

OBSERVED RELATIONSHIP OF POLIOMYELITIS INCIDENCE, AND ENVIRONMENTAL SANITATION  
IN DES MOINES, IOWA

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During the fall of 1939 Trask, Paul and Culotta<sup>1</sup> reported the recovery of the virus of poliomyelitis from sewage collected at Charleston, South Carolina, during an outbreak experienced in that community. In their report these writers state: "It is not evident from this work whether the presence of poliomyelitis virus in sewage is a direct or even indirect link in the chain which leads the infectious agent from one patient to another in this disease. Our report merely calls attention to the fact that poliomyelitis virus may not only present in sewage but that it may possibly be present in appreciable quantities." This is the first time that the presence of poliomyelitis virus is reported as having been demonstrated in sewage. In 1940,

Casey and Aymond<sup>2</sup> reported a statistical study of poliomyelitis in Louisiana, with an incidence three times higher in towns of 100 to 3,000 population having public water supplies but lacking sewerage facilities, than in large cities and truly rural areas.

It is the special purpose of this paper to report the scatter of poliomyelitis and its observed relationship to sanitation of the environment in Des Moines, during the period from 1929 to 1939 inclusive. The distribution of poliomyelitis cases in Des Moines, by months for the eleven year period is shown in Table I.

TABLE I  
Seasonal Distribution of Poliomyelitis  
Cases in Des Moines for the Eleven Year Period, 1929 to 1939

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
1929	....	....	....	....	....	....	....	3	6	13	1	1	24
1930	....	....	....	....	....	....	....	....	9	9	5	....	23
1931	....	....	1	....	....	....	....	....	5	4	....	1	11
1932	....	....	....	....	....	....	1	1	4	1	....	....	7
1933	....	....	....	....	....	1	....	....	4	....	....	....	5
1934	....	....	....	....	....	....	....	1	....	....	1	....	2
1935	....	....	....	....	....	....	....	1	2	....	....	....	3
1936	....	....	1	....	....	....	....	1	7	2	1	....	12
1937	....	1	1	....	....	....	....	10	8	4	2	....	26
1938	....	....	....	....	....	....	1	....	....	....	....	....	1
1939	....	....	....	....	....	....	1	....	4	29	24	4	62
Total	....	1	3	....	....	1	3	17	49	62	34	6	176

The majority of cases occurred during early fall, 93 per cent of the total being reported in the four months of August, September, October and November, and 63 per cent during September and October. Occasional cases occurred during the late fall and spring seasons.

A sanitary survey was made with reference to the 62 cases of poliomyelitis reported in Des Moines during 1939. Using the criterion of one or more outside toilet within two blocks of the patient's home as an index of the poor sanitation of the neighborhood, it was observed that over 70 per cent of the cases occurred in communities of this classification. Only sixteen cases were reported from the heavily populated west central portion of Des Moines, in which are located only 176 of the city's 4,880 outside toilets. Incidentally, over half of these sixteen cases occurred in the oldest part of this area where housing conditions are poor.

The first case in 1939 appeared on July 29 in a fairly good neighborhood; no cases were reported during the next sixty days. The second case occurred in a home using an outdoor toilet, and during the next ten days twelve cases were reported, all from home with outdoor toilets. Following this the epidemic became more widespread, by far the majority of the premises concerned being in areas where there were outside toilets. The greater share of these toilets are of the common pit privy type in a rather poor state of repair allowing insects and rodents ready access to the pit contents.

The accompanying chart [Figure 1. below] shows the incidence of poliomyelitis per 10,000 population in Des Moines for the year 1939, and the relative sanitary conditions of areas designated as A, B, C, D, E and F.

TABLE II  
Showing the Distribution of Poliomyelitis in Various Areas of the City of Des Moines in Relation to Population, Site of Area and Number of Outside Toilets, for the Year 1939 and the eleven-year period, 1929-1939

Area	Population	Square Miles	Population Density	Number of Outside Toilets In Area	1939		1929-1939	
					Cases	Rates*	Cases	Rates*
A	15,500	2.8	5550	106	1	0.6	12	7.7
B	73,200	12.9	5680	175	16	2.2	65	8.9
C	13,000	6.3	2060	263	2	1.5	15	11.5
D	11,400	15.3	740	1068	7	6.1	20	17.5
E	24,300	8.3	2030	1375	18	7.4	35	14.4
F	15,000	9.1	1710	1884	18	11.5	29	18.5

\*Rates per 10,000 population were used for convenience in graphical presentation.

