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PAN AMERICAN  
HEALTH  
ORGANIZATION

WORLD  
HEALTH  
ORGANIZATION



56th Meeting  
Washington, D. C.  
April-May 1967

Provisional Agenda Item 11

CE56/8 (Eng.)  
29 March 1967  
ORIGINAL: SPANISH

AEDES AEGYPTI ERADICATION IN THE AMERICAS

The Pan American Sanitary Bureau is continuing its endeavours to comply with the instructions given it by the Directing Council in 1947 to solve the problem of urban yellow fever in the Americas by eradicating Aedes aegypti.

To this end the Bureau has, for the last 19 years, been promoting the initiation or the intensification of the attack on this mosquito in the areas still infested and, to the extent of its financial possibilities, has provided all the countries and territories that have requested it, with technical assistance, equipment, and supplies for their campaigns for the eradication of this vector.

When the Bureau received its instructions from the Directing Council, Aedes aegypti had already been eradicated from Bolivia and a large part of Brazil. Since then, Brazil has completed its campaign, and the mosquito has also been eradicated from the following countries and territories which, like Bolivia and Brazil, are at present considered free of the vector: Argentina, Bermuda, British Honduras, Chile, Costa Rica, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and the Panama Canal Zone.

However, we have a long way to go before the continent-wide program for the eradication of this vector is completed and the possibility of urban yellow fever occurring in the Hemisphere is definitively removed. Indeed, as may be seen from the attached map, the problem still exists in the northern part of South America, in one country in Central America, in the United States, and in the Caribbean Area.

In the north of South America, French Guiana, Surinam, Guyana, Venezuela, and two localities in Colombia are infested.

French Guiana had been declared free of Aedes aegypti in 1958 but in 1964 it was found to be extensively reinfested and up to the present time eradication operations have not been resumed. In Surinam eradication work

was begun in 1963; however, the results of the campaign to date have been very meager. After being free of the mosquito for several years, Guyana was found to be reinfested in 1962; the campaign was not resumed until 1965, but the results have not been satisfactory. In Venezuela no progress has been made in the campaign in the last four years.

Colombia had achieved eradication of the mosquito in 1961, but between September of that year and the end of 1966 the country was repeatedly reinfested. The latest of these reinfestations were found in the city of Cucuta, near the Venezuelan border, at the end of 1965, and in the port area of Santa Marta, on the Caribbean coast, in October 1966. Up to the present time these two reinfestations have not been eliminated.

In Central America Aedes aegypti eradication was completed a few years ago, but in June 1965 the capital of El Salvador, a country which had been free of the mosquito since 1957, was found to be reinfested. It was first thought that reinfestation was confined to some areas in the city of San Salvador; however, once eradication operations were resumed in the city, a better knowledge of the situation was obtained and by the beginning of 1966 it was clear that the whole of San Salvador was infested, and that the reinfestation had spread to another 24 localities in the surrounding districts. Furthermore, an investigation made in September 1966 showed that many other areas in the country were also reinfested. However, in view of the small number of staff available to the campaign since it was reinitiated, eradication operations have been limited to the city of San Salvador and the international airport of Ilopango and even so it has not been possible to sustain an appropriate work cycle in those two localities. Consequently, the results of the campaign to date have not been satisfactory.

The United States of America, whose campaign covers Puerto Rico and the United States Virgin Islands, initiated eradication operations in 1964. However, the campaign has been covering only part of the areas assumed infested by Aedes aegypti and the results to date have been very meager.

In the Caribbean Area the campaign is in its final phase in Trinidad, where in recent years only small foci of reinfestation have been found; and progress is being made in Cuba, although the results are more limited than was anticipated. Eradication work is still suspended in Haiti, Jamaica, the Dominican Republic, Dominica, Guadeloupe and the British Virgin Islands. In the remainder of the Caribbean Area the campaign is bogged down or progressing very slowly, and the results obtained are not satisfactory.

In addition to the risk of urban yellow fever and of other diseases transmitted by the vector, which is being run by the countries and territories still infested, the presence of Aedes aegypti in those areas in the Hemisphere has been the cause of the frequent and costly reinfestations which have been occurring in the Americas.

This situation is a matter of concern to the Governing Bodies of the Pan American Health Organization, and in repeated resolutions they have called upon the countries and territories still infested to complete eradication of the mosquito as soon as possible, since the success of the continent-wide program for the eradication of the vector can only be ensured if the present sources of reinfestation in the Hemisphere are speedily eliminated. However, despite this insistence, the eradication campaign has made progress only in very limited areas in the last four years; during that period, the situation in some countries and territories has, in fact, considerably worsened. This development is mainly due to the financial and administrative difficulties the campaign has been facing in almost all the countries and territories still infested.

The most recent resolution on this subject was adopted by the XVII Pan American Sanitary Conference held in Washington from 26 September to 7 October 1966. In this Resolution XIX, the Conference, bearing in mind the seriousness of the present status of the continent-wide program, urged the Governments of the countries and territories already free of Aedes aegypti to maintain a strict vigilance service against reinfestation and called upon the Governments of the countries and territories still infested to take timely measures to overcome any administrative difficulties that may be hampering the progress of their campaigns, and to give the highest priority to the provision of the funds, personnel, and supplies needed to complete those campaigns as soon as possible.

In the same resolution the Conference instructed the Director of the Pan American Sanitary Bureau to take all necessary measures to intensify and accelerate the continental campaign and to study and put into practice appropriate systems for ensuring that the Aedes aegypti eradication campaign is carried out, simultaneously and in a coordinated manner, in all countries in which the problem still exists, including frequent and periodical meetings, under the auspices of the Bureau, of the national authorities responsible for the programs.

It also authorized the Director of the Pan American Sanitary Bureau to obtain funds to finance the prompt eradication of Aedes aegypti.

As a first move to comply with the instructions contained in that resolution the Director has convened a conference on Aedes aegypti eradication to which all the countries in the Americas, with the exception of Canada, have been invited, as have been representatives of each of the following political units: Netherlands Antilles, French Departments, Surinam, and British Territories.

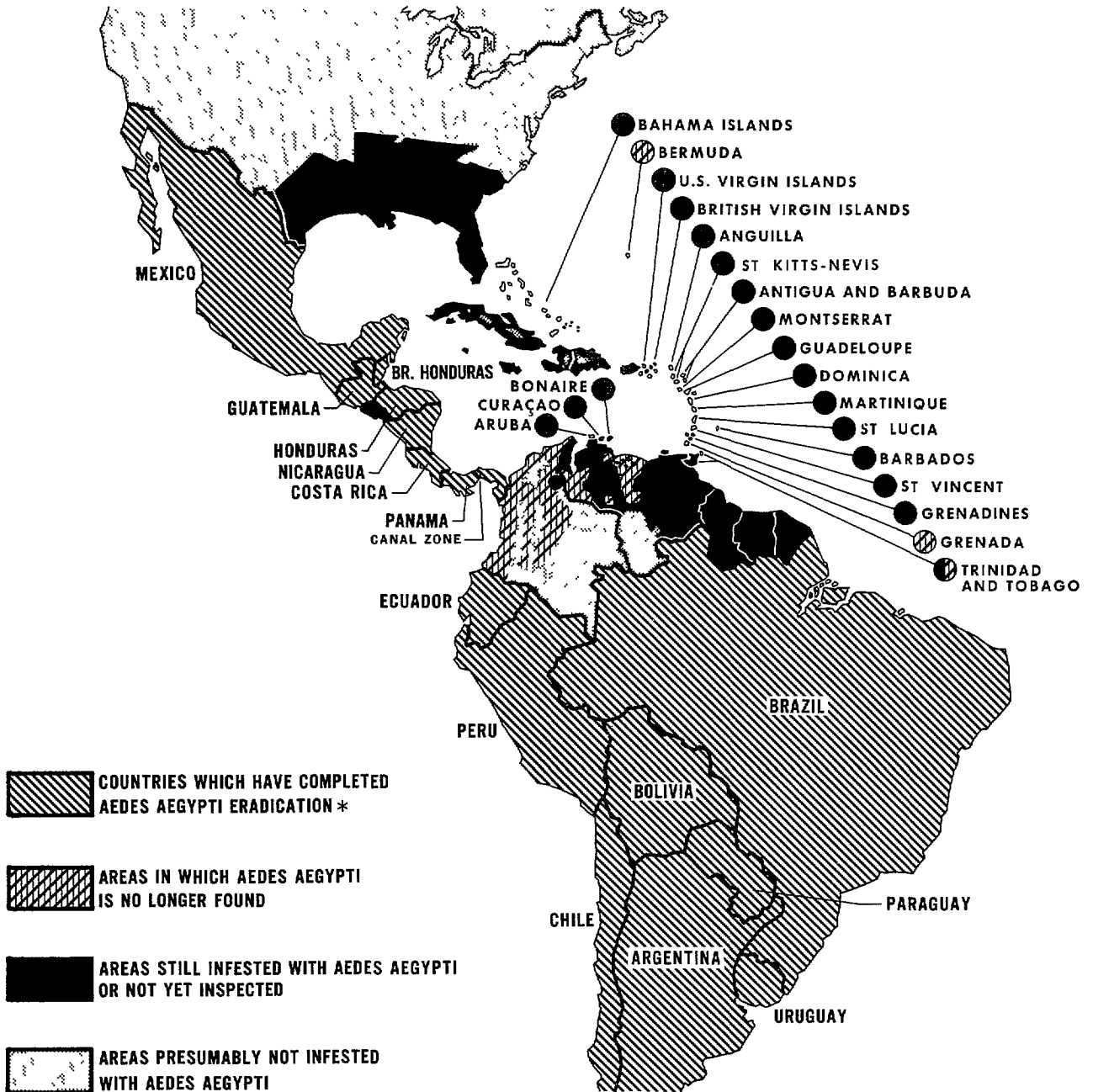
The Conference, which will be held at the Headquarters of the Organization in Washington from 3 to 5 April, will undertake a review of the continent-wide eradication program and will study the plans for the eradication of the mosquito, or for the establishment of a vigilance service in each of the countries and territories of the Hemisphere which the participants have been invited to present during the meeting.

As soon as the Conference is over, a meeting will be held in Washington from 6 to 12 April of a study group whose task it will be to translate the recommendations of the Conference into concrete form. That group, which will consist of experts with broad experience in the eradication of Aedes aegypti in various areas of the Americas, will draw up, on the basis of the recommendations of the Conference, a general plan for the conduct of coordinated campaigns in the countries and territories still infested, and for the maintenance of adequate vigilance in those areas already free of the mosquito. That plan, in addition to tracing the work program for the eradication campaigns and the vigilance services, will include an estimate of the funds needed for the eradication of the mosquito or for vigilance against reinfestation in each of the countries and territories of the Hemisphere.

The decisions taken by the Conference and the plan drawn up by the Study Group, as well as a report on the two meetings, will be submitted to the Executive Committee when it meets in Washington.

Annex

# STATUS OF THE AEDES AEGYPTI ERADICATION CAMPAIGN DECEMBER 1966



\* ERADICATION CARRIED OUT ACCORDING TO THE STANDARDS ESTABLISHED BY THE PAN AMERICAN HEALTH ORGANIZATION



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56th Meeting  
Washington, D. C.  
April-May 1967

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Agenda Item 11

CE56/8 (Eng.)  
ADDENDUM I  
1 May 1967  
ORIGINAL: SPANISH

STATUS OF THE Aedes Aegypti ERADICATION IN THE AMERICAS

REPORT OF THE STUDY GROUP ON  
Aedes Aegypti ERADICATION

REPORT OF THE STUDY GROUP ON AEDES AEGYPTI ERADICATION

Washington, D.C., U.S.A. 6-12 April 1967

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Washington, D.C. - 6-12 April 1967

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## AEDES AEGYPTI ERADICATION IN THE AMERICAS

### Report of a PAHO Study Group

The PAHO Study Group on Aedes aegypti eradication in the Americas met in Washington, D.C., U.S.A., from 6 to 12 April 1967. Dr. Alfredo N. Bica opened the meeting and welcomed the members of the Group in the name of the Director of the Pan American Sanitary Bureau.

Dr. Adrián Torres Muñoz was elected Chairman; Dr. Solón Veríssimo, Vice-Chairman; and Mr. Freddy González Valdivieso, Rapporteur.

