

## EPIDEMICS OF MOSQUITO-BORNE ENCEPHALITIS IN THE UNITED STATES, 1960-1965

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It is the purpose of this paper to summarize the human epidemics chronologically, and give an overall summary of highlights for the period.

The year 1960 was characterized by a sparsity of human arboencephalitis. No discrete outbreaks of the disease were recorded.

In 1961, the only discrete outbreak was the episode of urban St. Louis encephalitis (SLE) in the Tampa Bay area of Florida. This epidemic of 25 cases and 7 deaths represented a recurrence of the disease in the area, since Florida's first major outbreak of St. Louis encephalitis occurred in the same area in 1959. One point of interest was the lateness of the outbreak; it started in early October and extended into December (Waters *et al.*, 1963).

During 1962, there was one large epidemic of encephalitis in the United States, again, urban St. Louis encephalitis in the Tampa Bay area—the third and the largest episode in the area in a 4-year period. There were 222 confirmed cases and 43 deaths (Bond *et al.*, 1965). The case fatality rate of approximately 20 percent was one of the highest on record for the St. Louis virus. This undoubtedly was influenced by the prevailing age of the population. The St. Louis encephalitis virus shows a predilection for older people; and according to the 1960 United States Census, St. Petersburg (where all 3 human outbreaks began) is the Number 1 city in this country for elderly people—i.e. 28 percent of its population are age 65 or over. A significant finding was the demonstration that *Culex nigripalpus*, a tropical mosquito, is an important vector of urban SLE. There were 40 isolations of

the virus from this species (Chamberlain *et al.*, 1964; Dow *et al.*, 1964).

In 1963, the only recorded human outbreak was western encephalitis (WE) in the High Plains area of West Texas. In Hale County there were 26 confirmed cases of this disease (Tipton, 1966). It is of interest that the western virus had been quite active enzootically in Hale County every year since 1959, but there was no apparent spillover into the human population until 1963. Unusually high infection rates were found in *Culex tarsalis* in 1963. For example, half of the *C. tarsalis* pools collected in Hale County from August 18 through 24 were positive for the western virus (Hess, 1966).

The year 1964 was a record-breaker for droughts, and it also broke records for widespread dispersion of urban St. Louis encephalitis. The two largest outbreaks of SLE occurred in Houston, Texas, and the Camden area of New Jersey. Outbreaks of lesser magnitude occurred in Memphis, Tennessee; Danville, Kentucky; McLeansboro and Alton, Illinois; and Evansville, Indiana. There were mixed outbreaks of rural SLE and western encephalitis in the High Plains area of Texas and in eastern Colorado. During 1964 the first recognized epidemic of California encephalitis was reported.

Houston's first recognized epidemic of arboencephalitis included approximately 300 valid cases of SLE with 19 confirmed deaths—a fatality rate of about 15 percent. The largest number of cases and deaths occurred in lower socioeconomic areas. There was a preponderance of cases among males, and among Negroes the attack rate was twice as great as among whites. The SLE virus was isolated from 22 pools of *Culex pipiens quinquefasciatus* (the southern house mosquito) and from four birds: bluejay, pigeon, domestic goose.

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and mockingbird. The highest incidence of SLE antibodies was found in the house sparrow, pigeon, bluejay, and mockingbird. It was postulated that permanent resident passerine birds were the principal source of the virus (Anon. 1965).

The outbreak of urban SLE in the Camden-Philadelphia area was unique in that it constituted the first record of SLE virus for any State east of the Alleghenies with the exception of Florida. The occurrence of a major epidemic of SLE at 40° north latitude was quite unexpected. The outbreak involved 115 cases and 10 deaths (94 cases with 8 deaths in New Jersey). The majority of cases—nearly two-thirds of the New Jersey patients—occurred in females over 40 years of age. The SLE virus was isolated from five pools of mosquitoes, of which four were *Culex pipiens* (Goldfield *et al.*, 1965).

In addition to urban SLE, rural SLE activity was recognized in two areas—Hale County, Texas, and eastern Colorado. This activity involved also the western virus. In Hale County there were 7 confirmed cases of St. Louis encephalitis and 24 of WE (USPHS, CDC, 1965). In Colorado, there were 25 confirmed cases of SLE and 14 of WE (Mollohan, 1966). With respect to the western encephalitis in Hale County, the attack rate for Latin Americans was over 3 times as high as for Anglo Americans.

