Initiation of the *Aedes aegypti* Eradication Programme of the USA

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The *Aedes aegypti* eradication programme of the USA is part of an international effort to eliminate the urban vector of yellow fever from the Western Hemisphere. The concept of eradicating the vector had its genesis in the early 1930s in Brazil, where experience demonstrated not only the practicability of eradication but the need for international cooperation to ensure the effectiveness of operations against *A. aegypti*. Other Latin American countries subscribed to the concept and initiated programmes to eradicate *A. aegypti*. Currently, as shown in Fig. 1, 16 countries have achieved eradication, and active programmes are being carried out by the remaining infested countries on the American continent and in several areas of the Caribbean.

The USA, as a member nation of the Pan American Health Organization (PAHO), concurred in the Organization's resolutions of 1947 and 1961 to effect the eradication of *A. aegypti*. During this period, the Public Health Service maintained an active awareness of the geographical distribution of *A. aegypti* by means of repeated surveys (Bradley & Atchley, 1953; Hayes & Tinner, 1958; Tinker & Hayes, 1959) and conducted a surveillance in seaport and airport areas which included dissection of arriving and departing aircraft. Also, from 1957 to 1961, the Communicable Disease Center of the Public Health Service conducted a pilot eradication project at Pensacola, Fla., to develop methodology and determine cost data which could be utilized as the basis for planning an eradication programme for the USA.

Following the PAHO resolutions of 1961, the Communicable Disease Center was requested to develop plans to eradicate the mosquito species from the USA. These initial plans were developed with an awareness of the "no-priority" status of this programme in the minds of many public officials; of the administrative problems posed by the complex relationships between federal, State, county and city governments in the USA, and of the customs and mores of the people. The prospectus was predicated on the following assumptions and considerations.

**Scope.** The yellow-fever receptive area of the USA, as designated in 1960 by the Public Health Service and WHO (*Wkly epidem. Rec.*, 1960) (Fig. 2), is comprised of 9 southern States, plus Puerto Rico, the Virgin Islands, and the island State of Hawaii. Thus the programme would ultimately affect some 40 000 000 people living in an area exceeding 500 000 square miles (1 295 000 km²). *A. aegypti* infestations, as indicated by the afore-mentioned surveys, would be mostly urban and would be found primarily in the commercial and poor residential neighbourhoods, which comprise about 20%-30% of the premises of the average urban community.

**Duration.** As indicated by the Pensacola study, eradication could be achieved in five years. This assumption was based on the premise that funds would be made available to permit concurrent initiation of operations throughout the infested region.

**Financing.** Since the stimuli to conduct this programme stemmed from national rather than State or local interests, financing would be a federal responsibility.

**Administration.** The programme would be conducted through contracts with the States involved. Each State would comprise a separate project independent of all other projects but with the Public Health Service co-ordinating and directing the total programme.

**Operational methods.** The standard methods of field operations, as adapted from the Pensacola study, would include:

(a) entomological surveys to disclose infestations and to indicate their distribution and severity;

(b) premises-by-premises inspection and insecticidal treatment of breeding-sites in artificial and

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FIG. 1
STATUS OF THE Aedes aegypti ERADICATION CAMPAIGN IN THE USA AS AT DECEMBER 1964

*ERADICATION CARRIED OUT ACCORDING TO THE STANDARDS ESTABLISHED BY THE PAN AMERICAN HEALTH ORGANIZATION*
natural water containers (DDT would be the insecticide of choice; malathion would be used in the eventuality of the species' developing resistance to DDT and in Puerto Rico and the Virgin Islands, where A. aegypti is already resistant to DDT);

(c) co-ordination of inspection work with development of premises and community environmental sanitation programmes to eliminate potential sources of breeding, such as containers;

(d) periodic reinspection and application of remedial measures until eradication is achieved; and

(e) an extensive and continuous public information programme to gain support and co-operation of the citizenry in the eradication effort.

