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ERADICATION OF THE AËDES AEGYPTI MOSQUITO
FROM THE AMERICAS

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I—TECHNICAL EVOLUTION OF THE CAMPAIGN

Initial Phase in the Control of Insect Vectors of Diseases

The confirmation in 1900 of the theory formulated by Carlos Finlay¹ nineteen years before the demonstration of the *Aëdes aegypti*'s role as vector of yellow fever, substantiating the discovery of Ross² a few years earlier (1898) with respect to malaria transmission by the *Anopheles*, opened new paths in preventive medicine and led us to the present-day possibilities of eradicating insect-borne diseases in man.

The control, or rather the destruction, of insects which from time immemorial have caused damage, or at least annoyance, to man was undoubtedly a matter of great concern even before these events. But no thought had been given to the role the insects played, nor had any idea been gained of how to destroy them regularly and effectively. The first initiative in the Americas was taken by William C. Gorgas (1901) in Havana, Cuba,³ immediately after the experiments made by Walter Reed and his collaborators⁴ on the American Commission, under the inspiration of Finlay. Early in that same year, in South America, in a small city in the interior of Brazil (Sorocaba, São Paulo), Emilio Ribas,⁵ who had long been concerned with the yellow fever problem, initiated the campaign against the *Aëdes aegypti* after learning of the first results of the Havana experiments, and following along general lines the same measures for exterminating the mosquito. Shortly thereafter (1903), in Rio de Janeiro, Oswaldo Cruz undertook an extensive campaign which, like Gorgas' work in Havana, was to pave the way for the initial technique for destroying mosquitoes.

The surprise caused by the revelation of the mosquitoes' role and the interest which it naturally aroused led at first to rather disordinate measures against the mosquitoes in their known breeding places, and in their alate stage when they took refuge in houses. Attention was turned to the *Aëdes aegypti* and the *Anopheles*, but an effective program was not evolved until the biology of the vectors became better known. Both Gorgas and Oswaldo Cruz, from
the beginning, undertook combined campaigns against the two vectors, and
only later did they discover that it would be easier and more economical to
combat them separately. The campaign against malaria vectors then took the
direction plotted by sanitary engineering.

After the biology of the *Aedes aegypti* became better known, the measures
taken against them were aimed at attacking them in their aquatic and alate
stages so as to exterminate them as rapidly as possible. For the first stage,
use was made of larvicide substances with a base of mineral oils, cresols, and
even potassium permanganate, as recommended by Finlay in his "plan to
abolish yellow fever." Also started was the use of mechanical means to pro-
tect deposits by hermetic sealing, caulking, or screening of openings. The use
of larviphagous fish was adopted when other measures could not be used.
Expurgation or fumigation with sulfur fumes and volatile substances were
used against the mosquito in its alate stage.

With the appearance of evidence that the *Aedes aegypti* also was devel-
oping in abandoned deposits in yards, and even in holes in trees and crevices
in plants, cleaning methods were used in such places and everything that
could collect water was removed, buried or destroyed. The fundamental
measure, however, was the institution of thorough inspections of houses and
outbuildings. In the beginning, these inspections were not carried out sys-
tematically, following set cycles according to the biology of the mosquito, such
as those later established.

In Havana and Rio de Janeiro thousands of men were recruited for cam-
paigns that were to prove memorable, launching as they did the bases for
techniques of combating the *Aedes aegypti*, which were rapidly extended to
other great cities of the Continent when the astounding results of the measures
were made known.

In the United States, the success of the campaigns in Boston, New York,
Philadelphia, New Orleans, and other cities which had been periodically at-
tacked by yellow fever, is well known. In Mexico, Veracruz was freed from
the disease, and in Panama it was the control of *Aedes aegypti* and of the
malaria vectors by Gorgas (1910) that permitted the construction of the Canal.
In South America, yellow fever disappeared almost as if by magic from all
the important sea and river ports, after the implementation of measures
against the *Aedes aegypti*.

**Phase of Expectancy and Surprise in the Campaign against**

*Aedes aegypti*

Impressed by the success initially achieved, Gorgas maintained that the
most effective method implemented in Havana was the fumigation, but he
himself was deceived as to the results of the measure in Panama. In Rio de
Janeiro Oswaldo Cruz always favored the combined attack on larvae and
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adults. The fact is that in 1908, when all the large cities in the Americas had already used the same measures, in the midst of great satisfaction and a certain lack of forethought, yellow fever ceased to be of concern to the public health authorities of the Americas and almost all action against the vector of the disease was abandoned.

The truce lasted twenty years, during which there were sporadic reports of the disease and a series of conjectures and theories were devised on how it should be controlled in the event it reappeared, such as those still being discussed in some countries. It was emphatically affirmed that a 5% index of infested houses provided complete safety against the invasion of the disease and that once the disease was destroyed at its key centers it could never again cause concern. With this idea in mind, the Rockefeller Foundation, which had devoted long study to yellow fever, took the initiative to eradicate it in the Americas by attacking it in its last strongholds, which were considered to be in Guayaquil, Ecuador, and on the east coast of Brazil, as well as the southern littoral of the Caribbean Sea. Progress was made in this period in the techniques of combating the urban vector of yellow fever, but little advance was achieved in so far as the epidemiology of the disease is concerned.

