

# HISTORY OF *Aedes Aegypti* CONTROL WORK IN TEXAS

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In 1922, Texas suffered a very severe outbreak of dengue fever, estimated to have affected a million people, including some 70 percent or more of the citizens of Galveston and Houston. In the following year yellow fever edged its way up into Central Mexico, and there was fear that it might eventually enter Texas, either by land or sea. The United States Public Health Service therefore set up *Aedes aegypti* control programs in border towns from El Paso to Brownsville, in the Texas ports, and in the city of San Antonio, since this city, which has been called the

Mexican capital of the United States, is the first destination of many immigrants from Mexico. I was placed in charge of the program from Laredo to Galveston. The breeding index of *Aedes aegypti* (i.e., percentage of premises with one or more breeding containers) was successfully brought down in most places, including San Antonio, to what we thought was a safe level of less than five percent. This was done by means of house to house inspection under the direction of a local supervisor who worked in conjunction with the local health department, and by an

extensive publicity campaign. That the results were fairly good may be judged from the fact that in early September eight cases of dengue, in widely scattered parts of San Antonio, were reported. Investigation showed that all eight worked in one block in the wholesale district of the city where there was a flooded basement, breeding *Aedes aegypti*, that had escaped the notice of inspectors, and whence no complaints had been made concerning the abundance of mosquitoes. The significant point is that not a single secondary case ever developed.

After that episode, *Aedes aegypti* control was largely neglected for nearly 20 years. With our entrance into World War II in 1942, it was felt that conditions were favorable for the possible introduction of dengue, and that if an epidemic got started it might create havoc in areas important to the war effort, either because of troop concentrations or presence of important industries. The Malaria Control in War Areas branch of the United States Public Health Service in Atlanta, the forerunner of the present Communicable Diseases Center, therefore undertook the control of *Aedes aegypti* as well as malaria-carrying mosquitoes in war areas, in conjunction with the several coastal states involved.

To make a long story short, after being approached first by the Texas State Health Department in Austin, then by M.C.W.A. in Atlanta, and finally by the Surgeon General's office in Washington, I found myself a Special Consultant in charge of *Aedes aegypti* control in the State of Texas.

Our first task was a preliminary survey to determine in what cities or areas control programs should be set up. We made spot checks of what were considered likely *Aedes aegypti* breeding areas all along the border and coast from El Paso to Orange, and also in San Antonio and a number of other inland cities, including Austin, Dallas, Fort Worth and Waco. This survey turned up some very unexpected and highly interesting facts. No *aegypti* breeding was found in El Paso, and a negligible

amount in the other inland cities except San Antonio. *Aegypti* breeding was extensive in Laredo, throughout the Rio Grande Valley, and in Corpus Christi, Houston and Galveston along the coast. In all of these places breeding indexes of from 20 to 40 percent were recorded. We found *Aedes aegypti* breeding in a spittoon in one Health Officer's office in the Rio Grande Valley while he was telling us he doubted that this mosquito was abundant in his area. To convince the Health Officer at Galveston, who was "from Missouri" and wanted to be shown, we took him on a tour of a block across the street from the City Hall, where we found a 100 percent index, with an average of about 2½ breeding containers per premise. On this survey, or subsequently, we found literally many hundreds of breeding places in containers in cemeteries, thousands in barrels of water for fire protection in cotton compresses and warehouses, dozens in water buckets in downtown stores, and hundreds more in jardineres or in containers growing plants in water in homes. In one fine home where we heard bitter complaints about nothing being done about mosquitoes breeding in an adjoining bayou (which was free of breeding), we counted 21 flower-growing containers breeding *aegypti*, plus a 3' X 5' sump in the basement which was teeming with larvae!

