

St. Louis Encephalitis Outbreak During 1956 In Grand Junction, Colo.

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THE FIRST sizable outbreak of St. Louis encephalitis among humans in the Rocky Mountain area occurred in 1956 in Grand Junction, Colo., and the surrounding valley on the western slope of the mountain range.

The area had experienced only scattered cases of St. Louis encephalitis since the disease was first recognized in St. Louis in 1933 (1). The midwest and the Pacific coast, however, had had occasional outbreaks and frequent sporadic cases of both St. Louis encephalitis and western equine encephalitis, two of the three arthropod-borne encephalitides which are found in this country. Eastern Colorado, with its dry, rolling plains, falls into the midwestern epidemiological pattern, but little is known about the natural occurrence of St. Louis encephalitis and western equine encephalitis in the mountains, canyons, and valleys of western Colorado, in which Grand Junction lies.

A city of 18,500 people, Grand Junction is at the junction of the Colorado and Gunnison Rivers in Grand Valley, which spreads over 15 by 30 miles at about 4,500 feet above sea level. The valley is encircled on three sides by pla-

teau and bordered on the fourth by desert. Numerous canals, irrigation ditches, and small swampy patches along the borders of the river contribute to the city's mosquito-breeding potential.

The outbreak of 1956, which occurred farther above sea level than any previously reported, was part of a statewide rise in activity of the St. Louis encephalitis (SLE) virus. Thirty-one cases of encephalitis were reported from Grand Junction and from the surrounding parts of Mesa County. There were no fatalities.

Epidemiological Methods

As each case of encephalitis occurred it was reported to the Mesa County Health Department by a private physician. Epidemiological information was then collected on each patient by a physician-epidemiologist or by a public health nurse from the department.

Attempts were made to collect an acute-phase serum specimen soon after the onset of the disease. Convalescent-phase serum specimens were generally collected between 3 and 8 weeks later. All paired serum specimens were tested with the serum neutralization (SN) test, the complement fixation (CF) test, and the hemagglutination-inhibition (HAI) test for antibodies against the SLE and western equine encephalitis (WEE) viruses. Single convalescent-phase specimens were tested with the HAI test only.

A case was classified as "confirmed" if a fourfold rise in titer was obtained with the CF or HAI tests or if a tenfold rise in neutralization index could be demonstrated. A case was classified as "suggestive" if the illness was clinically compatible with the disease and a CF titer of at least 1:8 or an HAI titer of at least 1:80 could be demonstrated in either a single convalescent-phase specimen or in paired specimens where a rise in titer was not demonstrable.

After the outbreak of human encephalitis had run its course still more information was desired. Accordingly, two serologic surveys were performed. The first was conducted in November 1956 among yearling chickens for HAI antibodies against the SLE and WEE

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viruses. Serums from 103 chickens in 3 flocks on the outskirts of the city were tested.

The second survey, conducted in January 1957, was designed as an indicator of immunity levels among the human population. Serum specimens were obtained from a total of 340 volunteers representing all age groups, all parts of town, and all economic classes. The specimens were then tested for the presence of complement-fixing antibodies against the SLE virus by the Virus and Rickettsia Laboratory of the Communicable Disease Center, Public Health Service. One hundred of these specimens, selected to give equal distribution among the different age and sex groups, were tested for HAI antibodies against both SLE and WEE viruses. Also, 96 of the 100 were tested for neutralizing antibodies against SLE. Antibody levels were classified as significant, equivocal, or insignificant by use of the following criteria:

Classification	Test		
	HAI	SN ¹	CF
Insignificant.....	<1:10	0-32	<1:2
Equivocal.....	1:10	33-50	1:2
Significant.....	>1:10	>50	>1:2

¹ Neutralization Index.

There were no attempts at virus isolation from mosquitoes nor was the predominant mosquito species identified, the reason being that cold weather had brought about an end to the mosquito season by the time the investigation began.

Epidemiological investigations revealed that the outbreak of human cases apparently began on July 28 when a farmer from Fruita, 10 miles west of Grand Junction, became ill with symptoms of fever, severe headache, stiff neck, nausea, malaise, weakness, generalized muscle pain, and hand tremor. On July 29 he was hospitalized. The same day, a 3-year-old girl in Grand Junction became ill with similar symptoms. From that point the cases increased in number until October 15. By that time 31 cases had been seen by physicians in Grand Junction and Fruita. Thirty of these were among residents of Grand Junction.

The peak of the epidemic curve was reached in late August, and a secondary rise occurred during the first 2 weeks of November as 3 more

cases of encephalitis were reported. The etiology of these last three is unknown. Serologically they were not arthropod-borne encephalitis.

All age groups were affected, with the largest number of cases (seven) in the group from 20 to 29 years of age (table 1). Clinical illness was almost equally divided between males and females.

