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AN EPIDEMIC OF A SEVERE PNEUMONITIS IN THE BAYOU REGION OF LOUISIANA

VI. A COMPARATIVE STUDY OF THE VIRUSES OF LYMPHOGRANULOMA VENEREUM, PSITTACOSIS, AND LOUISIANA PNEUMONITIS[1]

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In previous papers of this series[2] the epidemiological, clinical, pathological, and etiological aspects of an outbreak of severe pneumonitis occurring in the bayou region of southwestern Louisiana were described and the isolation and description of an agent belonging to the psittacosis-lymphogranuloma venereum group of viruses was reported. A virus was isolated from blood, sputum, or lung tissue from three individuals suffering from the disease, and the circumstances surrounding the isolations were such as to indicate causal relation of the virus to the outbreak of human illness. From the data accumulated it was held that the agent had not previously been described and accordingly a new virus belonging to the above group of viruses was designated.

Francis and Magill (*1*) isolated an agent which they termed the virus of acute meningopneumonitis. This virus was extremely infective for mice when administered intracerebrally or intranasally but was capable of producing only occasional deaths in guinea pigs. Eaton, Beck and Pearson (*2*) studied an agent obtained from cases

[1] From the Division of Infectious Diseases, National Institute of Health.

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of pneumonitis in California and differentiated it from the viruses of meningopneumonitis and psittacosis. This virus had a low intraperitoneal virulence for mice as compared to a high intranasal or intracerebral virulence for these animals but was more infective intraperitoneally for guinea pigs than was meningopneumonitis virus. In a subsequent paper, Beck, Eaton, and O'Donnell (*3*) state that the viruses belonging to the group which cause atypical pneumonitis in man may be divided into three groups based upon pathogenicity and latency tests and upon active cross immunity tests. The groups would include (*a*) psittacosis, (*b*) ornithosis, and (*c*) human pneumonitis (Strain S-F) of unknown origin. Meyer and Eddie (*4*), and Meyer, Eddie, and Yanamura (*5*) described the virus of ornithosis, and showed that it was of very low virulence for mice when given intraperitoneally. The available evidence indicates that except for the source in nature the viruses of ornithosis and meningopneumonitis are identical. Rivers and Berry (*6*, *7*) have shown that guinea pigs develop fever and occasionally succumb as a result of intraperitoneal inoculation with psittacosis virus and that mice are extremely susceptible to infection.

On the basis of reports in the literature it appeared that the agents of pneumonitis in man which resemble the virus described by us were those of psittacosis and meningopneumonitis. Lymphogranuloma venereum, mouse pneumonitis, and Eaton's S-F viruses can be eliminated on the basis of their failure to produce illness or death in mice or guinea pigs inoculated intraperitoneally. It was considered that by the criteria of infectivity of the viruses for mice when inoculated by various routes and of virulence of these viruses for guinea pigs when inoculated intraperitoneally, the differentiation between psittacosis, meningopneumonitis, and Louisiana pneumonitis virus could be made. This paper records the results of such tests, which serve to separate this virus from the others under consideration.

EXPERIMENTAL

It was demonstrated in a previous report in this series (V. Etiology) that mice were susceptible to the virus of Louisiana pneumonitis by every route tested and it was considered that this fact was a differential character between this agent and those responsible for psittacosis and meningopneumonitis. This hypothesis was tested and found to be essentially correct.

The original experiment designed to test the differential susceptibility of mice to these agents when administered by various routes employed the intracerebral and subcutaneous routes of inoculation. Since it was known that the viruses used produced death by the former method of inoculation, only 5 mice were given 0.03 cc. of each of the respective viruses intracerebrally. Groups of 50 mice each were

tested with each virus subcutaneously, using doses of 0.3 cc. The viruses employed consisted of a 10-percent suspension of infected mouse spleen in 0.85-percent salt solution. The Louisiana pneumonitis strain was one isolated from case 17 and was in the fourth mouse passage. The psittacosis virus was isolated by the senior author from a budgerigar, and the meningopneumonitis virus was obtained from Dr. Thomas Francis, Jr. (School of Public Health, University of Michigan). The results are shown in table 1. All the agents were capable of killing all mice injected intracerebrally with the amounts of inocula used. However, there was a marked difference in the degree of susceptibility of mice to subcutaneous administration of the different infectious agents. Only 2 percent of the mice given meningopneumonitis virus subcutaneously succumbed; 16 percent of those receiving psittacosis virus died; and 98 percent of the mice given Louisiana pneumonitis virus succumbed.