**Manpower and equipment.** Field personnel and equipment needs were estimated under the following formula:

- **Inspection of premises:** 75 urban or 20 rural premises/man-day.
- **Insecticidal treatment of premises:** 20 urban or 10 rural premises/man-day.
- **Supervision:** 1 foreman to 8 inspectors or 12 spraymen.
- **Vehicles, sprayers and insecticides:** As needed to serve this operational force and meet its schedule of performance.

**Research.** Laboratory and field studies would be conducted continuously to improve methodology, develop alternate means of control (other insecticides, chemosterilants, and biological methods), and solve special problems that are encountered in the field operations.

Following general acceptance of the plan, funds were appropriated in the autumn of 1963 for the initiation of the programme. The Communicable Disease Center, to which the Public Health Service delegated the responsibility for achieving eradication, immediately established the *Aedes aegypti* Eradication Branch to conduct the programme. The organizational structure for the programme is shown in Fig. 3.
Under the programme plan developed by the Branch (Schliessmann, 1964; Schliessmann & Magennis, 1964), each State enters into an individual contract with the Public Health Service and therefore comprises a separate project. By this means, a State's normal autonomy is preserved within a framework that allows federal control of an essentially local operation. The Branch assigns federal personnel to State and local health departments, as needed, to co-ordinate and supervise the programme in conjunction with, and under, State and local policies; develops the methods of operations; prepares the necessary operational manuals, and issues the guiding directives; trains the inspectors and spraymen; furnishes material and supplies; provides consultation and guidance to the State programmes; conducts supportive research and studies; and maintains surveillance in the States bordering the infested area.

Each project is headed by a federal employee, the project officer, together with a permanent employee of the State health department, the project director. The project officer provides technical direction for all programme activities of his project area. The project director participates in all State programme planning and is responsible for seeing that all programme activities are carried out in accordance with State policies and in co-operation with local health departments. In the field, the supervisors are full-time federal employees, while the foremen and the inspector-spraymen are hired by the State and paid with contract funds. Thus, State employees paid with contract funds carry out the field operations.

Available funds permitted implementation of programme plans in the Virgin Islands, portions of Puerto Rico and Florida, and along the USA/Mexico border in Texas. Following negotiations of these four contracts in April 1964, field staffs were hired and trained, and inspection and spraying operations were begun in June 1964. Since success of an eradication programme in the USA is dependent on the co-operation of an informed public, an extensive public information programme was carried out in each project area. Pertinent facts were presented in newspapers, on radio and television, in handbills and posters, through the schools, before civic groups, and to Boy Scouts and other youth organizations. Also in 1964, a more intensive survey was made of the total area of possible infestation (Morlan & Tinker, 1965); and evaluation of a rapid, mechanized method of operation was begun in Louisiana, in a city with a population of 100 000 and subject to seasonal infestations.
Field personnel were recruited in each operational area and trained in mosquito biology, public relations, methods of inspection and procedures for application of insecticides, use and care of equipment, precautions to observe in inspecting and spraying, and the importance and mechanics of record-keeping and accurate reporting. In general, field operations consisted of premises-to-premises inspections and application of insecticides on a three-month cycle where DDT was used and on a reduced cycle in areas utilizing malathion. In obtaining permission to enter private property, the field personnel carried out an important public relations programme by acquainting the householders with the objective of the programme and encouraging premises sanitation.

Three men usually comprise a spray work crew: a truck driver, a hose man, and a nozzle man. The basic spray equipment is a 300-US gallon (1125-litre) power sprayer operated at a recommended pressure of 250 lbf/in² (17.6 kgf/cm²). Each unit is mounted on a 1½-ton short-wheel-base truck and carries one or two 250-foot (176-metre) lengths of high-pressure spray hose. Orchard-type spray guns are used, which can be adjusted to discharge the spray in a wide angle or a solid stream. For use in lightly infested areas and in places not accessible to power equipment, each spray team is also supplied with 3-US-gallon (12-litre) hand compression sprayers and other suitable hand equipment.