Serum was collected from 20 of the 31 patients through which the illness of 3 of these 20, or 15 percent, was confirmed serologically as SLE. An additional 13 cases, or 65 percent, were classified as serologically suggestive of SLE. Attempts to demonstrate antibodies against the common encephalitides (SLE, western equine encephalitis, eastern equine encephalitis, lymphocytic choriomeningitis, and mumps) all failed in serum samples from the remaining four, or 20 percent, of the cases.

Table 1. Comparison of the age distribution of clinical cases of encephalitis with that of the population which had measurable antibody levels against the SLE virus, Grand Junction, Colo., 1956

Age groups (in years)	Clinical cases		Survey		
	Number of cases	Percent of cases	Percent with CF antibodies	Percent with HAI antibodies	Percent with neutralizing antibodies
0-9.....	3	9.7	1.8	20.0	20.0
10-19.....	4	12.9	4.4	20.0	22.2
20-29.....	7	22.6	4.0	0	15.0
30-39.....	6	19.3	0	0	21.1
40-49.....	3	9.7	0	0	0
50-59.....	2	6.5	9.1	20.0	20.0
60 and over..	6	19.3	4.8	0	0
Total.....	31	100.0	2.9	5.0	16.7

The serum surveys showed that 1 percent of the 100 humans and of the 103 chickens surveyed had significant antibody levels against WEE. In contrast, 16.5 percent of the chickens and 0 to 12.5 percent of the humans, depending upon the test used, had significant antibody levels against the SLE virus (table 2). The percentage of each human age group with antibodies against the SLE virus can be

Table 2. Results of serologic surveys for SLE in Grand Junction, Colo., 1956

Species	Test used	Number tested	Titers					
			Insignificant		Equivocal		Significant	
			Number	Percent	Number	Percent	Number	Percent
Human.....	CF	340	330	97.1	10	2.9	0	0
Human.....	HAI	100	95	95.0	3	3.0	2	2.0
Human.....	SN	96	80	83.3	4	4.2	12	12.5
Chicken.....	HAI	103	84	81.6	2	1.9	17	16.5

compared with the age distribution of the clinical cases in table 1.

Discussion

The epidemic curve and age distribution of the outbreak roughly paralleled those in the original outbreak of SLE in St. Louis, Mo., in 1933 and in a more recent outbreak in the Rio Grande Valley in Texas in 1954 (3). In each, the epidemic curve started upward in late July or early August, reached a peak in late August, and then declined through September and October, and in each outbreak the majority of the cases were in the middle and older age groups. The attack rate in the Grand Junction outbreak of 162.3 per 100,000 compares with that of the original outbreak in St. Louis of 100 per 100,000 and the more recent Texas outbreak, 163.9 per 100,000, but is far below that in Calvert City, Ky., in 1955 in which the attack rate was 865.6 per 100,000.

In the light of an expected mortality of 5 to 30 percent from SLE (4), the fact that none of the 31 patients died is unusual. Observations by some workers have shown that SLE in humans is usually somewhat milder in the west than in the midwest. These workers postulate that the reason for this is the presence of a strain of SLE virus in the west which is less pathogenic for man than the midwestern strains (personal communication from Dr. Carl M. Eklund).

Approximately 12.5 percent of the population tested for previous inapparent infection had neutralizing antibodies against the SLE virus at a significant level. This is comparable with the 11.8 percent found in Weld County in north-

eastern Colorado in 1951 (5). In the Weld County survey few under the age of 20 years had significant antibody levels, whereas in Grand Junction nearly half of those with antibodies were less than 20 years of age. There are a number of possible explanations.

The marked differences in the serologic survey results according to the test used were due partially to the fact that neutralizing antibodies against the SLE virus persist for a considerable length of time, possibly more than 10 years, while CF antibodies persist only for a period of several years (6). HAI antibodies are thought to have a duration somewhere between those of the other two. Consequently, when all three tests are run, it is possible to obtain some indication of the activity of the SLE virus in a given area over a period of possibly 10 years. Accordingly, survey results in table 1 might be interpreted thus: the SLE virus was moderately active in humans in the years 1954-56 since 2.9 percent of the population have CF antibodies. A larger number, 5.0 percent, have HAI antibodies so it is likely that the virus was also moderately active in the years 1951-53. Since a still larger number, 16.7 percent, have neutralizing antibodies, it can be assumed that this moderate level of activity goes back beyond 5 years, possibly as far back as 10 years. It must be realized, however, that a single year with heavy activity between 1946 and 1951 could bring about the difference in results between the serum neutralization test and the other two tests. There is no record of such activity having occurred prior to 1956.