One of the most exciting events during 1964 was the recognition of an epidemic of California encephalitis in the United States. This epidemic, which was centered in Ripley County, Indiana, included 12 serologically confirmed or presumptive cases, all in children 16 years of age or below (Marshall, 1965). In retrospect, it was learned that California encephalitis was also active in three other States in 1964, viz, Ohio (32 cases), Wisconsin (4 cases), and North Carolina (1 case) (Mays, 1966, and USPHS, CDC, 1966).

The year 1965—in contrast to 1964—was unusually wet and cool in many parts of the United States. Associated with this condition, there was widespread activity of western encephalitis virus in the West,

of eastern virus in the East, and of California virus in the Midwest. It is of interest to note that Dr. A. D. Hess of the Communicable Disease Center's Disease Ecology Section at Greeley, Colorado, correctly predicted an impending outbreak of western encephalitis in Colorado on the basis of temperature, precipitation, and other indices during the spring period.

Considerable epidemic activity of the western virus occurred in five States: Colorado (68 cases), North Dakota (21 cases), Texas (20 cases), Montana (15 cases), and Wyoming (11 cases) (USPHS, CDC, 1966). It was the most extensive activity of WE since the pandemic of 1941.

In 1965, Colorado experienced its greatest floods of record and also the greatest outbreak of confirmed encephalitis. There were 68 cases of western encephalitis, with 3 deaths, and 18 cases of rural SLE (Mollohan, 1966).

In Hale County, Texas, which was involved for the third consecutive year, there were 12 confirmed or presumptive cases of WE and 5 confirmed cases of rural SLE (USPHS, CDC, 1966).

The WE infection rates of *Culex tarsalis* in Hale County, Texas, in eastern Colorado, and in Montana were among the highest ever recorded (Hess, 1966).

Although there were no recognized human outbreaks of eastern encephalitis (EE) in the United States during 1965, there were 8 reported cases of this relatively uncommon human disease: 3 cases in Florida, 2 in Georgia, 1 in North Carolina, 1 in Maryland, and 1 in New Jersey (USPHS, CDC, 1966). However, epizootics of this disease in equines occurred all along the Atlantic Coast. Hardest hit was North Carolina with 461 reported horse cases and 461 deaths. It was the greatest year of EE activity among equines in the United States since 1949 (USDA, ARS, 1966).

California encephalitis was reported from six States in 1965; Ohio (29 cases), Wisconsin (14 cases), Indiana (7 cases), Iowa (6 cases), North Carolina (3 cases), and Minnesota (1 case) (USPHS, CDC, 1966).

Special studies of this disease were conducted in Ohio by the Ohio Department of Health during 1965. Of the confirmed cases, there were 20 males and 9 females with a range in age from 4 to 20 years. Of mosquito pools tested to date, four pools have been positive for the CE virus—two of *Aedes canadensis* and two of *Aedes triseriatus*, both of them woodland species. Of a number of wild animal bloods tested, positive sera were found in the grey, the red, and the fox squirrel, and in the 13-striped ground squirrel (Mays, 1966).

These data, coupled with other findings throughout the United States suggest that the basic transmission cycle for California encephalitis is atypical; i.e. a rodent→*Aedes* mosquito cycle rather than a bird→*Culex* mosquito cycle.

#### Summary of Highlights for the Period 1960-65

- Two of the greatest outbreaks of record for urban St. Louis encephalitis occurred, viz, in the Tampa Bay area of Florida and at Houston, Texas.
- For the first time an epidemic of St. Louis encephalitis was reported in the Northeast.
- A new primary vector of St. Louis encephalitis was found in Florida, namely, *Culex nigripalpus*.
- During 1964—a record year for widespread dissemination of urban St. Louis encephalitis—numerous isolations of SLE were made from mosquitoes of the *Culex pipiens* complex in at least six states, thus verifying the importance of this group of mosquitoes as primary vectors of urban St. Louis encephalitis.
- In 1965, when Colorado experienced its greatest floods of record, it also had its greatest outbreak of western encephalitis of record.
- In 1965, Dr. A. D. Hess of the Communicable Disease Center correctly predicted an impending outbreak of western encephalitis in Colorado based on temperature and precipitation indices during the spring period.
- During 1965, it was demonstrated again that human outbreaks of eastern encephalitis do not necessarily follow extensive epizootics of this disease among equines.

- In 1964, it was learned for the first time that California encephalitis is of public health significance—thus making a total of four agents for this important group of encephalitides in the United States.
- Recent studies in Ohio substantiate prior findings that the basic transmission cycle of California encephalitis is rodent→*Aedes* mosquito rather than bird→*Culex* mosquito.
- The recorded epidemics of mosquito-borne encephalitis during the 5-year period 1961-65 add further evidence that the encephalitis problem in this country is on the rise.

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