In 1928, much to everyone's great surprise and concern, an epidemic broke out in Rio de Janeiro and cases appeared also in several cities in Colombia, Venezuela, and Bolivia. The Aedes aegypti infestation in the capital of Brazil had returned, perhaps, to the figure recorded prior to the work of Oswaldo Cruz, and the problem was much worse, as the city was triple its former size. It was a difficult trial for those responsible for public health in Brazil, and the losses suffered by the country were enormous. Within a few months, a veritable army of thousands of men was mobilized to attack the Aedes aegypti in all its life phases and as quickly as possible. All measures previously at command were put into action, some of them in an exaggerated proportion and with a certain amount of disorganization and near panic brought about by the unexpected event. The use of fumigation was abused in the attempt to prevent the appearance of new cases. But the disease persisted for almost two years, despite all efforts to extinguish it promptly. The sums of money spent would today equal tens of millions of dollars.

When the initial surprise had passed, it was seen that the former optimism had not been justified and that the calculations and conjectures regarding the extinction of the disease were not in keeping with the facts. Something was occurring that had not been taken into account, although it had been foreseen by former observers. In 1932, Soper clarified the problem when he announced the existence of jungle yellow fever in Brazil (Canaan Valley).

Phase of Revelation and Optimism in the Solution of the Problem

The discovery of jungle yellow fever gave rise to the idea of eradicating the Aedes aegypti. The results obtained in 1930 in the Rio de Janeiro cam-
campaign and those that were being achieved since 1923 by the Rockefeller Foundation in other Atlantic port cities of Brazil, such as Niterói Vitória, Recife, and Natal, led to the belief that the solution of the problem which arose with the discovery of the yellow fever virus in the South American forests would be possible only with the absolute eradication of the urban vector-mosquito of the disease, since the palliative control measures were no longer justified. With this end in view, the Brazilian Government, in 1932, entrusted the Rockefeller Foundation with responsibility for the campaign throughout the country, with the exception of the city of Rio de Janeiro, although later it too was included. This measure made possible the organization of a service which, as far as we know, has been the greatest ever to be undertaken against a communicable disease. In this respect, there was complete understanding on the part of the Government, which laid the financial and legal foundations for the campaign, utilizing thousands of persons trained and prepared in all parts of the country to serve with an organization devoted wholly to the problem. Working standards were instituted on the basis of (a) wise administration; (b) strict execution of the measures recommended by experience, with the compulsory use of petroleum in all deposits with foci; (c) organization of supplementary services to discover residual foci, as indicated by the capture of adults, a method that was being used against malaria and thereafter became essential to the evaluation of the anti-\textit{aegypti} work. With the use of these three basic measures, evidence was gained that the \textit{Aedes aegypti} could be eradicated in Brazil with a few more years of work, if certain aspects of the problem that had been disclosed by experience were solved. The first revelation was that the success of the campaign in Brazilian port cities depended upon the application of the control measures to all other localities maintaining sea, river, or land communication with such cities, necessitating an extension of the work to the suburbs and later as far into the rural areas as \textit{Aedes aegypti} were found. There were regions in Brazil in which the mosquito had spread to such an extent, as was the case in the northeast, that it was necessary to cover such regions in their entirety, just as if they were a single “ever-increasing adjacent area.”

Another difficulty that had to be overcome was the resistance of the \textit{Aedes aegypti} egg to desiccation and, in general, to temperature biologically unsuitable to other species of the mosquitoes. This resistance, which is known to reach 450 days in the laboratory, amounts to an average of more than a year under natural conditions. This is one of the factors on which the criterion of \textit{Aedes aegypti} eradication is based, and we shall take up this point later. The campaign that was proceeding in Brazil under the guidance of the Rockefeller Foundation was not limited to that country alone. It was extended to Bolivia, Paraguay, Peru, and Colombia, giving the same good results and showing that the eradication of the \textit{Aedes aegypti} was to be considered a project no longer limited to national boundaries but rather one continent-wide in scope.

The measures adopted made it possible to extend the visiting cycles from
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the former intervals of 7 to 15 days, to one month, thereby affecting considerable economies and permitting, more than before, the execution of extensive eradication campaigns.

In 1940, an event occurred that convinced even the most skeptical persons of the idea of eradicating a species of mosquito. The *Anopheles (Mysomia) gambiae*, which, coming from Africa and discovered in 1930 by Shannon at Natal, in Rio Grande do Norte, Brazil, had been poorly combated and succeeded in penetrating a vast area of that State and of the State of Ceará, causing great epidemics of malaria in 1938 and 1939 and creating a problem that to many malariologists seemed insolvable. The vector was, however, conquered and eradicated in Brazil that year in a memorable campaign conducted under the guidance of the Rockefeller Foundation,\(^{10}\) using the same basic principles of organization and discipline and a large group of persons who had been working actively in eradicating the *Aedes aegypti*.

