence of any resistance or any behaviour change in any malaria vector. Thus on the evidence we can reasonably expect in most areas that DDT residual spraying will effectively kill malaria mosquitoes of a given community season after season for at least six years. There is also reason to fear

that sooner or later repeated exposure of a community of Anopheles mosquitoes to DDT or related insecticides will result in the development of strains which will either not be poisoned, or else will avoid contact with treated surfaces.

### Malaria eradication

The term "malaria eradication" should not be confused with the expression "vector eradication"; the latter implies complete extirpation of the malaria-carrying species of Anopheles from a given area. This is neither economically feasible nor technically possible except under unusual conditions. Well implemented attempts in Cyprus and Sardinia to eradicate Anopheles mosquitoes failed although in each case malaria was eradicated. The per capita cost in Sardinia was four times greater than that of equally complete malaria eradication on the Italian mainland.

Malaria eradication, possible today by DDT residual spraying, implies the planned elimination of the disease from an entire country within a period of 10 years or less. Planning further implies that by regional and inter-regional co-operation, neighbouring countries will co-ordinate their programmes so that a cleared area will not be menaced by one where malaria is still endemic. The plan should ensure that no given area would be exposed to residual insecticides for more than six years.

Such a bold concept is not considered to be unrealistic by those best qualified to judge. For example, the XIVth Pan American Sanitary Conference in October 1954 resolved as regards malaria: "that the member Governments should convert all control programmes into eradication campaigns within the shortest possible time, so as to achieve eradication before the appearance of anopheline resistance to insecticides..". Also the WHO Malaria Conference for the Western Pacific and South-East Asia Regions in November 1954 in Baguio: "having reviewed the evidence that it is possible by DDT residual spraying to terminate malaria transmission over wide areas, recommends that the ultimate goal of a nationwide malaria control programme be the eradication of the disease".

In practice, when all factors are favourable, experience shows that one year's spraying with residual DDT will stop malaria transmission in a given area (see Table I). However, unless this freedom from transmission is actively maintained for three years, the reservoir of infection in the human population will not die out. Since there are often unfavourable factors and because a margin of safety is required, it is now generally considered that routine spraying will be necessary for four years. If there is then adequate evidence that transmission has been completely blocked, spraying may be terminated provided that the area is kept under strict surveillance by trained vigilance teams. All cases of fever must be investigated, residual pockets of malaria must be eliminated by adequate therapeutic measures,

and if necessary, spraying must be reinstated where evidence indicates that renewed transmission is likely or is taking place.

While it is generally not economically or socially feasible to use antimalaria drugs to eradicate the disease when it is widely prevalent, their use may be indicated in the later stages of a nation-wide malaria eradication plan, when small foci of malaria are being found and dealt with by vigilance teams. However, in some areas it may be found advisable to make use of drugs as a supplementary measure at an earlier stage.

By definition, when in a given area there has been no locally contracted case of malaria for a period of three years as determined by adequate surveillance, then the disease is no longer endemic (see Table I). At this point the special malaria eradication organization can safely leave an area and the local health department can take over the responsibility for detecting and dealing with any reappearance of malaria. Thus, in planning nation-wide malaria eradication, it is usually necessary to visualize four years of residual spraying followed by at least three more of special surveillance. As under average conditions some areas will always lag behind others, the special organization for nation-wide malaria eradication should probably be planned for a period of 10 years. Thereafter the specially trained personnel will be available to attack other health problems.

#### Costs

From reports submitted to the WHO, it appears that the annual cost of malaria eradication by DDT residual spraying varies from an average of 11 cents in South East Asia to 46 cents in the Americas per capita of those protected. About 48 per cent of the costs of operations goes for insecticide, spraying equipment and transport. Expenditure will decline when spraying is interrupted as maintenance costs will be notably less than those of active eradication procedures. However, an accelerated and complete eradication programme which must clear the last possible focus of infection promptly may cost some 10 per cent more than a less exacting programme (see Annex I).

#### Benefits

The benefits of substituting malaria eradication programmes for routine malaria control derive from the fact that the former will be self-limiting, whereas the latter has no discernible end. Italy had thousands of cases of malaria in 1939 after many years of classical malaria control by drugs, drainage and larviciding. Vigorous malaria control of a similar type was carried out at enormous cost in the United States from about 1915 through 1945 but the country remained malarious - highly so in some counties. The cost of the accelerated programme with DDT residual spraying which virtually eradicated malaria from the United States in the years from 1946 to 1952 was a good investment.

As to the general economic and social benefits of malaria eradication to the countries cleared of the disease, there can be no doubt (see WHO Chronicle, Vol. 9, No. 2-3). As regards non-malarious countries, obviously they too will share in the benefits if they have import or export business with countries once malarious and now freed of this burden.

### Conclusion

The reasons for an accelerated programme are to be found in the fact that the mosquito vector may become resistant to DDT if the attack is prolonged and that eradication thereafter would be unreasonably costly and often impossible. There is therefore today no other logical choice: malaria eradication is clearly indicated, presents a unique opportunity and should be implemented as rapidly as possible. Time is of the essence.

### International implications of a world-wide malaria eradication programme

An important international implication of malaria eradication derives from the fact that infective Anopheles mosquitos or insecticide-resistant strains of vector mosquitoes or human malaria carriers infective to mosquitos can easily cross national boundaries. Such an interchange of mosquitos and malaria parasites between countries may have little importance if the countries are malarious but in some cases the investment made by a country in eradicating its malaria may be jeopardized by a neighbouring country which has not taken similar measures. The spread of DDT-resistant strains of malaria mosquitos might be particularly dangerous. Also it is quite possible for imported infective mosquitos or infective human carriers to start the transmission anew in a country where such transmission had been interrupted. Hence, the importance of regional and inter-regional programmes and the special significance of plans such as that to eradicate malaria from all the Americas. There is urgent need for full international co-operation and co-ordination as well as international assistance in malaria eradication programmes.

Another international implication of malaria eradication is that today there are several agencies dispensing money for social and economic improvement of underdeveloped countries. These agencies are greatly interested in practical projects that promise important gains at reasonable costs. Malaria eradication by residual spraying is now a thoroughly practical proposition in many areas and is thus receiving considerable financial support. But once Anopheles resistance to insecticides develops, the costs of control are apt to become so much higher than questions of economic feasibility will arise.

International aid moneys have great importance in assisting countries to carry out malaria eradication programmes; in fact without such aid some countries would find it impossible to adopt such a programme. They would thus remain malaria foci dangerous to surrounding countries.

Adequate planning is of great importance in connexion with international assistance and such planning must include the national and international aspects of malaria eradication. Total coverage, which is essential, may in some cases be unusually expensive. Hence in some countries it may be necessary for the central government to provide increased financial support to the local authorities for the implementation of the eradication programme. Sometimes it will be necessary for countries to merge a part of their programme into an inter-country programme so that contiguous areas will receive simultaneous and thorough treatment. Regional Offices of WHO can be of great assistance in drawing up and promoting such intercountry plans and agreements.

While a continental plan of eradication has great advantages, and seems possible now in the Americas, such a plan may not be feasible on every continent. In some cases eradication will have to proceed by areas and these should be chosen on the basis of (1) a topographical configuration or other conditions that can provide barriers so that after the area has been cleared of malaria, spraying can be safely discontinued; and (2) the willingness and ability of the country concerned to carry out the programme. Co-ordination of programmes in time and in efficiency as well as in topography is indispensable.

As already noted, all national malaria control programmes should aim at malaria eradication. It seems feasible that continent-wide programmes can be planned for the Americas and Europe and that large sub-continental programmes are feasible in the Eastern Mediterranean as well as in the South-East Asia and the Western Pacific Regions. On the African continent south of the Sahara, since there have not yet been demonstrated any wide areas cleared of malaria by residual spraying, it seems premature to plan in terms of continent-wide eradication. The problem of an effective and economical method of eradicating malaria in tropical Africa has not yet been solved. Pilot projects are being carried out and these require increased emphasis and assistance in order that a solution may be obtained as quickly as possible.

In the planning and implementation of world-wide malaria eradication, WHO will be expected to give technical advice and to co-ordinate the necessary resources. It should, therefore, be provided with the means of fulfilling the following functions:

1. Technical advice

1.1 Exchange of information and provision of facilities to make quickly available to all malaria services of governments such technical data as are of value to their programmes.

1.2 Organization of malaria conferences, study groups, and meetings of chiefs of malaria services.

1.3 Supply of malaria advisory teams on request of countries to help in solving particular problems or to provide independent assessment as to progress of efficiency of operations, or to suggest such modifications in planning of operations as might be indicated.

1.4 Advisory services of highly experienced malariologists of international reputation as requested.

1.5 The provision of training facilities through fellowships, study tours, and malaria courses.

## 2. Co-ordination of research

There is still urgent need for co-ordination of research in connexion with malaria eradication. The two most immediate research projects would appear to be:

2.1 Experimental study of the development of resistance in anopheline vector species to the several chlorinated hydrocarbon insecticides and the possibility of the loss of such resistance when the insecticide is withheld.

2.2 The preparation of a staple food item containing an anti-malarial drug, for example, chloriquinized salt as used by Pinotti in the Amazon area, which could be distributed to a population living under such conditions that residual spraying is not practicable and where routine administration of drugs as such would be impossible.

## 3. Co-ordination of resources

As regards the provision of equipment, transport and supplies, or even, in some cases, of financial help for local expenses, WHO might well be given authority to co-ordinate and stimulate appropriations from various agencies or non-governmental bodies.

A TENTATIVE PROGRAMME TOWARDS WORLD-WIDE MALARIA ERADICATION

A calculations given in the following table are rough estimates. The rate of annual increase in the number of protected people for each region varies owing to variations that can be foreseen for the development of the different national programmes.

1. In general it has been assumed that only in 1955 will the programme reach total coverage of areas aiming at malaria eradication.
2. It has also been assumed that full interruption of transmission will be achieved usually only during the second year of total coverage spraying and that, therefore, house-spraying might be withheld in any suitable area that has been completely sprayed for at least four years, provided that by the fourth year appropriate surveillance and treatment of traced cases is undertaken, and provided that the infant parasite rate has been negative in the second, third and fourth years.
3. It has been estimated that the per capita cost per year of active surveillance and treatment of cases will amount to 40 per cent of the cost of active protection by spraying.
4. The duration of "epidemiological surveillance" as mentioned above has been foreseen for five years after which maintenance could be entrusted to the general health services and would no longer need to be the concern of the special antimalaria organization.
5. The total per capita cost per year of the residual spraying campaign given in tables (c) and (d) has been calculated on the basis of the following averages for each region:

Africa	\$0.41
Americas	\$0.455 (in 1958; \$0.42 in 1955)
Eastern Mediterranean	\$0.20
South-East Asia	\$0.11
Western Pacific	\$0.175
Europe	\$0.20

To the above figures 10 percent has been added to cover the increased cost of eradication as compared with the cost of subtotal control (Table (d)).

6. As the American Region has supplied corrected data, no attempt has been made to apply the considerations and calculations mentioned in paragraphs 1, 4 and 5 above for that region.
7. It may be noted that as a world average the cost of supplies, transport and equipment amounts to some 48 per cent of the total cost of spraying operations (without the 10 per cent supplement mentioned in paragraph 5). This percentage is based on an average requirement per

million population to be protected of 100 tons DDT 75 per cent wettable powder, 250 sprayers, and 20 vehicles, applied to the proportion of population belonging to the various regions in the programme foreseen for 1958.

8! It should be noted that as eradication from the whole of the African, Eastern Mediterranean and Western Pacific Regions cannot at the moment be envisaged, for the purposes of this tentative programme limited targets have been set for those regions as detailed below:

<u>Region</u>	<u>Population of malarious areas (in millions)</u>	
	<u>Total</u>	<u>Provisional targets</u>
AMRO	131.5	131.5
SEARO	253.0	253.0
EMRO	50.0	40.0
WPRO	23.0	18.0
EURO	34.0	34.0
AFRO	<u>111.0</u>	<u>10.0</u>
Totals	602.5	486.5

It should also be noted that the above figure for the Americas includes 74.3 million already completely protected.

TABLES

(a) Millions protected by spraying

<u>Region</u>	or											
	1953	<u>1954</u>	<u>1955</u>	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>
Americas		25.3	32.0	45.5	54.5	57.2	25.2	11.7	2.7	-	-	-
S.E. Asia	74	100	150	165	190	105	170	88	63	48	33	
E. Mediterranean	14	14	20	25	30	25	20	15	10	.....	.....	
W. Pacific	9.7	10	12	14	15	6	6	4	3	2	.....	
Europe	25	25	26	28	5	7	8	6	4	2	.....	
Africa	6.7	7	7.5	8	8.5	2.3	2.5	2	1.5	1	.....	
		154.7	189.0	261.0	294.5	305.7	170.5	118.2	117.7	81.5	53	33

(b) Millions protected either by spraying or by surveillance

<u>Region</u>	or											
	1953	<u>1954</u>	<u>1955</u>	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>
Americas		25.3	32	45.5	54.5	57.2	57.2	57.2	57.2	57.2	-	-
S. E. Asia	74	100	150	165	190	205	220	253	253	253	253	253
E. Mediterranean	14	15	20	25	30	40	40	40	40	40	.....	
W. Pacific	9.7	10	12	14	15	16	18	18	18	18	.....	
Europe	25	25	26	28	30	32	34	34	34	34	34	
Africa	6.7	7	7.5	8	8.5	9	10	10	10	10	10	
		154.7	189	261	294.5	330.7	359.2	379.2	412.2	412.2	355	297
	74.3*	229	263.3	335.3	368.8	405	433.5	453.5	486.5	486.5	486.5	486.5

\* 74.3 million population living in potentially malarious areas in the Americas already completely protected are included in the grand totals for the years 1954 to 1962 inclusive. They are also included in the grand totals for the years 1963 and 1964 together with 57.2 million which will no longer be under surveillance then, and in that for the year 1964 populations in the Eastern Mediterranean and West Pacific Regions which will no longer be under surveillance are also included.

(c) Cost of spraying operations (without 10 per cent. increase)  
in millions of dollars

Region	or <u>1953</u> <u>1954</u>	<u>1955</u>	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>
Americas*	9.9	13.48	20.4	25.1	26	(11.4)	(5.3)	(1.2)			
S.-E. Asia	8.14	11	16.5	18.15	20.9	11.55	7.7	19.68	6.96	5.28	3.63
E. Mediterranean	2.8	3	4	5	6	5	4	3	2	.....	.....
W. Pacific	1.7	1.75	2.1	2.45	2.6	1.05	1.05	0.7	0.525	0.35	.....
Europe	5	5	5.2	5.6	1	1.4	1.6	1.2	0.8	0.4	.....
Africa	3.015	3.15	3.375	3.6	3.825	1.035	1.125	0.9	0.675	0.45	.....
	30.55	35.38	51.57	59.9	60.32	31.43	20.77	16.68	10.96	6.48	3.63

(d) Total cost of operations including 10 per cent. increase of  
spraying operations for eradication, and cost of surveillance  
at 40 per cent. of cost of spraying in millions of dollars

Region	or <u>1953</u> <u>1954</u>	<u>1955</u>	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>
Americas*	9.9	13.48	20.4	25.1	26	(11.4)	(5.3)	(1.2)			
S.-E. Asia	8.14	12.1	18.15	19.97	22.9	17.11	15.07	17.91	16.02	14.83	9.7
E. Mediterranean	2.8	3.3	4.4	5.5	6.6	6.7	6	5.3	4.6	3.2	2
W. Pacific	1.7	1.925	2.31	2.7	2.88	1.85	1.995	1.75	1.63	1.505	0.56
Europe	5	5.5	5.72	6.16	3.1	3.54	3.84	3.56	3.28	1	0.72
Africa	3.015	3.465	3.71	4	4.21	2.34	2.59	2.43	2.27	2.115	0.6
	30.55	39.77	54.69	63.43	65.69	42.94	34.79	32.15	27.80	22.65	13.15

\* Figures in brackets are the assumed figures but were not supplied by AMRO.

JCS/UNICEF-WHO/3  
12 April 1955

ORIGINAL: ENGLISH

UNICEF-WHO  
JOINT COMMITTEE ON HEALTH POLICY  
Eighth Session

MALARIA ERADICATION  
Note by Executive Director of UNICEF

At its session ending 18 March 1955, the UNICEF Executive Board endorsed the general proposition that UNICEF provide increased aid to enable governments to intensify their control programmes in order to achieve malaria eradication. However, in view of the seriousness of the obligations proposed to be undertaken by UNICEF, the Board wished to have greater assurances than could be given at the current Board session that UNICEF would be taking the proper steps in the proper way and that these steps were in accordance with an overall plan for cooperation among countries as well as effective plans at country operating levels.

As a consequence, the Board proposed that a special meeting of the UNICEF/WHO Joint Committee on Health Policy be convened for the purpose of clarifying for UNICEF the relevant technical and policy aspects of malaria eradication programmes and, in particular, indicating to UNICEF the areas in which such programmes might usefully be undertaken in the near future.

Excerpts from the UNICEF Board Report on this subject are given in the Annex to this paper.

The technical and policy questions on which the UNICEF Board would be grateful to have recommendations from the JCHP fall into two groups:

- 1) the degree of inter-country coordination required, and
- 2) the thoroughness of execution required in the individual country.

1) Inter-Country Coordination

Question (b) below applies specifically to the Americas. The other questions also have a specific application to the Americas, but the Board would be grateful if the answers could be elaborated sufficiently to apply to requests now being received from countries in other regions in which it is planned to cease overall residual spraying after a period of years.1/

/ (a) is it sound...

(a) It is sound and feasible, from a technical point of view, to plan and carry out, at the present stage, malaria eradication on a regional or continental scale?

(b) If the answer to (a) is affirmative for the Americas:

What should be the regional plan for extending protection from areas already covered to those not covered?

In the present state of technique, should eradication be planned in all areas of the Americas?

Specifically, what areas should the regional plan cover, and what should be the order and time period in which protection should be extended over them?

Does a certain time-table need to be followed to make eradication effective?

(c) It is possible to take corrective measures if the scheme does not go according to plan, and what would be the nature of these measures? (For example, country coordination may not be sufficient to insure strict observance of the time-table that may be recommended in (b); or one or more countries may neglect to prosecute eradication measures in areas of low incidence or generally in their territory; or a country, for internal financial reasons, may interrupt or fail to carry to completion an eradication campaign.)

It is possible to find natural geographic barriers or, if necessary, to create and maintain man-made barriers to the spread of malaria by movement of infected people if it should not prove possible to eradicate the disease from the whole continent?

If it proved impossible to execute the whole of the regional scheme, what would be the likely results? To what extent would the investment of the governments and the Fund in the eradication plan be lost?

(d) Is it prudent to envisage also the possibility of a breakdown of the regional scheme for technical reasons such as an unexpectedly rapid development of resistance to insecticides?

It is also possible that, for reasons beyond its control, such as lack of contributions, the Fund would be unable to fulfill completely its moral commitment to assist campaigns which it undertook in principle to assist.

/What would be...

What would be the likely results in the event of a breakdown, either technical or financial?

Would the population have partially lost its "tolerance" and be subject to dangerous epidemics?

To what extent would the investment of the governments and the Fund be lost?

2) Effective Planning and Implementation in the Individual Country

[The answers to the questions below presumably would have general application to all projects where countries desire to interrupt spraying after a period of successful control.]

(e) What conditions or safeguards are necessary in order to make an eradication campaign effective? (Note points in this connexion raised by the UNICEF Board; see Annex, para. 51.)

(f) A period of three years' operation in any given was adopted in the estimation of the cost of an eradication programme. If transmission is not completely stopped in the first year, does this mean that it is necessary to repeat operations for a further year beyond the three years?

On the basis of current knowledge, would the experts consider three years for spraying in a given area as a reasonable basis for costing for eradication campaigns?

What is the likelihood that, for practical reasons, a longer period will be necessary? Under what conditions could this period be shortened?

Excerpts from Report of the UNICEF Executive Board  
On Its Session 7 - 18 March 1955, E/ICEF/294.

Increased UNICEF Aid for Malaria Eradication

41. The question of increased UNICEF aid for malaria eradication was placed before the Executive Board in the Executive Director's General Progress Report (E/ICEF/281, paras, 5-18); in an Information Note by the Executive Director on the financial aspects of an increased UNICEF contribution for malaria eradication (E/ICEF/L.755); and in a report by the Director of the Pan American Sanitary Bureau/Regional Office of the World Health Organization on "Malaria Eradication in the Americas" (E/ICEF/282) which included a request for UNICEF participation in an accelerated regional approach in the Americas. The Board was also asked to express its policy toward a particular case, namely, that involving an eradication programme in Mexico, which contains two-thirds of the unprotected population of the Americas.