TABLE 1.—*Effect of subcutaneous and intracerebral introduction of 10-percent spleen suspension of meningopneumonitis, psittacosis, or Louisiana pneumonitis virus into mice*

Type of virus	Route of inoculation	Size of inoculum (cc.)	Number of mice inoculated	Number of mice dying	Percentage of mice dying
Meningopneumonitis	Intracerebral	0.03	5	5	100
Do	Subcutaneous	.3	50	1	2
Psittacosis	Intracerebral	.03	5	5	100
Do	Subcutaneous	.3	50	8	16
Louisiana pneumonitis	Intracerebral	.03	5	5	100
Do	Subcutaneous	.3	50	49	98

These results were upheld by further study. Another group of mice was tested for susceptibility to these agents, using intracerebral, intraperitoneal, and subcutaneous routes of inocculation. Ten-percent suspensions of spleen in salt solution were used; doses of 0.03 cc. were given intracerebrally, 0.3 cc. intraperitoneally, and 0.3 cc. subcutaneously. The results obtained are shown in table 2. It is

TABLE 2.—*Results obtained following inoculation of mice with 10-percent spleen suspensions of mouse passage strains of meningopneumonitis, psittacosis, and Louisiana pneumonitis virus employing intracerebral, intraperitoneal, and subcutaneous routes of injection*

Type of virus	Route of inoculation	Size of inoculum (cc.)	Number of mice inoculated	Number of mice dying	Percentage of mice dying
Meningopneumonitis	Intracerebral	0.03	10	10	100
Do	Intraperitoneal	.3	10	2	20
Do	Subcutaneous	.3	10	0	0
Psittacosis	Intracerebral	.03	10	10	100
Do	Intraperitoneal	.3	10	10	100
Do	Subcutaneous	.3	10	3	30
Louisiana pneumonitis	Intracerebral	.03	7	7	100
Do	Intraperitoneal	.3	10	9	90
Do	Subcutaneous	.3	10	8	80

apparent from tables 1 and 2 that inoculation of these viruses into mice by the subcutaneous route serves to differentiate psittacosis and meningopneumonitis virus on the one hand, and Louisiana pneumonitis virus on the other.

Another experiment was made to determine the effect on mice of inoculation of the various viruses by intraperitoneal, intramuscular, and subcutaneous routes. The viruses were titered by intracerebral introduction of 0.03 cc. of serial tenfold dilutions of mouse spleen containing meningopneumonitis and psittacosis virus and serial hundredfold dilutions of Louisiana pneumonitis virus. The titers obtained (table 3) indicate that the source of meningopneumonitis virus used contained fewer fatal infective units per cubic centimeter than

TABLE 3.—*Comparison of the results obtained following inoculation of mice intracerebrally, subcutaneously, intraperitoneally, and intramuscularly with mouse-passage strains of tissue suspensions containing meningopneumonitis, psittacosis, or Louisiana pneumonitis virus*

Type of virus	Route of inoculation	Size of inoculum (cc.)	Dilution of suspension	Number of mice inoculated	Number of mice dying	Percentage of mice dying
Meningopneumonitis	Intracerebral	0.03	[1] 10^{-3}	8	8	100
Do	do	.03	10^{-4}	8	4	50
Do	do	.03	10^{-5}	8	1	12
Do	do	.03	10^{-6}	8	0	0
Do	Intraperitoneal	.3	10^{-1}	16	0	0
Do	Intramuscular	.3	10^{-1}	16	0	0
Do	Subcutaneous	.3	10^{-1}	16	0	0
Psittacosis	Intracerebral	.03	[2] 10^{-4}	8	8	100
Do	do	.03	10^{-5}	8	5	37
Do	do	.03	10^{-6}	8	0	0
Do	Intraperitoneal	.3	10^{-1}	16	12	75
Do	Intramuscular	.3	10^{-1}	16	0	0
Do	Subcutaneous	.3	10^{-1}	16	1	6
Louisiana pneumonitis	Intracerebral	.03	[3] 10^{-5}	8	8	100
Do	do	.03	10^{-7}	8	0	0
Do	Intraperitoneal	.3	10^{-1}	16	16	100
Do	Intramuscular	.3	10^{-1}	16	15	94
Do	Subcutaneous	.3	10^{-1}	16	13	81

