

AN HISTORICAL REVIEW OF THE LAST CONTINENTAL U.S. EPIDEMIC OF DENGUE¹

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INTRODUCTION. Although briefly mentioned in the literature (Hayes and Ritter, 1966), and frequently referred to in training courses in vector control presented by the Public Health Service (Pratt and Litig, 1969), the last epidemic of dengue to occur within the continental U. S. has remained essentially undocumented. As this episode is considered to have historical significance as well as value from the standpoint of abatement and epidemiology, it is here recounted over 25 years later, while those with first-hand information are available to provide details and interpret records.

By 1945 dengue had become a rare disease in Louisiana. In 1922, 7,561 cases were reported in the State. In 1923, 1,376 cases were reported. One case was reported in 1924, and only sporadic cases were reported thereafter.

EPIDEMIOLOGY. Dengue transmission apparently commenced in 1945 in the Welcome community of St. James Parish (county) Louisiana in the Mississippi River delta region between Baton Rouge and New Orleans in early August. It was rumored that a World War II veteran who had served in the Pacific Theatre of Operations had returned to Welcome and suffered an illness with the symptoms of dengue early in August. Subsequent efforts to contact this veteran and confirm the account were unsuccessful; however,

an assumption of the validity of this report seems warranted by the circumstances. Houses in this area were in small groups with frequent breaks (usually sugarcane fields) wider than the normal flight range of the mosquito vector, *Aedes aegypti*, and the disease spread slowly. Residents from Back Vacherie, located off State Route 20, (and possibly from Napoleonville in adjoining Assumption Parish) visited Welcome during August, and the disease appeared in that community about the first of September. Dengue remained in these isolated foci until the school vacation ended. The St. James High School opened on September 3, 1945. About two weeks later an explosive outbreak was in progress throughout the school district with the disease practically restricted to students. It was not until cases occurred in school children that the disease was reported to the Louisiana State Department of Health, September 14, 1945. Action by the Department in confirming and controlling the disease will be described following the continuation of the sequential development of the epidemic.

Table 1 shows the week of onset and

TABLE 1.—The onset of reported or suspicious cases of dengue in St. James Parish in 1945.

Week beginning	Number of cases
August 19	9
August 26	1
September 2	5
September 9	36
September 16	45
September 23	15
September 30	24
October 7	3
October 14 (last case October 19)	5
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Total	143

number of reported or suspicious cases of dengue in St. James Parish.

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Almost all of the cases that occurred during the week of September 23 were in houses where initial cases had occurred during the week of September 9, or in adjacent houses, and were largely in pre-school children and adults. This sequence fits well the intrinsic and extrinsic incubation periods of the disease.

From the inception of the outbreak in early August until mid-September, the area of concern was that portion of St. James Parish on the right (west) bank of the Mississippi River. The population was almost entirely confined to a 23-mile

stretch of the River Road from Vacherie upriver, and from that community southward for a distance of approximately 8 miles on the Vacherie-Thibodeaux highway (State Route 20). In this area there dwelled approximately 6,000 people in about 1,300 houses. Figure 1 shows the location of the epidemic areas.

Records are incomplete concerning the inception of dengue in a second area, comprising the town of Napoleonville in Assumption Parish, a 4-mile stretch of State Route 70 south of the town, and a ring of sugar plantation quarters within a 2-mile