The strategy used against the *A. gambiae* was planned according to the living conditions that the mosquito had to adopt in order to survive and spread in northeast Brazil, these conditions being very similar to those of the *Aedes aegypti* owing to the domestic habits of the adult and its preference for small collections of water. The attack was based on the systematic use of Paris green in all collections of water, and on fumigation with a compound based on pyrethrum and carbon tetrachloride in a kerosene solution (PTQ). Repeated treatments were applied to all houses so as to eliminate the greatest number of adults possible, using a De Vilbiss sprayer quite similar to those used today in DDT sprayings. Inspection was maintained of innumerable collections of water that formed and of pools that appeared in dry river beds and were used for irrigation or for watering animals. At the same time intra-domicile captures were made in order to evaluate the results of the measures adopted. The eradication of the *Anopheles gambiae* in Brazil\(^{11}\) demonstrated that the experience acquired and the personnel employed in the campaign against one insect vector of disease could be utilized in combating other vectors, an idea that anticipated the theory of coordinated campaigns which came about with the discovery of residual-action insecticides.

The Second World War (1939-1945), with all its horrors, provided at least one benefit in making DDT known and usable. A new stage in combating insect vectors began, and a general advance was made in anti-arthropod measures in both public health and agriculture, with the improvement of techniques and the study and utilization of other substances having residual action.

As far as we know, the first use of DDT to combat the *Aedes aegypti* was made in 1945 in Bolivia, where it was applied in a 2% alcohol solution. Thereafter, it was used in Brazil and in other countries and became the basis of the so-called perifocal method, which has been employed ever since with absolute success. There can be no question as to the advantages derived from
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the use of DDT and the opportunities it has afforded of intensifying and accelerating the eradication of the *Aedes aegypti*.

With the advent of DDT the time arrived to give more serious thought to the eradication of *Aedes aegypti* on a continent-wide scale. With the withdrawal of the Rockefeller Foundation from yellow fever work, the Pan American Sanitary Bureau, which had undergone a complete reorganization in 1947, inherited the responsibility for the problem. It was evident that the point demanding first attention was the eradication campaign. On the other hand, it was realized that the program that had been under way in Brazil for a number of years could not achieve complete success unless the country's frontiers and ports were fully protected against constant *Aedes aegypti* reinfection. It became essential to pursue on a continental scale the work that had been done within the country. In other words, an attempt had to be made to extend the campaign to neighboring countries, all countries with which communication was maintained, until the threat of reinfection disappeared. This was what Brazil proposed to the Directing Council of the Pan American Sanitary Organization at its meeting in Buenos Aires in 1947, where the following decision was taken:

"1. To entrust to the Pan American Sanitary Bureau the solution of the continental problem of urban yellow fever, based fundamentally on the eradication of *Aedes aegypti*, without prejudice to other measures which regional circumstances may indicate, and

"2. To develop the program under the auspices of the Pan American Sanitary Bureau, which, in agreement with the interested countries, shall take the necessary measures to solve such problems as may emerge in the campaign against yellow fever, whether they be sanitary, economic or legal."

**Decisive Phase for Continent-Wide Eradication**

To carry out the terms of the Directing Council's decision, the Pan American Sanitary Bureau has endeavored to use all possible means to promote and intensify the campaign in all affected countries, coordinating efforts to facilitate and hasten its success. It was principally DDT that brought that goal within reach, but a technique based on the use of that insecticide had to be evolved so as to achieve the desired results within the shortest time and at the least possible cost. From the very beginning DDT proved most effective against the *Aedes aegypti*, but some time was lacking before the necessary norms and technical details could be established to standardize the work.

DDT, used as a larvicide merely to substitute for petroleum, would have done little to advance the campaign. It was apparent from the start that DDT could be used systematically, because of its innocuousness to man in recommended dosages, in deposits with or without water as a protection against new
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foci, a protection achieved previously through complicated mechanical processes.

This method facilitated the use of the insecticide, since the worker had only to carry a container with the solution, emulsion, or suspension of DDT at 3 to 5% in order to make the application, but it has the disadvantage of attacking the mosquito only in its larval stage, thereby making little use of the residual action of the insecticide, for the organic matter usually found in home water deposits tends to reduce and even to eliminate its residual power. It was felt that the over-all application to the inside surface of dwellings, a method used in combating malaria vectors and certainly capable of eliminating all possibility of the *Aedes aegypti*'s survival, particularly when DDT is applied also to all the dwelling's containers would be too expensive and time-consuming in a campaign that, owing to its very nature, should be intensive and rapid. Therefore, preference was given to a process that was not so extensive or so expensive but could give effective results by using measures adapted to the biology of the *Aedes aegypti*. It was thus decided that DDT should be applied in solution, emulsion, or suspension of from 3 to 5%, using a small sprayer, to both the outside and inside of all deposits, with or without water, and to a section of the nearby wall, so as to eliminate the existing foci and prevent the formation of other foci by destroying the female adults seeking to lay their eggs. This simple and economical method, which we call perifocal because it reaches the *Aedes aegypti* in their microclimate, was adopted by the Pan American Sanitary Bureau beginning in 1948, after confirmation of its effectiveness in the field.