Initially, both the DDT and the malathion were applied as a 2.5% formulation. As a result of use experience, the DDT has been cut to 1.25%, with no apparent loss of effectiveness. The insecticides are applied as water emulsions to all actual and potential breeding containers and to adjacent adult resting habitats.

The scope of the first year’s activities can be seen in the following summary: office and storage space for each project and area were arranged for; some 150 federal employees and 900 contract personnel were hired, trained and assigned; 179 power sprayers and 400 vehicles were obtained and put into the field operations; and equipment and insecticides for general field use were purchased.

Operational problems have been rather nominal. Some delays were experienced in procurement of equipment and supplies and in recruitment of both federal and contract personnel. In the mainland projects, where 2.5% DDT was used initially, some ornamental fish were killed, wildlife damage was reported but not confirmed, and succulent vegetation was occasionally damaged by the xylene solution. As a result, a localized resistance by wildlife conservation groups was encountered. Many of these problems were alleviated as a result of the reduction in the strength of the insecticidal formulation, closer supervision of operations, and informational work explaining the restricted and closely circumscribed use made of DDT. Also, in view of the total objectives, concern was expressed by research groups as to whether laboratory colonies of A. aegypti would be retained.

Old automobile tires present a continuing problem. They are among A. aegypti’s preferred breeding-containers, and they frequently serve as a means by which the eggs are transferred from one place to another, sometimes for considerable distances and over State and international boundaries. These and other minor problems hold less import for the programme, however, than the new findings on A. aegypti distribution. According to results of surveys in the late pre-programme years, the distribution was thought to be mainly urban and to be centred mainly in commercial and lower socio-economic residential areas, or about 20%-30% of the average urban community. Results of the 1964 summer survey, together with data collected by operations personnel during routine inspections, showed that (1) A. aegypti breeding is widely dispersed throughout urban areas; (2) breeding inside houses, in boats, and in bromeliads, tree-holes and other unusual or unexpected places occurs more frequently than anticipated; and (3) surprisingly, there is a significant rural problem.

Despite the problems experienced by the programme, significant accomplishments were attained during the first year of operation. Considerable reductions in A. aegypti indices have been achieved in all areas, and portions of each area are now free of infestations.

Operations are to be greatly expanded in Puerto Rico, Florida and Texas, and the programme will be extended into Alabama, Georgia, Mississippi and South Carolina. A contract was negotiated with Hawaii, effective 1 April 1965, and surveys are under way there to obtain the data needed in planning operations for that State.

CONCLUSIONS

Field operations for the eradication of A. aegypti from the USA were begun in 26 locations in 1964 and were greatly expanded in 1965. Significant
reductions have been achieved, with a few areas rapidly approaching negativity. In infested areas, the mosquito breeding has been found to be more abundant and more widely distributed throughout both urban and rural areas than was anticipated. An analysis of field operations and surveys conducted throughout the yellow-fever receptive area has permitted a more precise definition of the scope of the problem and has more clearly defined the technical and logistical complexities of the operations. The surveys throughout the Mississippi River basin, supplemented by limited field operations, indicate that a large geographical segment of the yellow-fever receptive area is either free of infestations or that the mosquito is present in exceedingly small numbers. Research for the development of new or improved methodology is being continued, and field programmes will be under way in all heavily infested States by the end of 1966. Despite technical and logistical problems that have tended to delay the anticipated rate of progress, the results clearly indicate the feasibility of eradication. With continued budgetary support, eradication will be accomplished, the threat of yellow fever eliminated, and concurrent environmental improvements affecting some 40 000 000 people will be achieved.

REFERENCES

Schliessmann, D. J. (1964) Mosquito News, 24, 124-132
Schliessmann, D. J. & Magennis, N. J. (1964) Pest Control, July, pp. 34-48
Wkly epidem. Rec., 1960, 35, 429