42. Following recent experience in several countries, member governments of the World Health Organization have become concerned about the potential danger of development of resistance to DDT by malaria-bearing mosquitoes. Conferences in Asia and the Americas reflecting the collective opinion of responsible public health administrators and malariologists have urged governments to eradicate malaria so that the spraying campaign can be safely terminated before resistance occurs. Another important factor leading to the new emphasis on malaria eradication (rather than malaria control) is the economic burden of recurrent expenditures for residual spraying under control programmes. Considerable difficulties have been encountered by public health administrations in securing funds for the continuation of a programme, year after year, when the disease is no longer a major cause of sickness. With the possibility of limiting large expenditures to a few years under eradication programmes (leaving only the need for maintenance programmes at a considerably lower level of expenditure), the development of nation-wide campaigns would be encouraged.

43. After several years of achieved malaria control, residual spraying can be safely discontinued if proper safeguards have been set and the whole campaign has been planned toward the objective of eradicating malaria...

44. Estimates by WHO show that approximately 309 million persons in reporting countries have yet to be protected against malaria. Of this number, the UNICEF Administration estimates that about 135 million are in countries that may request UNICEF aid. During the period 1955-1959, aid may be sought from UNICEF for some 49 million of these, although not more than 40 million would be covered in any one year.

45. The cost of international aid for anti-malaria campaigns has been between 10¢ to 20¢ per person protected per year, with an average of about 12¢. On the basis of these estimates, the cost to UNICEF of aid for malaria eradication would be about \$5 million per year. . . .

47. Subject to the provisions set forth in paragraphs 55-56, 61 and 62 below, the Executive Board endorsed the general proposition that UNICEF provide increased aid to enable governments to intensify their control programmes in order to achieve malaria eradication. It requested the Executive Director to continue to prepare requests on the same UNICEF principles as in the past but at the increased tempo which governments may desire. The Board would continue to receive requests on the same basis from all parts of the world.

48. The Board believes that through this means a very important opportunity is offered UNICEF for a fundamental contribution to welfare of children. The Board expressed its appreciation for the planning reflected in this new approach which, in the long-run view, will be more effective and economical.

49. In order to meet the unusual need for allocations in this field, project allocations would be made annually for one-year periods (instead of for two or three years, as has been the case in the past). At the same time, however, the Board would give approval in principle for its participation in a country programme over a period of years.

50. The Board was conscious that, once full-scale eradication programmes have begun with its aid, UNICEF will bear a heavy moral responsibility for ensuring that aid is continued until success is achieved.

#### Technical Aspects

51. It is apparent that successful eradication requires planning involving large areas, total coverage, and great thoroughness of control with all that this implies in terms of such elements as the willingness of governments to participate as fully as possible (including governments of countries in which the incidence may not be regarded as serious); prior surveys of the malaria situation; the availability of trained personnel; the development of efficient and economical organization; the assurance of low per caput cost; the formation of better systems of epidemiological surveillance; the degree of inter-country coordination of programmes required, etc.

52. It is the practice of the UNICEF Board not to embark upon large-scale commitments of a long-range nature without a full understanding of how the UNICEF investment would produce desired results both on an over-all basis and in specific country application.

53. The Board was grateful for the technical assurances bearing upon these points which were given by the representatives of WHO at the Board and Programme Committee meetings, including assurances that required technical personnel would be available in the Americas, and that training of the bulk of local personnel need be only of a short-term character. Among those governments in the Americas where discussions of individual country programmes had begun, a full desire to proceed had already been indicated.

54. Nevertheless, in view of the seriousness of the obligations proposed to be undertaken by UNICEF, the Board wishes to have greater

assurances than could be given at the current Board session that UNICEF would be taking the proper steps in the proper way, and that these steps were in accordance with an over-all plan for cooperation among countries, as well as effective plans at country operating levels.

55. As a consequence, the Board proposed that a special meeting of the UNICEF/WHO Joint Committee on Health Policy be convened for the purpose of clarifying for UNICEF the relevant technical and policy aspects of malaria eradication programmes and, in particular, indicating to UNICEF the areas in which such programmes might usefully be undertaken in the near future.

56. It was generally recognized that the problem called for urgent action. Therefore, the Board proposed that the special meeting of the JCHP be convened in the near future so that its report will be available to the Board for its September session and can, in the meantime, serve as a guide to the UNICEF Administration in bringing forward requests to the September session...

#### Costs of International Project Personnel for Malaria

62. The Board appreciated the assurances that in the Americas the costs for international project personnel in malaria projects would be met in full by WHO and PASB and that there was no intention to request UNICEF to bear the costs of any of the required international project personnel. The Board wishes to see these assurances firmly spelled out not only for the Americas but for other areas where UNICEF might be giving more aid to malaria projects. (The general question of UNICEF/WHO financial relations is discussed in paras. 119-131.)

#### Malaria Eradication in Mexico

63. Mexico has the most serious malaria problem in the Americas. Of a total of 30 million persons in Latin America unprotected against malaria, 19 million live in Mexico. This presents a problem of very large proportions, as the Government wants to mount a four-year eradication programme, 1956-1959. The cost of insecticides, transport and sprayers needed by Mexico for this campaign is estimated to be between \$6 million and \$8 million.

64. The Government of Mexico has indicated its serious interest in prosecuting this programme to its ultimate objective of eradication, and is now in the process of making firm financial arrangements to insure the availability of funds for the local expenses of the entire campaign.

65. In view of the desire of the Government of Mexico to proceed with the necessary preparatory steps, including financial arrangements

/ and the training

and the training of personnel, the Government requested an indication from the Executive Board of UNICEF of its willingness in principle to assist this programme with imported supplies.

66. The Board agreed in principle to participate in the proposed four-year malaria eradication programme. This would be subject to the conclusions of the JCHP on the various aspects of UNICEF aid to large-scale malaria eradications programmes, and, as far as Mexico is concerned, the development of detailed plans for effective field operations and the provision of the local financial resources necessary to prosecute the campaign to its full objective.

#### Malaria Eradication in Certain Other Countries

67. In connexion with the apportionments made at the present Board session for anti-malaria campaigns in Haiti and Trinidad (see paras. 189 and 190), it was understood that any relevant recommendations of the JCHP would be applied in the execution of these campaigns.

PAN AMERICAN SANITARY BUREAU  
REGIONAL OFFICE OF WORLD HEALTH ORGANIZATION

NOTES ON MALARIA CONTROL IN THE AMERICAS (1954)  
WITH ESTIMATES ON COST OF ERADICATION

Washington, D. C.  
24 March 1955

A reconnaissance in 1950 of the progress made by the American nations in the control of malaria (1) revealed a dramatic improvement following the introduction of DDT as a residual insecticide and led to the conviction that malaria eradication for the hemisphere is feasible.

A similar reconnaissance in 1954 (2) indicated that anticipated progress toward eradication had not occurred in a number of countries.

The XIV Pan American Sanitary Conference (October 1954), considering the repeated observation that malaria dies out spontaneously within a few years, once transmission has been suppressed, and the reports of resistance to DDT of certain Anopheles mosquito vectors after several years of exposure, recommended that all control programs be transformed into national eradication programs to get continental eradication before American anophelines become DDT resistant.

The Conference considered the situation urgent and instructed the Pan American Sanitary Bureau to coordinate national efforts in a hemispherical program.

The attempt is made in these notes to present the malaria situation as it was in 1954 and give estimates of costs of a continental eradication program. The estimates are admittedly based on incomplete data but are believed adequate for a rough estimate of the general proportions of the problem.

The residual insecticidal action of DDT has pinpointed the attack on malaria transmission to the home, where both mosquito and man are usually infected.

The number of houses in a malarious area has become the most important factor in planning a malaria eradication program, rather than the number and type of mosquito breeding areas or the number and severity of malaria cases.

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- (1) Fourth Report on Malaria by Dr. Carlos A. Alvarado; PASB publication No. 261 - Annex B - August 1951. English translation not published.
  - (2) Fifth Report on Malaria by Dr. Carlos A. Alvarado; PASB document CSP14/36 - Annex 1 - 5 October 1954.

In the eradication program, the same consideration must be given to sparsely populated regions with low grade malaria endemicity as is given to densely populated highly endemic zones, since these would otherwise remain as sources of reinfection for the cleared zones. Eradication requires complete coverage for a long period - at least three years - to let the organism die out in the human host.

Reduction in malaria occurs immediately after transmission is interrupted, even from partial control measures. However, the true measure of success of an eradication program is the complete disappearance of the infecting organism, the plasmodium of malaria, from man and from the mosquito. Once eradication is undertaken, measures must not be relaxed until the task is completed. When the objective of eradication is reached, costly control measures may be discontinued with impunity except for the threat of reintroduction of the plasmodium in infected persons.

The importance of carrying a control program to the point of eradication is emphasized by the present situation in Argentina where malaria has been effectively controlled for a number of years. At present, malaria is held at a low level in the most seriously infected states by spraying only 148,000 houses at a cost of \$276,000 a year, and is no longer a serious health problem. Before control measures can be discontinued, however, an additional 42,000 houses must be sprayed for several years at an annual added cost of \$119,000 to remove the residuum of malaria, which constitutes a continuing hazard of reinfection of cleared areas should the control program be discontinued. When this has been done and when continental eradication is achieved, Argentina, no longer fearing auto-reinfection nor reimportation of the malaria parasite from Brazil, Paraguay and Bolivia, will be free to almost eliminate budgeting for malaria except for a small surveillance and emergency service.

In the following summary "Status of Malaria Control Programs" countries are grouped, not in the order of the severity of malaria, but rather in the order of the completeness with which control programs approach eradication. Two tables showing various eradication estimates by country, are attached.

Table I gives the estimated number of homes in the malarious zones of each country, and the number in the present control program. The columns listing unit costs and the additional houses to be sprayed in country-wide programs indicate the anticipated annual cost for each country. The estimate of the speed with which each country's program may be expanded is adjusted to the need of training large numbers of new workers and of developing vastly increased budgets. The final four columns of Table I give the estimates of total annual costs from 1955 through 1958.

Table II is concerned solely with finance. The first column lists available information on expenditures by each country during its 1954 anti-malaria program. The next four columns list by years

the estimated additional funds required in each country from 1955 to 1958. What part of the required sum each country may appropriate for each of these years remains to be seen. The table indicates the requirements, without establishing the source of funds.

Many American countries now recognize the possibility of malaria eradication and either have already developed or may be expected to develop, effective eradication programs. Means must be found to promote equally effective programs in the others because continental eradication can be achieved only through prosecution of a full program in the entire malarious area of the continent. This objective should be achieved as soon as possible to avoid the hazard of insect resistance to insecticides and to permit the early reduction of present malaria control costs.

The cost estimates are based on programs using DDT. Any change in choice of insecticides may alter the relative cost of insecticide and labor but should not greatly affect the total cost.

As programs approach peak activity, malarimetric services must be developed to determine the specific areas where transmission continues in spite of control measures so that correction can be made. After full coverage has been effected, programs may be reduced on the basis of malaria eradication, fully checked by field investigations, until all programs are finally discontinued.

Status of Malaria Control Programs in the  
Americas by Countries - December 1954

With the exception of Mexico and Haiti, where eradication programs are planned to begin in 1955, malaria has steadily declined during the past eight years in every malarious country of the Western Hemisphere. The degree and speed of reduction has varied among nations commensurately with difficulties encountered and effort expended. Countries are grouped below in decreasing order of program completeness.

I. MALARIA ERADICATION ACHIEVED.

Uruguay: Essentially a non-malarious country. The opportunity for transmission is so slight that introduction of the disease can be ignored.

Chile: Malaria transmission, always limited to the the northern coastal valleys, has disappeared since the introduction of the DDT spraying program.

United States: The U.S. Public Health Service followed up its World War II anti-malaria activities (MCWA) with the National Malaria Eradication Program, inaugurates in 1947, with the cooperation of certain

state and local health agencies. Control operations reached their peak in 1948 when 1,365,000 homes in 13 States were sprayed at a cost of \$5,000,000, following which operations were curtailed each year until 1952, when less than 100,000 houses were sprayed. For several years the cases of indigenous malaria occurring in the U.S.A. have been secondary to imported malaria from Mexico or from the Pacific. Only 62 such cases were found in the U.S.A. during the two year period, 1952 and 1953.

French  
Guiana:

Malaria has been eradicated, but the 6000 homes at risk must still be DDT sprayed at an annual cost of \$21,000.

Puerto  
Rico:

Everyone is under DDT protection. Malaria eradication is so nearly achieved that Puerto Rico should be included in this classification.

Bahama  
Islands:

Barbados:

Bermuda:

Free of malaria; not subject to reinfection.

Netherlands

Antilles:

Virgin Islands:

II. MALARIA NEARLY ERADICATED.

Argentina:

Malaria has been eradicated from large areas but a small amount of infection remains scattered over an extensive zone which must be cleared up before control measures can be effectively reduced. The movement of seasonal labor into northern Argentina from Bolivia gives Argentina a vested interest in malaria eradication in the latter country.

Brazil:

Malaria has been eradicated from some areas and control programs are well advanced in others. However, approximately 6% of the malaria yet to be found in the continent is in Brazil. Beginning in 1955 operations in a number of States in the South and in Northeast Brazil are being reoriented for eradication. In the regular DDT spraying program there are now 2,416,000 houses at an annual cost of \$4,103,000. To achieve eradication an additional 804,000 houses at \$1,371,000 per annum must be included.

TABLE I

SCHEME OF THE SEQUENCE OF EVENTS IN MALARIA ERADICATION PROGRAMMES

YEARS	-1	1	2	3	4	5	6	7	8	9	10
(a) Exceptionally favourable conditions: Infant Parasite Rate negative after first spr											
PHASE	SURVEY	ATTACK	CONSOLIDATION		M A I N T E N A N C E						
Spraying operations (on a total coverage base)		XXXXXXXXXXXXXXXXXXXX			No more spraying except for special interventions						
Infant parasite rate	+++	-	-	-							
Epidemiological surveillance: new malaria cases traced	(?)	(?)	(?)	+	-	-	-				
Protection from reintroduction of: a) DDT-resistant mosquitos b) malaria carriers											
(b) Average conditions: Infant Parasite Rate negative after second year of spraying											
PHASE	SURVEY	ATTACK	CONSOLIDATION		M A I N T E N A N C E						
Spraying operations (on a total coverage base)		XXXXXXXXXXXXXXXXXXXX			No more spraying except for special interventions						
Infant parasite rate	+++	+	-	-	-						
Epidemiological surveillance: new malaria cases traced	(?)	(?)	(?)	(?)	+	+	-	-	-		
Protection from reintroduction of: a) DDT-resistant mosquitos b) malaria carriers											

Note: Interruption of spraying; when infant parasite rate has been negative for three years.

Malaria is no longer endemic when epidemiological surveillance has failed to trace new malaria cases, presumably infected (for three consecutive years) in the area of eradication.

Dominican Republic: Malaria is no longer a serious health problem. There are 160,000 houses in the regular DDT spraying program, now costing \$162,000 a year, which program protects the entire population at risk. Continuance, requiring only \$62,000 additional each year, should soon achieve eradication.

Jamaica: DDT spraying now protects all houses in the malaria zone at a cost of \$53,000 a year. Continued a few years, this program should achieve eradication.

### III. MALARIA ERADICATION PROGRAM WELL ADVANCED.

Nicaragua: The DDT spraying program protects 210,000 houses of the 225,000 in the malaria zone at a cost of \$416,000 a year. The 15,000 remaining can be added at an additional annual cost of only \$30,000.

Panama: The DDT spraying program covering 44,000 houses, costing \$151,000 last year, controls most of the traditionally severe malaria which previously plagued the country. The little that remains is so scattered, however, that conversion to eradication requires spraying of another 33,000 houses at an additional annual cost of \$125,000.

Trinidad: Although only 78,000 of the 101,000 houses in the malaria zone need DDT treatment (\$195,000 last year), local conditions have prevented eradication. Unusual non-domiciliary transmission of malaria, due to the out-door biting habits of Anopheles bellator, a local vector, forces consideration of control measures other than DDT spraying.

Venezuela: Venezuela has been a leader in planning a national eradication program and has already eradicated malaria from an extensive area of some 80,000 square miles through DDT spraying of 548,000 houses at a yearly cost of \$2,168,000. The inclusion of another 83,000 houses at an annual cost of \$369,000 should lead to eradication, except for certain areas where unusual vectors may present special problems.

### IV. GOOD CONTROL PROGRAM - READY FOR CONVERSION TO ERADICATION.

British Honduras: Malaria has been practically eradicated on the coast where 9,000 houses are sprayed once for about \$9,000 a year. However, eradication requires two annual spraying at an additional \$9,000 per annum.

- Costa Rica: The present program covers 76,000 houses at an annual cost of \$152,000. Eradication can be achieved by including 5,000 more houses at an additional annual cost of only \$10,000.
- Cuba: Some malaria is still found in two sectors of the island where drainage and larvicidal measures (\$53,000 per annum) are giving good general control. Inauguration of a DDT spraying campaign comprising 120,000 houses, at about \$480,000 a year, would soon achieve eradication.
- Honduras: Severe malaria, previously crippling much of the country, has been controlled by a regular DDT spraying program including 50,000 homes which last year cost \$110,000. Conversion to an eradication campaign requires the spraying of 21,000 more houses at an additional cost of \$94,000 a year.
- Windward Islands: Malaria is kept under good control by spraying 18,000 houses at \$72,000 a year. An additional 41,000 houses at \$168,000 a year would have to be sprayed to achieve eradication.
- V. GOOD CONTROL PROGRAM.
- Bolivia: The malaria of a formerly heavily infected area is now controlled by spraying 32,000 houses at an annual cost of \$72,000. Eradication would require the addition of 130,000 houses at an increased annual cost of \$288,000.
- Guadeloupe: At least 75% of the formerly severe malaria is under control by DDT spraying of 24,000 houses at an annual cost of \$72,000. An eradication program would require addition of 29,000 houses at an extra annual cost of \$87,000.
- British Guiana: On the coast malaria eradication has come about through years of DDT house spraying, which no longer need be applied even so frequently as once each year. There are 30,000 houses in the program which cost \$88,000 during 1954. In the hinterland, near the Brazilian border, however, there are 1000 houses which will require an additional annual expenditure of only a few thousand dollars before colony-wide eradication will be achieved.
- Martinique: The control program has reduced the serious malaria problem by at least three-quarters. DDT

spraying covers 24,000 houses at an annual cost of \$72,000. Eradication can be achieved by adding 29,000 houses at an estimated annual cost of \$87,000.

#### VI. INCOMPLETE MALARIA CONTROL.

Colombia: The malaria problem of Colombia is the second largest on the continent. The severe infection in unprotected portions of the country constitutes 13% of the malaria remaining in the Americas. Although \$1,217,000 was spent during 1954 to spray, either once or twice, 390,000 of the 1,400,000 houses in the malaria zone, the program was spotty and inadequate. Conversion to eradication requires the spraying of 887,000 additional houses at an estimated annual cost of \$3,508,000.

Ecuador: Last year 188,000 houses were DDT-sprayed at a cost of \$251,000. Malaria, however, is still a serious problem, and an additional 124,000 houses at \$304,000 a year must be included to achieve eradication.

El Salvador: The malaria control program last year cost El Salvador \$263,000 and covered 128,000 houses. Eradication would require the inclusion of approximately 100,000 more homes at an estimated cost of an additional \$252,000.

Guatemala: Internal political troubles were reflected in the administration of the malaria program in 1953. Considerable improvement occurred in 1954, but at best the program now covers not more than one-third of the country. Guatemala spent \$50,000 to spray, once each, 47,000 of the 198,000 homes in the malaria zone, which program indirectly protects so many more homes (111,000) that the eradication campaign would require the inclusion of only 40,000 additional homes at an estimated extra annual cost of \$124,000.

Paraguay: The amount and the severity of malaria in Paraguay are subject to conflicting reports. It is planned to survey the situation at an early date to determine the number of additional houses where spraying is necessary. Should all of the 85,000 homes in the malaria zone need spraying, an estimated \$136,000 per year would be required for eradication.