More striking, however, than the almost ubiquitous *aegypti* breeding in these cities was the complete or almost complete absence of it in certain other cities. Whereas some 35 percent of all the premises in Galveston were producing *aegypti*, at Texas City, 10 miles away across the bay, not a single *aegypti* breeding place was found, nor were any found at either Orange or Port Arthur. At Beaumont a half dozen of the most likely blocks in the less tidy parts of the city were negative, but a few barrels on a wharf, where the prevailing wind was fortunately away from the city, were found breeding. In contrast to Houston's city-wide index of 30 percent or more, no breeding places were found in Baytown, La Porte or ad-

joining cities on the first survey, although on a subsequent check, in late August, two breeding places in adjoining premises were found in Baytown. These and other examples of uneven distribution of *Aedes aegypti* in Texas cities were discussed in a paper some years ago (Chandler, 1945) and an explanation for it suggested. Work by Hatchett (1946) indicated that the climate of South and Central Texas, where there are alternating periods of warm and cold weather, is highly destructive to *Aedes aegypti* since in scattered small containers (secondary foci) the eggs hatch and the larvae or newly emerged adults are subsequently killed. In large or protected containers, however, such as cisterns, fire-protection barrels, indoor sumps, etc. (primary or "mother" foci), breeding can continue through the winter, and seeding of secondary foci occurs immediately upon the advent of warm weather. In the semi-tropical Rio Grande Valley "mother foci" would include a much larger range of containers than in the more northern cities. Even as far south as Beeville and Kingsville, however, the influence of cisterns was apparent. Beeville was full of them and had extensive *aegypti* breeding, whereas no cisterns or barrels were found in Kingsville and no *aegypti* breeding was discovered there. In Corpus Christi, Houston and Galveston the most important mother foci were fire-protection barrels (there were 7000 to 8000 in Galveston, and over 10,000 in Houston) and cisterns, some in the form of large overhead cypress tanks, some underground, and some in attics or basements. In San Antonio winter carry-over was not so often in cisterns as in shallow wells with brick or concrete walls and indoor water containers in areas without piped water supply, and in flooded basements, indoor water plants, etc., throughout the city.

After this preliminary survey it was decided to establish local *Aedes aegypti* control projects in Laredo, two in the Lower Rio Grande Valley (Hidalgo County and Cameron County), Corpus Christi, San Antonio, Houston and Galveston. The

State Health Department kindly established a separate headquarters for the *Aedes aegypti* work in Houston, for my benefit. With help from the State and from M.C.W.A. we selected supervisors for each of the seven projects, and arranged for office space and more or less local assistance in each area, in which the local Health Departments were very helpful. The organization thus began with local projects which were responsible to the Houston office, this in turn to the Austin office, then M.C.W.A. in Atlanta, and finally the Surgeon-General's office in Washington. Through these channels filtered all appointments, leaves, promotions, reimbursements, requests for equipment, etc., and then, after being duly pondered over, they eventually filtered down again, leaving trails of forms scattered like roses along the way.

The work of the local projects was directed mainly towards three things—education, house to house inspection, and elimination of breeding places, particularly primary foci.

The educational program was an all-out one which left no possible approach untried. This included newspaper articles; radio plugs; leaflets in Spanish and English distributed by inspectors or in schools; lectures to schools, churches, boy scouts, civic clubs, garden clubs, P.T.A.'s, etc.; poster contests in schools; and back door chatter by inspectors. Dengue became as well known as polio is today, and even some of the doctors took to diagnosing cases. We investigated an alleged outbreak in Baytown which turned out to be an epidemic of food poisoning acquired at a banquet in Houston on the night before.

The inspection program depended primarily on a small force of paid inspectors—from one and a supervisor in Hidalgo County to several dozen in Houston. Some were paid by the Public Health Service, but most of the health departments assigned, or paid for, additional men. To recruit these men in 1942, when nearly every male citizen who was able to walk and carry a gun was in the Armed Forces,