Experience has demonstrated that with the perifocal method:

(a) one well-applied DDT treatment eliminates the *Aedes aegypti* from small localities (less than one thousand houses) where, generally, there is no problem of hidden foci or foci difficult to reach; (b) normally, two DDT applications during a year are sufficient to solve the problem in average localities (from one to five thousand houses); (c) four carefully made applications of DDT to all infested points in a large city (over five thousand houses) at intervals of three months, are sufficient to free it from *Aedes aegypti*.

Phase of Perfecting and Evaluating the Technique

In the succeeding phase, an effort was made to adapt the campaign to new working standards developed with the use of DDT, taking the greatest advantage possible from the experience derived from petroleum. Since the action of DDT as we have used it provides safety for at least three months, it was possible to extend the minimal visiting cycles to that period, thereby effecting considerable economies in the campaign. Moreover, as the insecticides came to be used systematically in all deposits, with or without water, providing an even greater margin of safety, it was possible also to make a considerable reduction in the complementary services concerning closed and uninhabited

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dwellings, and to almost discontinue the special inspection of inaccessible de­
posits, control of cemeteries, and cleaning of vacant lots. Nor was it necessary

to maintain the compulsory application of the law by the use of writs of in­
fraction and fines, other than for those cases in which permission was not
given to make house inspections and appropriate applications of DDT.

Other measures that have gained even greater importance with the use of
DDT are the search for breeding foci difficult to reach, making captures that
lead to such foci, and the compulsory use of the capture method as the final
word in proving the eradication of the species in urban areas.

Another important modification that did much to simplify former ideas
in this regard, was in the method of determining indices, which formerly were
in every third house in all city blocks in the locality, whereas today it suffices
to check every third house until the first positive one is found in each block.
In small localities in rural areas it is sufficient to find one focus in order to
determine what measures should be taken to eradicate the Aëdes aegypti.
The new system adopted in this regard does not permit learning the degree
of infestation, but it is sufficient to serve as a guide for using DDT.

With the reduction of the complementary services and practical discon­
tinuance of the special services, the number of forms used to record data and
to note down the measures taken was greatly decreased. From the more than
one hundred forms used previously, less than ten essential ones are now being
utilized.

Requirements that have not been relaxed but have been made even more
rigid are those referring to the use of sketches and itineraries to direct the
work in the field, to the need for demarcating work areas for each inspector,
and, particularly, to the repeated and timely check work carried out not only
by the chief inspectors but also by the chief or director of the campaign. The
requirements also stand with respect to the use of flags to indicate the presence
of an inspector or chief inspector in the house being worked and, in addi­
tion, the field personnel still must use uniforms to facilitate their work and
to permit their ready identification.

After some years of experience in campaigns based on DDT, it was pos­
sible to formulate standards governing techniques and evaluation of results,
these being contained in the "Guide for the Preparation of Reports on the
Aëdes aegypti Eradication Campaign in the Americas," distributed by the Pan
American Sanitary Bureau in January 1954. This Guide describes the two
basic reporting forms, a monthly one containing data for publication in the
Bulletin of the Pan American Sanitary Bureau, and a quarterly form show­
ing data on the initial and the present conditions in all localities found with
Aëdes aegypti in each country. With such data it has been possible to evalu­
ate correctly the results of the anti-aegypti campaign in the countries and ter­
ritories where work is under way. A direct appraisal of the activities is made
by advisers and inspectors maintained by the Pan American Sanitary Bureau in the countries to instruct the local personnel and to follow up and intensify the work.

The culminating result of the use of the aforesaid standards and of the experience we have gained with the development of the anti-aegypti campaign in the Continent, is the criterion established for proving the eradication of the mosquito, which, along general lines, can be described as follows: Taking as relevant factors the average period that the mosquito egg resists desiccation, or about one year, and the probable duration of the residual action of DDT, estimated at three months, it has been proved that it is necessary to repeat the examination of the results in cycles, according to this residual action and within the average period that the egg is resistant. This procedure has in view to discover possible flaws in the techniques used and to permit greater reliability in the data presented, especially when the last examination is confirmed by search for capture of adults at the time the search for foci is made, in accordance with the standards adopted.