- Peru: Peru has the fifth most serious malaria problem on the continent, comprising 4% of the existing malaria. The control program is incomplete and covers only part of the malarious area. There are 755,000 homes in the infected zone and only 270,000 are being sprayed at a cost of \$578,000. Eradication would require the spraying of an additional 229,000 at an extra annual cost of \$480,000.
- Leeward Islands: Moderately severe malaria is found in only three of these islands (Antigua, Montserrat and St. Kitts-Nevis). The disease is held at a low level by DDT spraying 8,000 homes at an annual cost of \$15,000. Eradication requires spraying and additional 21,000 homes at an extra annual cost of \$72,000.
- Surinam: Surinam maintains reasonably good malaria control on the coast by spraying 10,000 of the 33,000 homes at an annual cost of \$30,000. To achieve eradication on the coast there must be added to this program another 15,000 homes at an annual cost of \$45,000. Country-wide eradication necessitates an expensive spraying program in the hinterland, where there is much malaria. Such a program would include 8,000 homes at an annual spraying cost of \$96,000. With a full program, the annual cost is estimated at \$171,000.
- Haiti: Haiti, containing 6% of the malaria residuum, represents the fourth most severe malaria problem on the continent. In 1953 a small demonstration program covering 26,000 homes in the malaria zone was initiated at an estimated cost of \$21,000, of which Haiti contributed \$8,000. An eradication program is quite difficult financially for Haiti. There are approximately 414,000 homes in the malaria zone, of which 390,000 must be sprayed at an estimated cost of \$624,000 per annum.
- Mexico: Mexico has the most severe and the largest malaria problem in the hemisphere. Probably 64% of the total malaria remaining in the Western Hemisphere is to be found in this country. The malaria control program has covered 126,000 homes at an annual cost of \$222,000. Converting this program to one of eradication requires steady expansion until, at most, 3,098,000 homes in the malaria zone are brought into the DDT spraying program. The maximum annual cost (1957) is estimated at \$6,773,000.

TABLE I - MALARIA ERADICATION ESTIMATES - (COSTS IN U.S. DOLLARS)

Countries	Total Number Houses Malaria Zone	No. Houses DDT-Sprayed 1953	No. Houses Indirectly Protected 1953	Cost of Program 1953	Cost per House, One Spraying	Additional Houses for Eradication	Total Houses to be Sprayed 1955-1958	Estimated Annual Cost Eradication Program (Based on Two* Sprayings per Year)				Remarks	
								1955	1956	1957	1958		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)		
Argentina	371,000	148,000	181,000	\$219,000	\$1.04	42,000	190,000	\$274,000	\$395,000	\$395,000	\$395,000	These estimates are derived from incomplete data, and are subject to correction after detailed country programs have been finally approved	
Bolivia	210,000	32,000	48,000	18,000	1.11	130,000	162,000	100,000	200,000	360,000	360,000		
Brazil	5,360,000	2,416,000	2,140,000	5,037,000	0.85	804,000	3,220,000	5,474,000	5,474,000	5,474,000	5,474,000		
Colombia	1,400,000	390,000	123,000	755,000	1.85	887,000	1,277,000	944,000	1,888,000	3,776,000	4,725,000		
Costa Rica	81,000	76,000	0	152,000	1.00	5,000	81,000	162,000	162,000	162,000	162,000		
Cuba	120,000	0	0	53,000	2.00	120,000	120,000	66,000	132,000	264,000	480,000		
Dominican Republic	208,000	160,000	48,000	118,000	0.70	0	160,000	118,000	224,000	224,000	224,000		* Puerto Rico to be sprayed only once each year.
Ecuador	353,000	188,000	41,000	181,000	0.89	124,000	312,000	226,000	452,000	555,000	555,000		
El Salvador	257,000	128,000	29,000	243,000	1.13	100,000	228,000	304,000	515,000	515,000	515,000		
Guatemala	198,000	47,000	111,000	100,000	1.00	40,000	87,000	125,000	174,000	174,000	174,000		
Haiti	414,000	26,000	24,000	8,000	0.80	364,000	390,000	78,000	156,000	312,000	624,000		
Honduras	83,000	50,000	12,000	75,000	1.44	21,000	71,000	94,000	188,000	204,000	204,000	** Mexico estimates 1955-1958 taken from January 1955 calculations by Government of Mexico	
Mexico	3,140,000	126,000	42,000	106,000	0.84	2,972,000	3,098,000	2,047,000	4,368,000	6,773,000	6,090,000		
Nicaragua	225,000	210,000		416,000	0.99	15,000	224,000	444,000	444,000	444,000	444,000		
Panama	100,000	44,000	23,000	158,000	1.79	33,000	77,000	198,000	276,000	276,000	276,000		
Paraguay	85,000	2,000	0	12,000	0.80	83,000	85,000	15,000	30,000	60,000	136,000	*** Surinam: 25,000 coastal houses at \$1.50 each, 9,000 inland at \$6 each.	
Peru	755,000	270,000	256,000	588,000	1.06	229,000	499,000	735,000	1,058,000	1,058,000	1,058,000		
Venezuela	631,000	548,000	0	1,096,000	2.01	83,000	631,000	1,370,000	2,537,000	2,537,000	2,537,000		
British Guiana	93,000	30,000	62,000	79,000	2.31	1,000	31,000	99,000	143,000	143,000	143,000		
British Honduras	15,000	9,000	6,000	4,000	1.00	0	9,000	5,000	10,000	18,000	18,000		
French Guiana	6,000	6,000	0	18,000	1.50	0	6,000	18,000	18,000	18,000	18,000		
Guadeloupe	53,000	24,000	0	72,000	1.50	29,000	53,000	90,000	159,000	159,000	159,000		
Jamaica	42,000	42,000	0	53,000	0.65	0	42,000	55,000	55,000	55,000	55,000		
Leeward Islands	29,000	8,000	0	24,000	1.50	21,000	29,000	30,000	60,000	87,000	87,000		
Martinique	53,000	24,000	0	72,000	1.50	29,000	53,000	90,000	159,000	159,000	159,000		
Puerto Rico	256,000	129,000	127,000	315,000	2.44	0	129,000	315,000	315,000	315,000	315,000		
Surinam	33,000	10,000	0	30,000	***	23,000	33,000	40,000	80,000	171,000	171,000		
Trinidad	101,000	77,000	23,000	111,000	1.10	1,000	78,000	139,000	172,000	172,000	172,000		
Windward Islands	59,000	18,000	0	72,000	2.00	41,000	59,000	90,000	180,000	236,000	236,000	Revised 12.VII.55	
<b>TOTAL</b>	<b>14,731,000</b>	<b>5,238,000</b>	<b>3,296,000</b>	<b>\$10,185,000</b>		<b>6,197,000</b>	<b>11,434,000</b>	<b>\$13,775,000</b>	<b>\$20,524,000</b>	<b>\$25,096,000</b>	<b>\$25,966,000</b>		

TABLE II - MALARIA ERADICATION ESTIMATES - TWO SPRAYINGS PER YEAR - (COSTS IN U.S. DOLLARS)

Countries	Country Contribution	Estimated Additional Annual Funds for Eradication Program				Remarks
	(1954) (1)	1955 (2)	1956 (3)	1957 (4)	1958 (5)	
Argentina	276,000	0	119,000	119,000	119,000	Country Contributions, Column (1), are taken from V Report on Malaria, Table 5, as submitted to the XIV Pan American Sanitary Conference held in Santiago, Chile, CSPL4/36 Amex I, 7 October 1954, calculated to the nearest thousand, excepting those starred (*), which were calculated from unpublished reports.
Bolivia	13,000	87,000	187,000	347,000	347,000	
Brazil	4,103,000	1,371,000	1,371,000	1,371,000	1,371,000	
Colombia	1,217,000	0	671,000	2,559,000	3,508,000	
Costa Rica	24,000	138,000	138,000	138,000	138,000	
Cuba	53,000	13,000	79,000	211,000	427,000	
Dominican Republic	162,000	0	62,000	62,000	62,000	
Ecuador	251,000	0	201,000	304,000	304,000	
El Salvador	263,000	41,000	252,000	252,000	252,000	
Guatemala	50,000	75,000	124,000	124,000	124,000	
Haiti	16,000	62,000	110,000	296,000	608,000	
Honduras	110,000	0	78,000	94,000	94,000	
Mexico	222,000	1,825,000	4,646,000	6,551,000	5,868,000	
Nicaragua	190,000	258,000	256,000	258,000	258,000	
Panama	151,000	47,000	125,000	125,000	125,000	
Paraguay	15,000	0	15,000	45,000	121,000	
Peru	578,000	157,000	480,000	480,000	480,000	
Venezuela	2,168,000*	0	369,000	369,000	369,000	
British Guiana	88,000	11,000	55,000	55,000	55,000	
British Honduras	8,000	0	2,000	10,000	10,000	
French Guiana	21,000*	0	0	0	0	
Guadeloupe	72,000*	18,000	87,000	87,000	87,000	
Jamaica	55,000*	0	0	0	0	
Leeward Islands	15,000*	15,000	45,000	72,000	72,000	
Martinique	72,000	18,000	87,000	87,000	87,000	
Puerto Rico	300,000	15,000	15,000	15,000	15,000	
Surinam	0*	40,000	80,000	171,000	171,000	
Trinidad	195,000	0	0	0	0	
Windward Islands	59,000*	31,000	121,000	177,000	177,000	
<b>TOTAL</b>	<b>\$10,747,000</b>	<b>\$4,222,000</b>	<b>\$9,805,000</b>	<b>\$14,379,000</b>	<b>\$15,249,000</b>	

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PAN AMERICAN SANITARY BUREAU

REGIONAL OFFICE OF WORLD HEALTH ORGANIZATION

Washington, D. C.

14 February 1955

HEMISPHERE-WIDE MALARIA ERADICATION

Statement by Dr. Fred L. Soper, Director

The XIV Pan American Sanitary Conference (Santiago, October 1954) issued an urgent mandate (Resolution XLII) to the Pan American Sanitary Bureau to take all possible measures to eradicate malaria in the Americas as rapidly as possible.

The mandate followed the presentation of information on

- 1) the spontaneous disappearance of malaria from geographical areas within three years after/interruption of transmission.  
complete
- 2) the reinfection of previously malarious areas by persons from uncontrolled districts, and
- 3) the development of resistance to DDT by certain Anopheles mosquitoes following its prolonged use for the partial control of malaria.

The action was based on the conclusion that -

- 1) malaria can be eradicated from a given area in a few years,
- 2) the full benefits of eradication require that all malarious areas in all countries of the region be covered by the program,
- 3) the potential development of resistance to DDT by the Anopheles mosquitoes of the Americas is a threat to the efficacy of present control programs, as well as to future attempts at eradication, and
- 4) relief from the great economic burden of malaria to afflicted populations, and from the annual cost of present partial control measures would more than justify the increased cost of eradication.

The Conference recognized the inadequacy of the Bureau's financial resources and called upon the Bureau to secure the participation of other organizations. The definite solution of the malaria problem, in the opinion of the XIV Pan American Sanitary Conference, has a priority over all other health programs and requires the urgent concerted action of all organizations interested in the welfare of the hemisphere. Here, the opportunity to derive permanent benefits from the investment of capital funds over a relatively short period of time is unique.

During a full half century after the discovery that malaria is a mosquito-borne disease, and until only a short decade ago, malaria was the most difficult problem facing public health workers in the tropics and sub-tropics, and in many parts of the temperate zones. Previous to the introduction of DDT as a residual insecticide, economically feasible measures for the control of rural malaria were not known. The initial results of this new measure have been so dramatic that many health workers and many fiscal authorities have come to disregard malaria as a continuing problem, and fail to recognize the promise and the threat for the future implicit in the developments of recent years.

Before considering these implications, it may be well to restate the salient points regarding malaria as a health problem.

#### Economic Importance of Malaria

Devastating epidemics of malaria have at one time or another occurred in practically every country of the Western Hemisphere. In its malignant form, malaria is highly fatal, particularly among the young, and is still one of the world's great killers of children. Although other diseases may decimate, only malaria depopulates. In the past, malaria has caused large areas to be abandoned to the jungle and the development of enormous fertile tracts has been prevented. Survivors of severe malaria, and of repeated mild infections, may suffer the lifelong debilitating effects of chronic infection. Malarious populations tend to live on a bare subsistence basis, contributing nothing to the common good. Even where the incidence of infection is relatively low, there is a surprising inhibition of both mental and physical effort.

Malaria is a serious burden on the economy of every malarious country. It has been well said that where malaria fails to fill, it enslaves. It is an economic disease. No infected area may hope to meet the economic competition of non-malarious regions. In agriculture and industry, labor is inefficient and the output is often reduced by one-third to one-half and even more.

Less than thirty years ago the annual cost of malaria to the south-eastern United States was estimated to be over \$500,000,000. Today, industry is expanding in each of these states, now that malaria is gone. After World War II, malaria control in Greece in a single year augmented the labor effort by 30,000,000 man days. Rice production increased by 15% per acre in the first year after malaria was controlled in Burma and in Pakistan. After malaria was controlled in Iran, the rice crop was harvested by 4 laborers per hectare, whereas formerly 10 were needed.

As a primary basis of economic development, malaria must be suppressed. It represents the outstanding opportunity to improve

economic conditions through disease eradication, since even where malaria has been partially controlled the annual cost of continuing control is a considerable financial drain on national budgets.

Impact of DDT on Malaria Control; Eradication proposed 1950

Malaria may be transmitted by various species of Anopheles mosquitoes, but the species most dangerous as vectors of malaria are those which enter human habitations to feed. Since Anopheles usually roost on inside walls before and after sucking blood, DDT on these walls is effective in killing those mosquitoes, which become infected, before the end of the incubation period required for them to become infective. The transmission of malaria is stopped by the chemical attack on those mosquitoes which enter human habitations rather than on Anopheles in general.

The introduction of DDT has halted the extension of expensive drainage works and costly larviciding operations and has led to the control of malaria in many agricultural areas, where the isolation of dwellings one from another makes other methods of control impractical. Thus was the door open to the development of nationwide control programs. These in turn led to the most promising observation that malaria, as a mosquito borne disease, disappears from an infected population within a few years after transmission ceases. The further observation has been made that malaria reappears in cleared areas only when reintroduced by an infected person from an endemic zone. The United States, for example, parts of which were previously highly malarious, has been free of epidemics of malaria for a decade except for a small outbreak of 35 cases infected in 1952 by mosquitoes which had fed on a returned veteran from Korea.

By 1950 nearly all countries in this hemisphere with a malaria problem were engaged in serious efforts to control it. It was absent from Chile and Uruguay, eradicated in British Guiana, nearly gone from the United States and Argentina and was greatly reduced in Brazil and Venezuela. Control programs were well advanced in most of the others. So rapidly had programs expanded that approximately 75% of the total homes in the malarious zones of the Americas were sprayed that year. It was hoped that the remaining 25% (four and one-half million homes) would soon be brought into the program. In order to stimulate further program extension, and envisaging the possibility of eradicating the disease from the Western Hemisphere, the XIII Pan American Conference (1950) recommended that the Pan American Sanitary Bureau stimulate and coordinate anti-malaria programs and arrange economic assistance where possible to individual countries, with a view to achieving the continental eradication of malaria.

Campaigns were expanded by Governments, trained technicians were provided by PASB/WHO and equipment and materials were supplied by UNICEF to the Caribbean and Central American area and to four

South American countries. Malaria control campaigns were initiated in every malarious country of the hemisphere. The disease toppled from its position as the leading public health program in the Americas. Hopes were high and the householders' enthusiasm for the method appeared to ensure success of the eradication program.

#### Difficulties and Danger; DDT Resistant Anopheles

But success was not to come so easily. Unfortunately the house fly, which was the householder's visible measure of the value of any insecticide, developed a marked resistance to DDT and the residual spray program lost much of its initial prestige. The publicity given to the rapid reduction in malaria following the introduction of residual spraying resulted in the general conviction that malaria is no longer an important problem and can safely be disregarded.

Instead of rapidly increasing appropriations, a lag set in and four years later, 1954, 22% of homes in malaria areas still were not included in control programs. Authorities reacted to other fiscal pressures and reluctantly appropriated funds for controlling a disease which seemed to cause but little damage. This situation, disappointing as it was, might have been accepted for the time and gradually improved from year to year in individual countries as opportunity appeared, had it not been for the threat inherent in the recent development of resistance to DDT by certain Anopheles. In Greece, the three local vectors have developed resistance and DDT is no longer effective in controlling malaria in some villages. Another important malaria vector, Anopheles sudaicus, has become resistant in Indonesia. In Central America one of the principal mosquito vectors is exhibiting a changed behaviour to the insecticide, a change which may presage the development of resistance.

#### Urgency of Eradication

It is most unfortunate that resistance is developing before malaria has been eradicated, since the pre-DDT control methods are too expensive for general use in rural areas and are limited because of cost to urban and village application. It is obvious that malaria must be eradicated from the Americas before the threat of anopheline resistance to insecticide materializes here.

Government representatives at the XIV Pan American Sanitary Conference (October 1954) recognized the danger of prolonged control programs, and the consequent hazard of the development of DDT-resistant strains of Anopheles resulting in the return of epidemic malaria, and approved a program of continental eradication to meet the threat. The Conference recognized the need, as the eradication program progresses, to consider measures to prevent the importation of infected persons into areas already free from infection. The

Conference bespoke the utmost urgency in achieving the continental eradication of malaria and urged the Member Governments to immediately convey all control programs into eradication programs.

Extra effort applied now makes the difference between success and failure. A few years of all-out drive can so reduce the amount of malaria that residual pockets may thereafter be eradicated economically with drugs, if necessary. When malaria has disappeared, surveillance or vigilance squads can ensure continued freedom from the disease at a low and entirely feasible cost.

The full promise of eradication for the continent depends obviously on the simultaneous wiping out of malaria infection from all countries in the Americas. Once this is done, expenditures can be greatly reduced and vigilance relaxed except against reinfection through immigrants or travellers from other parts of the world.

If one State "drags its feet" in the program or if, in order to reduce expenditure, it fails to destroy all of its pockets of malaria, that State becomes a menace to its neighbours. Control may be good for a year or two; but if it then becomes slack, hidden sparks may start new fires. Complete control for at least three years is necessary, because certain malaria parasites may persist in the infected person for this period in the absence of reinfection.

#### Conversion from Control to Eradication

Realizing the urgency of the situation and the need for quick action, the XIV Conference (1954) authorized an immediate annual increase of \$100,000 in expenditure to enable the Bureau to implement the Resolution of the XIII Conference (1950) "... to provide for greatest intensification and coordination of anti-malaria work in the hemisphere, stimulating existing programs, facilitating interchange of information and furnishing technical and, whenever possible, economic assistance to the various countries with a view to achieving the eradication of malaria from the Western Hemisphere." Considering the obvious inadequacy of this sum for financing active collaboration with governments in the extension of national programs, the Conference called upon the Director of the Bureau to secure the financial participation of organizations, public and private, national and international, in order to achieve eradication.

Having established the technical, economic and health bases for an eradication program, and having received a mandate from the Pan American Sanitary Conference, action is now required to establish -

- a) adequate technical guidance and coordination,
- b) country-by-country arrangements to convert control into eradication, and
- c) mobilization of international assistance of all agencies which may be able to participate in the program.

PASB/WHO as the international agency charged with responsibility for technical guidance and coordination of inter-American health programs and specifically the hemisphere-wide malaria eradication program, has already taken action to assure regional technical guidance on an adequate basis. The Bureau is developing a competent professional group directly responsible for technical advice wherever needed, to assist Governments to intensify their malaria control programs and convert them into eradication programs. This group is responsible for the coordination of country programs, so that concerted progress shall be achieved within overall regional plans and schedules. Technical and administrative standards for the organization and administration of the eradication programs are being established; operating manuals are being prepared, including a uniform system for reporting activity and continuously evaluating progress.

Eradication depends on action at the national level. Each nation, as a member of PASB/WHO automatically has undertaken an obligation to all the other countries, as well as to its own population, for execution of an eradication program. Action in all countries should proceed simultaneously. Inasmuch as conditions and the extent of existing control measures vary from country to country, a new plan is being made in each case covering the details of an eradication program. This plan provides for a unified country-wide service, operated according to international technical standards with uniform reporting procedures to facilitate international coordination and analysis.