[1] All mice given 10^{-1} and 10^{-2} dilutions intracerebrally died.
[2] All mice given 10^{-1}, 10^{-2}, 10^{-3} dilutions intracerebrally died.
[3] All mice given 10^{-1}, 10^{-2}, 10^{-3}, and 10^{-4} dilutions intracerebrally died.

either of the other viruses. The dilutions of viruses were introduced intracerebrally in doses of 0.03 cc. and those containing LD_{50} doses were 1.5×10^{-4}, 1.6×10^{-5}, and 1×10^{-6} for meningopneumonitis, psittacosis, and Louisiana pneumonitis virus, respectively. The results shown in table 3 should be interpreted with the above dosage of virus in mind. The dose of meningopneumonitis virus used failed to kill any of the mice injected by subcutaneous, intraperitoneal, or intramuscular route, and the concentration of psittacosis virus used was capable of producing death among 75 percent of mice inoculated intraperitoneally but was nonfatal when injected by other routes. The concentration of Louisiana pneumonitis virus employed produced fatal infections in 100 percent of those mice injected intraperitoneally, 94 percent of those injected intramuscularly, and 81 percent

of the mice inoculated subcutaneously. The essential difference between the viruses under study is that the Louisiana virus is capable of infecting and producing death in the majority of mice regardless of the route of inoculation, while the other viruses show a considerable degree of variation in the percent of fatal infection induced, depending upon the route of injection.

TITRATION OF VIRUS

The demonstration of the fact that the Louisiana virus was capable of producing fatal infection in mice when inoculated by the subcutaneous, intramuscular, or intraperitoneal route as well as by the intracerebral route suggested that it might be possible to distinguish this agent from other related viruses by comparative titrations of virus administered to mice by various routes.

Pooled lots of liver and spleen from mice moribund or recently dead following inoculation with one of the above viruses were employed. The tissues were removed from the mice, ground in a mortar, and suspended in sufficient salt solution to make a 10-percent suspension. Further tenfold dilutions of the respective suspensions were made to 10^{-8} in 0.85-percent salt solution. Doses of 0.03 cc. and 0.3 cc. of each dilution of each virus were given to groups of five mice each by intracerebral or intraperitoneal inoculation. The animals were observed for 14 days following inoculation. The results of such an experiment are shown in table 4.

It is apparent that meningopneumonitis virus has but little ability to produce fatal illness in mice when administered intraperitoneally,

TABLE 4.—*Relative intracerebral and intraperitoneal infectivity for mice of meningopneumonitis, psittacosis, and Louisiana pneumonitis virus when serial ten-fold dilutions of 10 percent tissue virus is administered to groups of 5 mice for each dilution and doses of 0.03 cc. and 0.3 cc. are given by the respective routes*

Dilution of tissue suspension	Route of inoculation	Strain of virus inoculated into mice			
		Meningopneumonitis—number of mice dying [1]	Psittacosis—number of mice dying [1]	Louisiana pneumonitis (case 17)—number of mice dying [1]	Louisiana pneumonitis (case 16)—number of mice dying [1]
10^{-1}	Intracerebral	5/5	5/5	5/5	5/5
10^{-2}	do	5/5	5/5	5/5	5/5
10^{-3}	do	5/5	5/5	5/5	5/5
10^{-4}	do	4/5	5/5	5/5	5/5
10^{-5}	do	0/5	4/5	1/5	4/5
10^{-6}	do	1/5	2/5	2/5	1/5
10^{-7}	do	0/5	0/5	1/5	2/5
10^{-8}	do	0/5	0/5	0/5	0/5
10^{-1}	Intraperitoneal	1/5	4/5	5/5	5/5
10^{-2}	do	2/5	4/5	5/5	5/5
10^{-3}	do	0/5	5/5	4/5	5/5
10^{-4}	do	1/5	2/5	4/5	5/5
10^{-5}	do	0/5	1/5	3/5	4/5
10^{-6}	do	0/5	0/5	0/5	1/5
10^{-7}	do	1/5	0/5	0/5	1/5
10^{-8}	do	0/5	0/5	0/5	0/5