was no small job. We tried to get men who were willing to work, had enough tact and culture to talk to housewives, could learn to recognize a mosquito larva, if not an *Aedes aegypti*, and were conscientious and punctual. We had to use high school boys, men past 70, partial cripples, occasional alcoholics, and even members of the gentler sex (some of whom did excellent work). All were given indoor instruction, then sent out with a tried inspector, and by the end of about a week, if still with us, he or she went out on his or her own responsibility to assigned blocks. We had to use a system of "snoopervision" to keep some of our men from emptying beer mugs instead of tin cans, but considering all things I think the degree of efficiency achieved was quite remarkable. In some projects additional inspectional help was obtained from boy scouts, school children, and even firemen. These inspections accomplished two things—they actually got some inspections done and corrections made, and they had great educational value, not only for the children who participated, but also for the parents who heard about their experiences. In Corpus Christi all the boy scouts in the city were given preliminary training and then on one big day every house in the city was given an inspection. On our program it was never possible to make as frequent re-inspections of premises as was done in Key West, where an out and out eradication program was developed. In Key West there were a number of special details, and, I believe, regular re-inspections were made every ten days. In Houston alone this would have required the services of 600 men. However, by concentrating on the areas of the cities where the highest indexes were found, and with the cooperation of other agencies and arousal of public interest, it was possible in all our projects to reduce the initial indexes of 20 percent to 40 percent to from 1.5 to 5 percent.

In the larger cities, particularly Houston, San Antonio and Galveston, special inspectors were assigned to business areas

and establishments, and the supervisors themselves made the chief contacts with cotton warehouses, stores, etc., where barrels or buckets were in use.

Corrections were made or attempted wherever *aegypti* breeding was found, or where it could be expected. Enormous numbers of containers were turned bottoms up, or collected and disposed of (occasionally involving some difficulties for the garbage department). Old tires were slashed, burned, placed under cover, or treated with phenothiazine (DDT was not then available). Sumps and flooded basements were treated with chemicals, lily ponds were stocked with *Gambusia*; and flower vases in cemeteries and water plants in homes were treated with bits of phenothiazine—treated paper. But particular stress was laid on elimination of mother foci. Managers of stores and warehouses were made responsible for preventing mosquito breeding in their establishments, and nearly all cooperated excellently. Cisterns were eliminated wherever the owners could be persuaded to part with them, and eventually most of them disappeared. Practically all of the underground ones were sealed in, and hundreds of overhead ones were torn down. Those that were left were temporarily treated with kerosene, but eventually were mosquito-proofed with plastic screen; this screening was still in good shape when examined 8 to 10 years later.

With the end of the war, the M.C.W.A.-sponsored *Aedes aegypti* control came to an end, and those of us who had worked very hard on it during the war years waited with much interest, and I must admit with not too much optimism, to see what would happen to the indices that we had seen reduced, on an average, by about 90 percent during the war years from 1942 to 1945.

In 1945, the cities where we had operated recognized the advantages of house to house inspection over the old haphazard complaint method of detecting sanitary defects, and most of them not only saved the majority of our trained men, but added

to them, and integrated the *Aedes aegypti* inspection with the general sanitation program of the city, making inspections for sewage disposal, garbage, rat-harboring places, animal nuisances, fly breeding, etc. In Houston there is still a corps of about a dozen house to house inspectors, and a corps of four follow-up inspectors, both under the direction of men who were active in the *aegypti*-control program.

To our very great gratification, the results of our four years of work have been nothing short of spectacular. With no special effort to control them after 1945, *Aedes aegypti* almost or completely disappeared from Texas cities and areas where there had been active projects. In Corpus Christi, according to R. H. Waldrop, who was supervisor there in the latter part of the *aegypti* program, *Aedes aegypti* has been completely eradicated; the last ones found were in a junk yard in 1948. One of the most efficient and accurate inspectors under Waldrop is now Vector Control Supervisor for the Health Department in Corpus Christi. Like anyone who has once been trained to look for *aegypti* breeding places, he cannot pass a likely place without looking, but in spite of that, and in spite of a reward offered by Waldrop for any *aegypti* found in the city, none has been found, even by the P.H.S., State and local inspectors in a reconnaissance survey in 1952. Bradley and Atchley (1953) reported that *Aedes aegypti* had not been reported in Key West for two seasons and apparently had been eradicated from that island "Thus," they said, "North America has one successful eradication project to its credit." It seems evident that Corpus Christi, which had a general, city-wide, full season index of about 10 percent in 1942, which means indexes of from 20 percent to 40 percent in some areas of the city at the peak of the season, must also be included in the elite class of *aegypti*-free cities, and probably was the first one.