The chief problem in each country is to provide adequate materials and finances for large scale operations without interruption until eradication has occurred. It is important that the eradication program commence on as large a scale as possible and progressively expand until the entire malarious zone of the country is covered. Temporary, inadequate and intermittent effort is costly and ineffective. Emphasis on careful training of eradication staffs and on tight administration can assure such thorough results that malaria will disappear in three or four years after complete coverage of the area has occurred. Taking into consideration the recruitment and training period and the progressive nature of the organization of control measures, it is probable that the manpower, transportation and supply requirements will be spread over a somewhat longer period.

Continuing evaluation of the distribution of malaria is an essential part of any eradication program, as a check on the efficacy of the method and the efficiency of its application and as an indication of eradication itself and of the possibility of discontinuing costly control operations. The application of DDT should be discontinued as soon as possible in an area, not only to reduce costs, but also to avoid the threat of DDT resistance of vector Anopheles, due to prolonged exposure. When discontinued in any area, surveillance must be continued and intensive local house spraying initiated in and about any focus of reinfection which may be found.

#### Cooperation of International Agencies Needed

In many countries the cost of malaria control is felt to be a heavy burden, and substantial international assistance is needed to stimulate

the expansion of the program to cover the additional areas necessary for nation-wide eradication. In promoting national eradication programs, it is important to know the approximate amount of outside assistance available from all sources. Under the Conference mandate to secure the financial participation of all organizations which may be in a position to assist, the Director of the Bureau is reviewing the problem with agencies already active in this field, as well as others which may desire to participate. The principal active agencies are UNICEF, FOA and PASB/WHO. Of the 36 countries (nations and territories) infected with malaria, PASB/WHO is providing technical advice and other assistance to 21. UNICEF, for its part, has provided assistance with supplies and equipment to 19 of these. Of other agencies, FOA has given the most assistance, having aided the control program in several countries, and still does in four. Malaria eradication is expensive and might well absorb all money available to international agencies, and more. Two past mistakes must be avoided; eradication should not be planned as a cheap current program but one for short-term capital investment for permanent dividends; governments should be given adequate technical and material aid, not only during the initial period but until eradication is achieved.

Each agency is urged to carefully consider this problem and determine as early as possible, in broad outline, the basis on which it can cooperate and assist in the hemisphere-wide malaria eradication program. In addition to the financial aspects of assistance, it is important to establish an overall plan providing for organizational and administrative action by each agency to assure cooperation and coordination at both international and country operating levels.

Ciudad Trujillo  
October 1950

RESOLUTION XVIII  
MALARIA CONTROL

WHEREAS: Efforts towards the solution of the malaria problem have been undertaken to a greater or lesser extent by all countries in the Western Hemisphere, some having solved the problem completely while others have made remarkable progress in the control of the disease; and

It is certain that, due to the adoption of new techniques of malaria control and to sufficiently intensive and coordinated efforts on the part of Member Countries and territories, total eradication of the disease from the Americas can be achieved.

THE XIII PAN AMERICAN SANITARY CONFERENCE  
RESOLVES:

To recommend to the Pan American Sanitary Bureau to include henceforth in its operating programs the development of such activities as are necessary to provide for greatest intensification and coordination of anti-malaria work in the Hemisphere, stimulating existing programs, facilitating interchange of information and furnishing technical and, whenever possible, economic assistance to the various countries with a view to achieving the eradication of malaria from the Western Hemisphere.

Santiago, October 1954

RESOLUTION XLII  
ERADICATION OF MALARIA IN THE AMERICAS

The XIV Pan American Sanitary Conference,

Considering:

That in the course of the technical discussions on the topic "Eradication of Malaria in the Americas" it was made evident that:

(a) The experience of those countries that have achieved eradication of malaria shows that, once transmission is intercepted, the infection in human beings disappears within a few years, as the result of the natural death of the parasite;

(b) Recent observations indicate the development of resistance by some anopheline species to certain insecticides, a phenomenon that, in time, may cause serious difficulties and even failures in anti-malaria campaigns; and

(c) The eradication of malaria in some countries calls attention to the international problem of preventing the importation of new cases into areas already free from infection.

RESOLVES:

1. To declare that it is of the utmost urgency to carry out the terms of Resolution XVIII of the XIII Pan American Sanitary Conference, which recommends that the Pan American Sanitary Bureau promote the intensification and coordination of antimalaria work, with a view to achieving the eradication of this disease in the Western Hemisphere; and that the Member Governments should convert all control programs into eradication campaigns within the shortest possible time, so as to achieve eradication before the appearance of anopheline resistance to insecticides.
2. To instruct the Pan American Sanitary Bureau to take steps to implement the aforesaid resolution and to study international measures to ensure the protection of those countries or territories that have achieved eradication of the disease.
3. To authorize the Director of the Pan American Sanitary Bureau to secure the financial participation of public or private organizations, national or international, in order to further the aims set forth in this resolution.

THE PRESENT STATUS OF THE ANTI-MALARIAL  
DRUGS CHLOROQUINE, PYRIMETHAMINE  
(DARAPRIM), AND PRIMAQUINE

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The short time allotted for this presentation requires that it be limited to considerably less than is implied in the title. It will not be possible to discuss all the aspects of the three drugs under consideration, and this paper is therefore limited to those salient features which are believed to be of primary concern to this audience. A short developmental history of these drugs will be presented along with their pharmacological properties and toxicity. In regard to these latter points, the most important aspects are the maintenance of adequate concentrations, possible side actions, and the margin of safety between effective and toxic doses. Beyond these points, the question of greatest importance to those responsible for the chemotherapeutic control of malaria is efficacy. This property of a drug must be measured on the basis of the following criteria:

- (1) suppressive effect, and the practicability of dosage regimens required to obtain it;
- (2) therapeutic effect against overt attacks;
- (3) the possibility of radical cure; and
- (4) the development of resistance.

An attempt will be made to provide information on all the above points as an aid to evaluating the three drugs under discussion, not only in relation to each other, but also in relation to those other compounds which have in recent years been added to the armamentarium of the malarialogist.

#### Chloroquine

Chloroquine (7-Chloro-4-(4-diethylamino-1-methylbutylamino)quinoline) was synthesized and studied under the name of Resochin by the Germans as early as 1934, but after a few human tests it was discarded because it was considered too toxic. Later, sontochin, the 3-methyl derivative of chloroquine, was more carefully studied in Germany and during World War II by the French in North Africa, who discovered its high anti-malarial activity and that it was well tolerated. Following the fall of North Africa this knowledge became

1 Reprinted from "Industry and Tropical Health" Second Conference 1955

available to United States investigators who, within a short time, synthesized a large series of derivatives, nine of which were given limited study in man; four of these, SN 9584 (7-chloro-4-(3-diethylamino)propylamino) quinoline, oxychloroquine (SN 8137), amodiaquin (Camoquin), and chloroquine (Aralen) appeared to be superior to the others. Expanded clinical studies showed that chloroquine surpassed other members of the group as an antimalarial and was less toxic. The drug now has general acceptance throughout the world.

Chloroquine has distinctive pharmacological properties and it is important that they be understood if the potentialities of the compound are to be fully realized. The absorption of chloroquine from the gastrointestinal tract is rapid and almost complete. It becomes extensively localized in the tissues in amounts up to 500 times the concentrations in the plasma. This tissue affinity, plus the fact that the drug is metabolized and excreted slowly, allows for blood levels sufficient for complete suppression of attacks of malaria for upwards of six weeks or longer, depending on dosage, after administration of the drug has stopped. Because of these phenomena, coupled with the fact that antimalarial activity is closely linked with the amount of drug in the plasma, it is essential that loading doses be employed in order to obtain concentrations in the blood sufficient for rapid therapeutic effectiveness. Under accepted regimens of therapy, effective chloroquine concentrations are reached within two to three hours. If the drug is given intramuscularly, sometimes a necessary procedure in acute falciparum malaria, therapeutically effective levels are reached in less than 15 minutes.

Toxicity due to chloroquine is extremely low at dosages recommended for suppression or therapy. A group of volunteers given weekly doses of 300 mg., an amount sufficient for complete suppression, exhibited no toxicity,<sup>1</sup> while in another study group, given the same dose, there were more complaints among individuals receiving placebos than among those actually taking the drug.<sup>2</sup> At high dosages, symptoms of dizziness, blurring of vision, headache, diarrhea, and mild epigastric distress do occur, but these manifestations diminish or disappear when the dosage is decreased or completely withdrawn.<sup>3</sup> When given intramuscularly, there is less local tissue reaction than from either quinine or quinaerine (Atabrine).

The effectiveness of chloroquine as an antimalarial agent rests largely on its pronounced activity against erythrocytic parasites. This activity is probably greater and more dependable than that of any other known drug. It does not prevent infection with any of the human malarias, nor does it prevent or destroy the late tissue forms of Plasmodium vivax, but it is so effective against all species of malaria parasites in the circulating blood that single weekly doses of 300 mg. (500 mg. of the diphosphate salt) will produce complete suppression. This dosage will result in the suppressive cure of falciparum malaria, but against vivax, and probably against quartan malaria, the disease will become clinically active some weeks after suppression has been stopped. Clinical attacks of

the disease can be terminated with single oral doses of 600 mg. (base) of the drug, but vivax infections are likely to relapse within four weeks.<sup>4</sup> The most effective treatment of an acute attack is 600 mg. (base) in a single dose followed in six hours by a second dose of 300 mg. (base), then 300 mg. (base) on each of two succeeding days, a total of 1500 mg. (base) in three days. Under this system of therapy, the fever is generally eliminated within 24 hours and the circulating parasites are removed within 48 to 72 hours; infections caused by P. falciparum are generally cured (i.e., radical cure) while vivax infections will ordinarily relapse six to eight weeks following treatment. The interval from treatment to relapse is longer than that following administration of any other drug, a characteristic attributable directly to the drug's pronounced tissue affinity.

So far no evidence of resistance to chloroquine has come to light, and no differences in strain susceptibility have been demonstrated, probably due to the fact that its low toxicity has allowed for the employment of dosages well above the minimum effective level. Outside of its inability to produce radical cure of vivax infections, its only limitations seem to be cost and supply.

Certain other 4-aminoquinolines also deserve comment. Among these are amodiaquin (Camoquin) and sontochin. The former is an effective antimalarial drug, slightly less active and somewhat more toxic than chloroquine, although the differences are too small for practical significance. Sontochin, dose for dose, is slightly less toxic than chloroquine, but it also is distinctly less active, and the larger doses required to obtain the same effect obviate the apparent advantage.

In summary, it can be said that chloroquine is the most efficient and effective drug for the treatment and suppression of all malaria infections. At the recommended dosage for therapy (1,500 mg. in three days) fever subsides in 24 hours and parasites are removed in 48 to 72 hours; single weekly doses of 300 mg. result in complete suppression; periods of latency are longer than those following any other drug; it does not stain the skin and eyes; and it does not ordinarily produce undesirable side actions.

#### Pyrimethamine (Daraprim)

Pyrimethamine (Daraprim), 2,4-diamino-5-p-chlorophenyl-6-ethylpyrimidine, had its origin in studies directed toward antagonists of nucleic acids, during which American workers noted the close structural relationship between certain of the 2,4-diamino-5-substituted pyrimidines and chlorguanide (Paludrine). When one of the 5-substituted compounds was shown to have activity against gallinaceum malaria equal to that of quinine, other compounds containing this moiety were synthesized and their assessment as antimalarials proceeded without delay. One of the most effective compounds, now known as pyrimethamine, was 60 times more active than chlorguanide against Plasmodium gallinaceum, and 200 times

more effective against P. berghei. Against P. cynomolgi, pyrimethamine was found to be 30 times more active than chlorguanide and 500 times as active as chloroquine. The effectiveness of pyrimethamine against human malaria was reported first in 1951;<sup>5</sup> since then it has received intensive study in this country and in England.

Details of the absorption, elimination, and plasma concentration of pyrimethamine in man are incomplete because, according to recent evidence, the drug itself gives rise to an active metabolite which is not basic and therefore cannot be determined by chemical methods generally employed for the estimation of drugs in biological fluids, and so far microbiological methods have been equally unsuccessful. Data from rhesus monkeys,<sup>6</sup> where doses above those recommended for man were employed, indicate that absorption from the intestinal tract is relatively slow but essentially complete. It localizes to a moderate degree in the lung, liver, kidney and spleen. About 20 per cent of the drug administered can be recovered in the urine as metabolic products and unchanged drug. The drug does not ordinarily accumulate in the plasma. At the dosage recommended for suppression, the toxicity of pyrimethamine is very low. Among a group of 11 volunteers, in England given 50 mg. twice weekly for three months, two complained of slight gastro-intestinal upset. In a second group of 40 volunteers given two doses, complaints were higher among the 20 receiving placebos than among those who actually took the drug.<sup>7</sup> In this country, volunteers who received single 25 mg. doses weekly for 17 weeks showed no ill effects.<sup>8</sup> Twenty-five mg. given daily for seven weeks produced a megaloblastic type of anemia in six out of 12 volunteers, but remission was rapid when the drug was stopped.<sup>9</sup>

Pyrimethamine is a potent drug of extraordinary effectiveness against erythrocytic parasites of all the malarias. It probably has some action against the primary exoerythrocytic forms of all the malarias, and it is active against the late tissue forms of Plasmodium vivax although the exact conditions necessary for such action are not as yet clearly defined.

It is the most active suppressive agent known. In single weekly doses of 25 mg. complete suppression is obtained against all species of malaria. Suppressive cure is possible against some strains of P. vivax and against P. falciparum.

Pyrimethamine is not a good drug for therapy of acute attacks; although eventually effective, its action is too slow for rapid termination of fever and parasitemia.

In addition to its suppressive ability, this drug exhibits a phenomenal effect on gametocytes.<sup>10</sup> It does not appear to affect the production or morphology of these sexual forms, but in wholly susceptible mosquitoes the parasites are not able to develop beyond the early oocyst stage, thereby blocking the chain of transmission. The gametocytes are affected adversely as early as two hours, and as late

as 144 hours, after the patient has received the drug. This property of the drug might be put to good use, especially in falciparum areas. One of the characteristics of this infection is that gametocytes seldom, if ever, appear in the circulating blood until 10 days or more after the onset of the acute attack, which is ordinarily three to five days after treatment has been terminated. Even the best schizontocidal drugs do not affect falciparum gametocytes adversely; so, though the patient is apparently well, he is not prevented from acting as a source of gametocytes for infecting the local mosquitoes. Because the drug is known to persist at therapeutically active levels for upwards of 17 days,<sup>8</sup> the transmission cycle might be broken by administering 25 mg. of pyrimethamine on the last day of treatment of the overt attack.

The development of pyrimethamine resistance was recognized during the early investigations. This phenomenon was first demonstrated against Plasmodium gallinaceum and P. berghei,<sup>11</sup> and later it was shown that resistance acquired by P. cynomolgi could also be transmitted through the mosquito.<sup>12</sup> Our own studies demonstrated that parasites of the Chesson strain of P. vivax could be induced to build up resistance to pyrimethamine, and that the resistance thus acquired could be transmitted through the mosquito.<sup>13</sup> Under ordinary conditions, this characteristic would be considered highly unfavorable. However, since the resistance was acquired slowly and only after careful planning, and even when it appeared the parasites were highly susceptible to chloroquine and other schizontocidal drugs, it is considered doubtful if resistance will prove a hazard in the field.

In summary it can be said that pyrimethamine possesses certain remarkable properties: small weekly doses (25 mg.) result in complete suppression of all the malarias, and suppressive cure is obtained against P. falciparum and against certain strains of P. vivax. It has a lasting adverse effect on gametocytes; it is tasteless, a characteristic of special importance when treating infants and children; and it is relatively inexpensive. Its limitations appear to be slowness of action when employed for therapy of an acute attack, and the possibility that certain strains of malaria parasites may develop resistance to the drug in the field, a phenomenon that can be prevented by always administering adequate doses for therapy or suppression.

#### Primaquine

The two drugs previously dealt with owe their position among antimalarial agents mainly to their ability to destroy erythrocytic stages of the malaria parasite. (Pyrimethamine also appears to have activity against at least some forms of fixed tissue parasites although, as mentioned earlier, its action at this point is not as yet clearly defined.) Thus their usefulness is limited primarily to suppression of the overt attack or to its treatment. The 8-aminoquinolines, on the other hand, owe their position to their ability to destroy the exoerythrocytic parasites and thereby bring about radical cure of the infection. The drug now to be discussed, primaquine, 8-(4-amino-1-methylamino)-6-methoxyquinoline, is the most effective

of this group of compounds.

Pamaquine (or Plasmochin) was the first synthetic antimalarial drug and the historical precursor of primaquine. When first introduced, in 1925, it was used for the treatment of acute attacks of malaria, but this practice was soon discontinued because doses required to eliminate the asexual blood forms were in excess of the amount that could be administered with safety. During the early trials it was learned that the drug was lethal to gametocytes of all species of malaria, and consequently control of malaria in some areas was attempted through the combined use of pamaquine and quinine. Although results led to no unequivocal conclusions as to effects on mass transmission rates, they did indicate that the combination of quinine and pamaquine reduced the relapse rate in vivax malaria significantly. It was believed that quinine enhanced the effect of pamaquine; later, this synergistic effect was credited to all the 8-aminoquinolines. Recent evidence, however, discounts any synergism between quinine and the 8-aminoquinolines.

Because of the toxicity of pamaquine and the greater over-all usefulness of quinacrine (Atabrine) and other early derivatives, interest in the 8-aminoquinoline series was more or less dormant until a complete review of the field was made near the end of the malaria research program in the United States during World War II. Following this re-evaluation, a wide variety of new derivatives were synthesized and tested; ability to cure vivax infections was discovered to be a general attribute of this group of compounds. Among a group of some 60 compounds, four (pentaquine, isopentaquine, SN 3883, and primaquine) were found to be better tolerated than pamaquine.

Pentaquine was the first of the newly-synthesized compounds found to exhibit activity equal to that of pamaquine. It was less toxic than pamaquine, the parent compounds, but still too toxic to allow for the administration of effective amounts in single daily doses. Isopentaquine and SN 3883 were studied next, and although each was found to be active and less toxic than pentaquine, the advantages were still not sufficient to warrant their general use.

Still later, primaquine was found to possess decided advantages. It is the most highly active and best tolerated 8-aminoquinoline yet tested, and amounts sufficient for cure can be given in single daily doses. Because of these characteristics, primaquine will probably replace all other 8-aminoquinolines for the cure of relapsing malaria.

Primaquine, like all the other 8-aminoquinolines, is rapidly absorbed, elimination is accomplished entirely within 24 hours through metabolic conversions and excretion of the degradation products in the urine; and only a very small amount is fixed in the tissues.

When primaquine is administered at the recommended dosage, no toxicity should be expected. When dosages are increased, toxic

manifestations may include anorexia, nausea, epigastric distress, abdominal cramps, and, occasionally, vomiting, vague chest pain, and weakness. In addition there may be striking effects on the formed elements of the blood and the bone marrow, marked by leukopenia, anemia, methemoglobinemia, and suppression of myeloid activity, with lesser effects on the heart and circulation. These manifestations disappear when the drug is withdrawn. The tendency for hemolytic reactions is increased in all the dark-skinned races.<sup>14</sup>

Because the tendency for methemoglobinemia, granulocytic neutropenia, and probably for acute hemolytic anemia, is potentiated by quinacrine (Atabrine), neither primaquine nor any other 8-aminoquinoline should be given with or following quinacrine administration.<sup>15</sup>

Although primaquine is active against primary exoerythrocytic forms of Plasmodium vivax and even more active against this stage of P. falciparum, the time of action in relation to dosage is such as to preclude its adoption for use as a true causal prophylactic. Against asexual blood forms, primaquine displays activity against vivax and falciparum parasites, but the degree of activity is too low for therapeutic effectiveness. It is highly effective against the gametocytes of all the malarias, but its rapid elimination coupled with its inherent toxicity limits its general usefulness as a gametocytocidal agent.