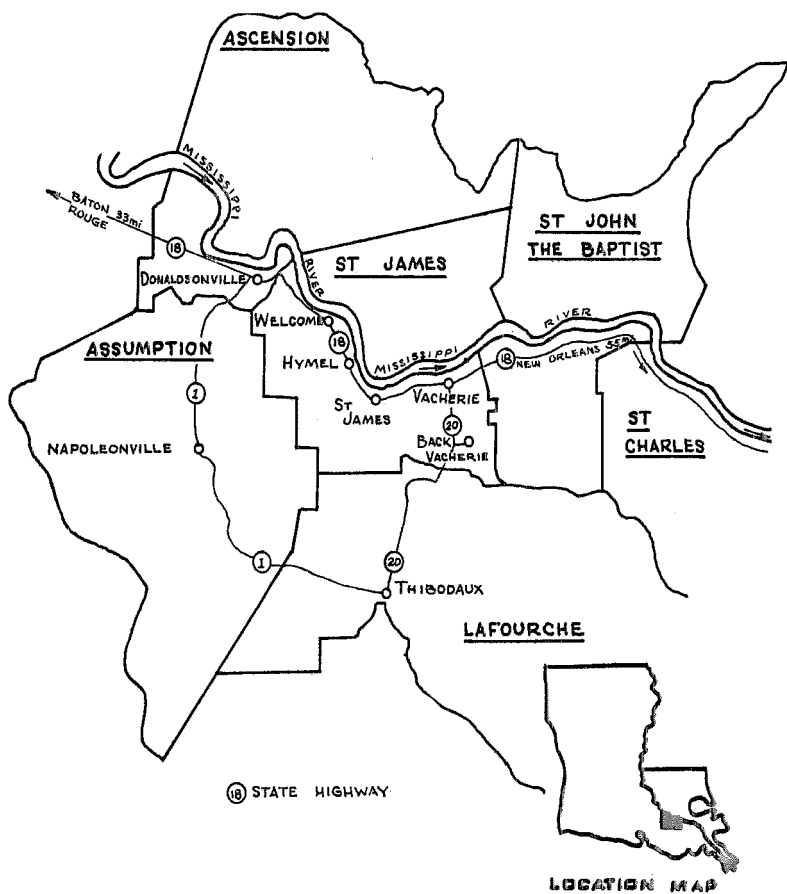


FIG. 1.—1945 Dengue Fever Epidemic, St. James Parish, Louisiana.

radius of town. The records state that cases of the illness, as in St. James Parish, apparently appeared in August, but that spread was slow until about the week of September 16, some 15 days following the opening of school. Here also, cases during mid-September were almost entirely among school children. Secondary cases involving pre-school children and adults began about October 1.

Following notification of the outbreak late on September 14, the State Department of Health rapidly took action. The Director of the Division of Preventive Medicine presented information on a reported 16 cases of dengue to the Department staff the following day. The next morning (September 17) he went to St. James Parish to conduct a personal investigation. Upon his return to New Orleans that night, he reported to the Director of the Division of Public Health Engineering, who had responsibility for control measures, that in addition to the 16 reported cases there were 6 more probable cases, between Vacherie and St. James, a distance of about 7 miles. This area contained approximately 150 homes. Up to this time and subsequently, only clinical diagnoses were made by the Director of the Division of Preventive Medicine, the St. James and Assumption Parish health officers and private practitioners in the areas affected. While no laboratory work was done to isolate virus or determine antibodies, the cases frequently presented typical clinical symptoms of dengue such as rash on the soles of the feet and palms of the hands, joint and muscle pains, fever, and intense headache.

The records list 111 reported or presumed cases for St. James Parish by October 3. This number had risen to 143 by October 19th. By early October "a number of cases" had also been observed in Assumption Parish. The records state, however, that medical treatment was not sought in either parish by a number of victims with symptoms resembling those of dengue.

Investigation by members of the State Department of Health revealed five or

more suspicious cases near Hymel about the middle of September. These were unreported as "no physician was in attendance."

An accurate assessment of the magnitude of the epidemic cannot be made. For the lack of more specific data, the epidemic has subsequently been characterized as comprising several hundred cases. This may be a reasonable estimate even without consideration of the very mild or inapparent cases.

CONTROL OPERATIONS. Following the confirmation of the epidemic by the Director of the Division of Preventive Medicine, the Director of the Division of Public Health Engineering moved rapidly to plan and mobilize for action. Approval was secured from the Officer in Charge of the Malaria Control in War Areas Program (MCWA), U. S. Public Health Service, in operation at that time in the State as a cooperative endeavor of the PHS and the State Department of Health, to use MCWA personnel, equipment, and supplies on hand, and to provide promptly additional supplies including pyrethrum aerosol bombs and phenothiazine larvicide.