[1] Numerator=number of mice dying; denominator=number of mice inoculated.

while it produces considerable mortality when given intracerebrally. The strain of psittacosis virus used was about a hundred times more infectious by the intracerebral than by the intraperitoneal route. The results obtained with the pneumonitis virus from case 16 show that there is essentially no difference in the titer of virus as obtained by inoculation of mice by either route, and this is likewise shown by the results obtained by using a strain of pneumonitis virus isolated from case 17.

The data gathered in this way show that there is a definite difference in the tropism of the three viruses. This difference is manifested when serial dilutions of virus are administered to mice by intraperitoneal and intracranial routes and is of value in identifying the agents.

REACTION OF GUINEA PIGS TO INFECTIONS WITH PSITTACOSIS, MENINGOPNEUMONITIS, AND LOUISIANA PNEUMONITIS VIRUS

Guinea pigs are susceptible to infections produced by intraperitoneal inoculation of material containing the Louisiana virus but are not usually affected to a similar degree by contact with the viruses of psittacosis or meningopneumonitis. This difference between the reaction of these viruses in guinea pigs was tested in the following experiment.

Suspensions containing 10-percent spleen tissue from mice dying of psittacosis and meningopneumonitis infections were prepared. Similar preparations were made from the spleens of mice that died following injection of a second-passage strain of virus obtained from the sputum of case 17. Guinea pigs weighing about 300 gm. which had shown no febrile reaction for 2 weeks prior to inception of the experiment were used. Groups of eight mice each were inoculated intracerebrally with 0.03 cc. of the respective viruses for control. Groups of four guinea pigs each were injected by the intraperitoneal route, with the three viruses. In these groups of four, two animals were given 0.25 cc. and two were given 0.5 cc. of the suspension. The results are shown in table 5. Observations were made for 12 days after inoculation.

The febrile reactions are shown in figure 1. The psittacosis and meningopneumonitis viruses in the quantities administered were capable of producing febrile reactions of varying degree and duration in guinea pigs but failed to produce other symptoms or death. The virus isolated from cases of pneumonitis in Louisiana, however, produced a febrile, fatal disease in all guinea pigs tested. Death occurred in 7 to 9 days and fever within 3 or 4 days after inoculation. Weakness, anorexia, and emaciation constituted the main signs and symptoms of illness in these animals. The pathological features include splenomegaly and a fibrinous exudate in the peritoneal cavity.

TABLE 5.—*Susceptibility of guinea pigs to intraperitoneal inoculation of 0.5 cc. or 0.25-cc. amounts of 10-percent tissue suspensions containing meningopneumonitis, psittacosis, or Louisiana pneumonitis virus*

Strain of virus inoculated	Guinea pig No.	Dose of inoculum (cc.)	Duration of fever in days	Clinical illness	Death
Meningopneumonitis	1	0.25	8	0	0
Do	2	.25	5	0	0
Do	3	.5	5	0	0
Do	4	.5	9	0	0
Psittacosis	5	.25	5	0	0
Do	6	.25	5	0	0
Do	7	.5	7	0	0
Do	8	.5	1	0	0
Louisiana pneumonitis	9	.25	4	+	+
Do	10	.25	5	+	+
Do	11	.5	5	+	+
Do	12	.5	4	+	+