#### 1. INTRODUCTION

"Man's conquest of urban yellow fever in the Americas was neither easy, swift nor cheap." Dr. Fred L. Soper

"If there is one characteristic that distinguishes the Americas today, it is the tendency to believe that nothing is impossible. We have only to observe the ideas and proposals being advanced at the highest decision making levels of the political sector, the myriads of real accomplishments and the genuine zeal to move in concert and solidarity towards the progress and well-being of all the people." Dr. Abraham Horwitz

Yellow fever is a rural and urban human disease transmitted by the domestic mosquito, Aedes aegypti. Aedes aegypti, an African mosquito, breeds by preference in artificial water containers of all kinds. This selective breeding has enabled Aedes aegypti to travel to all the continents of the world and to establish itself as an indigenous infestation in all of them.

Yellow fever is also a jungle disease of animals (monkeys, marmosets, and marsupials) transmitted by forest mosquitoes.

Urban and jungle yellow fever occupy distinct ecological niches; either may exist for long periods of time entirely independent of the other.

Man becomes a victim of jungle yellow fever when bitten by infected forest mosquitoes. The person infected in the forest is the link through which yellow fever endemicity is reestablished in cities and towns. Jungle yellow fever virus is readily urbanized in the presence of Aedes aegypti.

Aedes aegypti first came under attack in Havana in 1901; the disappearance of yellow fever in Havana led to successful campaigns in the endemic centers of Panama, Brazil, Mexico, and other countries. Unexpectedly, these campaigns resulted in the disappearance of yellow fever not only from the endemic centers but from large tributary areas. This widespread disappearance of yellow fever led in turn to the belief that yellow fever could be eradicated by a temporary limited attack on the Aedes aegypti mosquito in the endemic centers.

The Rockefeller Foundation initiated a campaign for the eradication of yellow fever in 1915. A reconnaissance of the yellow fever situation in 1916 was followed by active collaboration with infected countries in anti-Aedes aegypti campaigns. Such campaigns were carried out in Ecuador, Colombia, Peru, Mexico, Central America, Bolivia, and Brazil. In each country, yellow fever receded and disappeared from its cities and towns.

An unusual rural endemic of aegypti-transmitted yellow fever in northeastern Brazil was dominated in 1934. This marked the final victory of the Foundation's effort to eradicate yellow fever; Aedes aegypti-transmitted yellow fever, the only yellow fever known when the campaign for eradication started, had been eliminated. However, no victory celebration was held because of the discovery of jungle yellow fever and the repeated observation of the reinfection of cities and towns from jungle outbreaks.

The first shock of disillusion came in 1928 with the reinfection of Rio de Janeiro where yellow fever had been unknown for twenty years. The outbreak of 1928-1929 in Rio came at a time when there were no ready sources of infection known. Rio became once more a true endemic center which, during fifteen months, disseminated the infection to smaller towns in the interior and along the coast, from Buenos Aires to Pará. Urban outbreaks secondary to the Rio epidemic were dominated only after a three-year campaign.

The unexplained reinfection of Rio was followed by similarly mysterious infections of three widely separated towns in Colombia (1929), Venezuela (1929), and Bolivia (1932). These four Aedes aegypti-transmitted epidemics occurred at points many hundreds of miles from each other and so isolated that there could be no possibility of the infection passing from one to the other.

The discovery of jungle yellow fever in Brazil in 1932, and in Brazil, Bolivia, and Colombia in 1933, gave a ready explanation of the source of virus for the unexplained outbreaks in Brazil, Bolivia, Colombia, and Venezuela. This discovery made it clear that the victory over urban yellow fever was an empty one which could be negated at any time by the introduction of yellow fever virus from the jungle. The prevention of urban yellow fever then would depend either on maintaining costly anti-Aedes aegypti services permanently in all cities and towns or on eradicating this mosquito completely from the region.

Fortunately, the confirmation of jungle yellow fever in widely separated points in Brazil, Bolivia, and Colombia in 1933 occurred simultaneously with the demonstration in a number of Brazilian cities that the Aedes aegypti mosquito could be eradicated.

The reinfection of Rio de Janeiro in 1928 was erroneously but inevitably attributed to the unobserved transfer of virus from the notoriously endemic area of northern Brazil. As a result, the anti-Aedes aegypti campaign in the north was intensified. This intensification amounted to a complete reorganization beginning in 1930.

Detailed maps were prepared to ensure getting complete coverage of each community worked; careful detailed daily records of all work done were kept; sufficient supervision and field checking was done to permit certification of the validity of the Aedes aegypti breeding indices; and the destruction of oiling of all containers found with mosquito larvae was strictly enforced to guarantee against the continuing infestation of individual water containers. As a final check on anti-larval work, especially trained inspectors searched houses for adult Aedes aegypti. This search resulted in the discovery and elimination of the final hidden breeding places on which low level infestation depends.

The eradication of Aedes aegypti and the complete disappearance of this mosquito from all the large cities of north Brazil was the result. Once eradication had occurred, it proved to be more economical to eliminate Aedes aegypti from the suburbs and the interior towns from which reinfestation might come than to maintain the large city control programs indefinitely. Thus the concept of the eradication of Aedes aegypti throughout Brazil became the unofficial policy of the National Yellow Fever Service.

The initial hesitation of many workers and health authorities to undertake this tremendous task, which involved anti-mosquito campaigns in every state and territory of the country, was overcome by the behavior of yellow fever itself.

Between 1934 and 1940, a series of wavelike epidemics of jungle yellow fever moved from the headwaters of the Amazon River Valley in Mato Grosso down into the Paraguay-Paraná Basin. These epidemics swept through the monkey-infested forests of all of the states of southern Brazil, of Paraguay, and of Misiones Province in Argentina. During this period yellow fever cases were found in a number of cities and towns; four infectious cases were identified in Rio de Janeiro itself. (Had Aedes aegypti still been present, the reinfection of Rio, as in 1928-1929, would surely have been repeated.) Sharp local Aedes aegypti-transmitted outbreaks, clearly due to urbanization of jungle virus, were observed in 1935-1936 in Teofilo Otoni and Figueira in Minas Gerais, and in Cambará, Paraná. Other less well documented invasions of cities and towns occurred during this period.

Following this experience, there was never any doubt of Brazil's determination to eradicate Aedes aegypti; it became the official objective of the National Yellow Fever Service in 1942. In the meantime, Aedes aegypti had been eradicated in Bolivia. In 1942, Brazil proposed to the XI Pan American Sanitary Conference that the countries of the Americas should join in a campaign for the continental eradication of Aedes aegypti.

Brazil continued to suffer reinfestation with Aedes aegypti along its other southern frontiers. The problem of the frontier with Uruguay was settled by a coordinated program which resulted in the eradication of Aedes aegypti in Riviera in 1947.

To meet the serious problem of reinfestation from Paraguay, Brazil brought the proposal for the permanent solution of the urban yellow fever problem through the eradication of Aedes aegypti in the Western Hemisphere in 1947 before the Directing Council of PAHO. The Directing Council acted favorably and entrusted the problem to the Pan American Sanitary Bureau for the solution of legal, technical, and financial questions.

The following year yellow fever appeared in Panama, close to the Canal, and during the next decade invaded one after another of the countries of Central America, British Honduras, and Mexico. Since 1947, yellow fever has been shown to exist in Trinidad and all of the countries of the mainland of the Americas except Canada, the United States, El Salvador, Uruguay, and Chile. In 1966, yellow fever occurred in six South American countries, from the shores of the Caribbean in the north to Rio Grande do Sul, Brazil, and Corrientes Province, Argentina, in the south.

Since 1944 jungle yellow fever has invaded the Paraguay-Paraná River system five times without causing any urban yellow fever. This absence of urban yellow fever is guaranteed by the continued absence of Aedes aegypti in this region.

The cumulative effect of the Rockefeller Foundation-sponsored program beginning in 1918, and of the continuing drive for the eradication of Aedes aegypti in the Americas is a period of freedom from urban yellow fever during the past thirty years, unique in the history of the past four centuries. Since 1937, only two instances of yellow fever occurring in the presence of Aedes aegypti have been recorded: one at Senna Madureira, in the Amazon Valley of Brazil, in 1942, and the other at Port of Spain, Trinidad, in 1954. A very real threat of the urbanization of yellow fever virus in Venezuela in 1966 was met by large-scale fumigation and massive vaccination of urban and rural populations.

The countries of the Americas subject to the invasion of jungle yellow fever, which have already eradicated Aedes aegypti, must realize that the guarantee of their safety from reinfestation lies in the completion of the eradication of Aedes aegypti in the Americas.

The countries which still have Aedes aegypti must recognize that their permanent protection from yellow fever, dengue, and hemorrhagic fever depends on completing the eradication of Aedes aegypti.

## 2. PRESENT STATUS OF THE Aedes Aegypti ERADICATION PROGRAM

So far, the mosquito has been eradicated in the following countries, which are considered to be free of it: Argentina, Bermuda, Bolivia, Brazil, British Honduras, Chile, Costa Rica, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and the Panama Canal Zone. The problem persists in the northern part of South America, in one country in Central America, in the United States of America, and in the Caribbean Area.

In the northern part of South America, French Guiana, Surinam, Guyana, Venezuela, and two localities in Colombia are infested.

French Guiana had been declared free of Aedes aegypti in 1958, but in 1963 this department was found to be extensively reinfested, and eradication operations have not yet been resumed there. In Surinam, eradication operations were begun in 1963, but the results obtained so far, have been very meager. After being free of the mosquito for several years Guyana was found to be reinfested in 1962, but the campaign was not resumed until 1965, and the results obtained since then have not been satisfactory. In Venezuela, the campaign has been unable to make any progress in the last four years.

Colombia achieved eradication of the mosquito in 1961, but, between September of that year and the end of 1966, the country has been repeatedly reinfested. The latest of these reinfestations were discovered in the City of Cúcuta near the Venezuelan border at the end of 1965, and in the port area of Santa Marta, on the Caribbean coast, in October 1966.

Aedes aegypti eradication was achieved in Central America several years ago, but in June 1965, the capital of El Salvador, a country which had been free of the disease since 1957, was found to be reinfested. To begin with, the reinfestation was thought to be confined to a few areas in San Salvador, but as soon as eradication operations were resumed in the city, the situation became clear and, by the beginning of 1966, it was known that San Salvador was completely infested, and that reinfestation had spread to another 24 localities situated in the adjoining areas. Furthermore, an investigation made in September 1966 showed that many other areas in the country had also been reinfested. However, in view of the small number of personnel available to the campaign since it was resumed, eradication operations have been limited to the City of San Salvador, and to the International Airport of Ilopango, and even so, it has not been possible to sustain an adequate work cycle in these two localities. Consequently, the results obtained by the campaign so far have not been satisfactory.

The United States of America, whose campaign includes Puerto Rico and the American Virgin Islands, began eradication operations in 1964. The campaign covers only part of the areas presumed to be infested by Aedes aegypti, and the results obtained so far have been very meager.

In the Caribbean Area, the campaign is in its final phase in Trinidad where, in recent years, small foci of reinfestation have been found. It is advancing in Cuba, although the progress made has been less than was anticipated. Eradication operations have been suspended in Haiti, Jamaica, the Dominican Republic, as well as in Dominica, Guadeloupe, and the British Virgin Islands. In the remainder of the area the campaign is bogged down or is moving forward very slowly, and the results obtained have not been satisfactory.

### 3. OBSTACLES TO THE COMPLETION OF THE PROGRAM

The Study Group examined the working documents of the Conference on Aedes aegypti Eradication in the Americas held in Washington, D.C. from 3 to 5 April 1967, under the auspices of the Pan American Sanitary Bureau.

This examination showed that, in the last five years, the eradication campaign had made some progress in very limited areas, and that in several countries and territories the situation had in fact considerably worsened. That development was mainly due to financial, technical and administrative difficulties which are hampering the satisfactory progress of the campaign in almost all the countries and territories still infested.

Among those difficulties special mention must be made of the following:

1. Insufficient funds and personnel to ensure adequate coverage of infested areas.
2. Deficient organization and administration.
3. Personnel problems which impair the quality of field work.
4. Resistance of the mosquito to chlorinated insecticides.
5. Reinfestations.