The Public Health Entomologist (E. B.J.), working under the general direction of the Director and Assistant Director of the Division of Public Health Engineering, was charged with overall responsibility for formulating control strategy and directing the operations. As the *New Orleans States* pointed out in a feature story which appeared on September 26, 1945, medical history would be made in St. James Parish if State Health authorities succeeded in preventing the spread of an outbreak of dengue fever by principally using military-proved DDT and pyrethrum aerosol bombs. At this time most of those concerned with the operation had seen neither item. It is noteworthy that this proved to be not only the first, but also the last occasion to pursue such measures in the abatement of an epidemic of dengue within the continental United States.

As the control operations were being readied, the Division Director requested

the Health Officer of St. James Parish to have his sanitarian proceed immediately with inspections and contacts designed to, (1) eliminate all unneeded water containers, (2) put a cupful of kerosene in all cisterns (screening material was unavailable because of wartime shortages), and (3) arrange for publicity through churches, schools, and other means on the epidemiology of dengue and the value of mosquito control.

Organized field operations began early on September 20 in St. James Parish, and on September 26 in Assumption Parish with two aims: first, to prevent the spread of dengue outside the area already affected, and then to eliminate the disease within the area involved.

To prevent undue alarm among the affected population, activity was kept as normal as possible. Some health authorities could remember and others knew from the records that a mass exodus invariably resulted from a yellow fever epidemic in southern Louisiana. Accordingly, they now endeavored to keep the population in place to lessen the likelihood of establishing new foci of infection. Wartime gasoline and tire rationing and the absence of many young men who were still on active military duty doubtless aided this effort considerably. Places of assemblage such as schools, churches, and theatres were given a residual spraying with DDT and kept in operation.

To stop the spread of the epidemic, a break in the continuity of housing of 1,000 feet or more at the periphery of the affected area, a "cordon sanitaire," was selected as a starting point. Sugarcane fields provided this interruption in housing. From such a point work was directed toward the center of the epidemic area. The point selected first was in the vicinity of Vacherie, as a number of cases of dengue were reported from there, and the population was greater than elsewhere in the affected area. As soon as possible thereafter, starting points were established on the remaining two avenues of entry into the epidemic area of St. James Parish. Work in Assumption Parish followed the same

principles. Thus, circumscribing belts 2 miles wide were completed on October 1 wherein each house received insecticidal treatment designed to break the chain of dengue transmission by killing adult and larval *Aedes aegypti* and slowing reinfestation by the vector.

Two types of crews were used. One type (inspectors) concentrated on searching for cases of dengue and for *Ae. aegypti* and made some selective insecticidal treatments. The other group (sprayers) applied a residual spray of DDT to the interior of all dwellings as well as locating and eliminating larvae. The inspectors were able to cover the area more quickly than the sprayers, as less time-consuming work was performed at each premises and logistics proved less of a problem. Both groups began work in the circumscribing belts, completing these before moving into the enclosed, infected area.

Inspectors traveled quickly to all premises. They inquired as to illness, and when they found any that could be dengue, they sprayed the interiors of the affected and adjacent houses with aerosol bombs containing pyrethrum. The aim was to kill quickly all adult *Ae. aegypti* that might be infected. At the same time, the premises were checked thoroughly for all possible places where *Ae. aegypti* could breed. Discarded containers were disposed of or destroyed when practicable, and other sites were treated with kerosene or phenothiazine. The householders were asked to cooperate by re-treating sites, especially cisterns, twice each week with a small quantity of kerosene.

Sprayers, beginning in the circumscribing belts, applied a residual spray of DDT (subsequently estimated to approximate a rate of 200 milligrams per square foot of wall surface) to the interiors of all houses, their porches and privies, and to certain public buildings. The places of public assemblage were treated first. Crews sprayed weeds and shrubbery near houses and the area beneath them with a pyrethrum larvicide in order to reach hidden breeding sites. They also searched premises for *Ae. aegypti* breeding and treated

all active and potential producing sites.