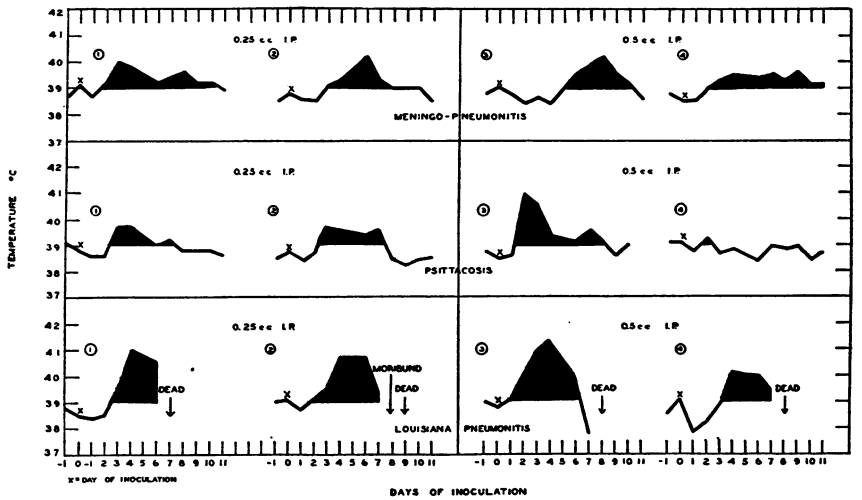

FIGURE 1.—Results obtained in guinea pigs following intraperitoneal inoculation of 0.25 cc. of meningopneumonitis, psittacosis, or Louisiana pneumonitis virus

IMMUNITY TEST

In order to determine further whether the three agents under consideration could be differentiated by other methods than those previously discussed, mice and guinea pigs were immunized with killed antigens of these viruses and these immunized animals were tested by intraperitoneal inoculation of graded doses of Louisiana pneumonitis virus.

Antigens were prepared by adding 0.2 percent formalin to 10-percent suspensions of infected yolk-sac tissues in salt solution and storing the mixtures at ice-box temperatures for a week before use. The mixtures were frequently agitated during this interval. Membranes for use in the preparation of vaccines were selected on the

basis of the large number of demonstrable elementary bodies, and the finished vaccines were shown to contain large numbers of these bodies when samples were smeared and stained with Machiavello's stain. The virus content of the suspensions used to prepare the vaccines was not determined.

Groups of mice and guinea pigs were given 0.25-cc. doses of the respective vaccines on two occasions at 8-day intervals. Vaccine was administered intraperitoneally. Two weeks after administration of the last dose of vaccine the animals were tested for their resistance against graded doses of Louisiana pneumonitis virus. Groups of immunized animals were given intraperitoneally 0.3-cc. amounts of mouse spleen virus diluted 10^{-2}, 10^{-3}, 10^{-4}, and 10^{-6} in salt solution. Normal mice and guinea pigs were used as controls and were given 0.3 cc. of the same virus intraperitoneally, using tenfold serial dilutions from 10^{-2} to 10^{-7}. The results are shown in table 6. The virus used was capable of producing death in 50 percent of normal

TABLE 6.— *Results of immunity test in mice and guinea pigs immunized with two intraperitoneal injections of formaldehyde-killed yolk-sac virus vaccine of meningopneumonitis, psittacosis, or Louisiana pneumonitis, and tested for the presence of immunity against various dilutions of Louisiana pneumonitis virus administered intraperitoneally*

Dilution of Louisiana pneumonitis administered intraperitoneally	Dose of virus (cc.)	Mice tested for resistance											
		Not immunized			Immunized with meningopneumonitis vaccine			Immunized with psittacosis vaccine			Immunized with Louisiana pneumonitis vaccine		
		Number tested	Number dying	Percent dying	Number tested	Number dying	Percent dying	Number tested	Number dying	Percent dying	Number tested	Number dying	Percent dying
10^{-2}	0.3	10	10	100	21	20	95	14	13	93	24	13	54
10^{-3}	.3	10	8	80	21	20	95	14	13	93	24	16	67
10^{-4}	.3	10	10	100	24	24	100	14	13	93	24	15	63
10^{-5}	.3	10	8	80									
10^{-6}	.3	10	7	70	24	21	88	14	12	86	24	4	17
10^{-7}	.3	10	5	50									
		Guinea pigs tested for resistance											
10^{-2}	.3	5	5	100	5	5	100	5	5	100	5	0	0
10^{-3}	.3	5	4	80	5	3	60	5	5	100	5	1	20
10^{-4}	.3	5	4	80	5	3	60	5	2	40	5	0	0
10^{-5}	.3	5	3	60									
10^{-6}	.3	5	2	40	5	3	60	5	2	40	5	0	0
10^{-7}	.3	5	0	0									

mice receiving 0.3 cc. of a 10^{-7} dilution of virus intraperitoneally and in 40 percent of normal guinea pigs receiving 0.3 cc. of a 10^{-6} dilution by the same route. The vaccine prepared from Louisiana pneumonitis virus resulted in almost complete protection of guinea pigs and partial protection of mice from infection with this virus. Animals vaccinated with killed suspensions of the other agents failed to resist

infection with Louisiana pneumonitis virus. The vaccine prepared from Louisiana pneumonitis virus was administered to two humans without producing untoward results.