Primaquine finds its greatest usefulness as a truly curative agent against vivax malaria. Chesson strain vivax malaria of Southwest Pacific origin is notoriously difficult to cure, and in a well-controlled study, when primaquine in doses of 20 mg. daily for 14 days was given concomitantly with quinine, cure was achieved in only 85 percent of the volunteers.<sup>16</sup> However, in another study conducted against the same strain, and equally well controlled, it was reported that dosages of 22.5 mg. daily for 14 days with quinine "prevented relapse in practically 100 percent of the cases."<sup>17</sup>

In the spring of 1951, when cases of vivax malaria began to appear in the United States among military personnel returned from Korea, it became necessary to evaluate the curative effects of primaquine against that strain of vivax. Studies carried out at Fort Benning, Ga. and Fort Knox, Ky. during the summers of 1951 and 1952 showed that when chloroquine was employed for therapy of the overt attack, and primaquine was given concomitantly at 15 mg. single dose for 14 days, radical cure was achieved, while in a comparable group who received chloroquine alone the relapse rate was 39 percent.<sup>18</sup> In a further test of the curative properties of primaquine, the drug was given to a large group of returnees during the latent phase of their infection. Among the men who received primaquine, 15 mg. single dose daily for 14 days, none developed malaria during the next six months of observation, while 17.5 percent of those given a placebo daily for 14 days came down with vivax malaria during the same period of observation.<sup>19</sup>

In conclusion, with these evidences at hand it is clear that we are now in possession of a drug which will eradicate Plasmodium vivax infection. To produce this result two courses of action are open: (1) If the patient is in the throes of an acute attack, treatment should be instituted immediately with chloroquine and then concomitantly, or shortly afterward, primaquine therapy instituted at 15 mg. single dose daily for 14 days. Against certain strains of vivax, a second course of primaquine may be necessary. (2) If the patient has left the malarious area and infection is known or suspected, primaquine may be given according to the same regimen but without chloroquine.

#### GENERAL SUMMARY

The discussion presented above attempts to set forth the chief attributes of chloroquine, pyrimethamine (Daraprim), and primaquine as antimalarial agents. Each lacks certain qualities sought for in the ideal drug, but when used in combination, the goal is not far off. The development of chloroquine and certain other 4-aminoquinolines made possible for the first time complete suppression of all the malarias on a once-weekly schedule, and provided the most efficient agent for the prompt alleviation of acute attacks. Although pyrimethamine is not recommended for therapy of overt attacks because of its slowness of action, it is the most efficient suppressive agent known, and its pronounced effect against falciparum gametocytes may contribute to the control of this infection. With the development and recent large-scale appraisal of primaquine, a drug of acceptable toxicity is now available for the radical cure of Plasmodium vivax infections. Taken as a whole, drugs are now available for the complete chemotherapeutic control of malaria. Assuming equally efficient advances in vector control, malaria should soon lose its place as the most prevalent human disease.

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PRIORITIES IN INTERNATIONAL TECHNICAL ASSISTANCE  
HEALTH PROGRAMS

Joint Statement by the  
Public Health Division of the  
FOREIGN OPERATIONS ADMINISTRATION  
and the  
Public Health Service and Children's Bureau of the  
U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Need for Priorities

Some system of priorities in health technical assistance to underdeveloped countries is essential since health needs are so vast and the resources in funds and trained personnel are so limited. The establishment of such priorities has been given attention, but not solved, by the World Health Organization and other multilateral agencies. Widely differing conditions, needs, and resources in different countries, varying motivations by governments in requesting assistance, and diverse backgrounds and viewpoints of health technicians in the field all complicate the pattern of suggested projects for each country.

In the rush in which the U. S. bilateral technical assistance programs developed, the drive was to recruit effective and experienced personnel, to supply them with the means for getting things done, and to obtain early results. There was little time for careful thought, little experience to draw on, and pressures were great from all sides.

More recently, there has been time for stock taking. The evaluation of the Institute of Inter-American Affairs' program by the Public Health Service was a major step in this direction. This study emphasizes the importance of orderly planning at the country level but does not provide a framework of over-all priorities--an approach which is badly needed for the globe-girdling health program in which the United States is now involved.

Such a program must be based on a clear--the clearest possible--understanding of all the elements concerned in it. It must be shaped with thought, not luck. Depending for success upon cooperation with other governments, it must shape itself to their wishes but must also avoid giving way to inadvisable expediency.

Development of the Statement

The priorities statement which follows represents the results of thoughtful consideration of the matter experienced workers in the international health field, crystallized in a three-day conference of professional personnel of the Public Health Division of the Foreign Operations Administration, the Division of International Health of the

Public Health Service, and the Division of International Cooperation of the Children's Bureau. This group consisted of 12 individuals and included experienced members of the major public health disciplines. One or another member of the group had worked in or visited officially every country in which U. S. technical assistance programs are being conducted.

At this meeting, the first step was to consider certain elemental questions. What are the purposes and aims of U. S. technical assistance programs? Is there really a need and place for health activities in the technical assistance programs? If so, what are they and why? Discussion of these questions occupied about a full day and the result is very briefly summarized in the first paragraph of the attached document.

The various bases on which health activities in technical assistance programs should be chosen and judged were then discussed, keeping the general program goals and justifications in the first paragraph constantly in mind. It was felt by all that we are working in these countries for only a limited period of time; that our basic purpose is to show other countries how they may do the job themselves rather than for us to step in and try to do the job for them; that for many reasons we should favor activities that could affect the welfare of large numbers of the people and do so within a relatively brief interval of time; and, that while a great many health activities are theoretically or actually desirable, certain of them are impractical for technical or scientific reasons and certain others because of administrative or cultural difficulties.

In the course of the discussion, a rather interesting chart was developed for a rough classification of various program elements. Down one axis were listed the various types of activities in the field of public health, sanitation, professional education, etc., that had previously been suggested, engaged in, or might conceivably be suggested. Across the other axis were listed a series of criteria, some of which have been referred to above; economic impact, political impact, technical feasibility in the light of present-day scientific knowledge, administrative feasibility, cultural acceptability, early recognizable results, results in relation to cost, take-over ability by host country, and number of persons affected.

There followed careful discussion of each possible activity in relation to each criterion. Each activity was then rated under each criterion from zero to four plus. As a result, for the first time, it was possible to step back and look at activities in international technical assistance in health from an over-all, objective, yet relative view.

#### Priority Categories

From the consensus developed on each type of project as shown on the chart, the results seemed to fall into three broad categories of priorities:

1. Certain activities or programs which were always and unquestionably justified wherever the related problem existed,
2. Certain activities or programs to which we would ordinarily not react particularly favorably in the absence of special precise explanation and justification,
3. Certain activities or programs which it was definitely felt were not justified and should not be engaged in by our technical assistance programs. In this later case, it was recognized that in rare instances certain peculiar non-health considerations might result in a decision to engage in one of these activities.

The group recognized fully that any such priority grouping would not be subscribed to in every detail by all health technicians in all country programs. Application of the list must be related to country conditions and the stage of development of the country's resources and health administration. Because of this, each of the FQA health program chiefs has been urged to go through the same evaluation and program development analysis in terms of the problems and situations peculiar to the country in which he is working. Despite its limitations, however, it is believed that thoughtful application of this document to program plans on a country-by-country basis is resulting in a more consistent policy and greater effectiveness in attaining the objectives of the technical assistance program.

#### Review and Revision

Subsequent to its original issuance in August 1953, this priorities statement was reviewed and discussed by the FQA Health Advisory Committee at its first meeting in March 1954. The Committee gave general approval to the document, suggesting only a few changes. The present statement includes revisions based on the views of the Committee.

#### STATEMENT OF PRIORITIES

##### General Principles

Priorities are based on demonstrated ability of a health program to:

Strengthen economy by health benefits which release effective human energy, improve citizen morale, improve environment for local and foreign investment, open new land and project areas;

Contribute to our political objectives by reaching populations with highly welcomed personal service programs; by demonstrating our deep human interest in man and his dignity.

In determining priority, the following factors have been weighed, recognizing considerable country variation:

- a. technical and administrative feasibility
- b. early recognizable results
- c. results attainable relative to cost
- d. take-over ability by host country
- e. number of persons affected

In applying the priorities, the mission will take into account local economic, political, and cultural factors and the relationship of each project to the current health administration and to the long-range health program of the country.

Within each of the three priority groups which follow, the numerical order is not intended to indicate priority within the group.

#### First Priority Programs

1. Mass campaigns against malaria and yaws, where they are major problems and against selected gross nutritional deficiencies such as kwashiorkor, beri-beri, xerophthalmia and goiter, where they may be readily attacked.
2. Development of protected small community water supplies.
3. Demonstrations through health centers of services on a community-wide basis including sanitation, communicable disease control, health records and statistics, home visiting, maternal and child health, nutrition, health education, laboratory, and general clinical services where required to gain acceptance of the community. Health centers should be used for sub-professional training and field experience for professionals and should be limited in scope and number to the national capacity to absorb and operate them.
4. Advice and assistance in strengthening and leading stability to the organization and operation of public health administration of the host government.
5. Inclusion of training and health service projects in proposed or existing community or village development programs.
6. Advice and assistance in planning and designing, and supervision or construction, of hospitals, health centers, laboratories and other health facilities.
7. Development and support of basic training of nurses to demonstrate the proper status of nursing as a profession

and to provide leadership for indigenous training.

8. Training of sub-professionals to meet major specific health problems in preventive medicine, nursing, sanitation, limited medical services; such training to develop personnel for a planned program which must include professional supervision and periodic refresher training. Where practicable, opportunity should be given for advancement of outstanding individuals to higher levels.
9. Fellowships in public health, preferably project related, in U. S., not necessarily limited to one year, awarded to physicians, engineers, nurses, health educators, laboratory technicians, public health statisticians, and administrators. Training should be provided in the host country or region to the maximum extent possible.
10. Programs for training key medical school teachers in major clinical and pre-clinical specialties. Training should be provided in the host country or region to the maximum extent possible.
11. Construction of demonstration health centers and nursing schools when necessary to success of these programs by insuring physically adequate, effectively planned facilities.

#### Second Priority

These projects require special explanation showing economic and political values, feasibility and relationship to total health program.

1. Mass campaigns against other diseases where of major importance; e.g., trachoma, louse-borne typhus, leprosy.
2. Consultation on urban water or sewerage system.
3. X-ray, audio-visual, or other major equipment for hospitals or health centers.
4. Excreta disposal projects, other than as an integral part of a community general sanitation program.
5. Refuse disposal, fly control, and food protection projects.
6. Assignment of U. S. personnel to foreign institutions, except on a short-term consultation basis (3 months or less).
7. Occupational health services.
8. Projects for tuberculosis immunization (B.C.G.), case-finding, and ambulatory treatment, where the problem warrants and facilities permit.

Third Priority

The following types of projects, which have been suggested from time to time, have too low a priority under FOA objectives to be undertaken within available funds, except when fully justified by most unusual circumstances:

1. Mobile clinics requiring specialized motor equipment, or for general medical care
2. Construction or financing of construction of hospitals, water and sewerage systems, or other major structures
3. Operation of hospitals by U. S. personnel or at U.S. expense
4. Training of practicing physicians in clinical specialties in U. S.
5. Dental health projects
6. Mental hygiene projects
7. Establishment, equipping, or operation of blood banks
8. Medical rehabilitation projects
9. Mass treatment for intestinal parasites
10. Geriatrics projects
11. Poliomyelitis control or treatment projects
12. Training in tropical medicine in U.S.

## POLICY ON SUPPLIES AND EQUIPMENT

Purchase of such items from FOA health funds is justifiable only when

1. Necessary to effectiveness of a technician;
2. Necessary to make an important demonstration complete and convincing, or to initiate or complete a major control project;
3. Many people are reached through use in a training project.

## BASIC HEALTH TEAM

The basic health team of a mission, to accomplish the desired objectives, must include a public health physician, nurse, sanitary engineer, health educator, and health administrator.

DDT, 75 PERCENT, WATER-DISPERSIBLE POWDER  
ICA SPECIFICATION NUMBER 101055

October 10, 1955 - ICA No. 101055

DEFINITION

DDT, 75 percent, water-dispersible powder shall be prepared from dichlorodiphenyltrichloroethane (DDT), which shall conform to the requirements for grade B of Federal Specification O-D-370, together with such inert diluent(s) and conditioning agents as are needed to meet the requirements of this specification. The material shall be a powder, white to cream in color which wets readily on stirring into water.

PACKAGING

DDT, 75 percent, water-dispersible powder, shall be packed in 100-pound lever-lock fiber drums with metal tops and bottoms and inner lining bags of pliofilm 140 or 235 gauge or polyethylene, minimum thickness .004 inch, hermetically sealed after filling. The shipping cube measurement of the drum shall be not less than 5.25 cubic feet.

CHEMICAL AND PHYSICAL REQUIREMENTS

1. DDT Content (w/w basis)

The content of actual DDT found in any one sample, taken from any part of the consignment, and determined by the methods described under Test Procedure A, shall not be less than 73.50 percent. The average content for all samples of a consignment must not be less than 75% of actual DDT.

2. Suspensibility

The suspensibility test given under Test Procedure B (3) is to be performed on the material as received and also after tropical storage pretreatment, Test Procedure B (5). When tested as received, the 25 ml. aliquot must contain at least .375 grams of DDT, i.e., 1.5 percent weight to volume. After the tropical storage pretreatment, the 25 ml. aliquot must contain at least .300 grams of DDT, i.e., 1.2 percent weight to volume.

3. Maximum Diameter

Not less than 98 percent shall pass through the 74 micron (U.S. Standard No. 200) sieve when tested as described in Test Procedure C.

4. Wettability

The powder shall be substantially wetted in not more than three minutes when tested by Test Procedure D.

## 5. Acidity

The acidity shall not be greater than 0.3 percent calculated as  $H_2SO_4$  when tested in accordance with Test Procedure E.

### TEST PROCEDURES

#### A. Determination of DDT Content

(1) Total Chlorine: Weigh accurately a sample of the water-dispersible powder containing about 1 g. of technical DDT and extract it quantitatively with chlorine-free and thiophene-free benzene. If a Soxhlet apparatus is used, care must be taken to insure that extraction is complete and that channelling has not occurred. Concentrate the extract to such a volume that it can be transferred quantitatively to a 100-ml. volumetric flask, fill up to the mark with benzene and mix thoroughly. Transfer a 10-ml. aliquot to a 250-ml. Erlenmeyer flask and add 25 ml. of 99 percent isopropanol. Shake the flask and add 2.5 g. of metallic sodium in the form of ribbon or small pieces. Connect to a reflux condenser and boil gently for at least one hour, shaking the flask occasionally. Remove excess metallic sodium by cautiously adding 10 ml. of 50 percent aqueous isopropanol through the condenser at the rate of 1-2 drops per second. Boil for a further 10 minutes, then add 60 ml. of water.

Cool, add two or three drops of phenolphthalein solution, neutralize by adding 50 percent nitric acid dropwise, and then add 10 ml. in excess. Cool to room temperature, add a slight excess of 0.1 N silver nitrate, and coagulate the precipitated silver chloride by digesting on a steam-bath for half an hour, with frequent stirring. Cool, filter through a fast paper, and wash thoroughly with distilled water. Add 5 ml. of 10 percent ferric alum solution and titrate the excess silver nitrate in the filtrate with 0.1 N potassium thiocyanate.

Alternatively, the end-point may be determined electrometrically.

Subtract the quantity of silver nitrate found in the filtrate from that originally added. The difference will be that required to combine with the chlorine originally present in the DDT. One ml. of 0.1 N silver nitrate is equivalent to 0.003546 g. of chlorine. Calculate the weight of DDT (molecular weight 354.37) in the sample by multiplying the weight of chlorine found by two and from this value calculate the DDT content of the water-dispersible powder.

#### B. Suspensibility Test

(1) Standard Hard Water: The standard hard water to be used in preparation of suspensions is designed to provide a hardness of 342 ppm calculated as calcium carbonate and is defined as water of the following composition:

Calcium chloride, anhydrous	0.3037 gram
Magnesium chloride, hexahydrate	0.1388 gram
Distilled water, to make	1 liter

(2) Preparation of Suspension: Two hundred ninety ml. of standard hard water at approximately 30°C. are added to 20 grams of the powder previously weighed into a jar. This gives a 5 percent DDT suspension. The jar shall be a screw-cap glass jar of one U.S. liquid quart capacity, clear and transparent, substantially cylindrical, approximately 16 cm. in inside height (vertical clearance), and without abrupt shoulders or other shape features that would interfere with the efficient transfer of the suspension from the jar to another vessel. (A U.S. quart fruit jar of suitable type, shape and dimensions satisfies these requirements.) The material charged to the jar shall be rotated end-over-end at the rate of 60 rpm for 2 minutes; the axis of rotation shall be midway between the top and bottom of the jar and perpendicular to its vertical axis.

(3) Suspensibility Test: An aliquot of the suspension prepared under B (2) is used for this test. Immediately after the rotation for 2 minutes is completed the jar is opened and stirred with a glass stirring rod for one minute. A 50 ml. aliquot is measured out immediately with a graduate and transferred to a 100 ml. glass-stoppered graduate, 18 cm. in internal depth from the bottom to the 100 ml. mark. (The graduate should have previously been fitted with a cork stopper having a center bore for a 25-ml. volumetric pipette and a shallow V-cut on one side as an air vent. The pipette is placed in the stopper so that the tip will be exactly at the 50-ml. mark of the graduate.) A portion of standard hard water at about 30°C. and not more than 40 ml. in volume is used to rinse the transfer vessel. All rinsings are added to the 100 ml. graduate. The graduate is placed in a constant temperature bath or cabinet held at 30° plus or minus 1°C. After the contents have come to this temperature, enough standard hard water at 30° plus or minus 1°C. is added to bring the volume to the 100 ml. mark. This gives a 2.5 percent DDT suspension. The graduate is stoppered and any sediment caked on the bottom of the cylinder must be resuspended with a minimum of agitation before starting the inversions. Then the graduate is smoothly inverted 30 times by hand and replaced immediately in the constant temperature bath. After standing 30 minutes, a 25 ml. aliquot is removed from the 50 ml. mark using the pipette previously fitted with the stopper. The DDT content of the aliquot may be determined by any conventional method or by the following procedure (4).

(4) Rapid Procedure for Estimating the Technical DDT in the Aliquot from the Suspensibility Test, B(3): A Buchner funnel, Corning catalog 6060, size 42½, in a 250 ml. suction flask is fitted with #1 Whatman filter paper. A suspension of Celite 266 is poured into the funnel to give a filter cake approximately 1/20 inch deep. After the 2.5 percent DDT suspension has stood 30 minutes, a 25 ml. aliquot is pipetted from the 50 ml. mark onto the prepared Buchner. At the beginning of the transfer, a small amount of the Celite

suspension is added to the funnel along with the DDT suspension; if this is not done the suspension is likely to filter too slowly. Wash the powder on the filter with four 25 ml. portions of distilled water. Remove the funnel from the flask and rinse the funnel stem with acetone to remove any drops of water which might be present. Transfer the funnel to a clean, dry, 250 ml. suction flask and wash with six 20 ml. portions of acetone. Do not allow the cake to go completely dry as it will crack and leak. Remove the flask to a steam bath and evaporate to about 15 ml. with the aid of a glass bead. Transfer to a tared 50 ml. beaker and evaporate in a 55°C. water bath using a gentle current of air. After the acetone has apparently evaporated, add approximately 5 ml. CP isopropanol and continue evaporation; add a second 5 ml. of isopropanol and evaporate to dryness. Transfer the beaker to a forced air oven at 55°C. and leave for 40 minutes. Weigh the residue and calculate as technical DDT.

(5) Tropical Storage Pretreatment: Twenty grams of the powder are poured into a 250 ml. Griffin low-form beaker and leveled off without compacting. Place on top of the powder a loose fitting rigid disc so formed and weighted as to exert a pressure of 25 grams per square centimeter upon the powder. Keep the powder thus under pressure in an oven at 55° C.  $\pm$  2° C. for 20 hours. Take the sample from the oven, remove the pressure assembly, and allow the powder to come naturally to room temperature. After cooling, the entire sample including any caked material is transferred to the jar used for preparation of suspension under B(2).

#### C. Maximum Diameter Test

This test is performed only after tropical storage pretreatment given under B(5). The suspension of pretreated material prepared under B(2) is utilized after removal of the 50 ml. aliquot for the susceptibility test B(3). Transfer the remaining suspension to a 74 micron sieve freed from any grease or other water repellent material. Rinse onto the sieve any solid particles remaining in the jar with tap water. Wash the residue on the sieve with an oscillating, moderately vigorous spray of tap water at 15 to 30° C. for 10 minutes. Determine the weight of residue on the sieve by backwashing onto a filter and drying at 55°  $\pm$  2° C. to constant weight.

#### D. Wettability Test

Add without agitation 5 grams of the water-dispersible powder to 100 ml. of standard hard water contained in a 250 ml. beaker, and observe the time required for the sample to become wetted throughout.

#### E. Determination of Acidity

Disperse 10.0 grams of the sample in 25 ml. of acetone and warm to effect solution of the DDT. Add 75 ml. of distilled water and titrate immediately with 0.02 N NaOH using methyl red as indicator.