The eradication of the vector by means of residual-action insecticides comprises fundamentally two operations: the treatment of areas found to be positive, and the verification of treated areas in order to evaluate the results of the treatment. Each verification is followed by a new treatment of the areas found still infested until eradication of the mosquito is achieved.

If the campaign is to be successful, not only must treatment be carried out correctly with an effective insecticide, but the treatment-verification cycle must be adjusted to the duration of the residual effect of the insecticide employed, and that cycle must be strictly complied with. In addition, areas capable of easily reinfesting one another must be treated and also verified at the same time, as if they formed a single locality.

If the campaign does not have sufficient funds or staff available to carry out this type of coverage, it will be very difficult to eradicate the mosquito in a country.

Punctuality is an essential factor in the success of field operations. Any delay in making the verification of a treated area, or in treating an area found positive, can delay elimination of the mosquito. Moreover, the eradication of the vector in a country must be completed within a short period of time. Campaigns which drag on for many years make for reinfestation within the country itself and for the development of insecticide resistance.

It is clearly extremely difficult for a campaign to carry out verification and treatment punctually, and to put a work program into effect without delays if it does not have complete administrative flexibility which enables it to take without loss of time such measures as may be necessary for the satisfactory conduct of field activities.

The eradication of Aedes aegypti calls for painstaking, exacting, and honest work which can only be obtained if certain basic conditions relating to field personnel are satisfied, including the following: careful selection and training; adequate salaries; a strict chain of command, discipline, and defined responsibilities; strict, continuous and unremitting supervision of field work with the dual purpose of correcting faults and improving the technical competence of the personnel.

Clearly the campaign will not be able to establish or maintain those conditions if the administration of the campaign does not have the authority to act with complete independence in all matters relating to personnel. Furthermore, it is obvious that in many countries it will be very difficult, for various reasons, to meet these requirements.

Nevertheless, it should be borne in mind that they are a decisive factor in the quality of the work done by the field personnel, and only high quality field work is capable of ensuring the success of a campaign, in which incomplete treatment or careless inspection of a house may delay eradication of the mosquito in a locality for several months.

Aedes aegypti resistance to chlorinated insecticides has largely contributed to the present situation of the campaign in the Caribbean Area and in the northern part of South America. The problem exists today, to some extent, in all the countries and territories in those areas. Because of this resistance, the campaign has been suspended in various places and has been considerably delayed in many others.



However, at present the problem has lost much of its importance since we already have other organophosphorus insecticides available which can be used to replace the chlorinated insecticides. The residual action of those insecticides is shorter than that of DDT or Dieldrin. As a result, it is more expensive to use them, but the results obtained in in some areas show that they can eradicate Aedes aegypti resistant to chlorinated insecticides.

In any event, it is obvious that an effective insecticide cannot by itself ensure the success of the campaign. Likewise there is no need to emphasize that the continued use of an insecticide in a campaign which is unnecessarily prolonged favors the development of resistant strains. There is no doubt that the present resistance of the vector to DDT is to a certain extent the result of the fact that, for various reasons, many campaigns were unable to eradicate the mosquito in a reasonable period of time, despite the initial effectiveness of the insecticide.

There is no need to emphasize the importance that infestations occurring within a country have for its campaign nor the importance that inter-country reinfestations have for the continental campaign, especially after the vector has developed resistance to chlorinated insecticides. It is enough to mention the fact that some of the areas where the campaign is today meeting major difficulties were formerly negative.

Both in the case of autochthonous and of imported reinfestations, the success of the campaign depends on their being averted or reduced to a minimum. For that purpose it is essential: a) to cover at the same time, as if they formed a single locality, the areas of the country capable of reinfesting one another with ease; b) to coordinate the campaign in an appropriate manner in all the areas still infested in the Americas; c) to maintain strict vigilance against the reintroduction of Aedes aegypti in areas which are being freed of the vector; d) to complete eradication of the mosquito as soon as possible.

#### 4. NEED TO COMPLETE ERADICATION OF THE VECTOR IN THE HEMISPHERE

In the opinion of the Study Group, the existence of Aedes aegypti in extensive areas of the Hemisphere represents a threat of urban yellow fever that should not be underestimated. Eradication of the mosquito in a majority of the countries most exposed to the virus from the jungle areas in South America eliminated the possibility of urban yellow fever in their territories. Consequently, opportunities for the introduction of the virus to other countries have diminished. Nevertheless, it must be borne in mind that, in view of the ease and rapidity of modern travel, all the countries and territories of the Hemisphere are, from the epidemiological standpoint, very close to the enzootic areas of South America.

In the same way the epizootic outbreaks which periodically occur in the Hemisphere may carry the virus to areas far distant from the above-mentioned enzootic foci. In actual fact, in the last 20 years, as a result of several epizootics the presence of yellow fever virus has been confirmed in the forest areas of Trinidad and of all the countries and territories on mainland of the Continent with the exception of Canada, the United States of America, El Salvador, Chile, and Uruguay. This finding indicates the extent of the threat that jungle yellow fever represents for the areas in the Americas infested by Aedes aegypti.

By the mere control of Aedes aegypti in those areas, it would be extremely difficult to keep them permanently protected against yellow fever. Experience in Brazil showed that it was not practicable to sustain indefinitely a control program capable of ensuring that infestation indices would remain below the level critical for the transmission of the disease. Furthermore, it is clear that permanent control of the mosquito would in the long run cost more than eradication. Again, the protection of those areas solely by means of immunization is not to be recommended; in addition to the fact that it is highly improbable that it would be possible to maintain the whole population sufficiently and permanently immunized for an indefinite period, that type of protection would also turn out in the long run to be more expensive than the eradication of the vector. There is no doubt, in the light of present knowledge, that this last-mentioned measure namely, the eradication of Aedes aegypti, is, not only the least expensive way of effectively protecting those areas, but also the only way of definitively eliminating the possibility of the occurrence of urban yellow fever in them.

In addition to the threat of yellow fever, we should also take into account the risks of epidemics of dengue fever which the countries and territories infested by Aedes aegypti are exposed to. Although dengue fever is not a particularly serious disease, epidemics of dengue, like those which occurred in the Caribbean area between 1963 and 1966, can cause serious financial losses especially in countries where the tourist trade is an important source of revenue.

Another risk which infested countries incur is that of epidemics of hemorrhagic fever. So far, hemorrhagic fever has been identified only in Asia where Aedes aegypti is regarded as possibly the sole vector of the disease. However, the possibility that this infection, for which the case fatality rate in certain Asian outbreaks has been 10 to 15 per cent, may occur in the Western Hemisphere, cannot be excluded.

The eradication of Aedes aegypti will definitively eliminate the possibility of the occurrence in the Americas of epidemics of dengue fever or hemorrhagic fever against which no vaccine is available.

Moreover, the areas still infested by Aedes aegypti in the Americas have been the cause of the frequent reinfestations which have been occurring in the Hemisphere. In the last six years, in addition to the reinfestations mentioned above in Colombia, El Salvador, Guyana, French

Guiana, Trinidad, and Mexico, and several islands in the Caribbean Area, including Aruba, Antigua, Bonaire, Montserrat, St. Kitts and St. Vincent, have been reinfested.

In addition to the additional heavy outlay of funds they demand of the countries and territories which have already spent considerable sums of money on the eradication of the mosquito, these reinfestations also delay the completion of the continental program and increase the risk that the Hemisphere may experience more extensive and serious reinfestations capable of nullifying the program.

Aedes aegypti eradication has been achieved in 80 per cent of the ecologically favorable areas in the Americas. Owing to a lack of data we cannot calculate the amount of money spent on that endeavor. However, we do know that the attack on the vector in the Hemisphere has already cost millions of man-days of work for repeatedly inspecting and treating millions of houses. The safeguarding of that enormous investment in money and effort is of vital importance to the Americas.

The Study Group is of the opinion that it can only be safeguarded if the eradication of Aedes aegypti in the Hemisphere is completed without further delay.

#### 5. BASIC REQUIREMENTS FOR AN Aedes aegypti ERADICATION CAMPAIGN

In the opinion of the Study Group there is at present no technical obstacle to the eradication of the vector in the Americas. Effective residual action insecticides are available, as are techniques and methods which, when correctly applied, have been shown in extensive areas in the Hemisphere to ensure the elimination of Aedes aegypti.

However, it is not enough that the eradication of the vector should be feasible from the technical point of view; it must also be administratively and financially feasible. In other words, in addition to appropriate insecticides, techniques, and methods, the administrative and financial conditions must be such as to ensure the proper development of the whole process leading to the eradication of Aedes aegypti. Basically, those conditions are as follows:

- a) Firm decision on the part of the Government to eradicate the mosquito, and to assume the responsibility that eradication involves;
- b) Sufficient funds to cope uninterruptedly with the personnel, supply, and equipment requirements of the campaign until such time as the eradication of the vector is achieved;

- c) Appropriate organization on a national scale, enabling the campaign to carry out its activities in a uniform and coordinated manner throughout the country.
- d) Administrative independence and flexibility whereby the campaign can handle its budget without bureaucratic interference; establish conditions of employment of its staff; fix salary scales and per diem allowances; engage, transfer, discipline, or dismiss staff without delay or difficulty;
- e) Legal provisions providing the campaign with authority to quickly enforce its decisions and to adopt without delay the necessary measures to eradicate the mosquito.

## 6. OPERATION OF THE PROGRAM

The foregoing chapter outlines the basic requirements for the success of an Aedes aegypti eradication campaign.

The following paragraphs will deal with additional requirements, and other factors, which so far have not been mentioned but which the Group considers extremely important for the satisfactory conduct of the campaign, will be examined.

### 6.1 Planning and organization of the campaign

The campaign must be planned to end in as short a time as possible. Generally speaking it should not last for more than four years. Only in exceptional circumstances where the positive area is very extensive, infestation is high and general, and there is a problem of heavily infested cities, should the duration of the campaign be extended to a maximum of 6 years.

Aedes aegypti eradication must be regarded as a specific and urgent activity outside the routine activities of public health administrations. Nevertheless, as it is an activity which is to be continued for some years, it cannot be carried out satisfactorily without exceptionally efficient organization and planning..

In practice the success of the campaign depends on administration, methods, and funds. As stated in the foregoing chapter, at present the necessary technical elements for eradicating the mosquito are available. Likewise, for most of the countries and territories still infested, the cost of a campaign using modern techniques is not an insuperable obstacle, provided that the government gives Aedes aegypti eradication the priority it deserves. Furthermore, countries that need them may possibly obtain international funds for their campaigns. Consequently, the Study Group is of the opinion that the factor on which most emphasis must be laid is the efficient administration of all campaign activities.

We cannot expect satisfactory work from mediocre workers. Hence, the importance of the careful selection and training of the campaign staff and of a system that provides for the promotion of the best workers, to ensure that the campaign attracts first class personnel. The salaries must be sufficiently high to attract competent applicants, and to induce the collaborative spirit so necessary for a program of this scope. Working conditions must be attractive enough to induce personnel to wish to remain in the service, since excessive staff turn over reduces the quality of the work. Furthermore, it is difficult to count on the loyalty, discipline, and efficiency of a poorly paid staff.

The management of the program must be in the hands of a specialist with broad administrative experience, who is assisted by suitable and capable subordinates. When suitable personnel cannot be found in the country, thought should be given to the recruitment of temporary staff from abroad as a possible solution to the problem. The organization of the campaign must be based on a precise distribution of activities, a clear definition of the powers and duties of each employee, and lucid instructions.

Detailed knowledge of the country, the ecological conditions encountered by Aedes aegypti in various regions of the territory, internal and international communications, and other important factors will make it possible to draw up a suitable plan of work for the campaign. It is not enough to have prepared this plan beforehand; it is essential to continue to collect data and to study them so that they can be used in time to rapidly correct any errors that may have been made.

## 6.2 Legislation

The Aedes aegypti eradication campaign must be supported by the population and that support can be obtained through health education and propaganda. Furthermore, the campaign needs legal support, since the measures which will apply will be general in character. The nature of the legal measures to be adopted will vary according to the conditions in each country and the legislation in force. However, when those measures are framed, the following should be borne in mind:

- a) To confer on program staff the right to enter all premises and houses in order to take such measures as the campaign considers necessary for the elimination of Aedes aegypti, including the application of insecticides to all actual and potential mosquito breeding places.
- b) To make it a duty of the owners of uninhabited houses and of the occupants of houses which are habitually closed during working hours to permit campaign personnel to enter those dwellings.