Numerous attempts were made to demonstrate protective antibodies in the serum of patients and of guinea pigs recovered from infections with this virus and of rabbits given killed or living virus. Guinea pigs and white mice were used as test animals, and intracerebral, intraperitoneal, and combined routes of inoculation were employed. Serum and virus were given separately by the same or different routes and at different intervals or were combined and incubated at varying temperatures from 4° C. to 37° C. for periods of 1 to 24 hours before injection. No evidence was obtained to indicate that serums possessed any protective antibodies.

COMPLEMENT-FIXATION TESTS

Complement-fixation tests were performed on a variety of serums, employing a variety of antigens. These included antigens prepared from ornithosis, psittacosis, lymphogranuloma venereum, and Louisiana pneumonitis viruses grown in the yolk sac of chicken embryos. The yolk sacs were suspended in salt solution containing 0.1 percent formalin and were used as 10-percent suspensions. Serums were obtained from rabbits immunized with living virus contained in mouse tissue, from humans recovered from ornithosis, psittacosis, lymphogranuloma venereum, and S-F pneumonitis, and from a pigeon from which ornithosis virus had been isolated. The tests were run according to the method employed by Bengtson (*8*). The results shown in table 7 indicate that the agent under study belongs to the psittacosis-lymphogranuloma venereum group of viruses but that complement fixation failed to differentiate the viruses tested from others.

DISCUSSION

The psittacosis-lymphogranuloma venereum group of viruses contains a number of agents producing disease in various hosts. Until the recent work of Hilleman (*9*) no reliable method was available for the serological differentiation of the agents contained within the group. [3] The studies here presented show that the agent responsible for pneumonitis among humans in the bayou region of Louisiana may be differentiated from the viruses of psittacosis and meningopneumonitis. This is based primarily upon the ability of the former agent to produce fatal infection in mice inoculated subcutaneously or intramuscularly and consistently to produce fatal infections in guinea pigs inoculated intraperitoneally.

[3] The study by Hilleman appeared after work with this virus was completed.

TABLE 7.—*Complement-fixation reactions obtained with certain serums tested against antigens prepared from psittacosis, ornithosis, lymphogranuloma venereum and Louisiana pneumonitis virus*

Type of serum	Source of virus		Titer obtained with different antigens			
	Species	Identity	Psittacosis	Ornithosis	Louisiana pneumonitis	Lymphogranuloma venereum
Louisiana pneumonitis	Rabbit	B	1:256	1:128	1:128	1:16
Do	do	B_1	1:128	1:64	1:64	
Do	do	B_2	1:32	1:16	1:32	
Do	do	B_3	1:64	1:32	1:32	
Do	do	B_4	1:128	1:256	1:256	
Meningopneumonitis	do	MP_1	1:4	1:4	1:8	1:4
Do	do	MP_2	1:16	1:8	1:16	
Psittacosis	do	PS	1:8	1:8	1:64	1:8
Do	do	PS_1	1:8	1:4	1:8	
Do	do	PS_2	1:16	1:8	1:16	
Ornithosis	Pigeon	P	1:256	1:128	1:256	1:4
S-F [1]	Human	S-F	1:10	1:10	1:10	
Louisiana pneumonitis	Human	Pool	1:32	1:16	1:64	1:4
Do	do	Ortego	1:4	1:4	1:8	
Lymphogranuloma venereum.	do	L. G. V.	1:128	1:64	1:128	1:64
Do	do	Mob	1:32	1:8	1:32	1:16
Psittacosis	do	Cal	1:128	1:128	1:256	
Do	do	John	1:64	1:64	1:32	
Do	do	Mil	1:32	1:16	1:32	

[1] S-F virus isolated by Eaton, Beck, and Pearson (*2*).