Carry out a blank determination on 25 ml. of acetone and 75 ml. of distilled water and subtract blank from first titration. Percent acidity as  $H_2SO_4$  equals ml. 0.02 N NaOH multiplied by 0.0098.

#### SPECIAL MARKINGS

All containers shall bear, durably and legibly marked on the container, the following:

Manufacture's Name and Address \_\_\_\_\_

Insecticide -- DDT --- Water Dispersible Powder \_\_\_\_\_

to Contract No. \_\_\_\_\_

Batch Number and Formulation Date \_\_\_\_\_

Net Weight of Contents \_\_\_\_\_

Active Ingredients and their percentages and the following minimum precautionary notice:

"DDT is a toxic substance. Keep away from foodstuffs and empty foodstuff containers. Stow away from boilers and bulkheads in a cool place."

#### SAMPLING

##### Inspection

Any samples necessary shall be taken by an agent of the government for analytical purposes.

##### Production Control

The manufacturer shall be required to sample each batch or grind produced. In case of a continuous operation a batch shall consist of not more than 2,000 pounds. The manufacturer shall individually test all such batch samples, covering the total order, for compliance with the test for suspensibility as outlined in the specification (Test Procedure B) or the visual suspensibility test described below. The manufacturer shall make the results so obtained available to the Government prior to such further sampling and testing as may be required by the Government.

##### Visual Suspensibility Test

Place 3.3 grams of sample in a 100 ml. glass stoppered graduate, same dimensions described under Test Procedure B(3), and add standard hard water at a temperature of 30°C., prepared as under Test Procedure B(1), to bring to 100 ml. mark. Stopper and invert graduate 30 times and let stand for 15 minutes. At the end of this time if the sediment is above the 4 ml. mark it must be tested by Suspensibility Test procedures (B) with the exception of the Tropical Storage Pretreatment (B5).

In the event that such further sampling and testing should indicate noncompliance with the specification, the manufacturer shall, if requested, furnish the Government with the individual batch samples described above for that portion of the order showing non-compliance. In the case of questionable batches reliance will be placed only on Test Procedures B to determine suspensibility acceptance.

In no case will the manufacturer offer to the Government any batch or grind that does not meet the test for suspensibility as described in the specification (Test Procedures B) or the visual suspensibility test, depending on whichever is being used as a control check.

#### ACCEPTANCE

Acceptance will be made upon complete compliance with this specification.

ICA MANUFACTURING SPECIFICATION FOR 50% DIELDRIN  
WETTABLE POWDER WITH HIGH SUSPENDIBILITY

A. SPECIFICATIONS FOR FINISHED PRODUCT

1. Dieldrin content*	50%W minimum
2. Suspendibility, dieldrin in suspension at 50°F (10°C)**	70%W minimum
at 86°F (30°C)	70%W minimum
3. High temperature stability dieldrin content * (48 hr at 90°C)	48%W minimum
4. Package	50 lb. lever-lock fibre drums with innerlining bag of pliofilm 140 or 235 gauge or polyethelene minimum thickness .004 inches, hermetically sealed after filling

\* See paragraph B-4, Test Procedures.

\*\* See paragraph C, "Determination of Suspendibility of Wettable Powders".

B. MANUFACTURING AND TESTING INFORMATION

1. REGISTRATION AND LABEL

Active Ingredients:	<u>%W</u>
Hexachloroepoxyoctahydro-endo, exo-dimethanona- pythalene	42.5*
Related compounds	7.5
Inert Ingredients:	<u>50.0</u>
	Total <u>100.0</u>

\*Equivalent to 50% dieldrin.

2. MANUFACTURING FORMULA

<u>Material:</u>	<u>%W</u>
Technical Dieldrin *	50.5**
Attaclay	39.5
Urea	2.0
Duponol ME Dry	1.0
Marasperse CB	6.0
Sodium tripolyphosphate	<u>1.0</u>
	Total 100.0

- \* Formula is based on Technical Dieldrin of 100% purity and must be adjusted for dieldrin of lower purity.
- \*\* 1% overage of toxicant is used to insure compliance with ingredient statement.

### 3. MANUFACTURING PROCEDURE

Step 1 - Charge Attaclay and urea to blender and blend for 5 to 10 minutes.

Step 2 - Add balance of ingredients and blend for another 5 to 10 minutes. (Be sure blades clean bottom of blender.)

Step 3 - Pass pre-blended mix through a gross grinder (most attritor-type mills are satisfactory).

Step 4 - Pass through air-mill with air and feed rate adjusted to give as fine a grind as possible.

Step 5 - After-blend and package. (Be sure after-blender is clean prior to use.)

Step 6 - Check the quality of each batch for dieldrin content and suspendibility.

Note: If suspendibility does not meet specifications, pass the entire batch through the air-mill again and recheck.

### 4. TEST PROCEDURES

Sampling Obtain sample as described in SMS 488/52, Section 8, Shell Chemical Corporation Handbook of Aldrin and Dieldrin Formulations, SC:53:34.

Suspendibility See paragraph C, "Determination of Suspendibility of Wettable Powders".

Dieldrin content Determine dieldrin content according to SMS 549/52 in Shell Chemical Corporation Handbook of Aldrin and Dieldrin Formulations, SC:53:34 or SMS 596/52 in Shell Chemical Corporation Handbook of Aldrin and Dieldrin Formulations, SC:53-34 with the following modifications:

- (a) An extraction solvent of CS<sub>2</sub> plus 5% acetone shall be used.
- (b) Evaporate the extract to dryness on a steam bath and then dry in an oven at 75°C for 15 minutes.

- (c) Dissolve the dried sample in  $CS_2$  and proceed with analysis as described in either of the above methods.

#### High temperature stability

- (a) Accurately weigh out about a 6-gram sample of powder into a 100-ml test tube and stopper with a cork having a small vent hole.
- (b) Suspend test tube and contents in an oil bath, maintained at  $90^\circ C$ , for 48 hours. The tube should be suspended to a sufficient depth to leave about 3 inches of the tube extending above the surface of the oil.
- (c) Remove tube from bath, allow contents to cool and transfer entire contents to a chromatographic column. Wash out tube with solvent, add washings to column, and determine the dieldrin content according to either SMS 549/52 or SMS 596/52 in Shell Chemical Corporation Handbook of Aldrin and Dieldrin Formulations, SC:53-34.

NOTE: Dieldrin determination based on weight of extractable solids is not applicable for detecting loss of dieldrin.

### C. DETERMINATION OF SUSPENDIBILITY OF WETTABLE POWDERS

#### SCOPE

1. This method describes a procedure for the determination of the tendency of wetttable powders containing dieldrin to remain suspended in hard water. For specification tests, variant test temperatures or toxicant concentrations may be imposed. For laboratories lacking infrared spectrophotometric facilities, the suspendibility of dieldrin wetttable powders may be estimated by a simplified procedure.

#### METHOD SUMMARY

2. A suitable weight of wetttable powder is mixed with hard water to yield a suspension which is maintained at  $75$  plus or minus  $5^\circ F$  (or other specified test temperatures) for 30 minutes. An aliquot of the suspension is removed from the mid-level of the mixing cylinder with a pipet, and the toxicant present is recovered by filtration and extraction, and quantitative determination of the toxicant.

APPARATUS

3. a) Constant temperature bath, a large vessel in which several up-right cylinders can be immersed in water to the height of their 250 ml graduations.
- b) Filtration assemblies, consisting of suction filter flask and tubing, crucible adaptor, and 25 ml Gooch crucible fitted with a sintered glass disc of medium porosity.
- c) Graduated mixing cylinders, glass-stoppered, 250 ml capacity, 2 ml graduation interval; depth (inside) from bottom to 250 ml mark should be 250 plus or minus 15 mm.
- d) Oven, suitable for maintaining a temperature of 75 plus or minus 5°C.
- e) Pipet, calibrated to deliver 50 ml. Attach a cork to the lower stem such that, when inserted into the mixing cylinder the pipet is centered in the cylinder and the tip is located at the level of the 125 ml graduation. A groove must be cut along side of the cork to admit air to the cylinder while removing the aliquot.
- f) Steam bath, a conventional flat-topped bath having holes equipped with removable concentric rings is satisfactory.
- g) Thermometer, suitable for accurately measuring temperatures of 70-80°F.

MATERIAL

4. Unless otherwise indicated, it is intended that all reagents conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society.
  - a) Acetone, technical.
  - b) Asbestos, long fiber, acid-washed
  - c) Carbon Disulfide, c.p.
  - d) Filter Aid, diatomaceous earth, such as Hi-flow Super Cel
  - e) Hard Water, having a total hardness of 342 ppm of calcium carbonate. To prepare a liter of solution dissolve 0.403 g of calcium chloride dihydrate

(74-78%CaCl<sub>2</sub>) and 0.139 g of magnesium chloride Hexa-hydrate in distilled water in a volumetric flask and dilute to the mark. This concentration corresponds to an average "hard water" (1) and conforms to the conventions of the World Health Organization.

#### PROCEDURE

5. a) Determine the dieldrin content by the infrared spectrophotometric method (SMS. 596/52).
- b) To a 100-ml beaker containing 50 ml of 342 ppm hard water at a temperature of 75 plus or minus 5°F, add a portion of the well-mixed, representative powder equal in weight to the value shown in Table I. Mix well to form a slurry and transfer quantitatively to a clean and dry 250 ml-graduated mixing cylinder, using 342 ppm hard water to accomplish the transfer. Make up to 250 ml with hard water at the prescribed temperature.

(1) World Health Organization, Technical Report Series No. 54, Report on the Fourth Session of the Expert Committee on Insecticides, December, 1952, Annex 1 to Test Procedures.

TABLE I

#### WEIGHT OF WETTABLE POWDER TO BE TAKEN FOR SUSPENSIBILITY TEST

<u>Toxicant</u>	<u>Grams Toxicant/100 ml of Suspension</u>	<u>Grams Powder/250 ml for Suspensibility Test</u>
Dieldrin		
25% W. P.	0.625	6.250
50% W. P.	0.625	3.125

- c) Invert and right the tightly stoppered cylinder 30 times at the rate of one inverting and righting cycle per second. Place the cylinder upright in a water bath maintained at 75 plus or minus 5°F, making sure that the entire suspension is immersed, and leave for 30 plus or minus 1/2 minutes (See Note 1).

NOTE 1: Once the cylinder has been placed in the bath, it must not be subjected to further agitation and must be handled carefully in subsequent steps in order to avoid re-suspending any separated material.

- d) Assemble and prepare the filtration apparatus by filtering a sufficient volume of asbestos slurried with water to build up a mat 2-3 mm thick on the bottom of the crucible, using gentle suction.
- e) Remove the cylinder containing the test suspension and, with the upper end of the pipet stem closed with the finger to prevent inflow of fluid, carefully insert the pipet into the cylinder, seating the attached cork so that the pipet is properly centered. Withdraw 50 plus or minus 0.1 ml of the suspension at a uniform rate by means of a controlled suction in an interval of not less than 20 seconds and not more than 25 seconds.
- f) While applying gentle suction on the filter, discharge the contents of the pipet gently and uniformly onto the filter mat, avoiding disturbance of the latter. (See Note 2). If solids or turbidity appear in the filtrate, refilter through the same filter until the filtrate is perfectly clear. Discard the filtrate. Use a clean filter flask. While applying gentle suction, extract the solids retained on the filter with 3-50 ml portions of acetone.

NOTE 2: Some wettable powders tend to plug the filter, others contract or shrivel after filtration, so that channeling occurs and extraction is likely to be uncertain. These difficulties may be overcome by mixing the aliquot of sample suspension with 1-2 grams of a filter aid in a small flask, transferring the resulting slurry to the filter with additional water as necessary.

- g) Dieldrin-containing powders Transfer the acetone extract to a tared 300 ml evaporating dish to evaporate to dryness on a steam bath. Dry in a 70°C oven for 15 minutes, then allow to cool to room temperature. Wipe and weigh the dish and record the weight of the residue (Note 3). Determine the dieldrin content by the infrared spectrophotometric method (SMS 596/52), or by the hydrogen bromide method (SMS 549/52).

NOTE 3: The weight of acetone-extractable material is ordinarily not sufficiently dependable to be used for computing suspendibility values. However, it is a useful guide, and facilitates determination of the toxicant.

- h) Simplified Procedure for Toxicant Content. In laboratories not having infrared spectrophotometric facilities, and where less accurate results are acceptable, powders containing dieldrin may be tested as follows:

Evaporate the acetone extract (section 5-(f)) to dryness. Wash the residue through a filter with carbon disulfide into a clean, tared 100-ml evaporating dish, discarding any insoluble residue. Evaporate the filtrate to dryness on a steam bath. Wipe the outside of the dish, place in a 75°C oven for 15 minutes. Remove the dish and allow it to cool at room temperature. Weigh, and record the weight of the residue as suspended toxicant.

NOTE 4: If it is suspected that the actual toxicant content of the powder differs from the labelled amount, the toxicant content should be determined. This may be accomplished by extracting it from a known weight of the powder with carbon disulfide and determining it gravimetrically after removal of the solvent, as described above.

#### CALCULATION

6. Calculate the suspendibility of the wettable powder by means of the following equation:

$$\text{Suspendibility, \%w} = \frac{W \times 5}{S} \times 100$$

where:

W - weight of toxicant, grams, found in the 50 ml aliquot of the suspension, and  
 S = weight of toxicant, grams, present in the amount of wettable powder used for preparing the test suspension (derived from analysis of the powder), (see section 5a, or NOTE 4).

#### PRECISION

7. Duplicate results by the same operator should be considered suspect if they differ by more than the following amount: (See Note 5).

Repeatability - Dieldrin - 3%

NOTE 5: The precision of the suspendibility method is influenced by the precision of the methods by means of which the suspended toxicant are determined, and the above repeatability value is weighted to include the uncertainties which may arise from those sources.

Sufficient data are not available for making an estimate of the reproducibility of this method.

SPECIAL NOTE - SHIPPING: These drums are to be shipped in cool sections of the ships away from boilers and bulkheads.

SPECIAL MARKINGS:

All containers shall bear, durably and legibly marked on the container, the following:

Manufacturer's Name and Address \_\_\_\_\_

Insecticide -- Dieldrin - Water Dispersible Powder to Contract No. \_\_\_\_\_

Batch Number and Formulation Date \_\_\_\_\_

Net Weight of Contents \_\_\_\_\_

Active Ingredients and their percentages and the following minimum precautionary notice:

"Dieldrin is a toxic substance. Avoid contamination of foodstuffs and inhalation of dusts and mists made from this insecticide. In case of spillage on skin, wash with soap and water. Destroy empty containers."

F.O.A. COMPRESSION SPRAYER SPECIFICATION NO. 12055January 20, 1955

1. Description: The sprayer shall be of the cylindrical type hand-operated air pump for pressurization, a dip tube, hose, cut-off valve, lance, nozzle, and other accessories as specified.
2. Materials of construction: The tank body shall be made of one of the following metals: Stainless steel, with a composition of approximately:

Carbon	0.08-0.15 percent
Manganese	2.00 percent
Phosphorus	0.04 percent
Silicon	1.00 percent
Chromium	17.0-19.0 percent
Nickel	8.0-10.0 percent
Sulfur	0.03 percent

Silicon bronze, with a composition of approximately:

Silicon	2.80-3.25 percent
Iron	0.10 percent maximum
Manganese	0.75-1.25 percent
Lead	0.02 percent maximum
Copper	balance

All other metal parts which normally come in contact with the insecticide shall be made of one of the above metals, brass, monel or anodized aluminum.

All welding shall be done by automatic electric machines producing electric welds of the highest grade. Resultant welds shall have higher tensile strength than the metal on either side of the weld. Joints, requiring solder treatment, shall be silver-soldered. No wooden parts nor solder of which lead and/or tin are major components shall be used in the construction of the sprayer. All threaded connections and all joints shall be leak proof without the use of cement, shellac or chemical binders of any kind. All gaskets and rubber tubing which normally come in contact with the insecticide shall be of chemical resistant material.

3. Capacity<sup>1/</sup>: The capacity of the tank shall be 3 plus or minus 0.3 gallons with the pump and top in place.
4. Weight: The weight of the sprayer, when empty, shall not exceed twelve (12) pounds complete with hose, straps, cut-off valve, lance and nozzle.

1/ Capacity may be varied to meet USOM requirements.

5. Tank construction: The tank shall be of seamless or of modern welded construction which will withstand the pressure and fatigue tests described herein.
- 5.1 Tank bottom: The tank shall be fitted with a concave or convex bottom welded to the sides of the tank. The edge shall be rolled or constructed in such a manner that leakage from the tank does not result after the tank is half-filled with water, is pressurized to 50 p.s.i., and is dropped ten times from a height of two feet onto a solidly supported platform constructed of two-inch oak timbers. The tank shall be dropped in such a manner as to attain maximum damage and it may be dropped repeatedly on the same point.
- 5.2 Tank top: The tank top shall be welded to the sides of the cylinder, the resulting construction being of sufficient strength to withstand the pressure tests described herein..
- 5.3 Tank markings: The tank shall be clearly and permanently marked to indicate the recommended maximum liquid charge. Unless otherwise specified, this marking shall consist of an embossed horizontal line at the liquid level. Other intermediate liquid levels may be indicated if the manufacturer so desires. The tank shall also be clearly marked with the name and address of the manufacturer and the model number, if any.
- 5.4 Tank pressure: The tank shall be of such strength that it can withstand the following tests:
- 5.4.1 A hydrostatic pressure test of 100 p.s.i. applied gradually and allowed to remain for two minutes.
- 5.4.2 A fatigue test in which pressure of 62.5 p.s.i. shall be applied to the tank and released at the rate of approximately three cycles per minute until a total of 7,500 cycles have been accomplished without structural failure.
- 5.4.3 Every sprayer, as it comes off the assembly line, shall be tested with a minimum of 50 p.s.i. pneumatic pressure applied to the sprayer under water for the detection of leaks. Tanks which show such leaks shall be repaired and included in the shipment only by methods approved by the inspector.
- 5.5 Clips: The tank shall be fitted with clips to hold securely the nozzle and lance when not in use. The lower clip shall be in the form of a housing to hold the nozzle while the upper shall be a spring clip into which the lance will slip. The clips shall be so arranged on the tank that they will not come in contact with the body of the person carrying the tank with the strap over the right or left shoulder. No rivets shall be used in these fastenings through the body of the sprayer.

6. Straps: One or two adjustable straps, made of woven web cotton belting, shall be provided, each to be not less than 1-1/2 inches wide, 1/8 inch thick, and 32 inches long, measured to the ends of the clips. There shall be provision for ready adjustment in length. Straps, unless otherwise specified, shall be treated with paranitrophenol as a fungicide.
- 6.1 Strap hangers: Each tank shall be provided with two substantial strap hangers which shall be fastened to the sides of the tank. The hangers and the fastenings thereto shall be of such strength that failure will not occur when the can, half-filled with liquid and pressurized to 50 p.s.i. is dropped ten times from a height of one foot to hang by the strap.
7. Filler hole: The filler hole shall be not less than 3-3/4 inches in its diameter or minor diameter, if oval.
8. Strainers: Two strainers shall be provided located anywhere in the discharge line between the entry to the dip tube and the nozzle. These strainers shall be made of monel, stainless steel, or bronze screen wire. The openings in the strainers shall have no dimension greater than 0.02 inches. The total open area of each of the two strainers shall be not less than 1.6 sq. in. The strainers shall be mounted in such a way, or themselves shall have sufficient structural strength, that they will not be subject to accidental puncture or collapse. The strainers shall be easily removable and replaceable.
9. Pump construction: The pump shall be of seamless or electrically welded and finished construction. It shall withstand internal and external application of pressures of not less than 120 p.s.i. without structural failure.
- 9.1 Pump fitting: The pump shall be easily detachable from the tank.
- 9.2 Pump plunger shaft: The plunger shaft shall be of heavy duty construction and may be either a solid rod or a tube. If a hollow tube, the plunger rod shall be not less than 5/8 inch outside diameter and shall have a wall thickness of not less than .050 inch. If the plunger rod is of solid construction it shall be not less than 7/16 inch in diameter.
- 9.3 Pump cup leather: Cup leathers shall be shaped from chrome leather and, unless otherwise specified, shall be treated with paranitrophenol as a fungicide. Oak tanned or synthetic rubber cup leathers may be used if they can meet tests for wear and resistance to solvents comparable to the leather specified.
- 9.4 Pump Handle: The pump handle may be of the D or T type. It shall have sufficient width to accommodate both hands and shall have sufficient bearing surface so that the average hand will

not be subjected to undue pain when enough thrust is applied to pump the tank to a pressure of 70 p.s.i. The strength of the handle, its components and its junction with the plunger rod shall not be less in compression than the strength of the plunger rod.