The eradication criterion for urban areas where the Aedes aegypti finds all conditions favorable to survival should be as rigorous as possible, and there should not be less than two consecutive negative checks, through search for foci and for capture of adults, so as to confirm the absence of the mosquito for a period of at least one year after the last focus or the last adult was found.

In rural areas where living conditions are usually very precarious for the Aedes aegypti and there are no problems concerning breeding places difficult to reach and ovular resistance can be overcome relatively easily, eradication should be confirmed after a negative check by foci search in the total number of houses at least one year after the last focus was found in the area.

Taking into account the data that are presented by the various countries and the direct appraisal of the field work, a period evaluation is made of the results obtained in the anti-aegypti campaign in the Americas, with a view to intensifying and improving it and to proving the eradication of the species according to the established criterion.

II — PROGRESS IN THE ERADICATION OF Aedes Aegypti IN THE AMERICAS

Determining Factors

The development of the Aedes aegypti eradication campaign in the Americas dates back to the period when it was recognized that the solution of the urban yellow fever problem depended on the total elimination of the mosquito and not only on control measures to keep it within the so-called safety index of 5% of infested houses in the locality.
The initial technique of destroying mosquitoes was established early in this century by Gorgas in Havana, Cuba, and by Oswaldo Cruz in Rio de Janeiro, Brazil, after Walter Reed had confirmed Carlos Finlay's theory. The technique was based on control of the *Aedes aegypti* in its alate stage by means of fumigation and the elimination of foci, by protecting home containers and destroying useless or abandoned containers. This method prevailed until 1915, when the Rockefeller Foundation became interested in the problem, hoping that, on the basis of the results obtained in large seaport cities considered to be key centers of the disease, eradication of yellow fever throughout the Americas could be achieved.

By 1930 great progress had already been made in the techniques of controlling the *Aedes aegypti*, directed at their aquatic phase, with the creation of the so-called complementary services to adjust the work to certain biological peculiarities of the mosquito. Moreover, the domiciliary capture of alates had come into use as a means of directing the search for breeding foci that were hidden or difficult to reach, and of ascertaining conditions in the work area. The need was also recognized to extend the anti-*aegypti* work to all localities linked by land, sea, or river communications, as well as to intermediate localities into which the mosquito could penetrate by being transported in vehicles, carried in larval form in containers, or by its own flight.

With the discovery by Soper in Brazil (1932) of jungle yellow fever, it seemed evident that, if complete protection was to be afforded to urban populations, the solution of the problem depended on absolute eradication of the *Aedes aegypti*. It was then that the Rockefeller Foundation established with the cooperation of the Government of Brazil an organization that permitted the development of a systematic and intensive campaign against the *Aedes aegypti*, based on the compulsory use of petroleum in all containers with foci, and on technical and administrative principles which served as an example for other campaigns against this and other insects organized in Brazil and in other South American countries, and which still serve us as a guide in the continental *Aedes aegypti* eradication campaign. As the work was carried on by the Rockefeller Foundation until 1940 and thereafter under the exclusive direction of the Government in Brazil, the mosquito was eliminated in vast areas covering some three million square kilometers, thereby reducing to a third the problem of *Stegomyia* infestation in that country.

Good results were obtained also in Bolivia, Colombia, Ecuador, Paraguay, and Peru in campaigns conducted under the auspices of the Rockefeller Foundations until 1940, when that institution withdrew from its participation in the problem.

With the advent of DDT, the idea of eradication grew in scope, commanding attention no longer on a nation-wide but on a continent-wide scale. In September 1947, the Directing Council of the Pan American Sanitary Or-
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ganization, meeting in Buenos Aires, on the proposal of Brazil, approved a resolution entrusting the Pan American Sanitary Bureau with "the solution of the continental problem of urban yellow fever, based fundamentally on the eradication of Aedes aegypti."

Since 1947, the Pan American Sanitary Bureau has expended all possible efforts to promote and intensify the campaign in all affected countries, establishing cooperative agreements to assist them by providing personnel and material, for which purpose it has had the cooperation of TA/WHO, UNICEF, and the Institute of Inter-American Affairs.

The strategy adopted for the continent-wide campaign, planned according to circumstances and to meet the more urgent needs in countries that had done little or nothing against the Aedes aegypti, was aimed initially at protecting the areas most threatened by an invasion of the jungle virus in South America, and later in Central America and Mexico. The attack was then directed to the sources of spread of the mosquito in almost all islands of the Caribbean, there remaining now to be undertaken the final phase of expansion and extension of the campaign to all areas of the Americas where the aegypti finds conditions favorable to survival.