SUMMARY

Louisiana pneumonitis virus may be differentiated from psittacosis and meningopneumonitis virus by its ability to produce fatal infections in guinea pigs inoculated intraperitoneally and in mice inoculated subcutaneously or intramuscularly.

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TULAREMIA

ATTEMPTED TRANSMISSION BY EACH OF TWO SPECIES OF FLEAS: *XENOPSYLLA CHEOPIS* (ROTHS.) AND *DIAMANUS MONTANUS* (BAKER)[1]

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The role of fleas in the transmission of plague and the mechanism by which these insects carry the infection from one animal to another are well established. Neither of these factors has been put on a firm basis in the epidemiology of tularemia. The disease has been transmitted under experimental conditions by the bites of infected flies (*Stomoxys calcitrans* (*1*) and *Chrysops discalis* (*2*)), ticks (*Dermacentor andersoni* (*3*), and *Dermacentor variabilis* (*4*)), bed bugs (*Cimex lectularius* (*2*)), and mosquitoes (*Aëdes aegypti* (*5*)). McCoy (*6*) placed infected animals in a container with fleas and later placed healthy animals in the same container. Some of these became infected, but the experimental methods adopted do not furnish definite information of the transmission of the infection by flea bites.

For purposes of these investigations, two species of fleas were chosen, *Xenopsylla cheopis* (Roths.) (rat flea) and *Diamanus montanus* (Baker) (California ground squirrel flea). Tularemia occurs only occasionally among rats, but the rat flea is an efficient vector of plague and attacks other animals readily. The squirrel flea is also a good vector of plague and is common to ground squirrels, among which tularemia is frequently found.

The fleas were bred in the laboratory and were held without food for 72 hours. They were then placed in clean containers with white mice, which had been infected with a strain of tularemia isolated from a ground squirrel. Previous to exposure to the fleas, the mice had developed a high grade of bacteremia as determined by the observation of many organisms per microscopic field of their blood. The fleas were allowed to remain with the mice for from 2 hours to approximately 15 hours, until the death of the latter, and were then removed. Three hundred and four *X. cheopis* and 201 *D. montanus* were thus given an opportunity to become infected. For practical purposes, the *X. cheopis* fleas were divided into 3 lots numbering respectively 119, 105, and 80, and each lot was fed on a different infected mouse. In like manner, the 201 *D. montanus* were divided into each of 2 lots of 113 and 88, and similarly fed. In other words, a lot was the number of fleas of the given species which was afforded the opportunity to feed on a single infected mouse.

[1] From Plague Suppressive Measures, States Relations Division, Bureau of State Services.

The subsequent disposition of each of the lots was as follows:

X. cheopis:

Lot 1:

(a) 20 were killed and each was promptly inoculated into an animal.
(b) 26 were killed and stored in 2-percent saline for future inoculation.
(c) 24 were killed and stored dry for future inoculation.
(d) 24 were preserved alive for subsequent tests of transmission by biting.
(e) 25 were placed on a normal guinea pig in a clean container.

Lot 2: In the same categories, there were (a) 20; (b) 24; (c) 20; (d) 41; (e) none.

Lot 3: There were (a) 60; and (d) 20; (b, c, and e) none.

D. montanus:

Lot 1: (a) 20; (b) 24; (c) 24; (d) 20; (e) 25.

Lot 2: (a) 30; (b) 20; (c) 20; (d) 18; (e) none.

Exposure to the fumes of calcium cyanide was used to kill fleas in the various tests.

The fleas which were promptly inoculated, from all lots (category (a)), were each triturated in saline within 4 hours after they were removed from the container in which they had had an opportunity to feed on an infected mouse, and the emulsion of each flea was injected subcutaneously into a normal mouse. It was found that varying percentages of the fleas in each group taken from the individual lots produced the disease in mice when tested by this procedure. The results are shown by lots in table 1, and it will be noted that there was a variation of from 68 to 95 percent among the respective lots which apparently became infected. These percentages were used as the indices of the probability, or expectancy, of infection in the remainder of the fleas in each lot.