- c) To authorize the campaign to apply or cause to be applied appropriate measures for definitively eliminating Aedes aegypti breeding places, and for preventing the appearance of new breeding places.
- d) To authorize the campaign to implement such measures as may be considered necessary for preventing the reintroduction of the vector into the country or into areas of it already free of the mosquito.
- e) To authorize the campaign to impose penalties.

### 6.3 Management of the campaign

In order to eradicate Aedes aegypti the countries must mount a specific campaign to which the National Public Health Administration will have to assign the necessary priority. The management and supervision of eradication operations will have to be the responsibility of a central service which will be responsible for operations throughout the national territory. Where necessary, sectional services dependent on the central administration will be established and will be made responsible for operations in different parts of the country. However, it is essential that the central organization be given the necessary degree of authority, and that it be in a position to guide, coordinate, and supervise campaign activities throughout the country, both as regards to its technical and administrative aspects.

In some countries it will be advisable to establish a national Aedes aegypti eradication council composed of senior public health authorities, the director of the campaign, and PASB representatives. This council will have to meet periodically in order to evaluate the progress of the campaign, to study such problems as may be hampering it, and to assist in solving them. Likewise, the council will be responsible for keeping the highest government health authorities informed of the status of the campaign, and of winning for the program the support and prestige it must have.

The structure of the central service and of the sectional services will obviously depend on the size of the country and the importance of the problem. Nevertheless, the most appropriate and advisable arrangement seems to be centralization of the technical and administrative management of the program and decentralization of program execution.

Both the central service and the sectional services will have to be organized in such a way that they can fully cope with the administrative and technical needs of the program and ensure that it is conducted satisfactorily.

#### 6.4 Health education

The Study Group considers it unnecessary to emphasise the importance of health education in a campaign of this type. The extraordinary assistance that the population can give in eliminating the mosquito which breeds in domestic and peri-domestic artificial water containers is quite clear.

In principle, national integrated health plans should include health education activities connected with the campaign, designed to inform and motivate communities with respect to Aedes aegypti eradication and the cooperation they can give to the campaign. For that purpose close relations must be maintained from the outset, and mutual cooperation must be established with the general health services, whose staff will have to have sufficient knowledge of the Aedes aegypti problem and of the methods adopted to solve it, to be able to collaborate efficiently with the campaign.

In addition to these health education programs, the campaign will have to train its staff how to publicize the program and enlist the collaboration of the population. The appropriate use of pamphlets, posters, and handouts, as well as the joint action of schools, the press, professional, civic, cultural and social groups are among the most effective measures for motivating communities.

In countries which do not have any health education programs the campaign itself will, from the very outset, have to carry out those activities and to recruit for that purpose such expert staff as it considers necessary.

#### 6.5 Budget

Once it is started, an Aedes aegypti eradication campaign should be pursued without interruption or without reduction of the necessary operations. Consequently, the initial budget must make provision for the total cost of the program, from the beginning to the end. Every effort should be made to ensure that these allotments are approved once and for all. When the government, as usually happens, can only provide funds by annual allotments, they will have to be adjusted to a plan mapped out in a detailed program which is approved before the campaign is begun.

When proposing the initial budget, it must be made very clear that it is impossible to foresee the details of program execution with any degree of accuracy. The course of the campaign is determined not by a mechanical but by a biological process, and for this reason, its strategy may have to be modified as operations advance. Consequently, the greatest possible flexibility must be given to the financial administration of the program, and the director must be given wide powers in the use of funds.

Aedes aegypti operations may be regarded as a continuous and dynamic whole. Any interruption of those operations not only delays the completion of the campaign, but may also cause a return to the point of departure. Consequently, punctuality in the provision of funds will always be an essential condition to the success of the campaign. It is therefore recommended that the system for the supply of funds makes provision for the campaign always to have at its disposal the necessary amount of money to cover all expenses for a minimum period of three months.

#### 6.6 Personnel

Manpower is a decisive factor in the success or failure of an Aedes aegypti eradication campaign. Consequently, this component must be given due importance in the planning, organization, and execution of the program.

The Group emphasizes the need for strict and precise staff regulations from the very outset, so as to ensure that work is of the quality needed for eradicating the mosquito.

To obtain this type of work the Group is of the opinion that the following staff conditions should be met:

- a) Careful selection and training.
- b) Adequate remuneration including the payment of travel and per diem allowances.
- c) Maintenance of a strict grading system, discipline, and defined responsibilities.
- d) Strict, continuous, and unremitting supervision of field activities, with the dual purpose of correcting errors and improving the technical competence of personnel and the quality of their work.
- e) Establishment of a promotion system by means of which an employee may advance to higher levels solely on the basis of merit.
- f) Prompt and appropriate penalties for breaches of campaign regulations.

Careful attention should be paid to the selection of personnel of all grades. In selecting personnel, special attention should be given to the following aspects:



- a) Moral character;
- b) Physical capacity to carry out the work for which the applicant is being considered;
- c) General educational, professional, and technical background which should be appropriate to the post the applicant will hold;
- d) Demonstrated interest in, and understanding of, the program itself.

Training will be provided for personnel at all levels and of all grades, and its prime purpose will be to prepare staff members for their duties. In the opinion of the Study Group, an employee with a good knowledge of the general aspects of the program will be better able to carry out the specific functions assigned to him. Consequently, personnel training should comprise both a general part, on the basic aspects of the campaign, and a special part, including intensive and specific training for the activities he will be responsible for.

In any event, training will not be limited to the initial training that the employee receives on joining the staff. General and specific in-service training will be continued by means of appropriate supervision and special activities such as meetings and discussions, specially intended to help the staff refresh and increase their knowledge.

The appropriate management of field personnel through a well-defined, functional, and expeditious system is essential to the satisfactory operation of the program. Decisions concerning personnel selection, recruitment, authorization for leave or holidays, promotion, disciplinary action, and separation from the service should be taken solely and exclusively in accordance with the program regulations.

If personnel management, particularly personnel discipline, is defective, eradication will not be achieved. If this situation is not taken care of at the very start, there will be technical deficiencies in eradication operations, low personnel morale, and finally, the discredit and failure of the program.

#### 6.7 Stages of the campaign

The most advisable strategy for an Aedes aegypti eradication campaign is that which provides for the simultaneous coverage of all the infested area of the country. Such a strategy eliminates the possibility of autochthonous reinfestations, and normally makes it possible to eradicate the mosquito within a period of three to four years.

Only in exceptional circumstances when simultaneous coverage is not possible for financial reasons or because the infested area is very

extensive, should any consideration be given to the use of a strategy based on the division of the infested area into two, or at most, three parts, each of which would be covered separately. This strategy obviously increases the time needed to complete the eradication campaign in the country, and makes it necessary to adopt strict internal vigilance measures to prevent the reinfestation of the areas being freed of the mosquito until eradication is completed in the country.

It is clearly very difficult to apply this strategy successfully if the infested area cannot be divided into parts between which vehicular traffic is either relatively limited or concentrated on a few main roads so that a strict system of vehicle control can be established capable of preventing or reducing to a minimum the transportation of the mosquito in any of its stages of development. In the same way, the possibility of a vector being transported from one area of the country to the other by means of rail, ship or air traffic must also be provided for.

In any event, before any decision is made to apply this strategy in any country, the whole question must be very carefully considered and all the drawbacks and the risks involved in it must be carefully weighed against the reduced costs which such a strategy implies for the campaign as opposed to the strategy of simultaneous coverage of the entire infested area.

Whichever of the two strategies is adopted, an Aedes aegypti eradication campaign comprise of four basic stages: preparatory, attack, consolidation, and maintenance. If the strategy adopted for the program is coverage by parts, the order of succession of the four stages will naturally be the same in all parts of the territory. However, the several parts into which the infested area is divided will not be in the same stage at the same time, since eradication operations are begun in each of the parts at different times.

#### 6.7.1 Preparatory

The following activities are carried out in this stage although not necessarily in this order: preparation of the plan of operations; setting up of offices and establishment of the administrative system; recruitment and training of personnel; purchase of supplies and equipment; geographical reconnaissance of the area to be covered, including preparations of maps, demarcation of blocks, and, if necessary, the numbering of houses; and the preparation of work itineraries.

A start will also be made on activities designed to inform and motivate the population about the program and enlist the cooperation of the community in eradicating the mosquito.

The duration of the preparatory stage will of course vary, depending on the extent of the infested area, and the scope of the program. Generally speaking, this stage should be completed in the period of three to

five months but in some instances a longer period will be necessary. In any event this period should not exceed one year.

#### 6.7.2 Attack

Once the preparatory stage is completed, eradication operations proper will be begun throughout the area it is planned to cover. In the opinion of the Study Group, these operations should be carried out along the lines set forth in the PAHO manual of technical and administrative standards for the Aedes aegypti eradication campaigns.

Aedes aegypti eradication by means of residual-action insecticides comprises basically the following three operations:

- a) Initial survey to ascertain the exact distribution of the mosquito in each locality;
- b) Treatment of positive localities;
- c) Verification (post-treatment inspection) of treated localities to evaluate the results of treatment. Each verification will be followed by a further treatment of the areas found to be still infested until eradication of the mosquito is achieved.

The Group recommends that the methods laid down in the above-mentioned PAHO Manual be applied in these operations.

Essential factors in the attack phase are correct coverage of each locality, strict compliance with work itineraries, punctual maintenance of treatment and verification cycles, and efficient field operations. This can only be achieved as a result of the appropriate orientation, coordination, and supervision of the activities of all personnel.

To facilitate the attainment of this aim, field personnel should be organized into teams composed of not more than five or six workers as a maximum, with a team leader. For every five team leaders there will be a supervisor, who will be responsible for the general supervision of the work of the five teams. At a third level of supervision every 25 teams will have an inspector who will be responsible for the orientation, coordination, and general supervision of the work of the teams.

The treatment-verification cycles adopted will depend on the duration of the residual action of the insecticides used for the campaigns.

In the opinion of the Study Group, a cycle of 3 months for DDT or dieldrin and two months for the organo-phosphorous insecticides currently being used against Aedes aegypti, will be adequate. Nevertheless,

it should be borne in mind that only careful evaluation of the results obtained in the early months of work, supported by laboratory observations on the duration of the residual action of the insecticide, can say whether the cycle adopted by the campaign is adequate or whether it needs to be adjusted to the special conditions obtaining in the area.

Furthermore, the results obtained with insecticide applications must be continuously and carefully evaluated in order to promptly discover any defect interfering with the eradication of the mosquito.

It is strongly recommended that if the infestation index in a locality is not drastically reduced through the application of insecticides, as is to be expected, a careful and complete investigation should be made before normal operations are continued to determine and eliminate the cause of the failure of the treatment. If this is not done, the campaign may suffer severe setbacks and financial losses which would have been avoided.

The duration of the attack phase coincides in practice with the duration of the eradication of the mosquito, since this stage is to be considered completed only when the localities in the area covered have been inspected and found negative at least once and the Aedes aegypti problem in the area is reduced to the sporadic occurrence of small isolated foci of the mosquito.

The duration of the attack phase varies considerably, since it obviously depends on a whole cluster of factors. However, in normal circumstances, this stage should be completed in from 1 to 3 months, according to the size of the area covered and its degree of infestation.

### 6.7.3 Consolidation

In this stage the foci of Aedes aegypti that have managed to survive the attack operations will be eliminated.

In order to find these foci, the verification cycle employed in the attack phase will be continued in all the initially positive localities considered negative. These inspections will confirm that localities are negative and will prevent reinfestations.

The Group is of the opinion that in addition to the search for larvae adult mosquitoes should be captured in the course of the verification of certain localities in which the conditions make for the existence of hidden breeding places, in order to identify any possible hidden focus of the mosquito.

The consolidation phase is to be considered completed when the final verification confirms that all localities in the initially positive areas are negative.

#### 6.7.4 Maintenance

In this phase the inspection will be continued in the initially positive area until it can all be declared free of the mosquito, in accordance with the criteria for eradication established by PAHO.

During this stage a specific vigilance service will have to be organized.