- 9.5 Pump handle locking device: The handle shall be fitted with a quick action locking device which shall have sufficient durability to withstand 2,000 securing and releasing cycles without incurring visual evidence of wear. Up to 25 percent of the releasing operations may be made with pressure in the tank.
- 9.6 Pump check valve: The check valve shall be liquid-and air-tight. It shall be tested by applying a pressure of 62.5 p.s.i. to the tank filled sufficiently to immerse the check valve in the liquid. It shall be evidence of failure to meet this specification if more than 10 ml. of liquid enters the pump barrel, while it is under pressure, in a period of 15 minutes. Check valves shall have air passages of sufficient size to permit the plunger rod to be depressed through its entire length in a period of not more than 5 seconds with a force not greater than 3 pounds over and above the weight of the plunger assembly with discharge at atmospheric pressure.
10. Pressure release valve: The tank shall be equipped with a valve or other device designed to release pressure from the tank without danger to the operator without requiring the tank to be inverted. It shall be of simple, rugged construction, easily operated.
11. Nozzle spray<sup>2/</sup>: The nozzle tip shall be capable of producing a fan shaped spray with a distribution curve showing a plateau at the center. When operated at a pressure of 40 p.s.i. and a distance of 18 inches from a surface, the width of the plateau shall be not less than 14 inches. The sides of the curve shall have an even slope without secondary peaks. No differences in particle size shall be discernible to the eye throughout the width of the spray pattern.
- 11.1 Nozzle spray angle<sup>3/</sup>: The flat spray produced by the nozzle shall have a spray angle of between 70 and 90 degrees at 40 p.s.i.
- 11.2 Nozzle discharge<sup>4/</sup>: The rate of discharge from the nozzle shall be between 0.18 and 0.22 gallons per minute at 40 p.s.i.

<sup>2/</sup> More than one nozzle may be specified.

<sup>3/</sup> The angles may be specified as 60 and 70 if desired.

<sup>4/</sup> Discharge may be changed to 0.38 and 0.42 if higher delivery rate is needed.

- 11.3 Nozzle drip permissible: When continuously operated over a period of one minute, the nozzle, at a pressure of between 30 and 40 p.s.i., shall not produce dripping from the spray orifice at a rate in excess of 5 drops over the period of test.
- 11.4 Nozzle body facings: The nozzle body shall have flat or hexagonal faces to facilitate removal and replacement.
- 11.5 Metals to be used in the construction of nozzles: The nozzle body may be made of brass, stainless steel, anodized aluminum or other metal that will not rust or corrode under the action of the insecticide. The nozzle tip containing the orifice shall be of 18-8 stainless steel or of material of equivalent resistance to erosion.
12. Lance<sup>5/</sup>: Lances shall be of seamless construction and shall be easily detachable and extendable. Joints shall be leakproof and effected by surfaces with hexagonal or flattened faces. The wall of the tubing forming the lance shall be not less than 0.020" in thickness. One section of lance shall be supplied not less than 20 inches in length measured between the bases of the joints.
13. Cut-off valve: All metal parts of the valve body shall be of brass, anodized aluminum, or of stainless steel which shall contain not less than 8 percent nickel.
- 13.1 Valve stem: The valve stem shall be not less than 3/16 inch in diameter.
- 13.2 Connections: Valves shall be equipped with screw threads on the outlet ports. The inlet port may have a screw thread connection or may be equipped with a ribbed hose ferrule case as part of the valve body. The outer surface of the valve adjacent to the screw threads shall have opposing flat, or hexagonal faces, or the valve itself shall have flat faces, to permit the use of a wrench on them. A bayonet type of connector may be supplied on one or both ends of the valve, but such units shall be removable and not constructed as an integral part of the valve body.
- 13.3 Maintenance: The valves shall be so constructed that inner and outer parts are readily accessible and replaceable without the use of special tools.
- 13.4 Liquid passages: There shall be no liquid passages in the valve through which the entire liquid volume must pass that have cross-sectional areas of less than 0.04 square inch.

<sup>5/</sup> An additional lance section may be specified.

- 13.5 Cut-off valve handle: The handle shall be conveniently located on the valve to permit actuation by the hand. Pressures upon it shall be as listed below.
- 13.6 Lever movements (rotary): The force required to move the handle on a lever-type valve from the closed to open positions shall not require a torque of more than 200 inch-ounces.
- 13.7 Lever movement (linear): Valves depending upon linear movement for their actuation shall not require a force greater than 8 ounces if such force is designed to be exerted by one thumb or finger. Where such force may be exerted by the entire hand, the force required shall not exceed 2 pounds.
- 13.8 Locking device: A device to hold the handle in the open position shall be provided. It shall be readily locked or released from the locked position by the simple movement of one finger or thumb of the operating hand.
- 13.9 Shape: The valve handle and all associated parts shall conveniently fit the operator's hand without discomfort.
- 13.10 Reliability: Cut-off valves shall be capable of meeting the following tests under simulated natural conditions of operation. The valve shall be mounted on a test rack in such a manner that the body of the valve is held in a rigid position. A test fluid consisting of 60 percent kerosene, 5 percent benzene, 20 percent toluene and 15 percent xylene shall be applied to the inlet of the valve under a static pressure of 50 p.s.i. The outlet of the valve shall be carried through a spray nozzle designed to deliver 0.2 U. S. gallon per minute under the stated pressure. The nozzle may discharge directly or through appropriate piping into a reservoir from which the emulsion is pumped back under pressure to the inlet port of the valve. Where such recycling is used, the emulsion shall be changed after each 48 hours of test. The testing apparatus shall be so arranged by cams, solenoids, or other devices that the valve mechanism will be actuated at a rate of not more than 15 cycles per minute. The mechanism shall open the valve in a period of not less than 0.10 second nor more than 0.50 second and shall close the valve in not less than 0.10 second and not more than 0.20 second. Valves shall be deemed to have met this specification if, after 50,000 cycles of operation under the above conditions, there is no evidence of structural damage, deformation, or failure of the interior of the valve, and if no drip or leak through the valve or around the packing is evident during the entire test period. The above tests shall be repeated with the input pressure to the valve at 100 p.s.i. and the valve operated at this pressure for 500 cycles. The same criterion of acceptance shall apply to this latter test.

14. Dip tube: The dip tube shall extend to within one-half inch of the bottom of the tank. It shall be strongly supported at the point at which it emerges from the tank and at a point near its lower end within the tank.
15. Hose: Hose shall be chemical and oil resistant, length  $3\frac{1}{2}$  feet, inside diameter  $\frac{3}{8}$  inch and shall conform to the following specifications and tests: The hose shall have one or more plies of reinforcement made from cotton duck, cotton yarn, or synthetic fiber, of at least 2 end yarn. The material shall be evenly and firmly woven and free from unsightly defects such as dirt, knots and lumps as well as from irregularities of twists. The tube and cover shall be free from pitting and uniform in thickness. The reinforcement shall be applied on a bias of  $45^{\circ}$  to  $55^{\circ}$  with edges lapped at least  $\frac{1}{2}$  inch and shall be well frictioned on both sides with a rubber compound which shall firmly join the plies of the rubber tube and cover and to each other.

Physical Requirements for Hose

Tolerance in inside diameter, plus or minus - - - -	0.03 inch
Thickness: Tube, minimum - - - - -	0.04 inch
Cover, minimum - - - - -	0.02 inch
Fabric reinforcement plies, minimum - - - - -	1
Tensile strength: Initial, minimum - - - - -	800 psi
Decrease after aging, maximum	
percent - - - - -	35
Friction*: Between tube and plies, minimum - - - -	8 pounds
Between plies and cover, minimum - - -	8 pounds
Decrease after immersion, maximum	
percent- - - - -	50
Hydrostatic pressure test:	
Burst test before immersion, minimum- -	400 psi
Burst test after immersion, minimum - -	150 psi
Swelling, after immersion, maximum percent- - - -	30

Where aging is required, the sample to be tested shall be placed in an oven in which the temperature is maintained at  $172.4^{\circ}\text{F}$ . plus or minus  $1.8^{\circ}$ . The sample shall be so suspended that it will not be in contact with any metal part of the oven. The sample shall be removed and subjected to appropriate tests after 48 plus or minus 0.25 hours. The hydrostatic pressure test shall be carried out as follows:

Samples of hose not less than 20 inches in length shall be coupled to a hydraulic pump. Water shall be pumped through the tube. While the tube is full of water, the open end shall be closed with a metal plug and secured. The full indicated burst pressure shall be applied to the sample under test in a period of not more than 5 seconds. Where immersion is required, the sample shall be completely immersed in a solution of 60 percent kerosene, 5 percent benzene, 20 percent toluene and 15 percent xylene. Care should be exercised to avoid formation of air pockets

\* The rate of separation shall be not greater than 1 inch per minute under the specified load.

inside the tube and to keep sample from contact with the surfaces of the container. The sample shall be left immersed for a period of 72 plus or minus 0.25 hours at a temperature of 70°-80°F. After completion of immersion the sample shall be dried by hanging in air at 70°F. plus or minus 10° for 24 hours. Swelling shall be determined by measuring the inside and outside diameters of the sample before and after immersion.

16. Hose connections: The hose connections shall be of the clamp type. No connection which requires any special tool to remove or to replace it on the hose shall be deemed to have met this specification. The hose shall be held in close contact with the connection by a metal compression member on the outside surface. This member shall have a width of approximately the inside diameter of the hose, shall be constructed as one unit, and shall have no bolts, nuts or screws which may be easily separated from it. The unit shall have no sharp edges and a minimum of extended projections which may catch on clothing or other objects.

Hose connections shall be deemed to have met strength requirements if they withstand a static hydraulic pressure test of 300 p.s.i. for a period of 5 minutes without evidence of leakage or structural failure. Connections shall not be deemed to have met this specification if, after five applications to the hose, the tube or cover is damaged sufficiently to interfere seriously with subsequent applications. The five applications shall be made in series with no extended period of time intervening. Threaded terminal connections shall have finished, hexagonal faces, opposing flattened surfaces, or wings, to facilitate removal.

17. Gaskets: Gaskets of any material shall be submitted to the following tests: The gaskets shall be completely immersed in a test solution of 60 percent kerosene, 5 percent benzene, 20 percent toluene, and 15 percent xylene for a period of 72 plus or minus 0.25 hours at a temperature of 70°-80°F. After completion of immersion the sample shall be dried by hanging in air at 70°F. plus or minus 10° for 24 hours. The gasket shall then be replaced in its original position in the equipment. Any gasket shall be deemed to have failed to meet this requirement if it has swollen to the point where it cannot be readily replaced in the equipment or upon replacement fails to operate satisfactorily under normal operating conditions for a period of 8 hours.
18. Spare parts:<sup>6/</sup> As listed below for each sprayer and not to exceed 20 percent of value of each unit:

---

<sup>6/</sup> Percent and content may be varied to suit individual program needs.

2 discharge line strainers  
 4 cup leathers  
 4 pump cylinder gaskets  
 4 filler hole cover gaskets  
 12 gaskets for discharge line strainers  
 1 check valve assembly  
 2 cut-off valve stem assemblies including attached valve faces  
 2 pressure release valve stems and attached valve faces  
 2 stainless steel nozzle tips, Spraying Systems No. 8002 or equal  
 1 nozzle body cap  
 one length of discharge hose

Optional Items <sup>7/</sup>

YES

NO

18.1 Pressure gauge: The tank shall be equipped with a pressure gauge, back mounting, gearless, with a scale of from 0 to 60 p.s.i. The dial cover shall be of shatterproof plastic.

18.2 Constant pressure valve: The sprayer shall be equipped with a constant pressure valve attached to the tank and, hydraulically, shall be inserted in the discharge line. The valve shall be capable of delivering a set discharge pressure, plus or minus 3 p.s.i., at the nozzle despite fluctuation of pressure in the tank of between one and five times the value of the set discharge pressure. The set discharge pressure shall be readily adjustable from the outside of the tank, but shall be equipped with a means of covering or sealing such that the adjustment cannot be easily tampered with once it is set. The valve shall be capable of operating through 50,000 cycles of adjustment of pressure without failure and shall be capable of passing water wettable insecticides without stoppage of any of its passages. The valves shall be variable from 0 to 40 p.s.i. and shall be factory set to discharge at 25 p.s.i.

7/ These items shall be checked as to whether or not desired by USQM.

## ECONOMIC SURVEYS FOR MALARIA PROGRAMS

Malaria teams should try, in two or more areas (e.g. complete villages) typical of the region covered by the project, to gather a considerable amount of social and economic data. It is suggested that since malaria teams are composed of experts who are in short supply that they encourage local experts in population, vital statistics, or social problems to join the team to gather as much of the following data before the spraying starts to serve as a base or bench mark to compare the results after one, three, five and ten years.

These questions are suggested. Before starting any survey, considerable care must be taken in defining every term and in instructing the enumerators, in order to obtain comparable data. Obtain all data both by age and sex, for each category involving people.

1. Number of people by occupation (at least distinguish farm and non-farm).
2. Number of deaths by cause in the last year.
3. Number of births in last year (if possible) by age of mother, and by live birth order (i.e. first or second live birth of the mother).
4. How many can read and write.
5. How many are attending and how many have attended school and what grade attained? Attempt to learn from school, percentage of absence due to sickness.
6. How many are (1) employed  
(2) too young to work  
(3) too old to work  
(4) sick or disabled  
(5) unemployed but want to work
7. How many people have been sick and disabled during the past year and for how long? (1) If member of farm family ill, how much was spent to hire substitutes? (2) What was the cost of treatment of malaria cases before a residual control program was inaugurated? (3) Number of hospital beds occupied by malaria patients, (4) Cost of funeral expenses, if significant.
8. What is the pay of those employed by others? What are their annual earnings? (Include an estimate of goods and services provided by the employer).
9. What was the annual yield per acre (or hectare) of the basic crop of the farmer during the last year? What has been the

average yield in the past? If livestock raised, how many head per family? How many hectares or acres in the basic crop?

10. What is the value of an acre or hectare of basic crop land? Has the value of land been rising or falling in the past several years?

Specific questions for business concerns:

11. Secure a list of all businesses including (estate agriculture) in the region and the number of employees, annual payroll and the annual value of their product.

12. What percentage of male employees are absent each day? Of female employees?

13. During the past year how many have been sick for how long for what cause? By age and sex.

14. If banks, credit unions or other financial institutions, try to find out the total deposits and total loans of each.

15. If firm produces standardized product (such as yards of cloth), how much on the average does each worker of a given skill (such as weaver) produce in a day or some other unit of time?

Outline For Semiannual Report on  
Malaria Projects: Fiscal Year 19\_\_

The following information is requested for activity under this category initiated and/or in operation during the past six months:

- A.
  1. Name of project - (same as given in project proposal)
  2. Project number
  
- B. Location of activity or activities during reporting period (city, town, villages, and/or general geographic area)
  
- C.
  1. Date of initiation of field activities
  2. Agency responsible for field operations
  3. Senior USOM officer assigned to project
  
- D. Objective:
  1. Long-range objective - in terms of control or eradication of disease
  2. Objective for fiscal year
  3. Percent of objective accomplished to date
  
- E. Summary of operations:
  1. State Population at risk in country
  2. For project give the appropriate information requested on the accompanying sheets (Annex A)
  3. If nationals trained specifically for this project, state number completed training during reporting period
    - a. Professionals
    - b. Subprofessionals
    - c. Others - (specify)
  4. Give estimate of improvement in economy of region, if available. See attachment 14 of Malaria Manual.
  
- F. Summary evaluation of progress of project:

In one or two paragraphs give an evaluation of the progress of the project to date.

A. Survey Activities

1. Give brief general description of area in which you are working, including relevant information on topography, rainfall (annual and seasonal), population density, and agricultural practices important to mosquito production, e.g. crop irrigation, fish culture, etc.
2. Give malarimetric data summary
  - a. Before instituting control measures
  - b. At end of reporting period
3. List known vectors, in descending order of importance, general types and approximate extent of breeding areas present, malaria season or seasons, and summary of other entomological activities.
4. List other mosquito-borne diseases present and give incidence whenever possible.

B. Control Methods Used During Reporting Period

1. Insecticidal control.
  - a. For residual spraying of houses, give the following:
    - (1) Type of dwellings sprayed (e.g. mud, brick, bamboo)
    - (2) Insecticide and formulations used (e.g. DDT 75% W.P. as 5% mix in water).
    - (3) Number of houses sprayed.
    - (4) Average number of persons per house.
    - (5) Number of sprayings per house per year.
    - (6) Amount of technical material used (per square foot or meter) and amount used per capita.
    - (7) Number of persons protected.
    - (8) Technical problems encountered, including resistance observations.
    - (9) Effectiveness of spraying.
  - b. For other methods, give the following:
    - (1) Method used
    - (2) Amount insecticide used and area treated.
    - (3) Number of persons protected
    - (4) Technical problems encountered
    - (5) Effectiveness of method.
2. Permanent control
  - a. Type of drainage or other permanent measures.
  - b. Type of equipment used
  - c. Linear feet of ditch, cubic feet of earth moved, acreage of water surface eliminated

- d. Coordination with agricultural drainage or land improvement programs.
- e. Effectiveness of permanent control measures.

3. Chemotherapy

- a. Name of drugs used
- b. Methods of Administration and dosages. Give relationship to total malaria control program.
- c. Total amount of each drug used
- d. Number of persons treated
  - (1) Total receiving suppressive dosage
  - (2) Total receiving therapeutic dosage
  - (3) Grand total
- e.. Effectiveness of treatment.

FOA-10-1 (B-54)	SAMPLE PROJECT PROPOSAL & APPROVAL	1. COOPERATING COUNTRY	2. PROJECT NUMBER
		China (Formosa)	84-51-125(C)
PPA/S	SUMMARY	3. PROJECT TITLE	
		Malaria Control (A)	
FOREIGN OPERATIONS ADMINISTRATION UNITED STATES OF AMERICA		STARTING DATE	ESTIMATED COMPLETION DATE
		May 1952	Dec. 1957

4. FISCAL YEAR	5. APPROPRIATION SYMBOL	6. ALLOTMENT SYMBOL & CHARGE	7. ORIGINAL <input checked="" type="checkbox"/>
1956	US\$15,000 = 72-1161025 NT\$11,360,000 = 72FY575	084-71-600 084-71-600 WASHINGTON <input checked="" type="checkbox"/> USOM	AMENDMENT NO.

FOA/W USE ONLY DATE RECEIVED	ACTION	INFORMATION	FOA DOLLAR FINANCING		PREVIOUS TOTAL	INCREASE	DECREASE	TOTAL TO DATE
			(A)	(B)	(C)	(D)		
	(a) Total			15,000			15,000	
	(b) Participants							
	(c) U.S. Employed Technicians							
	(d) contract services							
	(e) commodities			15,000			15,000	
	(f) other costs							
	9. APPROVED FOR OBLIGATION			15,000			15,000	
	10. <del>FOA</del>	US Account	OTHER FUNDS				TOTAL	
	<del>XXXXXXXXXXXX</del>	<del>XXXXXXXXXXXX</del>	GOVERNMENT		NON-GOVERNMENT		(E)	
	Local Currency	Sec 402 Proceeds	CASH	KIND			(E)	
	NT\$ = Financing		(B)	(C)	(D)		(E)	
	(a) Total	NT\$ 11,360,000 US\$ 458,500	10,886,500	439,300	632,000 25,500		22,878,500 923,300	
	(b) Participants							
	(c) U.S. Employed Technicians							
	(d) contract services				NT\$ 619,500 US\$ Equi 25,000		619,500 25,000	
	(e) commodities	NT\$ 11,360,000 US\$ 458,500	10,886,500 439,300		12,500 500		22,259,000 898,300	
	(f) other costs							

FY52/55 CEA's

52-5, 54-109,  
55-6, 55-12

FY53/54 PA's

3027, 3032,  
3042, 3053,  
3018, 6592,  
231, 4015  
155 ProAg 125-  
006

PIO's 50089,  
50108

11. COUNTERPART DEPOSIT REQUIRED.. IF ANY	12. ESTIMATED TOTAL FINANCING					
	PRIOR FISCAL YEARS		THIS FISCAL YEAR		FUTURE FISCAL YEARS	
	FOA	COUNTRY	FOA	COUNTRY	FOA	COUNTRY
	507,000	#1,130,000 (CPT)	15,000	439,300 (Govt)	-	233,000 (Other)
		1,475,000 (Other)	458,500 (882)	25,500 (WHO)		

THE IMPLEMENTATION OF THIS PROJECT APPROVAL IS SUBJECT TO THE PROVISIONS ON THE REVERSE SIDE HEREOF OR IN ATTACHMENTS HERETO.