Another reason for the differences in survey results is that samples of different sizes were used in the three tests. More than three times

as many specimens were used in the CF test as in either of the others. CF results from those serum specimens which also were tested with the HAI and SN tests appear much closer to results of the three tests in age distribution of inapparent infection. However, to omit CF results from the remaining 240 samples would be to sacrifice accuracy unnecessarily.

An explanation for the low level of inapparent infection during the 1956 outbreak of clinical encephalitis has not been found. None of the 340 serums tested had a CF titer greater than 1:2. A control serum from a girl who had clinical SLE in August 1956, when tested, unidentified, with the other samples had CF antibodies at a titer of 1:64. It can be assumed from this that recent inapparent infection, had it occurred, would have been obvious from results of the CF test. The fact that inapparent infection is not greatest in age groups with the largest number of clinical cases also makes it appear that the cases of inapparent infection probably occurred sometime prior to the 1956 outbreak.

HAI results show that there was more SLE activity than WEE activity in Grand Junction in 1956. The fact that 16 times as many yearling chickens and 3 times as many humans had HAI antibodies against SLE would be indicative of this. Evidence exists that the virus of SLE was also more active than that of WEE in other parts of Colorado in 1956. Not only was the SLE virus isolated much more frequently from pools of *Culex tarsalis* mosquitoes in Weld County in eastern Colorado, but scattered cases of SLE were reported among humans along the east slope of the mountains and on the eastern plains where no cases of WEE were confirmed.

Summary

An outbreak of encephalitis among humans in Grand Junction, Colo., and the surrounding

valley during 1956, part of a statewide increase in activity of the St. Louis encephalitis virus, was the first outbreak of the disease in the Rocky Mountain area.

Thirty-one cases, with no fatalities, were reported in the outbreak, which occurred farther above sea level than any previously reported.

In a serologic survey of 340 persons, it was found that 16.7 percent had neutralizing antibodies against SLE.

A serologic survey of yearling chickens showed that the SLE virus was far more active than the western equine encephalitis virus in Grand Junction in 1956.

Differences in results from the complement fixation, hemagglutination-inhibition, and serum neutralization tests evolved from the use of different sample sizes in each test and from variations in the life of the antibodies sought in each test.

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Signs

and

Symptoms

of trends in public health

Colorado's 54,000 old-age pensioners are guaranteed \$100 a month income, and are permitted to go to any hospital and receive the same treatment as regular patients at State expense.

If the aged person cannot live alone, he goes to a convalescent or nursing home, and contributes all but \$5 of his monthly income; the State pays the balance. A sum of \$10 million has been set as the annual allocation to finance the program; Blue Cross and Blue Shield administer it. State officials believe that revenues earmarked for pensions will exceed the cost of the program.

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About 95 percent of all pedestrian deaths occur in residential areas rather than in congested business sections, AAA reports in a 163-page booklet entitled "Planned Pedestrian Program," a community do-it-yourself plan to halve pedestrian deaths.

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Death rate from accidents among children 1 to 4 years old dropped 18.4 percent between 1949 and 1956.

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An agreement between the Public Health Service and the automobile industry provides for the Service to concentrate on effects of auto exhausts on health while industry concentrates on developing engineering devices to reduce exhausts.

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Trioptic lenses have been developed with alleged magnifications of from 300 to 2,000 percent. They are said to promise help for 500,000 partially blind in the United States.

Dr. Leonidas H. Berry, Chicago specialist in internal medicine and originator of a plan for the rehabilitation of narcotic addicts, won the National Medical Association's distinguished service award.

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Not more than 1 million of the Nation's 57 million cars on the highway today are equipped with seat belts, reports the Cornell University Medical College auto crash injury research project. (See *Public Health Reports*, May 1958.)

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About 95 percent of the good drivers who have accidents do so because they become bored and distracted, according to Joseph Zabelski, safety education consultant, Michigan Automobile Club.

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New York City's Police and Health Departments are conducting a joint 6-month study on the effects of alcohol, barbiturates, tranquilizers, and allergy-relieving drugs on driving ability and traffic accidents.

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Successful treatment of alcoholics produces the new problem of a wife with "no one to mother," comments Dr. Herman Feifel, Veterans Administration Mental Hygiene Clinic, Los Angeles. The clinic has been treating nonalcoholic wives simultaneously with alcoholic husbands.

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The World Health Organization's global battle against disease is described by Albert Deutsch, in *Public Affairs Pamphlet No. 265*.

A demonstration program in Tahiti has attacked filariasis. Diethylcarbamazine was used to destroy the parasite in the blood stream and so control mosquito carriers. The program is a joint effort of the French Overseas Medical Service and the University of California, Los Angeles, Medical School.