The Study Group was also informed of the long-term program being undertaken by the World Health Organization for the evaluation and testing of new insecticides. More than 40 manufacturing companies are currently providing this program with recently developed compounds; so far, more than 1,400 compounds have been examined and new chemicals are being received at the rate of 200 a year. All these compounds are systematically evaluated by a group of ten laboratories and 4 WHO field research units. This evaluation includes cross-resistant studies, selection experiments, formulation development and toxicological research. The basic purpose of the program is to anticipate resistance problems and to develop suitable substitutes for the insecticides in use. A number of these currently under study (in addition to those mentioned) appear to be suitable for Aedes aegypti eradication.

### 7. INSECTICIDES FOR VECTOR ERADICATION

The Study Group noted that in some areas of the Americas Aedes aegypti is still susceptible to DDT. It recommended that any eradication campaign undertaken in those areas be based on the use of this cheap, effective, and safe insecticide.

The Study Group noted with satisfaction that considerable progress had been made in the last five years on the development of new insecticides that could be used in areas where Aedes aegypti resistance to chlorinated insecticides has developed.

Among these new insecticides special mention must be made of the organophosphorus insecticides, Abate, fenthion and malathion. Abate is a highly effective, persistent, and safe insecticide, the WHO Expert Committee on the Safe Use of Pesticides in Public Health (WHO Technical Report Series No. 356, 1966) has agreed to its application in water in slow release formulations. Fenthion and malathion have been shown to be effective and safe products for peripheral use and area treatment and for application to non-potable water.

Evidence was submitted to the Study Group indicating that fenthion and malathion, when used in association with Abate, at the correct dosage, and in accordance with the recommended application techniques, are

effective in work cycles of up to two months. The Study Group recommends that eradication programs in areas where DDT and dieldrin resistance has been confirmed be based on the use of the above-mentioned organo-phosphorus insecticides.

The Study Group was informed of the trials of new insecticides for use against Aedes aegypti, which PAHO has been carrying out in Jamaica in cooperation with the Government of that country, and of studies on the same problem being carried out in the United States of America and Venezuela.

## 8. VIGILANCE SERVICE

Vigilance to prevent reinfestation should be initiated as soon as Aedes aegypti eradication is completed. This vigilance will be continued without interruption in the Americas for as long as there are infested areas in this Hemisphere. Upon completion of Aedes aegypti eradication in the Hemisphere, it will only be necessary to maintain vigilance in the ports and airports in communication with infested ports and airports of other continents.

The Study Group has examined the reports on vigilance service in the countries in the Hemisphere that have already achieved Aedes aegypti eradication, presented to the Conference on Aedes aegypti Eradication in the Americas held in Washington from 3 to 5 April 1967. This examination showed that some countries were maintaining a perfectly adequate vigilance service; others have unsatisfactory vigilance services which need to be strengthened; still others do not maintain any vigilance services.

It is unnecessary to emphasize the risk of reinfestation being run by countries which are not maintaining adequate vigilance services in their territories, especially those, which, because of their geographical situation and ease of communications, are more exposed to the sources of reinfestation in the Hemisphere. Nor is there any need to insist on the advisability of all areas free of the mosquito in the Americas maintaining an efficient vigilance service.

This service should be aimed at preventing the importation of the mosquito and at discovering and promptly eliminating any reinfestation which it has not been possible to prevent.

For the achievement of these objectives the following measures are recommended:

### 8.1 Preventive Measures

These measures should include:

- a) Control of air traffic, to ensure compliance by airlines with the provisions of the international sanitary regulations dealing with disinsection of aircrafts.
- b) Control of sea and river transport, to ensure that small craft coming from abroad keep their water containers mosquito-proof; to inspect large vessels coming from infested areas, particular attention being paid to those parts of the vessels that may contain Aedes aegypti breeding places.
- c) Control of land transport. It is essential to control railroads and other forms of land transport coming from infested countries. Where necessary, they must be disinfected and all containers capable of transporting mosquito eggs must be treated. Special attention should be paid to used tires, regardless of their mode of entry, and importers should be required to provide information on their origin and destination. Such goods shall be appropriately treated.

#### 8.2 Means for discovering reinfestations

These vary from country to country depending on whether the countries are free of Aedes aegypti, are adjacent to unaffected countries, or adjoin countries still affected.

In the first instance the Study Group recommends:

- a) Vigilance at all international ports and airports, and all frontier posts served by international communication systems.
- b) A six-monthly vigilance cycle in which at least 10% of the existing houses are inspected.

In the second instance the Study Group recommends:

- a) Surveys in localities in which the ecological conditions are favorable to the vector, including inspection of at least 10% of existing houses.
- b) A six-month verification cycle covering 10% of the houses in initially positive localities.
- c) A three-monthly verification cycle covering at least 33% of the existing houses in international ports and airports, and at frontier posts situated on a frontier with an infested country.

The Study Group emphasizes the important role played by aircraft in the transportation of the mosquito from one country to another. With the continually increasing speed and size of modern aircraft the importance of the problem is growing. In the future, plans relating to the movement of air freight will require special attention.

It is to be noted that many countries still accept aerosol treatment when airborne, before landing, as a satisfactory means of disinsection. However, there is abundant evidence that this procedure is ineffective, and its future use is not recommended.

The countries should adopt as a uniform practice one of the two procedures approved by the WHO Expert Committee on Insecticides, namely, disinsection on "blocks away" and automatic Dichlorvos disinsection.

## 9. RESEARCH

In the opinion of the Group, research is an essential factor in solving many of the problems which may arise in the course of an Aedes aegypti eradication campaign.

The Study Group therefore recommends:

- a) That the present WHO program to develop new insecticides be continued and intensified, with particular reference to compounds that could be used in Aedes aegypti eradication. Special attention should be given to the development of an effective ovicide.
- b) That studies on resistance levels of Aedes aegypti to the different insecticides being used be performed systematically. It is suggested that PAHO/WHO provide the countries with such technical assistance as they may need for carrying out these studies.
- c) That PAHO/WHO assist the Governments in investigating any administrative problems that may arise in the course of the eradication program.
- d) That PAHO/WHO give consideration to expanding the activities of the testing unit in Jamaica so that it might undertake research on all aspects of the ecology, biology, and eradication of Aedes aegypti.
- e) That PAHO/WHO take steps to regularly provide interested governments with information on all aspects of the ecology, biology, and eradication of Aedes aegypti.



## 10. PARTICIPATION OF PAHO/WHO IN THE CONTINENTAL PROGRAM

The Study Group is of the opinion that the Pan American Sanitary Bureau has been playing a decisive role in the Aedes aegypti eradication program in the Americas. As a result of the stimulus and cooperation of the Bureau, which has included technical assistance provision of supplies and equipment, and, in some cases, financial support, it has been possible in the last nineteen years to eradicate the mosquito in many countries. In all the other countries and territories of the Hemisphere, eradication campaigns have been undertaken although many have not been successful.

As is stated in other parts of this report, it is of vital importance to the Americas that the Governments of the countries and territories still infested accelerate their campaigns so that the eradication of the vector in the Hemisphere can be completed as soon as possible.

In the opinion of the Group, this final effort to definitively solve the problem of urban yellow fever in the Americas will only be successful if PASB takes an active part in it. The participation of the Bureau should, in the opinion of the Group, include the following activities:

- 1) Negotiations with the governments to convince them to give the highest possible priority to the program. It is suggested that for this purpose the Director of the Bureau get into direct touch with the highest government authorities.

- 2) Energetic and broad assistance to the countries and territories still infested in conducting their campaigns. This assistance should cover all aspects of the program; financial assistance in the form of supplies and equipment, according to the availability of budgetary funds, and, in special cases, at the request of governments, direct participation in the programs. It should also include assistance to Governments to enable them, where necessary, to obtain external credit in the form of grants or loans for financing their campaigns.

- 3) Coordination of eradication programs in order to solve the problem of the reinfestations which are occurring in the Hemisphere. For this purpose it is essential to prepare and carry out a plan of operations designed to eliminate or reduce to a minimum the possibility of the importation of the mosquito. The ideal strategy for this coordinated program would of course be the simultaneous eradication of the vector in all the countries and territories infested. If this is not possible, the strategy applied might envisage the eradication of the mosquito by groups of countries and territories, whereby each group to be covered at one and the same time would comprise all the countries and territories which can reinfest one another, and the program would be begun in each group as soon as all the component units were prepared to do so.

It should be borne in mind that only this strategy can reduce the possibility of infection and that its success will depend upon each group initiating and carrying out its program as soon as possible. The Study Group suggests that, before a decision is taken on the strategy to be adopted and a plan of operation is prepared, PASB make careful study of the matter, in consultation with the governments concerned.

Furthermore, the Study Group is of the opinion that it is highly advisable for PASB to intensify and broaden its assistance to countries and territories already free of Aedes aegypti in maintaining their vigilance services. The Group noted that some of those countries at present maintain adequate vigilance services; others are carrying out insufficient vigilance activities; and still others do not have any vigilance service at all.

In view of the importance of the success of the campaign of appropriate vigilance in all areas free of the vector the Group recommends:

a) That PASB assist the governments maintaining vigilance services to make an evaluation of those services so that they may correct any deficiencies they have. It is suggested that this evaluation should be undertaken as soon as possible and it should include the inspection by local personnel and by PASB staff of a sample of the localities most exposed to reinfestation. It is also suggested that this type of valuation be repeated regularly in the future, especially in the countries that are most exposed to reinfestation, at intervals of not more than one year.

b) PASB should assist the countries that do not have any vigilance services to plan, organize, and maintain appropriate vigilance in their countries. It is suggested that this assistance include technical advisory services, personnel training, and, in some cases, the provision of supplies.

The Study Group realizes that if the Bureau is to play the part expected of it in accelerating the continental eradication program, it will need more funds than its regular budget could supply. For that reason the Study Group, bearing in mind Resolution XIX of the XVII Pan American Sanitary Conference, which authorized the Director of the Pan American Sanitary Bureau to obtain funds to finance the prompt eradication of Aedes aegypti, suggests to the Director that he explore the possibility of establishing a special fund for the eradication of Aedes aegypti which will provide the Bureau with the additional funds it needs for intensifying the continental program.

To give some idea of the total amount of money the Bureau would need, the Study Group has made an estimate of the specialized personnel needed for advising, coordinating, and evaluating all the eradication campaigns and vigilance services. Table No. 2 attached to this report shows the distribution of these personnel by duty station, suggested by the Group, and the cost of this personnel, including travel expenses.

The personnel recommended by the Group includes those officials who would make up the coordinating unit of the program, at the central office level, two zone coordinators, the advisers attached to various projects, and the personnel of the insecticide testing unit.

It should be borne in mind that the number of personnel were estimated on the understanding that eradication will be carried out simultaneously in all areas still infested. If that is not the plan adopted for the program, it will be necessary to revise personnel requirements according to the new strategy. Furthermore, it should be borne in mind that the duty stations of the personnel with the exception of those attached to country projects will of course be subject to such changes as the circumstances require.

#### 11. COST OF THE CONTINENTAL PROGRAM

One of the responsibilities the Study Group received from PASB was that of estimating the cost of Aedes aegypti eradication in the countries and territories still infested in the Hemisphere on the basis of the data contained in the documents submitted to the Conference on the Eradication of Aedes aegypti mentioned above.

Some of these documents included the budget prepared by the government concerned for their campaign; some only mentioned the present annual cost of the campaign; and still others contained no information on the cost of the program. Furthermore, two countries still infested have not provided any information.

On the basis of the data and the information available the Group estimates that the total cost of the campaign in the areas still infested, with the exception of the United States of America, will amount to approximately \$78 million. Table No. 1 attached to this report shows the distribution of these costs by country.

The criteria of the Group in calculating these costs were as follows:

- a) For the countries that submitted a budget for their campaign, the estimates prepared by them were accepted.
- b) For the countries which presented an incomplete budget or did not present any cost estimates, the cost of the campaign was estimated on the basis of the number of cases in the presumably infested area in each country or territory. The number of houses was estimated on the basis of the population of the area.

It must be borne in mind that the costs calculated by the Group are to be regarded only as an approximate estimate which does little more than give an idea of what the program might cost. In view of the

lack of accurate information, the Study Group had to calculate the cost of the campaigns, except for the few countries that presented their budgets, on the basis of general indices and averages which, given the diversity of the areas to which they were applied, can clearly give rise to sizeable errors. Furthermore, the cost estimates presuppose that the campaigns will last for the number of years given in Table 1; however, it must be borne in mind that any forecast of duration of a campaign of this type can only be approximate. Even then, the forecast is subject to a considerable margin of error.