Each wheelchair symbol represents a case of poliomyelitis per 10,000 population. Each toilet symbol represents 100 outside toilets. The number of outside toilets in each area was used as a criterion of the sanitation status. Area F with a population of 15,600 has over five times as many cases per 10,000 population as area B with a population of 73,200. There are about 1,900 outside toilets in area F and area B has only 176.

The location of all reported cases of poliomyelitis for the year 1939 and for the eleven year period 1929 to 1939 was determined and the incidence rate was computed for the various Des Moines areas. The data, including area,

total population, population density and number of outdoor toilets are exhibited in Table II.

It is observed in Table II that the incidence varies inversely with the population density, within certain limits, as has been heretofore reported. Table II is graphically presented in the accompanying line diagram, Figure 2 [below].

While the data for the eleven year period and the 1939 epidemic are not in exact agreement, it is believed that the relationship may be significant. The trend of a higher incidence in areas of poor sanitation is true over the eleven year period, as well as for the year 1939.

TABLE III  
Showing the occurrence of Poliomyelitis in Des Moines (1929-1939), in Relation to the 62 Year Average of Temperature and Rainfall for the Four Month Period, August, September, October and November

Year	Total Cases	Rainfall		Temperature	
		Above 62 year Average Cases	Below 62 year Average Cases	Above 62 year Average Cases	Below 62 year Average Cases
1929	24	24	...	...	24
1930	23	...	23	23	...
1931	11	...	11	...	11
1932	7	7	...	...	7
1933	5	...	5	5	...
1934	2	2	...	2	...
1935	3	3	...	...	3
1936	12	12	...	12	...
1937	26	...	26	26	...
1938	1	...	1	1	...
1939	62	...	62	62	...
Total	176	45	128	131	4

Weather conditions were rather unusual in Des Moines during the latter part of 1939. The fall season was very warm and dry. A new high temperature of 102 degrees was recorded on September 7 and on December 6 a new high was experienced for that month. The first light frost of the fall occurred on September 30, but cold weather was not encountered until Christmas. Since this weather coincided with Des Moines' rather severe outbreak of poliomyelitis, the weather conditions and number of cases each year for the eleven year period, were studied. Table

III indicates the cases occurring each year when rainfall and temperature were above or below the 62 year average for the four months, August, September, October and November. It is observed that over twice as many cases were reported when the rainfall was below and the temperature above the 62 year average. Not considering the 1939 epidemic, a majority of the cases still fall in the above category.

No correlation was found between the incidence of poliomyelitis in the 1939 epidemic, and the water or milk

supplies. A majority of the patients habitually used the public water supply. The cases occurring on any particular dairy route were approximately in proportion to that dairy's share of the total milk supply. The possible effect of other foods was not studied due to lack of data.

The city of Des Moines has an estimated population for 1939 of 153,000, occupying a rectangular area of six by nine miles and comprising 54.7 square miles. The business district is in the center of the area and the better residential sections are to the west and north. There are approximately 40,000 homes in the city. Several areas within the corporate limits are not heavily populated, making it difficult economically to reach these areas with public water and sewerage systems. There are 4,880 outdoor toilets serving a like number of homes. The municipal sewerage system is connected with 88 per cent of the homes. There are 2,880 private wells used for drinking water. Since many are used by several families, it is estimated that 91 per cent of the population uses water from the municipal supply. The milk supply is approximately 83 per cent pasteurized.

#### SUMMARY

1. Poliomyelitis cases apparently occur with greater frequency in areas of poor sanitation.
2. The disease is usually more prevalent during seasons when the rainfall is below and the temperature above average.
3. Improper disposal of human wastes appears to be an important factor, or to have some bearing in the occurrence of poliomyelitis.
4. More extensive studies are indicated to determine the possible significance of the virus in stools or sewage in relation to the spread of poliomyelitis.

#### REFERENCES

1. Paul, J.R., Trask, J.P., and Culotta, C.S.: Poliomyelitis virus in sewage. *Science*, xc:258 (September 15) 1939.
2. Casey, A.E., and Aymond, B.J.: The distribution of poliomyelitis in Louisiana. *Science*, sci:17 (January 5) 1940.

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The writer wishes to acknowledge the cooperation and assistance of Harry E. Ransom, M.D., City Health Commissioner of Des Moines, Carl F. Jordan, M.D., C.P.H., State Epidemiologist, and Marvin F. Haygood, M.D., C.P.H., Director Local Health Services, Iowa State Department of Health, in the preparation of this paper.