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The Washington, D. C., commissioners have been asked by the District of Columbia Welfare Department and the District's Nursing and Convalescent Home Association to conduct a survey of nursing homes to consider licensing requirements, adequacy of treatment, and facilities. Only the largest homes are required to be licensed at present. The association has asked the welfare department to raise monthly payment for indigents in nursing homes from \$110 to \$210.

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Dr. James F. Benedict, Erie County (N. Y.) medical examiner, asserts that plastic dry-cleaning bags used as mattress covers caused two infant deaths this year. The plastic apparently adhered to the nose and mouth so tightly that it prevented breathing.

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Colostomy and Ileostomy Care, a 55-page guide of practical information for nurses, has been published by the Cuyahoga Unit, Cleveland, Ohio, of the American Cancer Society.

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Upcoming Meetings: Midwest Institute on Alcohol Studies, June 21-26, Western Michigan University, Kalamazoo, Mich.

• Air pollution control association, June 22-26, Statler-Hilton Hotel, Los Angeles, Calif.

• First international conference on mental retardation, July 27-31, Eastland Hotel, Portland, Maine.

• Sixth international exhibition-convention of health technicians, June 9-12, Parc des Expositions, Porte de Versailles, Paris.

• Thirty-sixth annual conference of the American Physical Therapy Association, June 21-26, Hotel Leamington, Minneapolis, Minn.

A total of 135 medical, dental, engineering, science, nursing, and veterinary students from 120 approved 4-year professional schools spent the summer months of 1958 in Public Health Service facilities under the Service's training program.

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By following faithfully a prescribed self-help program at home, most arthritis victims can fight off the crippling caused by the disease, according to a new 24-page publication, *Home Care in Arthritis*, issued by the Arthritis and Rheumatism Foundation.

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The Texas State Health Department has published OH-1A, a procedural guide for reporting excessive radiation doses; OH-1B, an advisory guide on local preparations for and handling of excessive radiation doses; OH-1C, changes in basic philosophy on maximum permissible radiation exposures; OH-16A, a procedural guide for sanitary use of portable water coolers; and OH-27, a list of registered professional nurses active in industrial nursing in Texas, 1958.

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J. C. Maruzzella and P. A. Henry report in the *Journal of the American Pharmaceutical Association* that 100 aromatic oils used in perfumes possess antimicrobial properties against fungi and bacteria.

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The New York City Health Research Council was recently established with a budget of \$600,000. Its immediate targets will be problems of aging, maternal and child care, mental illness, heart disease, environmental hazards, and patient care. This is the first time a medical and public health research program has been supported solely by local tax funds.

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The 1958 report of the field teaching conference of the Southern Branch of the American Public Health Association is now available. Address inquiries to Miss Ruth W. Hay, Chairman, Field Teaching Conference, Box 229, Chapel Hill, N.C.

Health department cooperation with the fire marshals to help overcome hazards in schools, homes for the aged, private hospitals, kindergartens, and the like is reported by H. George Henderson-Watts, from the Saanich and South Vancouver Island Health Unit, British Columbia.

Public health workers are encouraged to draw attention to fire and accident hazards such as cluttered stairs, poisons and matches within reach of children, cracked and improperly insulated chimneys, electric cords hung over nails, multiple electrical outlets plugged into a single receptacle, absence of fire escapes or means of egress, bundles of old papers or rags, and flammable products, such as cleaning fluids, kerosene, and gasoline, in dangerous locations.

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The Veterans Administration neuropsychiatric hospital in Salisbury, N. C., is using gardening and landscaping for therapy, with a resulting dramatic improvement in mental illness. The gardening and landscaping, begun in 1954, currently engages 75 psychiatric patients.

The patients built water fountains, outdoor ovens, and a brick storage shed for bicycles and athletic equipment on a once barren, gully-scarred part of the hospital grounds. They transformed a similar area into smooth, terraced lawns with flower

About three-fifths of the aged population in the United States are not insured for hospital or medical expenses. Among the uninsured, the Health Information Foundation says, more than one-fourth have never tried to buy health insurance, and almost as many say they do not want it. Thirty-four percent of the uninsured say they can't afford it, and 16 percent say they do not believe they are eligible for it.

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Correction: The number of alcoholics in the United States, as estimated by Keller and Efron in the *Quarterly Journal of Studies on Alcohol*, was incorrectly reported in our January issue. They estimate 1,254,000 with complications, and a total of 5,015,000 with or without complications.

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gardens, park benches, and a half-acre vegetable garden. To the right in the illustration is a brick tool shed constructed by the patients. In the foreground is a flower garden built on a clay mound resulting from excavations for a hospital building. The soil was conditioned with pine needles and leaf mold gathered by the patients.

Many of its mental hospitals are using similar reclamation projects with therapeutic benefit to patients, according to the Veterans Administration.