## 12. FINANCING

The foundation of any program of eradication is the provision of adequate funds for its implementation. There is little doubt that the lack of funds has been at the root of many of the failures that have been reported. The Group is of the opinion that PASB can play a vital role in remedying the situation, and recommends that the Bureau take the following measures:

- a) To bring to the attention of the Governments of the countries in which Aedes aegypti still exists, the great benefits to health and the economy that will be derived from eradication of the mosquito in their territories.
- b) To persuade these governments of the absolute necessity of allotting sufficient funds for an adequate period of time and of solving their administrative problems and of providing personnel to permit the attainment of eradication as soon as possible.
- c) To stimulate the governments to recommend to international credit agencies that their credit policy make provision for the granting of loans for Aedes aegypti eradication program.
- d) To assist the governments in obtaining funds from bilateral and multilateral sources to supplement their national budgets for eradication.

The Study Group recognizes that it is no simple matter to obtain funds from granting agencies; however, it is aware that PASB has had similar experience in obtaining funds for community water supply, malaria, smallpox eradication, and other programs. It strongly recommends that this experience be brought to bear on the problem of Aedes aegypti eradication. In particular, it suggests that the support of the World Bank and the Inter-American Development Bank be sought, and that the possible assistance of the United Nations Development Programme, UNESCO, and other bodies be investigated. In making these recommendations the Study Group is fully aware that agreements must be concluded between governments, and the credit agencies, and that the role of PAHO is essentially advisory in character.

### 13. MANUALS AND FORMS FOR USE IN THE PROGRAM

The Study Group is of the opinion that it is essential to revise and bring up to date the manual on technical and administrative standards for Aedes aegypti eradication campaigns prepared by PASB in 1956. It recommends that the Bureau undertake this work during the present year, and that in the future this manual be periodically revised to keep it up to date. The Group also recommends that the manual be widely distributed so that the persons in charge of eradication programs and vigilance services in all the countries and territories of the Hemisphere have a reference work at their disposal.

The Group is of the opinion that, in order to effectively coordinate the continental program, it is essential to maintain up-to-date information that can be easily understood and interpreted by the persons and agencies interested in the programs. The Group therefore recommends that PASB revise the guide for the reports on the Aedes aegypti eradication campaign in the Americas, published in 1960 by the Bureau, with a view to up-dating and improving it. It suggests that, in revising it the following be taken into account:

- a) Need for simple, unambiguous forms.
- b) Need for changes in the forms because of the new insecticides and methods in use.
- c) Advisability of making the adaptations required by modern methods of handling statistical data.

### 14. CONCLUSIONS AND RECOMMENDATIONS

In 1947 the PAHO Directing Council entrusted the Pan American Sanitary Bureau with the solution of the urban yellow fever problem in the Americas through the eradication of Aedes aegypti. So far, the mosquito has been eradicated from about 80 per cent of the areas that are ecologically favorable to the vector in the Hemisphere. However, the problem still exists in the United States of America, El Salvador, Colombia, Venezuela, Guyana, Surinam, French Guyana, and in all the countries and territories of the Caribbean with the exception of a few small islands.

The presence of Aedes aegypti in these areas represents a continuing threat of urban yellow fever and other diseases transmitted by the vector for the countries that are still infested, as well as the risk of reinfestation for those which have completed eradication of the mosquito. As a matter of fact, in the last six years several countries and territories were reinfested by Aedes aegypti coming from those areas.

If the problem of urban yellow fever is to be definitively solved in the Hemisphere, it is essential to complete eradication of the mosquito in the above-mentioned areas without further delay in order to protect the enormous investment in money and effort which the eradication of Aedes aegypti has already cost the Americas.

As has been stated earlier in the report, there is no technical obstacle to the eradication of the mosquito. Effective residual action insecticides are available, as are techniques and methods that ensure the elimination of Aedes aegypti when correctly applied. However, the continental eradication program is not progressing satisfactorily.

As is mentioned in the report, this is due to the fact that in most of the countries and territories the campaign does not meet the essential conditions for the appropriate development of the whole process leading to the eradication of Aedes aegypti. These conditions are basically as follows:

- a) Firm decision on the part of the Government to eradicate the mosquito and to assume the responsibility that eradication involves;
- b) Sufficient funds to cope uninterruptedly with the personnel, supply, and equipment requirements of the campaign until such time as the eradication of the vector is achieved;
- c) Appropriate organization on a national scale enabling the campaign to carry out its activities in a uniform and coordinated manner throughout the country.
- d) Administrative independence and flexibility whereby the campaign can handle its budget without bureaucratic interference, establish conditions of employment of its staff; fix salary scales and per diem allowances; and engage, transfer, discipline or dismiss staff without delay or difficulty;
- e) Legal provisions providing the campaign with authority to quickly enforce decisions and to adopt the necessary measures to eradicate the mosquito without delay.

The Pan American Sanitary Bureau has been playing a decisive role in the Aedes aegypti eradication program in the Americas. As a result of the stimulus and assistance of the Bureau, which has included technical advisory services, the provision of supplies and equipment, and, in some cases, financial support, it has been possible in the last nineteen years to eradicate the mosquito in many countries. Eradication campaigns have been undertaken in all the other countries and territories of the Hemisphere, although many have not been successful.

It is of vital importance to the Americas that the government of the countries and territories still infested accelerate their campaigns so that the eradication of the vector in the Hemisphere is completed as soon as possible. This final effort to definitively solve the problem of urban yellow fever in the Americas will only be successful if PASB takes an active part in it. The participation of the Bureau should, in the opinion of the group, include essentially the following activities:

1) Negotiations with the governments to convince them to give the highest possible priority to the program. It is suggested that for this purpose, the Director of the Bureau get into direct touch with the highest government authorities.

2) Energetic and broad assistance to the countries and territories still infested in conducting their campaigns. This assistance should cover all aspects of the program; financial assistance in the form of supplies and equipment according to the availability of budgetary funds, and, in special cases, at the request of governments, direct participation in the program.

3) Coordination of eradication programs in order to solve the problem of the reinfestations which are occurring in the Hemisphere. For this purpose it is essential to prepare and carry out a plan of operations designed to eliminate or reduce to a minimum the possibility of the importation of the mosquito into the areas already free of it.

As mentioned above, 17 countries and territories have already achieved eradication of Aedes aegypti, and are currently considered free of the vector. Of these, some are maintaining satisfactory vigilance services; others are carrying out insufficient vigilance activities; and still others are not carrying out any vigilance operations at all.

In view of the importance to the success of the continental eradication program of vigilance operations in all the areas already free of the mosquito, it is recommended that PASB assists:

a) The government that maintain vigilance services, in making periodical evaluations of those services for the purpose of correcting any deficiencies which may exist in them;

b) With the countries and territories which are already free of the vector but which do not have any vigilance services; in organizing and maintaining appropriate vigilance.

It is clear that if PASB is to be able to fulfil the role expected of it, in accelerating the continental Aedes aegypti eradication program, it will have to have more funds than its regular budget can supply. For that reason, seeing that the XVII Pan American Sanitary Conference in

Resolution XIX authorized the Director of the Bureau to obtain funds to finance the prompt eradication of Aedes aegypti, it recommends to the Director that he explore the possibility of establishing a special Aedes aegypti eradication fund that will provide the Bureau with the additional funds it needs to accelerate the continental program.

Clearly, the foundation of any eradication program is the provision of adequate funds for its implementation. There is little doubt that lack of funds has been at the root of many of the failures that have been reported. If the continental program is to be successful, this situation must be remedied. It is therefore recommended:

a) That the Governments bring their influence to bear in international credit agencies to have them enlarge their credit policy to include the grant of loans for Aedes aegypti eradication.

b) That PASB provide the Governments with advisory services in obtaining bilateral and multilateral funds to supplement their national budgets for eradication.



TABLE No. 1

ESTIMATED COST OF THE ERADICATION PROGRAM IN THE COUNTRIES AND TERRITORIES  
STILL INFESTED

Country or territory	Total houses in infested area	Duration of campaign (years)	Cost in US\$		
			Personnel, supplies & Equipment	Insecticides	Total Cost
Antigua	14,000	3	170,000	6,000	176,000
Bahamas	29,000	3	345,000	13,000	358,000
Barbados	52,000	3	484,000	15,000	499,000
Colombia	41,000	2	38,000	1,000	39,000
Cuba	2,330,000	4	27,000,000	400,000	27,400,000
Dominica	14,000	3	170,000	6,000	176,000
Dominican Republic	740,000	4	5,536,000	330,000	5,866,000
El Salvador	220,000	4	2,070,000	30,000	2,100,000
French Guiana	8,000	3	113,000	4,000	117,000
Grenada	22,000	3	280,000	10,000	290,000
Guadeloupe	66,000	3	734,000	30,000	764,000
Guyana	135,000	4	1,160,000	60,000	1,220,000
Haiti	689,000	4	1,364,000	318,000	1,682,000
Jamaica	467,000	5	3,641,000	208,000	3,849,000
Martinique	67,000	3	734,000	30,000	764,000
Montserrat	3,000	3	45,000	1,000	46,000
Netherlands Antilles	44,000	3	522,000	20,000	542,000
St. Kitts-Nevis-Anguilla	13,000	3	170,000	6,000	176,000
St. Vincent	19,000	3	252,000	9,000	261,000
St. Lucia	21,000	3	275,000	10,000	285,000
Surinam	70,000	3	827,000	32,000	859,000
Trinidad and Tobago	50,000	2	161,000*	-	161,000
Turks and Caicos Islands	3,000	3	45,000	1,000	46,000
Venezuela	1,768,000	6	31,496,000	-	31,496,000
Virgin Islands (U.K.)	3,000	3	45,000	1,000	46,000
	6,888,000		77,677,000	1,541,000	79,218,000

\* Including cost of insecticides.

TABLE No. 2

PASB PERSONNEL NEEDED TO ADVISE, COORDINATE, AND EVALUATE ERADICATION  
CAMPAIGNS AND VIGILANCE SERVICES

Duty Station	Type of Personnel					Annual Cost US\$
	Consultant	Entomo- logist	Statis- tician	Health Inspector	S.T.C.	
Headquarters	2	-	1	-	20 months	94,607
Insecticide Testing Unit	-	1	-	1	6 months	43,638
Zone I	1	1	-	-	-	38,649
Zone II	1	1	-	-	-	38,649
Colombia	-	-	-	1	-	13,607
Cuba	1	-	-	4	-	81,555
Dominican Republic	1	-	-	2	-	51,364
El Salvador	1	-	-	2	-	51,364
Haiti	1	-	-	2	-	51,364
Jamaica	1	-	-	2	-	51,364
Venezuela	1	-	-	4	-	81,555
Antigua, Montserrat, St. Kitts-Nevis- Anguilla, Virgin Islands (U. K.), Bahamas, Turks and Caicos Islands	1	-	-	4	-	81,555
Guadeloupe, Martinique and French Guiana	1	-	-	3	-	67,948
Barbados, Grenada, St. Lucia, St. Vincent and Dominica	1	-	-	5	-	98,139
Netherlands Antilles, Guyana, Surinam and Trinidad and Tobago	1	-	-	4	-	81,555
TOTAL	14	3	1	34	26 months	926,913



*executive committee of  
the directing council*

PAN AMERICAN  
HEALTH  
ORGANIZATION

*working party of  
the regional committee*

WORLD  
HEALTH  
ORGANIZATION



56th Meeting  
Washington, D. C.  
April-May 1967

Agenda Item 11

CE56/8 (Eng.)  
ADDENDUM II  
1 May 1967  
ORIGINAL: SPANISH

AEDES AEGYPTI ERADICATION IN THE AMERICAS

REPORT OF THE CONFERENCE ON AEDES AEGYPTI ERADICATION  
IN THE AMERICAS



Pan American Health Organization

World Health Organization

# CONFERENCE ON AEDES AEGYPTI ERADICATION IN THE AMERICAS

WASHINGTON, D.C., UNITED STATES OF AMERICA

3-5 APRIL 1967

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## INTRODUCTION

The Directing Council of the Pan American Health Organization, at its First Meeting held in Buenos Aires in 1947, entrusted to the Pan American Sanitary Bureau the solution of the problem of urban yellow fever in the Americas through the eradication of Aedes aegypti.