Panoramic View of the Problem

The progress made in the Aedes aegypti eradication campaign in the Continent is reflected in the attached map, based on reports until December 1954 and on first-hand observation of the problem in each country. The results can be summarized as follows:

South America: The vast area in the eastern and northeastern part of Brazil treated for many years with petroleum, was shown in 1952, after four years of systematic DDT work, to be almost completely clean, and only the final checks are lacking to prove eradication of the Aedes aegypti throughout the country. The problem in Brazil, because of the country's area and existence of conditions favorable to the mosquito, undoubtedly represented one half of the problem in the Continent. Bolivia, in 1948, was the first country to be freed of the mosquito, French Guiana followed in 1952. Chile, Ecuador, British Guiana, Paraguay, Peru, and Uruguay, in that region of the Continent, are in the final stages of eradication. Argentina is now organizing a nation-wide campaign. In Colombia and Venezuela the work continues and is being intensified in Venezuela after the recent jungle virus threat. Surinam is the only part of South America where the campaign has not yet been started.

Central America: Subject to the results of the last checks now being made, Panama, Nicaragua, Costa Rica, Honduras, and British Honduras can be considered to be in the final stages of their campaigns. The campaign was intensified recently in El Salvador and Guatemala and the final stage should be reached next year. The Aedes aegypti is considered to be eradicated in
Areas in which *Aedes aegypti* is still present

Areas declared receptive to yellow fever by U.S. Public Health Service

Areas in which *Aedes aegypti* is no longer found

Progress of *Aedes aegypti* eradication campaign as of 31 December 1954
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the Panama Canal Zone (U.S.A.), although no statistical data are available to corroborate this fact.

**Greater Antilles:** Generally speaking, the situation in these islands is still not satisfactory. Cuba, where the idea of combating the *Aedes aegypti* originated, is quite infested as was revealed by the first results of the campaign initiated in March 1954. In the Dominican Republic the situation is better in the interior than in the capital, where it has not yet been possible to apply all the necessary measures. Nor has Haiti succeeded in developing a rapid plan of work. Jamaica is still infested, but measures are being taken to improve the campaign. Good results are being obtained in Puerto Rico with the measures adopted to accelerate the eradication of *aegypti*.

**Lesser Antilles:** In most of these small islands the campaign was initiated recently and there is a trend to extend it to the others. They include thirteen archipelagos, in ten of which *Aedes aegypti* work is already being conducted, although not always in satisfactory fashion. With respect to the spread of the mosquito, Trinidad, Tobago, and the Netherlands West Indies (Curacao, Aruba and Bonaire) are the most important points and they are now adopting measures that should result in the speedy elimination of the *Aedes aegypti*. In Trinidad an outbreak of yellow fever occurred last year, when the virus invaded Port-of-Spain, producing *Aedes aegypti*-transmitted cases, a fact that had not occurred in the Americas for over twelve years.

**North America:** In Mexico, the campaign that had been interrupted in 1953 was resumed in 1954. There are large infested areas in that country, particularly in the Yucatan Peninsula and along the Atlantic and Pacific coasts. It is expected that the recently initiated malaria-eradication campaign, with the application of DDT to large areas where the two problems coexist, will contribute much toward eliminating the *Aedes aegypti*.

Special reference should be made to the United States, the only country that has not initiated an *Aedes aegypti* eradication campaign. Ponderable reasons, some acceptable, others unjustifiable, have been postponing the start of the campaign in this country, which is in a position to carry it out quickly and brilliantly. The problem has more of a psychological basis and is difficult to solve from a political viewpoint. In view of the vast area considered as yellow-fever receptive by the Public Health Service, an area that includes part or the total territory of eighteen states in the south of the country, the task would be a difficult one to undertake, particularly in its initial stage, but there are many factors that tend to facilitate the campaign. Among them we can point out the interest being shown by the Communicable Disease Center and the willingness of the Government to make a study of the problem next year, beginning at the important seaports.
### Extent of the Problem and Cumulative Results of the Anti-Ae. aegypti Campaign in the Countries and Territories of the Americas Through June 1955 or Latest Reported Month*

<table>
<thead>
<tr>
<th>Country or Territory</th>
<th>Reported month</th>
<th>Extent of the problem in square kilometers</th>
<th>Preliminary survey</th>
<th>Total treated</th>
<th>Post-treatment inspection</th>
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* Bermuda, St. Croix (U.S. Virgin Islands) and Panama Canal Zone state that A. aegypti has been eradicated from their territories. Montserrat, Redonda and Sombrero in the Leeward Islands, St. John and St. Thomas in the U.S. Virgin Islands, and Dominica in the Windward Islands are carrying out campaigns but no reports are available. A. aegypti is present but no campaign has yet begun in the United States, Bonaire, Saba, St. Eustatius and Southern St. Martin in the Netherlands Antilles; Guadeloupe, Desirad, Les Saints, Maria Galante, St. Bartholomew and Northern St. Martin in the French Antilles; and Anegad, Jost Van Dyke, Tortola and Virgin Gorda in the British Virgin Islands.