USOM CLEARANCE AND APPROVAL	DATE	FOA/W CLEARANCE AND APPROVAL	DATE
J. E. Auburn Asst. Director for Operations ICA MSM/C	Sept. 7, 55 1/	This amount is US contribution, being local currency derived from sales of US financed surplus agricultural commodities under Sec. 402.	
COOPERATING COUNTRY CONCURRENCE C. C. Shao Acting Secretary-General, CUSA	Sept. 7, 55 2/	Converted at \$1 = NT\$24.78.	

# Considered as US contribution as counterpart is generated from ICA financed commodity exports sold for local currency.

FOA-10-1H (8-54) PPA/66- EL	PROJECT PROPOSAL & APPROVAL Continuation Sheet	A. COOPERATING COUNTRY China (Formosa)	B. PROJECT NUMBER 84-51-125(C) origin.
	FOREIGN OPERATIONS ADMINISTRATION UNITED STATES OF AMERICA	C. <del>SECRET</del> Project Title Malaria Control (A)	D. SHEET. SHEETS OF

If there is insufficient space to give adequate information on any PPA Schedule, use this sheet to complete the information, indicating above in block c the applicable schedule and indicating below the applicable block number, thus: "Block - continued."

5. Description of Project and Reasons for U.S. Financial Support:

See FY 1955 PPA.

6. Objectives of Project:

See FY 1955 PPA.

7. Significance of Project in Country Development Program and Relationship of this Project to Other Activities of FOA and Other Agencies, E.G. UN, USIA, U Voluntary Agencies:

See FY 1955 PPA.

8. Work Plan and Schedule:

Amend FY 55 PPA to add the following:

The proposed work plan for 1956 will include (a) Complete spray coverage of every area sprayed in 1954 and 1955, (b) a single spray round in every township not yet covered (chiefly the west-central coastal area) involving an additional population of approximately  $1\frac{1}{2}$  million people. This will insure against any encroachment of the previously-sprayed area from presumably non-malarious areas which may still harbor a few cases. In addition, this single coverage will be very welcome to the people who have never had a chance to get rid of fleas, bedbugs, cockroach and other household pests, and (c) treatment of every positive case encountered during the surveillance program and in out-patient departments of health stations and hospitals.

The total population to be protected by the program will be 7,000,000 living in the area as mentioned above under (a) and (b). Operationally, the island is divided into four regions (as shown in following table). There will be training courses for more than 8,000 temporary operational employees in the four regions prior to actual spraying which operation requires 60 working days in each region. The malaria surveillance program including intensive epidemiological observations, surveys and treatment of malaria cases will be intensified in 1956. Such activities will be conducted throughout the year in order to evaluate the results of the control operations, maintain standards, and implement the eradication of the disease. The schedule for operation is given below.

(1) Training:

Category	Dates:	Central	North	East	South
1. Hsien & City Supervisors	Jan. 9-21	Chao-Chow			
2. Township Supervisors	Jan. 30-Feb. 4	Mar. 5-10	May 7-11	June 4-9	
	Place:	The Capital City or town of each hsien or city.			

FOA-10-1H (8-54) PPA/Cont.	PROJECT PROPOSAL & APPROVAL Continuation Sheet	A. COOPERATING COUNTRY China (Formosa)	B. PROJECT NUMBER 84-51-125(C)
	FOREIGN OPERATIONS ADMINISTRATION UNITED STATES OF AMERICA	C. SCHEDULE PPA/EL	D. SHEET SHEETS 2 OF 5

If there is insufficient space to give adequate information on any PPA Schedule, use this sheet to complete the information, indicating above in block c the applicable schedule and indicating below the applicable block number, thus: "Block - Continued."

Category	Central	North	East	South
3. Foremen	Dates: Feb. 6-11 Feb. 13-18	Mar. 12-17 Mar. 19-24	May 14-19	June 11-16 June 18-23
4. Operators	Places: The Capital city or town of each hsien or city.			
	Dates: Feb. 27-Mar. 3	April 2-7	May 28 - June 2	June 2-7
	Place: Locally	Locally	Locally	Locally

(2) Dates of Spraying Operations:

Central	North	East	South
Mar. 5-May 5 1956	April 9-June 9 1956	June 4-Aug. 4 1956	July 23-Sept. 23 1956

9. Explanation and Expansion of Financial Plan

The total costs of the project from 1952 through 1957 are as follows:

Fund Sources	1952 - 1955	1956	1957	Purpose
Government, and Provincial and local	NT\$21,672,684	NT\$10,886,500	NT\$5,766,500	Salaries
ICA/CUSA	US\$507,000 NT\$17,681,558	US\$15,000 NT\$11,360,000	None	
ICA Thru JCRR #	CPTNT\$1,522,349	-	2,200,000	
WHO	US\$130,000	US\$25,500	None	Supplies

# Provided under Project 84-19-008(C).

The total costs of the project for 1956 are NT\$22,246,500 plus US\$40,500. Out of the NT\$ budget, NT\$10,886,500 is borne by the government and NT\$11,360,000 by ICA/CUSA. Out of US\$ budget, US\$15,000 is borne by ICA/CUSA and US\$25,500 by WHO, one third of the government funds if budgeted by the Provincial Government as malaria control budget and two thirds at the township level at the rate of NT\$1.00 per capita in the sprayed area. Government funds are used for salaries and wages of the workers, training of personnel, maintenance of laboratory, equipment, and vehicles, and supervisory activities. The US dollars from WHO are used for salaries of the three malaria experts provided by the organization and for scientific literature and equipment for laboratory. The ICA/CUSA funds are used to purchase DDT (NT\$ part) and sprayer spare parts, vehicles and vehicles spare parts (US\$).

FOA-10-IH (8-54) PPA/Cont.	PROJECT PROPOSAL & APPROVAL Continuation Sheet	A. COOPERATING COUNTRY China (Formosa)	B. PROJECT NUMBER 84-51-125(C)
	FOREIGN OPERATIONS ADMINISTRATION UNITED STATES OF AMERICA	C. SCHEDULE PPA/EL	D. SHEET SHEETS 3 OF 5

If there is insufficient space to give adequate information on any PPA Schedule, use this sheet to complete the information, indicating above in Block C the applicable Schedule and indicating below the applicable block number, thus: "Block - continued."

ICA/CUSA funds, both NT\$ and US\$, are needed during July and September 1955 in order to contract for early procurement of the required DDT, vehicles and spare parts for intensive field operations to be started early in 1956.

The requirement for U.S. financial support in the Taiwan Malaria Control project will reach its maximum in 1956. In 1957, the requirement will be reduced to one tenth. After 1957, the program will be carried on by the Government. In case U.S. financial support is terminated in the future, there is a good prospect of the availability of government funds to insure continued malaria surveillance and control efforts to the point where malaria can be entirely eliminated. The budgetary requirement for 1957 will be NT\$5,766,500 which will be borne by the Government.

The U.S.\$ costs and NT\$ funds for FY 1956 are on a grant basis and no obligation shall exist for payment into the counterpart fund by the recipient or the Chinese Government, if funds are utilized as authorized for the project.

#### 10. Analysis of Sources and Availability of Project Requirements:

Change FY 1955 PPA to read as follows:

The main project requisites are (1) temporary personnel with proper technique, i.e. 1,500 supervisors and foremen, 5,000 spraying operators and 2,500 helpers, (2) 840 metric tons of 75% water-dispersible DDT (3) 720 lift-pressure sprayers plus 2,200 hand sprayers (4) 1,200 sets of accessory equipment (5) necessary report forms (6) 1,500,000 hand-bills (7) necessary equipment and supplies for investigational activities (8) 10 vehicles in good condition.

Supervisors and foremen are drawn from the existing health personnel or local township offices. They will be given 1956 refresher training by the hsien (prefecture) supervisors with technical assistance of the Headquarters' personnel. Operators and helpers will be employed by each township and will be trained properly by the supervisors and foremen. DDT will be purchased from the Taiwan Agricultural Chemical Work in Kao-Hsiung. 720 lift-pressure sprayers are already on hand purchased from local manufacturers. Hand sprayers already on hand or on order from US and local firms total 3,600. Out of the 3,600, two-thirds of them can be salvaged if enough spare parts are available. Accessory equipment will be made locally using township funds. Report forms, hand-bills, laboratory equipment and supplies will be procured with the provincial malaria budget. 9 vehicles are on hand, one of which is 10 years old and can no longer be serviceable. Two vehicles must be procured, one to replace the old pick-up and the other for the additional duties in the malaria surveillance program, particularly for east Taiwan.

FOA-10-1H 8-54) PPA/Cont.	PROJECT PROPOSAL & APPROVAL Continuation Sheet	A. COOPERATING COUNTRY China (Formosa)	B. PROJECT NUMBER 84-51-125(C)
	FOREIGN OPERATIONS ADMINISTRATION UNITED STATES OF AMERICA	C. SCHEDULE PPA/EL	D. SHEET SHEETS 4 OF 5

If there is insufficient space to give adequate information on any PPA Schedule, use this sheet to complete the information, indicating above in Block C the applicable schedule and indicating below the applicable block number, thus: "Block - continued."

11. Economic and Technical Analysis:

Amend FY 1955 PPA to add the followings:

Malaria was rampant in Taiwan during the last war and immediately after V-J day. Annual malaria morbidity before the island-wide malaria control residual spraying program was estimated at no less than 1,200,000 among 5,500,000 people who live in the malarious parts of the province. In 1952, the first year of the present program, malaria was still listed as one of the first ten killers. However, thanks to the successful control program which has been intensively carried out since 1952, malaria now becomes a rather rare disease. New transmission, determined by malaria cases among infants borne since spraying started, has been virtually exterminated from the program area. The island-wide infant survey conducted during December 1954 to May 1955 by the local anti-malaria technicians in each township under the program detected only 5 parasite-positive infants among 46,696 infants examined for blood parasites. Three of the 5 positives were found from Kuo-hsing township of Nan-tou hsien, while the other two were from I-lan hsien. All these positive cases were found from the houses either accidentally missed during spraying or they were poorly sprayed. Elsewhere, new malaria transmission seems to have been stopped. At present, there appear only limited numbers of chronic residual infection cases which become increasingly significant as the number of such cases decreases. The last island-wide simultaneous parasite survey, conducted on December 17, 1954, showed a parasite rate of only 0.8% among children of pre-school age in 155 townships which had a parasite rate of 14.2% in 1952.

12. Supporting Basic Studies:

See FY 1955 PPA.

13. Summary Evaluation and Comment:

Delete the last paragraph of FY 1955 PPA and add the followings:

Payments for commodities will be made to the project from 72FY575 funds.

The USCM Controller's Office will have the rights of examination, inspection and audit with respect to property procured with 72FY575 funds, as well as any records or accounts established as a result of furnishing such funds.

In the event any payments from these funds are disallowed by the FOA Controller as the result of any examination, inspection or audit, the Chinese Government will refund the amount of the disallowance to the US Government.

SAMPLE

(Attachment 16)

PAGE 6

FOA-10-1H (8-54) PPA/Cont.	PROJECT PROPOSAL & APPROVAL Continuation Sheet	A. COOPERATING COUNTRY China (Formosa)	B. PROJECT NUMBER 84-51-125(C)
	FOREIGN OPERATIONS ADMINISTRATION UNITED STATES OF AMERICA	C. SCHEDULE PPA/EL	D. SHEET SHEETS 5 OF 8

If there is insufficient space to give adequate information on any PPA Schedule, use this sheet to complete the information, indicating above in Block C the applicable Schedule and indicating below the applicable block number, thus: "Block : - continued."

These funds may not be utilized for the following:

- a. The purchase of lands;
- b. Payment of any tax or assessment that is readily identifiable including, but not limited to, customs duties, income tax, stamp tax, etc;
- c. Administrative expenses including salaries or allowances in cash or in kind; and
- d. Representation and entertainment expenses including, but not limited to, donations, contributions, business cards, etc.

These funds are authorized only for payment of project requisites and limited to (a) locally available non-military services, excepting recurrent expenditures such as pay and allowances, and maintenance costs, (b) procurement of essential locally produced supplies and equipment at reasonable competitive prices, (3) purchase of barter credits to cover required imports from Japan.

Expenditures are authorized thru Dec. 31, 1956 at which time all accounts must be closed out and unexpended funds returned to the US Government account.

FOA-10-1F (8-54)	PROJECT PROPOSAL & APPROVAL Schedule C Commodities  FOREIGN OPERATIONS ADMINISTRATION UNITED STATES OF AMERICA	1. COOPERATING COUNTRY China (Formosa)	2. PROJECT NUMBER 84-51-125(C)
		3. PROJECT TITLE Malaria Control (A)	4. ORIGINAL <input checked="" type="checkbox"/>  AMENDMENT NO.
5.	PROJECT STATUS (If this is a continuing project)	FUNDS FROM PRIOR FISCAL YEARS (A)	THIS FISCAL YEAR (B)
	(a) Funds obligated to date	507,000 1/	-
	(b) Funds sub-obligated to date	506,970.18 2/	
6. PROPOSED CHANNEL OF PROCUREMENT USOM to CTC			

7. REQUIREMENTS					
COMMODITY CODE (A)	DESCRIPTION (B)	UNIT (C)	QUANTITY (D)	PROPOSED SOURCE (E)	ESTIMATED LANDED COST (F)
770	<u>Agricultural Equipment Excluding Tractors</u> Spare parts for compression sprayer	Lot	1	U.S.A.	5,000
820	<u>Motor Vehicles, Engines &amp; Parts</u> Vehicles: one pickup truck, one station wagon and spare parts for each vehicle.  Vehicle spare parts for 3 jeeps (Willys), 1 pickup (Willys) & 2 station wagons (Willys) on hand.	ea	2	U.S.A.	10,000
	1/ PA's \$466,000 ProAg 125-006 41,000 507,000				
	2/ PA's \$466,000 PIO/C's 50089 2,870.18 50108 38,100 506,970.18				
899	Misc. Project Items (Not more than 10% of Total)				
TOTAL - Must agree with Summary (PPA/S) Block 8, Line (e), column (B) or (C)					15,000

## ICA PROCUREMENT POLICIES

The following is a summary of ICA principles in regard to procurement of commodities, but should not be regarded in any way as a substitute for the appropriate Manual Orders, and other communications to the field, which establish ICA procurement policies and procedures in detail. This summary should only be used to familiarize staff members not directly concerned with the details of procurement with the general ICA concepts:

### A. The Procurement Process

#### 1. Origin and Types of Procurement Requests

In general, all requests for procurement of commodities originate with the cooperating country government and are included in the proposed program jointly developed with the ICA field mission.

The majority of proposed procurements of commodities are included in programs of project-type assistance - comprising activities primarily designed to assist cooperating countries in the development or accomplishment of specific projects. Such project-type assistance is distinguished from nonproject-type assistance which is primarily designed to accomplish the transfer of resources from the U. S. to a cooperating country to meet broad economic or defense support needs, and from special program assistance.

Proposed procurements for nonproject-type assistance are usually limited to bulk commodities.

#### 2. Review and Clearance of Proposed Procurement

Projects proposed are described and agreed upon by the cooperating country government and the ICA field mission in detail before submission to ICA/Washington for review and approval. Upon receipt of Washington approval, the ICA field mission and the cooperating country government sign a project agreement, and issue Project Implementation Orders (PIO/Cs) which authorize specific procurements and designate procurement agents. A copy of each Project Implementation Order is sent to ICA/Washington for monitoring, and/or for implementation (as may be required).

### B. Supply Procurement and Contracting Policies

#### 1. Scope of Policies Described

ICA finances the procurement of program supplies (raw, semi-manufactured bulk supplies, equipment and machinery) and their transport to cooperating countries. Such contracting is accomplished in accordance with all applicable ICA policies, standards, and regulations.

## 2. Contracting Policies

### (a) Dollar Procurement

#### (1) Decentralization

Procurement of supplies and equipment is undertaken by the cooperating countries to the maximum extent that they possess competency to undertake it.

#### (2) Commercial Channels

Use of normal commercial channels for procurement is preferred to procurement by government for all assistance.

#### (3) Source of Agricultural Commodities

Proposed Procurements of agricultural commodities, except for small amounts, are submitted to ICA/W for review, approval, and issuance of procurement authorizing documents in order to effect compliance with statutory limitations on such commodities.

#### (4) Sources of Nonagricultural Commodities

Nonagricultural items are procured from the supplier offering the required commodity at lowest cost on a delivered basis, whether such a supplier is located in the U. S. or elsewhere in the free world.

#### (5) U. S. Always a Source

Approved area sources for procurement always include the U. S. and its possessions, and may include all other desirable and practicable free-world country sources.

#### (6) Information to Small Business in the U. S.

Advance basic information concerning planned procurement is circularized to U. S. suppliers to afford them opportunity to bid for participation in furnishing commodities financed by ICA.

#### (7) Rejection of Bids

In procurement effected by a U. S. Government agency, all invitations to bid on commodities and equipment financed by ICA dollars contain a clause to the effect that any or all bids may be rejected as the interest of the U. S. Government may require. This provides administrative opportunity to prevent ICA-financed procurement from having an adverse effect upon the economy of the U. S., with special reference to any areas of labor surplus, or upon the industrial mobilization base.

- (8) Area Source Limitation  
ICA reserves the right to limit area procurement sources for such policy reasons as from time to time may be applicable.
- (9) Price Policies  
It is the policy of ICA not to pay more than lowest competitive market prices.
- (10) Commodity Specifications  
In general, ICA requires that procurement specifications describe only a commodity capable of adequately performing its intended function in the program. While efficiency and durability may justify procurement of higher than minimum adequate-grade equipment, the procurement of over-elaborate items is to be avoided.
- (11) Policy on ICA Financing of Local Currency Procurement  
ICA believes that the cooperating country should apply as part of its contribution such items as have been produced within the country. ICA local currency financing is also not to be extended to small value maintenance, repair, and operating supply items which are locally available unless the cooperating country cannot include such items in its contributions.
- Local equipment procurement of other than maintenance, repair, and operating items is effected with ICA dollar funds only in very unusual cases, when urgency does not permit any other course. Such exceptions are covered by a "Certificate of Necessity" signed by the Director of the Field Mission and are filed with related documents supporting the transaction.
- (12) ICA Policy Concerning Procurement of Excess U.S. Government and Used Commercial Equipment  
ICA utilizes opportunities to meet project requirements through the procurement of excess U.S. Government property but does not approve the procurement of used equipment from commercial sources.
- (13) Banking  
The selection of the U. S. bank to which letters of commitment are issued by ICA is the responsibility of the cooperating country. It is, however, a general ICA policy that cooperating countries utilize the services of as many U. S. banks as is

practicable and consistent with their internal procedures.

(14) ICA Labeling Program

All commodities and their shipping containers furnished to cooperating countries under ICA financing carry the official ICA emblem designed for this purpose.

(15) Competitive Bidding

ICA requires specifications to be written for competitive bidding except in rare circumstances where it is necessary to confine procurement to particular characteristics inherent only in one product. In all cases where procurement by a U. S. agency on a restrictive basis is desired, a full justification on a "Certificate of Necessity", signed by the Director of the ICA Field Mission accompanies such proprietary specifications for ICA/Washington review and approval prior to purchase.

(16) Method and Types of Procurement

In general, the types of procurement transactions, can be broken down into three classifications:

- a. U. S. Government agency procurement
- b. Cooperating government agency procurement
- c. Procurement by importers in a cooperating country.

Formal competitive bidding is the normal method of procuring ICA-financed commodities and equipment for projects.

In general, the procedure resembles that followed by U. S. Government agencies when procuring under similar circumstances.

Any non-U. S. Government agency is guided by the provisions of ICA Regulation 1 which requires competitive bidding to secure the lowest economic landed cost.

If an ICA-financed commodity is procured by an importer in a cooperating country, ICA policy requires that the importer adequately solicit the market to the extent that the maximum practicable number of potential bidders are informed in sufficient time to bid, and that the commodity is procured at lowest competitive market price (although the importer need not engage in formal bidding).