When PASB received these instructions, Aedes aegypti had already been eradicated in Bolivia and in a large part of Brazil. However, with the exception of Canada, all the remaining countries as well as all the territories in the Western Hemisphere were in some degree infested by the vector. In the 19 years that have elapsed since that time, Aedes aegypti has been eradicated from extensive areas in the Hemisphere, but much remains to be done before the continental eradication program is concluded. As a matter of fact, the problem still exists in the northern part of South America, where French Guiana, Surinam, Guyana, Venezuela and two localities in Colombia are infested; in El Salvador; in the United States of America; and in the Caribbean Area, where all the countries and territories, with the exception of a few islands, are extensively infested.

Apart from the danger to the infested countries and territories of the diseases transmitted by this mosquito, the presence of Aedes aegypti in those areas has been the cause of the frequent reinfestations which have been occurring in the Hemisphere and which are threatening the very success of the continental program to eradicate the vector.

This situation has been a matter of serious concern to the Governing Bodies of the Organization, which in successive resolutions have called upon the countries and territories still infested to complete eradication of Aedes aegypti as soon as possible, since the success of the continental program can only be ensured if the present sources of reinfestation in the Americas are promptly eradicated. However, in the last four years, the eradication campaign has made progress only in very limited areas; in a number of countries and territories the situation has in fact considerably worsened over this period.

In view of the seriousness of the present situation of the continental program, the XVII Pan American Sanitary Conference, held in Washington, 26 September to 7 October 1966, approved Resolution XIX in which the Conference instructed the Director of the Pan American Sanitary Bureau to take all necessary measures to intensify and accelerate eradication of Aedes aegypti in the Americas, and to study and put into practice the appropriate systems for ensuring that the eradication campaign is carried out simultaneously and in a coordinated manner in all the areas still infested. Among the measures designed to achieve such coordination, the Conference suggested that frequent and periodical meetings of the national authorities responsible for the program be held under the auspices of PASB.

2.

As a first step towards implementation of the above-mentioned resolution, the Director convened a Conference on the Eradication of Aedes aegypti in the Americas. With the exception of Canada, all the countries and territories of the Hemisphere were invited to send representatives to the meeting, the purpose of which was a complete review of the continental program to eradicate the vector.

## PARTICIPANTS

ARGENTINA: Dr. Julio C. Blaksley  
Ministry of Public Health  
Buenos Aires

BOLIVIA: Dr. Luis Gamarra Gutiérrez  
Ministry of Public Health  
La Paz

BRAZIL: Dr. Aníbal Rodrigues dos Santos  
National Department of Rural Endemics  
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CHILE: Eng. Julio Basoalto V.  
Ministry of Public Health  
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COLOMBIA: Dr. Augusto Gast Galvis  
National Institute of Health  
Bogotá

COSTA RICA: Eng. Horacio Ruiz Soto  
Ministry of Public Health  
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CUBA: Dr. Pablo Resik Habib  
Ministry of Public Health  
La Habana

DOMINICAN REPUBLIC: Dr. Fabio A. Cabrera Polanco  
Ministry of Public Health and Welfare  
Santo Domingo

ECUADOR: Dr. Felipe José Aroca  
Department of Health  
Guayaquil

EL SALVADOR: Dr. Alberto Aguilar Rivas  
Ministry of Public Health and Welfare  
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FRENCH DEPARTMENTS  
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Ministry of Public Health  
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GUATEMALA: Dr. René Rafael Alvarez Castillo  
Ministry of Public Health  
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Public Health Service  
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Mr. George Bevier (Consultant)  
National Communicable Disease Center  
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URUGUAY: Dr. Solón Veríssimo  
Ministry of Public Health  
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VENEZUELA: Dr. Miguel Dorante López  
Ministry of Public Health and Welfare  
Caracas

NOTE: The following countries were also invited: Barbada, Guyana,  
Haiti, Nicaragua and Panama.

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INAUGURATION OF THE CONFERENCE

Dr. Abraham Horwitz, Director of the Pan American Sanitary Bureau, inaugurated the Conference with the following address:

"Eradication of Aedes aegypti in the Americas-- the purpose of this Conference-- means to interrupt the ecological cycle of yellow fever and to definitively protect urban areas against the jungle form of this zoonosis. It also means to arrest the transmission of dengue and to prevent the appearance in the Americas of hemorrhagic fever, a highly lethal disease transmitted by the same vector which at present has been identified only in the Far East. It is not the purpose of this Conference to reopen the discussion on why Aedes aegypti should be eradicated. That decision was taken some twenty years ago, and has been reaffirmed at each meeting of the Directing Bodies of our Organization as well as in numerous statements by the Ministers of Public Health and other distinguished health workers in the Americas. There is general agreement on that point. Nevertheless, the complete eradication of the vector in the Hemisphere has not been achieved. Although substantial progress has been made, it has not kept pace with events, for epidemic dengue is of recent appearance as is the threat of hemorrhagic fever. Furthermore, in these twenty years the jungle virus has repeatedly moved in epizootic waves through Central and South America, following a well-defined path. Fortunately these movements have not produced yellow fever epidemics because Aedes aegypti was not present in the countries concerned. However, in recent years, the mosquito has started to reappear in areas from which it had earlier been eliminated, and is again threatening the neighboring countries. The introduction of chlorinated insecticides in that period, greatly simplified the more techniques used but in some places Aedes aegypti has developed resistance to those most commonly employed, namely DDT and dieldrin. This fact has further complicated the problem; prior to the advent of insecticides, the procedures used, were essentially based on the use of larvicides. Although effective, they are proportionately much more costly.

We obviously do not need to justify Aedes aegypti eradication; the question we must deal with-- and this was decided by the XVII Pan American Conference-- is how to make more rapid progress in attaining our goal. This entails a detailed review of the present status of the problem, clearly defining the countries and territories in which the vector is present, those in which it has been reintroduced and those that remain free of it as a result of an active vigilance program. In the light of this quantitative and qualitative study, a new continental plan should be drawn up, clearly defining the responsibilities of each Government, according to the situation in its country as well as those of the Pan American Health Organization, as the coordinating agency. The methods to be employed for the eradication of Aedes will of course be determined by the results of the trials of new phosphorus insecticides. The areas in which new biological or operational studies are required must also be defined. The funds needed for the entire undertaking must be estimated, and a clear

distinction must be made between national contributions and international credit. In this last connection, I should like to suggest that the international credit agencies broaden their lending policy so as to include loans for the eradication of Aedes aegypti, on the same conditions as those for malaria eradication.

In accordance with the resolutions of the XVII Pan American Sanitary Conference, I have had the honor to call this Conference, which will be followed by a meeting of a study group to draw up a new and detailed continental plan based on such conclusions as you may reach here as result of your discussions. All the pertinent documents will have to be presented to the 56th Meeting of the Executive Committee, which will be held in Washington, from 26 April to 5 May, and to the XVII Meeting of the Directing Council of the Pan American Health Organization, XVIII Meeting of the Regional Committee of WHO, which will be held in Trinidad this October.

We have been fortunate in obtaining the invaluable counsel of a man who, in my opinion, is the greatest living authority on yellow fever and Aedes aegypti eradication -- Dr. Fred L. Soper. After a lifetime of experience, he fathered the idea of eradication, worked out its theoretical underpinning and shaped its practice. He inspired governments, institutions, individuals and international agencies. He made the Americas truly aware of the need to eliminate a risk which has had such tragic consequences in the recent past, and which may very well appear again, and buttressed that awareness with the firm resolve of the Governments. The prodigious task accomplished in this field is due to his efforts when he was Director of the Pan American Sanitary Bureau. Dr Soper is the veritable embodiment of the idea of eradication, an humanitarian endeavor that calls for boldness, resolution, steadfastness in action, and the imaginative to envision the social consequences of yellow fever. Those consequences stretch far beyond the borders of communities and of nations for they are more the result of Nature's design than of man's. And thus the eradication of a disease or a vector is still another reflection of man's struggle to conquer his environment, facilitate his adaptation, and stimulate progress.

The presence of Dr. Soper here today symbolizes our resolve to continue his work until it triumphs.

The essential task is to intensify the activities now in progress, or to resume them, as the case may be, until Aedes aegypti is eliminated from the continent. Outweighing all other reasons is the moral commitment. Some 20 years ago an obligation was assumed by the authorized representatives of the American Governments. It has been re-affirmed on many occasions. Substantial progress has been made at no small cost and that alone inhences the moral responsibility of the governments that have not done their part in what is unquestionably a unique undertaking, encompassing the entire continent, wherever Nature decides.

As an indispensable prelude to continental development the discharge of our obligation is a matter of urgency. It is generally agreed today that we must increase communication between our peoples, not only from north to south but from east to west of the Americas, and vice versa, such a step means bringing all that modern science and technology recommends for man's wellbeing to geographical regions where nature interposes formidable obstacles. A single example suffices -- the jungle and the great river basins. As these regions are settled, the presence of Aedes aegypti will entail serious immediate risks for the entrepreneur, the technician and the worker, and long-term risks for the inhabitants of towns adjacent to areas in the process of development.

If there is one characteristic that distinguishes the Americas today, it is the tendency to believe that nothing is impossible. We have only to observe the ideas and the proposals being advanced at the highest decision-making levels of the political sector, the myriads of real accomplishments, and the genuine zeal to move in concert and solidarity towards the progress and wellbeing of all the people. In this spirit, I am confident that fresh and vigorous efforts will be made to solve the problem before us and will culminate in the eradication of Aedes aegypti in the Americas.

SUMMARY

In the 19 years that have elapsed since the Directing Council of the Pan American Health Organization entrusted to the Pan American Health Organization the task of eradicating Aedes aegypti from the Americas, that vector has been eliminated over extensive areas in the Hemisphere. Nevertheless, much remains to be done before the continental program to eradicate the mosquito can be concluded.

Up to the present time, the following countries have succeeded in eradicating Aedes aegypti and are considered free of the vector: Argentina, Bermuda, Bolivia, Brazil, British Honduras, Chile, Costa Rica, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and the Panama Canal Zone. Nevertheless, the problem still exists in the United States of America; in one of the Central American countries; in the entire Caribbean area; and in the northern part of South America where French Guiana, Surinam, Guyana, Venezuela and two localities in Colombia are still infested.

The presence of Aedes aegypti in those areas represents a risk of urban yellow fever that must not be underestimated. Given the ease and rapidity of travel today, all the countries and territories of the Hemisphere, from the epidemiological point of view, are very close to the enzootic areas of South America. Likewise, epizootic outbreaks that occur periodically on the Continent can spread the virus to regions at great distances from the above-mentioned enzootic foci. In fact, in the past 20 years, as result of various epizootics, yellow fever virus has been identified in the forests of all the South American countries except Chile and Uruguay, as well as in the forest areas of Trinidad, Mexico and all the countries of Central America, with the sole exception of El Salvador. This indicates the magnitude of the danger presented by jungle yellow fever to the areas in the Hemisphere still infested by Aedes aegypti.

It would be difficult, merely by controlling Aedes aegypti in those areas, to maintain them permanently protected against yellow fever. Experience in Brazil has shown us that it is impractical to maintain a program to control the vector, over an indefinite period, that would assure maintenance of an infestation index under the critical level for transmission of the disease. It is clear, moreover, that such a permanent control program would, over the long term, cost more than its eradication. Likewise, it could not be recommended that such areas be protected exclusively by vaccination. Apart from the improbability that the entire population could be sufficiently and permanently immunized over an indefinite period, this type of protection would also prove to be more costly than eradicating the vector, over the long term. In the light of present-day knowledge the latter measure, that is, the eradication of Aedes aegypti, is undoubtedly the most inexpensive way of providing effective protection as well as the only means of definitively eliminating the possibility of an urban yellow fever outbreak in the area.

Apart from the threat of yellow fever, it must be kept in mind that countries and territories infested by Aedes aegypti also run the risk of dengue epidemics. Although this disease has an extremely low fatality rate, epidemics such as those that occurred in the Caribbean areas between 1963 and 1966 can cause serious economic losses, particularly to those countries where the tourist industry is an important source of income.