In Galveston, which probably had more *aegypti* breeding than any other city in the United States in 1942, *Aedes aegypti* is on

the verge of extermination. Dr. Donald Micks, medical entomologist at the University of Texas Medical Branch, doing research on mosquitoes, tells me that he has not seen a wild *Aedes aegypti* in Galveston since he arrived there several years ago, and has to rear them to get specimens for class demonstration. I think it is safe to say that when an occasional *aegypti* is found in Galveston, e.g., one breeding place in 643 premises inspected in a reconnaissance survey in August of 1952 (see below), it is probably the result of a recent importation. Conditions apparently are no longer favorable for continued *aegypti* breeding in Galveston.

The same situation apparently exists in Laredo, where breeding places are very rarely found (a single one was found in 226 premises inspected in 1952), although there is abundant breeding across the Rio Grande in Nuevo Laredo, Mexico.

In Houston a similar condition prevails. Whereas in the war years I or my students could always find *Aedes aegypti* for class use in September near the Rice Institute, for the last five years we have searched in vain in what were formerly prolific breeding places. Inspectors in the city health department who, like those in Corpus Christi, are involuntarily attracted to looking for *aegypti* in likely places, have not seen any for years. In the 1952 reconnaissance survey a 9 percent index was found in an inspection of 565 premises in August, but the inspectors were guided to the most likely places by Mr. Waldrop, who knew them exceptionally well. Such an index in a few inspections in the most likely places at the peak of the season, if compared with a city-wide index for a full year, may give a very erroneous picture of the true situation. My belief is that even in Houston, *aegypti* is not far from extermination, and might be exterminated if an effort were made to find mother foci which escaped detection in 1942-1945, or have since become established.

In 1952 C.D.C. workers in cooperation with state and local health departments

made brief reconnaissance surveys of a number of cities in the *Aedes aegypti* belt of southern United States, including many that had had wartime *aegypti* control projects. Bradley and Atchley (1953), in reporting the results of this survey, reported negative findings in Corpus Christi, Hidalgo County (McAllen and Mission), Beaumont and Beeville; 1 premise each in Galveston and Laredo; 3 in 406 premises inspected in Brownsville; and 9 percent and 12 percent, respectively, in Houston and San Antonio.

As pointed out above, taken by themselves, and particularly as compared with the full-season, city-wide breeding indexes of 1945, these high figures, particularly in Houston, are misleading. We believe that the *Aedes aegypti* breeding index is well below the danger point (estimated at 5 percent) where yellow fever or dengue could cause serious epidemics if introduced, in all Texas cities with the possible exception of San Antonio. This has occurred without any special city-wide efforts at control for the last ten years, and the evidence available indicates that the situation is likely to stay that way. We believe that the principal factor in bringing this about has been the eradication of the great majority of mother foci, and the failure of *Aedes aegypti* to persist in secondary ones in the alternating warm and cold climate of southern Texas. Education undoubtedly has also contributed, by making so many people conscious of *aegypti*-breeding places in protected places in their homes—in water-plant containers, sumps, etc.—that not enough of these exist to keep the mosquitoes going. The possible failure of almost complete elimination in San An-

tonio may be due to the special types of mother foci there, such as shallow wells, drinking water barrels, etc., in parts of the city without piped water supply, and also flooded basements, and exceptionally wide use of indoor water plants.

In retrospect, the findings in our preliminary survey in 1942, in which the widespread presence of *Aedes aegypti* was so closely correlated with the presence of extensive mother foci, should have given us more faith than we had in the ultimate success of our wartime program. And perhaps we were even more successful than we thought we were in ferreting out and eliminating the mother foci. We may look forward to sporadic late-summer outbreaks of *aegypti* breeding, resulting either from accidental introductions from outside, just as once happened in our northern seaports, or perhaps occasionally from unusually extensive survival of these mosquitoes in a particularly favorable winter season. But unless control in still-existing mother foci, such as fire-protective barrels, is relaxed, or extensive new mother foci are developed, I believe we are not likely again to find ourselves in as vulnerable a position with respect to *aegypti*-borne diseases as we were in 1942.

#### References

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