** Information not available.
ERADICATION OF *Aedes aegypti* FROM THE AMERICAS

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- **Initial Stage**
- **Campaign in Progress**
- **Campaign Interrupted**
- **Campaign in Final Stage (as of beginning of final checks)**
- **Eradication Considered Completed**
## Status of the *Aedes aegypti* Eradication Campaign Based on the Use of DDT

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- **Initial Stage**
- **Campaign in Progress**
- **Campaign in Final Stage (As of beginning of final checks)**
- **Eradication Considered Completed**
ERADICATION OF AÈDES AEGYPTI FROM THE AMERICAS

Evaluation of the Campaign

In the first three columns of the attached table an attempt is made to evaluate the extent of the problem in each country, on the basis of knowledge of the areas presumed to be infested since they present conditions favorable to the Aedes aegypti, as compared with the total area of the country and the already inspected area in which the activities were carried out, figures for the latter being given in the other columns of the table.

To show the evolution of the Aedes aegypti eradication campaign in the Americas, we have presented one chart including all the countries and another for the non-self-governing territories. As regards the number of countries and territories undertaking this work, it can be seen that, from 1948 to 1954, the number of countries rose from 4 to 20 and that of territories from 0 to 14 in 1954 out of a total of 18 territories. Thus, only one country and four territories are still lacking to complete the effort that sooner or later will bring about the continental eradication of the urban vector of yellow fever in the Americas.

Indeed, the campaign is showing constant improvement, being pursued according to the standards derived from former experience with the use of petroleum, now much more simplified through the profitable use of DDT, with the result that all the work is done with greater speed and economy.

The strict application of the standards set forth in the "Guide for the Preparation of Reports on the Aedes aegypti Eradication Campaign in the Americas," published by the Pan American Sanitary Bureau in January 1954, and the adoption of the criterion for proving eradication, provide a good basis for confidence in the results that are being recorded. Eradication cannot be regarded as proved before a period of at least one year of absence of Aedes aegypti, during which three negative checks have been made, the last of these accompanied by the search for capture of alates. In rural areas where there is little possibility for the mosquito to resist the action of DDT, a single check made after one year can be accepted, so long as the check includes all the buildings in the area.

The final word in declaring the Aedes aegypti to be eradicated in a country or territory would certainly have to be given by the Pan American Sanitary Bureau, which reserves the right to have supplementary checks made directly under its supervision. This is what has just occurred in Paraguay, where, in the presence of the campaign adviser, the final check was made in spots where there was still some possibility of finding Aedes aegypti in Asunción, once one of the most highly infested cities in the Continent and today completely free, as is the rest of Paraguay. The countries in which the final check is next to be made are: Chile, Ecuador, Peru, Uruguay, in South America; and Panama, Nicaragua, Costa Rica, Honduras, and British Honduras, in
Central America. In the near future Brazil also will require this final check to be declared free from the *Aedes aegypti*. There is a thorough understanding on the part of the public health authorities in this respect, because the Pan American Sanitary Bureau, as an organization belonging to all countries of the Americas, utilizes for its activities technical personnel of various nationalities, in a practical demonstration of Pan-Americanism.

REMARKS

As was the case in the past with yellow fever and even more so after the revelation of the *Aedes aegypti's* role in transmitting the disease, only the presence of the virus or the immediate threat of it has been able to arouse those responsible for the protection of exposed populations, causing real panic and the adoption of emergency measures that no longer are compatible with the attitude that should prevail with respect to prevention of communicable diseases. For, unfortunately, even today not every one is convinced that eradication of the *Aedes aegypti* affords the only effective protection to all the Americas against the menace of jungle virus. Vaccination, which since 1937 has proved to be an excellent measure for protecting populations threatened by the jungle virus, does not provide complete safety, since it does not reach everyone and it is not economical because it requires periodic repetition.

The great advance made in the campaign in South America and now also in Central America was to a large extent brought about as the result of jungle yellow fever epidemics that occur frequently in the first region and that, in 1948, became a source of concern in the latter, for since that date the jungle virus has been appearing in sporadic outbreaks and its northward advance arrived at the Honduras-Guatemala border last year.

The fact that not a single case of yellow fever caused by the *Aedes aegypti* has occurred in the countries that are regularly carrying out campaigns against the mosquito, can be taken as evidence of the effectiveness of the measures adopted.

A real impact was produced late last year by the outbreak of yellow fever on the island of Trinidad, from where the disease had been absent for more than forty years and where the measures against the *Aedes aegypti* had been inadequate, with the result that cases transmitted by that mosquito occurred in Port-of-Spain. Another occurrence that merits serious thought was the case of yellow fever that was transported by plane in October of last year from the interior of Venezuela to Caracas, capital of the country, causing a real panic and giving rise to extreme measures by the authorities, who went so far as to spray DDT from airplanes and to use fumigation and other spectacular measures, in an attempt to pacify the population, whose state of mind was close to that reached by the inhabitants of Philadelphia in 1793, as was so well described by J. H. Powell17 (Bring Out Your Dead).
ERADICATION OF Aedes aegypti FROM THE AMERICAS

Such occurrences should no longer take place in our times, considering the weapons we now have to combat and eradicate Aedes aegypti throughout the Continent. This objective is justified not only because the mosquito is the urban vector of yellow fever and of dengue, but also because the work represents an important contribution to cooperation and security in the field of continental public health.