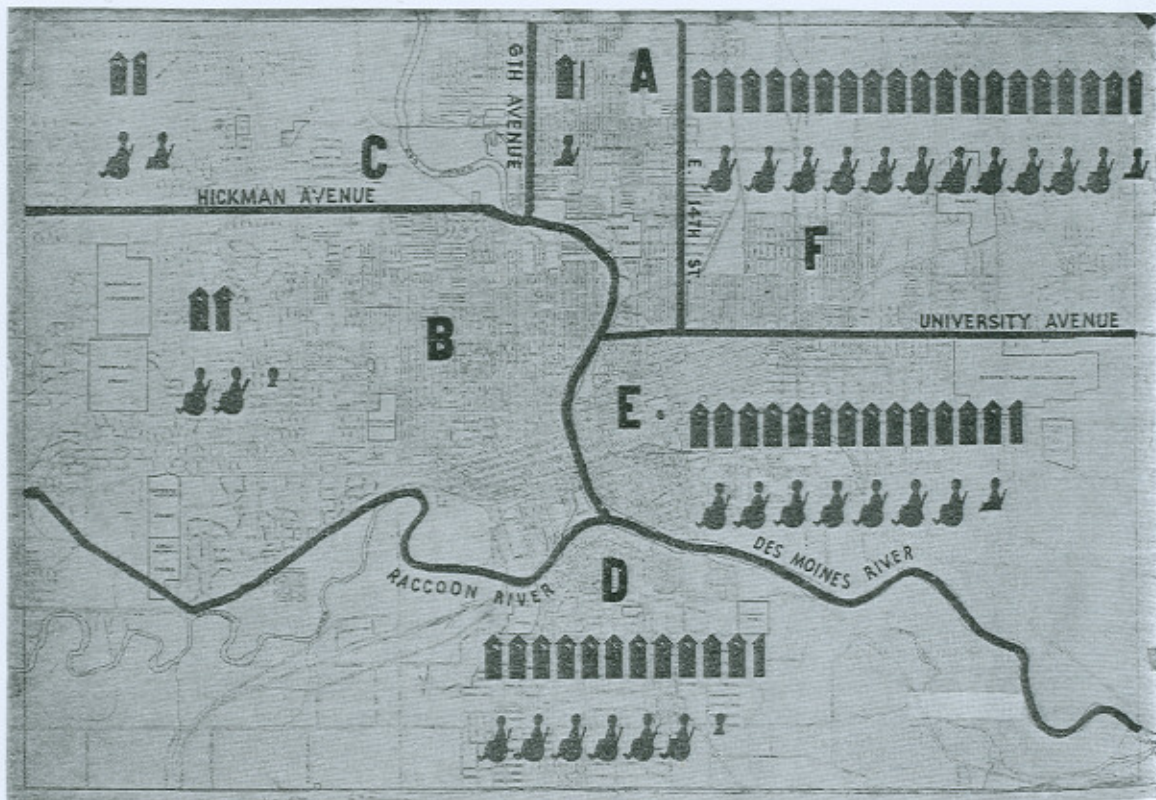


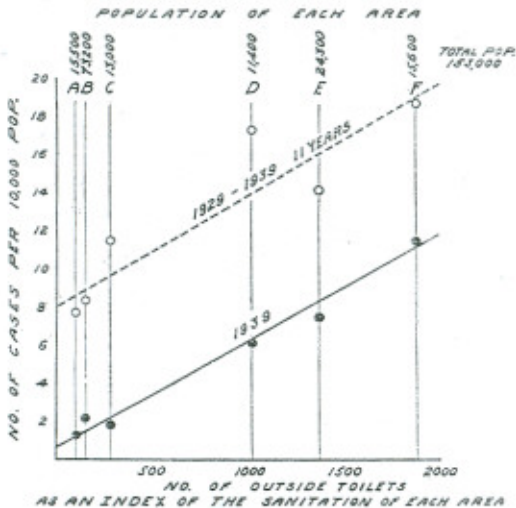
FIG. I

Showing the incidence of infantile paralysis in relation to the sanitation of various areas of Des Moines, 1939. The wheelchair symbol represents one case of infantile paralysis per 10,000 population. The toilet symbol represents 100 outside toilets as an index of the sanitation of the area.

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*RELATIONSHIP OF THE INCIDENCE OF INFANTILE PARALYSIS TO THE SANITATION OF THE AREA IN THE CITY OF DES MOINES 1929 - 1939*

Fig. 2.