After a 2-week period premises were systematically re-inspected. The same procedure was followed as on the initial inspections.

On the initial inspection in St. James Parish *Ae. aegypti* breeding was found on all of the 1,283 premises searched, and adult vectors were very numerous. Almost every premises had one or more cisterns, all but one of which was breeding *Ae. aegypti* (Figure 2).



FIG. 2.—Wooden cistern, a major breeding site for *Aedes aegypti*.

Initial inspections were completed and nearly half of the premises had been re-inspected by October 26 in St. James Parish. On the re-inspections no adult mosquitoes could be found, and larvae were located on approximately 5 percent of the premises, perhaps a critical index.

Residual spraying with DDT proceeded more slowly than inspection for several reasons. Local labor was scarce; hence labor, as well as materials, had to be brought in from New Orleans. The

houses, especially on the sugar plantations, were large, many with over 10 rooms. Many houses had fine furnishings, requiring slow and careful work. By October 10 all houses in the circumscribing belts in St. James Parish had been treated, and the addition of more labor speeded the "mopping up" operations within the infested area.

While the records are less complete for Assumption Parish, they do disclose that work in that area kept pace with that in St. James Parish. An interim report shows that by October 3, the premises inspected in Assumption Parish trailed St. James by 232 to 336; however, the premises receiving residual DDT spraying led by 240 (with 1,185 rooms) to 131 (with 814 rooms). Re-inspections in Assumption Parish also disclosed excellent control of *Ae. aegypti*.

RESULTS. No cases of dengue occurred beyond the areas originally affected in St. James and Assumption Parishes. In the 2-mile circumscribing belts, no cases occurred with onset more than 2 days after the premises were inspected and treated. New cases continued to occur, however, within the interior of the affected area on premises not yet treated. The continued occurrence was sometimes explosive. One physician referred the inspection crews to 17 cases during one day. When a section was completely inspected and treated, new cases of dengue ceased to occur. The onset of the last case reported in Assumption Parish was October 4, the last in St. James Parish was October 19.

Previous epidemics of dengue in this area were terminated by the death of infected *Ae. aegypti* as a result of the first killing frost of the season. Climatological records for nearby Reserve, Louisiana, for the 30-year period previous to 1945 disclosed that the average date of the first killing frost was November 28, and the earliest date on record for the 30-year period was October 25. To insure against dengue transmission recurring, inspections and DDT residual spraying were continued until November 6. From that date until November 19 in Assumption

Parish, and December 4 in St. James Parish, the parish health unit sanitarians continued to make routine inspections for *Ae. aegypti*. Renewed breeding was not found in either parish.

In an operational report dated October 26, 1945, the Public Health Entomologist stated that it seemed obvious that the spread of dengue to areas outside those originally affected had been prevented, and that there was good evidence that the disease had been eliminated within the affected areas. This proved true.

DISCUSSION. As far as the authors can determine, this was the first occasion in which an epidemic of dengue in the continental U. S. was halted before a killing frost. As previously noted, the onset of the last case of dengue was October 19. The first killing frost occurred after November 20 in 1945.

Yellow fever epidemics have been halted when control measures lowered the *Ae. aegypti* index (percentage of inspected premises found breeding) to 5 percent or less (Strode, 1951). Usinger (1944) reported, however, that achieving an index below 5 percent was necessary to terminate transmission of dengue in the 1943-44 epidemic in Honolulu, Hawaii. Gilbertson (1945), reporting on the same outbreak, generalized that the critical index—"index of sanitary significance"—for den-

gue transmission may be lower than the generally accepted 5 percent for yellow fever. In the Louisiana experience dengue transmission apparently ceased when the premises index was reduced to 5 percent.

The methods and materials used proved exceptionally effective. The experience gained might be of great value if dengue again invaded the mainland U. S. and became established. The insecticides used, with the exception of DDT, would be considered to present a minimum hazard to the environment in light of present sensitivity in this area. Other insecticides which are much less persistent than DDT, but sufficiently persistent to replace it in this application, are now available should they be needed.

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See page 359 for information on AMCA bulletins