Furthermore, consideration must be given to the risk of hemorrhagic fever epidemics in those areas. Up to the present time, hemorrhagic fever has been identified only in Asia, where Aedes aegypti is believed to be the sole vector of the disease. However, the possibility cannot be excluded that the infection, which in certain Asiatic outbreaks has had a case-fatality rate of from 10 to 15 per cent, could occur in the Western Hemisphere.

At the same time, the areas in the Americas that are still infested by Aedes aegypti have been the cause of the frequent reinfestations which have occurred in the Hemisphere and which are endangering the success of the continental eradication program. In the last six years, the following countries and territories have been reinfested by Aedes aegypti from the areas mentioned above: Antigua, Aruba, Bonaire, Colombia, El Salvador, French Guiana, Guyana, Mexico, Montserrat, San Cristobal, San Vicente and Trinidad.

This situation has been a matter of concern to the Directing Bodies of the Pan American Health Organization, which in successive resolutions have called upon the countries and territories still infested to complete eradication of the mosquito as soon as possible, since the success of the continental eradication program can only be assured if the present sources of reinfestation in the Hemisphere are speedily eliminated.

Nevertheless, in the last four years, the eradication campaign has made only limited progress except in a few restricted areas; in a number of countries and territories the situation during this period has, in fact, worsened considerably. This development is due to financial, technical and administrative difficulties that are hampering the satisfactory progress of the campaign in almost all the countries and territories still infested.

Among those difficulties, the following merit special mention:

1. Insufficient funds and personnel to ensure adequate coverage of the infested areas;
2. Deficient organization and administration;
3. Personnel problems that impair the quality of field work;
4. Mosquito-resistance to chlorinated insecticides;
5. Reinfestations.

Aedes aegypti eradication by means of residual action insecticides basically comprises two operations: treatment of the areas found to be positive, and verification of treated areas to evaluate the results of the treatment. Each verification is followed by a new treatment of the areas still positive, until eradication of the mosquito is achieved.

If the campaign is to be successful, not only must treatment be carried out correctly with an effective insecticide, but the treatment-verification cycle be adjusted to the duration of the residual effects of the insecticide employed, and that such cycle be rigorously observed. In addition, areas capable of reinfesting one another must be treated and verified at the same time, as if they constituted a single locality.

If the campaign does not have sufficient funds and personnel to carry out this type of coverage, it will be extremely difficult to achieve eradication of the mosquito in a given country.

Punctuality is an essential element in the success of field work. Any delay in carrying out verification in a treated area, or in treating an area found to be positive, can delay eradication of the mosquito. Furthermore, it is of the utmost importance that eradication of the vector in a given country be completed within a short period. Campaigns that drag on for a number of years make for reinfestations within the country, as well as the development of Aedes aegypti strains resistant to the insecticides.

It is clearly very difficult for a campaign to carry out the verifications and treatments punctually and to meet its work schedule without delays, if it does not have complete administrative flexibility that enables it promptly to make any such measure as may be necessary to the satisfactory progress of the field work.

Eradication of Aedes aegypti demands the most painstaking, accurate and conscientious work, which can only be assured if certain basic conditions relating to the field personnel are satisfied, including the following: careful selection and training; adequate salaries; a strict chain-of-command, discipline, and clearly defined responsibilities; and strict, continuing and unremitting supervision of the field work, with the dual purpose of correcting errors of the field personnel and improving their technical competence.

The campaign will clearly not be able to establish and maintain these conditions if its directors do not have full authority to handle matters related to such personnel with complete independence. Furthermore, it is also clear that it will be extremely difficult in many countries for various reasons, to meet all of these requirements.

Nevertheless, it should be borne in mind that the above-described requirements are a decisive factor in the quality of work performed by the



the field staff, and that only high quality field work is capable of ensuring the success of a campaign of this type, in which incomplete treatment or less than the most scrupulous inspection of a single house can delay eradication of the mosquito in a given locality for several months.

Aedes aegypti resistance to chlorinated insecticides has largely contributed to the present situation of the campaign in the Caribbean and in the northern part of South America. The problem is present today, in varying degrees, in all the countries and territories of those areas. Because of insecticide-resistance, the campaign has been suspended in a number of places and has been considerably delayed in others.

Nevertheless, that problem can now be considered solved, since phosphorus compounds are already available that can replace the chlorinated insecticides in vector eradication. Such insecticides have a shorter residual action than DDT or Dieldrin, but the results obtained with them in various areas have already shown that strains of Aedes aegypti resistant to chlorinated insecticides can be eliminated with these compounds.

In any event, it is clear that an effective insecticide cannot by itself ensure the success of the campaign. Likewise, the fact that the continued and prolonged use of an insecticide can contribute to the development of resistant strains needs no further emphasis. The present vector-resistance to DDT can undoubtedly be attributed, at least in part, to the fact that many campaigns were unable for a variety of reasons to eradicate the mosquito within a reasonable period, despite the initial effectiveness of the insecticide.

There is no need to emphasize the importance of intra-country reinfestations to the success of its campaign, or the importance of inter-country reinfestations to the continental program, particularly after vector-resistance to chlorinated insecticides became generalized. It is sufficient to mention that some of the areas where the campaign is encountering its greatest difficulties today were once negative.

In the case of both autochthonous and imported reinfestations, the success of the campaign depends on its ability to prevent such reinfestations or to hold them to a minimum. For that purpose it will be necessary:

- a) to treat at the same time, as if they constituted a single unit, those areas of the country capable of reinfesting one another;
- b) to coordinate the campaign in an appropriate manner in all the areas of the Americas that are still infested;
- c) to maintain strict vigilance against the introduction of Aedes aegypti in areas that are being freed from the vector;
- d) to complete eradication of the mosquito as soon as possible.

RECOMMENDATIONS

The Conference, after studying the reports presented by the participants and discussing the problems that are hampering progress of the continental campaign for the eradication of the vector, approved the following resolution.

THE CONFERENCE ON THE ERADICATION OF AEDES AEGYPTI IN THE AMERICAS,

Having examined the reports presented by the representatives of the participating countries and territories, and considering:

that the international commitments assumed at various times by the American countries and territories to complete eradication of Aedes aegypti are in part still pending;

that the presence of Aedes aegypti in extensive areas of the Hemisphere constitutes a grave risk of urban yellow fever and dengue epidemics, as well as the risk of epidemics of Asiatic hemorrhagic fever and other arbovirus diseases;

that the areas still infested are the cause of reinfestations in countries and territories that have already eradicated Aedes aegypti;

that these reinfestations are being more frequent and more serious as international communications increase;

that the delay in completing eradication in the areas still infested demands greater expenditures on the part of those countries that have already fulfilled their commitments, with great efforts, and now find themselves obliged to prolong costly vigilance services;

that the repeated reinfestations now occurring in the Americas are seriously endangering the very success of the continental program to eradicate the vector, and

that the problem of Aedes aegypti resistance to insecticides has been largely overcome.

RESOLVES:

- 1.- To recommend to the Participants that they convey to their Governments the unanimous decision of the Conference to urge the infested countries and territories to immediately fulfill the commitments they assumed to eradicate the Aedes aegypti.

- 2.- To recommend to the Participants that they reiterate to their respective Governments Resolution XIX of the XVII Pan American Sanitary Conference, of which the operative part reads as follows:
- "1.- To urge the Governments of the countries and territories already free of Aedes aegypti to maintain a strict vigilance service against reinfestation and that service take all the necessary measures to prevent the introduction of the mosquito into those areas.
- 2.- To urge the Governments of the countries and territories still infested to take timely measures to overcome any administrative difficulties that may be hampering the progress of their campaigns and to give the highest priority to the provision of funds, personnel, and supplies needed to complete those campaigns as soon as possible.
- 3.- To instruct the Director to take all necessary measures to intensify and accelerate the continental campaign so that Aedes aegypti may be eradicated in the Americas as soon as possible.
- 4.- To authorize the Director of the Pan American Sanitary Bureau to obtain funds to finance the prompt eradication of Aedes aegypti.
- 5.- To request the Director to study and put into practice appropriate systems for ensuring that the Aedes aegypti eradication campaign is carried out simultaneously and in a coordinated manner in all the countries in which the problem still exists, including frequent and periodical meetings, under the aegis of the Bureau, of the national authorities responsible for the programs."
- 3.- To urge the Director of the Pan American Sanitary Bureau to plan a coordinated continental program designed to complete the eradication of Aedes aegypti in the Hemisphere as quickly as possible, so as to give effect to paragraphs 3, 4 and 5 of the Resolution quoted in the foregoing paragraph.
- 4.- To request the Director to transmit this resolution to the Member Governments of the Pan American Health Organization and to submit it to the Governing Bodies of the Organization.

CONFERENCE

(Agenda and working documents)

After concluding his opening remarks, Dr. Abraham Horwitz asked the participants to propose candidates for the positions of Chairman, Vice-Chairman and Rapporteur.

The following persons were nominated and elected:

Dr. Augusto Gast Galvis, Chairman  
 Dr. James V. Smith, Vice-Chairman  
 Dr. Jorge Zepeda, Rapporteur

The documents listed below were presented during the meeting in accordance with the agenda. The presentation of each document was followed by a period of general discussion, on the conclusion of which the resolution containing the Conference recommendations was approved.

<u>Number of document</u>	<u>Title</u>	<u>Numerical Index</u>
EA/1	The status of the <u>Aedes aegypti</u> Eradication Campaign in the Americas (Dr. V. P. Musa)	1
EA/2	The <u>Aedes aegypti</u> Eradication and Vigilance in Argentina (Dr. Julio Blaksley)	2
EA/3	The <u>Aedes aegypti</u> , its distribution and eradication in Bolivia (Dr. Luis Gamarra)	3
EA/4	The Anti- <u>aegypti</u> Vigilance in Brazil (Dr. Anibal R. dos Santos)	4
EA/5	The Vigilance Service in Chile (Eng. Julio Bascalto V.)	5
EA/6	The <u>Aedes aegypti</u> Eradication Campaign in Colombia (Dr. Augusto Gast Galvis)	6
EA/7	The <u>Aedes aegypti</u> Eradication Campaign in Costa Rica (Eng. Horacio Ruiz Soto)	7
EA/8	The <u>Aedes aegypti</u> Eradication Campaign in Cuba (Dr. Pablo Resik Habib)	8

<u>Number of Document</u>	<u>Title</u>	<u>Numerical Index</u>
EA/9	The <u>Aedes aegypti</u> Eradication in the Dominican Republic (Dr. F. A. Cabrera Polanco)	9
EA/10	The <u>Aedes aegypti</u> Vigilance Program in Ecuador (Dr. Felipe Aroca)	10
EA/11	The <u>Aedes aegypti</u> Eradication Program in El Salvador (Dr. Alberto Aguilar Rivas)	11
EA/12	The <u>Aedes aegypti</u> Vigilance Service in Guatemala (Dr. René Rafael Alvarez)	12
EA/13	Present Status of the <u>Aedes aegypti</u> Vigilance Campaign in the Republic of Honduras	13
EA/14	Status of the Eradication Campaign in Jamaica (Dr. David A. Keen)	14
EA/15	The <u>Aedes aegypti</u> Vigilance Service in Mexico (Dr. Adrián Torres Muñoz)	15
EA/16	The Eradication Campaign in the Netherlands Antilles (Dr. Michel Van Veldhoven)	16
EA/17	The <u>Aedes aegypti</u> Eradication in Paraguay (Dr. Alcides Almada López)	17
EA/18	The <u>Aedes aegypti</u> Eradication Campaign in Peru - Vigilance Service (Dr. A. de la Fuente)	18
EA/19	The <u>Aedes aegypti</u> Eradication Campaign in Surinam (Dr. Edwin van der Kuyp)	19
EA/20	The <u>Aedes aegypti</u> Eradication in Trinidad and Tobago (Dr. O. Siung)	20
EA/21	The <u>Aedes aegypti</u> Eradication Campaign in the United Kingdom Territories in the Caribbean (Mr. J. V. Davies)	21
EA/22	The United States <u>Aedes aegypti</u> Eradication Program (Dr. J. V. Smith)	22
EA/23	The <u>Aedes aegypti</u> Eradication in Uruguay (Dr. Solon Verissimo)	23
EA/24	The <u>Aedes aegypti</u> Eradication Campaign in Venezuela (Dr. Miguel Dorante)	24
EA/25	The Early History of <u>Aedes aegypti</u> Eradication (Dr. Fred L. Soper)	25