With the constant increase in air traffic, no country can really be considered to be protected so long as the possibility of reinfestation by the Aedes aegypti exists, and, if for no other reason, the mosquito should be eliminated as a dangerous "export product."

In considering the progress made in the Aedes aegypti eradication campaign, we should take into account also the collateral benefits it has brought to many countries of the Americas. Suffice it to point to what happened in Brazil some years ago when, in the Anopheles gambiae eradication campaign, so much was done toward organizing the services against malaria and plague by using the personnel and technical and administrative standards of the former yellow fever service created by the Rockefeller Foundation.

In organizing the present campaign based on DDT, thought is given constantly to the possibility that, after the Aedes aegypti is eradicated, the structure can be used in establishing other campaigns against insect vectors, as is being done in Uruguay, where the anti-aegypti personnel will be utilized to combat triatomines, vector of Chagas' disease.

On the other hand, the use of DDT against malaria vectors, especially in Central America, has contributed much toward the eradication of Aedes aegypti wherever the two problems coexist. There is thus a double reward to be gained from the resolution adopted by the Pan American Sanitary Conference at its meeting in Santiago, Chile, in October 1954, which recommended the intensified use of that insecticide to eradicate malaria before the resistance to its lethal action becomes manifest. In the final analysis, the eradication of the Aedes aegypti, just as the elimination of malaria in the Americas, is a goal from which we should never again be swayed, after having reached the vantage point we now hold.

The campaign to eradicate the Aedes aegypti, with its extension to practically the entire Continent and the noteworthy results that have been achieved, can perhaps be considered as one of the greatest undertakings yet to be pursued in the field of public health, for the solution of a problem of continent-wide concern. To contribute toward this undertaking and toward the extension of its benefits in the future, with the perseverance and foresight inspired by the example of Carlos Finlay, is a source of justifiable pride for all of us who, for so many years, have devoted ourselves to this campaign.
For more than half a century the fight against the *Aedes aegypti* has been waged in the Americas, and although there have been disappointments and mistakes, there also have been the rewards of great success. For more than twenty years we have felt certain that the eradication of the mosquito is possible and for some eight years we have been engaged in this continent-wide campaign that has already solved at least two-thirds of the problem. The final success now depends, more than ever before, on what is decided in this great country.

**SUMMARY**

The first part of this paper presents a brief review of the evolution of measures to control the insect vectors of yellow fever and malaria, starting at the turn of the century with the confirmation of Finlay’s theory on the role of the *Aedes aegypti* in yellow fever transmission and the definition by Ross and Grasi of the *Anopheles*’ role as malaria vectors. Reference is made to the early campaigns of Gorgas in Havana and Oswaldo Cruz in Rio de Janeiro to combat these two mosquitoes, using the fumigation method for the alate stage and mineral oils for the larval stage, together with the protection or destruction of deposits. An account is given of how the control measures used also in other large port cities brought about the apparent disappearance of the disease in almost the entire Continent by the year 1908. Mention is made of what was done in the interval until yellow fever reappeared in Rio de Janeiro in 1928, when attention was attracted to certain epidemiological aspects of the disease, leading Soper, in 1932, to the discovery of the sylvatic aspect of yellow fever, and showing that the solution of the problem lay in the eradication of the *Aedes aegypti*. It was demonstrated, in campaigns conducted in several South American countries under the auspices of the Rockefeller Foundation, that eradication was possible with the use of technical and administrative measures based on systematic inspection of dwellings and compulsory application of petroleum to deposits containing foci.

Reference is then made to the decisive phase for *Aedes aegypti* eradication in the Americas, which began with the advent of DDT and the turning over of responsibility for the problem to the Pan American Sanitary Bureau in 1947.

It is shown how the campaign was extended to almost all the countries and territories, with the aid and collaboration of the Bureau and contributions from TA/WHO, UNICEF, and IIAA. Stress is laid on the value of the technical standards adopted, which are based on the application of DDT by the perifocal method. It is shown how these standards permitted the establishment of a criterion for proving eradication, based on the residual action of DDT and on the biology of the *Aedes aegypti*, together with a periodic evaluation made of the results, the latter being considered generally very satisfactory.
The second part of the paper presents a summary of the progress of the campaign, describing the results obtained in the various countries and territories, as depicted in the map showing the areas considered to be free as well as those still infested. Also included is a table presenting the statistical data that serve as the basis for the evaluation, together with two bar charts showing the evolution of the eradication campaign from 1948 to 1954 in the various countries and territories.

Finally, there is a commentary on certain aspects of the problem that are not yet fully understood, and the reasons are pointed out why the \textit{Aedes aegypti} eradication campaign in the Americas has not yet achieved the success that was to be expected.

**Bibliography**