TABLE 1.—*Percentage of fleas found infected, when afforded opportunity to feed on an infected mouse* [1]

Species of flea	Lot No.	Number of fleas	Maximum time [2] of exposure to infected mice	Percent positive
X. cheopis	1	20	Overnight	90
Do	2	20	Do	70
Do	3	60	Do	68
D. montanus	1	20	2 hours	95
Do	2	30	Overnight	80

[1] Fleas were killed immediately after removal from these mice and inoculated into a normal mouse.
[2] On every occasion the infected mouse died during the night.

The fleas of lots 1 and 2 of both *X. cheopis* and *D. montanus* which were killed and stored in saline, or were stored dry (categories (b) and (c)), were held for periods of from 3 to 13 days at room temperature (approximate mean of 73° F.), and were then triturated in saline in groups of 2 to 4 each, and the emulsion injected subcutaneously into individual normal white mice. It was found that none of the

inoculations of the several groups caused the development of infection when injected after 5 days of storage under dry conditions, and among the groups of *X. cheopis* the results were the same when stored in saline. However, four of the groups of *D. montanus* produced the infection after 6 to 7 days of storage (table 2). Since it was found that the micro-organism was viable in fleas immediately after they

TABLE 2.—*Period of survival* P. tularensis *in fleas exposed to infected mouse* [1]

Method stored	Species of flea	Number of groups of fleas inoculated	Number of fleas inoculated	Number of groups found infectious after storage for different periods		
				3–5 days	6–7 days	8–13 days
Dry	*X. cheopis*	6	24	4		
	Do	3	12		0	
	Do	2	8			0
	D. montanus	4	16	3		
	Do	4	16		0	
	Do	3	12			0
2 percent Saline	*X. cheopis*	4	16	4		
	Do	4	16		0	
	Do	5	18			0
	D. montanus	4	16	3		
	Do	4	16		4	
	Do	3	12			0

[1] Fleas were killed, stored dry or in saline, and inoculated in groups of 2 to 5 into healthy mice.

were removed from an infected animal and killed, it appears that it may remain viable in the dead fleas in storage for not more than 6 to 7 days, and usually for less than 6 days, under the conditions of these tests. This finding may be of practical significance in that it may very well explain the failure to obtain evidence of the infection by the injection of fleas which have been collected in the field and shipped to a remote point for examination. It has been noted that the frequency with which infection was produced in the laboratory by the inoculation of fleas which had been 5 to 6 days in transit from the field has not seemed to represent the probable incidence of tularemia among the rodents in the locality under survey, when other circumstances were taken into consideration.

Eighteen or more fleas were held from each of the five lots (category (d)), to determine whether they would transmit the infection by biting. Upon removal from an infected mouse, each flea was placed in a separate clean test tube and transferred to a clean tube every 4 days throughout its life. The entire number was kept at room temperature, which varied from a minimum of 66° F. and a maximum of 80° F., with a mean of 73° F. The maximum temperature of 80° F. did not persist for more than a few hours during any day of the period through which the fleas were held. Each flea was given an opportunity, individually, to bite the clipped abdomen of normal white mice at intervals of from 1 to 4 days until the flea died or was killed.

Several fleas were fed on each mouse, and when a flea survived sufficiently long it was fed on more than one mouse. The maximum number of mice on which any one flea fed was 12. The droppings of every flea were injected into a mouse to determine whether they would produce infection; and, upon its death, the flea was triturated in saline and the suspension inoculated subcutaneously into a mouse. The production of the disease by either or both of these procedures was the criterion on which a flea was classified as infected. The total number of *X. cheopis* thus found was 41, whereas the expectancy of infection was 62.0 percent, and there were 19 infected *D. montanus* and an expectancy of 32.7 percent. The number of times the infected fleas of each lot fed on a normal mouse during an interval of 1 to 4 days, and thereafter weekly, are indicated in table 3. During the first 4 days, one or more infected *X. cheopis* bit and fed on normal mice 33 times, and infected *D. montanus* fed 25 times. After the fourth day, there were 141 feedings by *X. cheopis* and 113 by *D. montanus*.

TABLE 3.—*Expected and proved infection in fleas, with number of feedings on healthy mice, and period of survival*

Species and lot number of fleas	Total number of fleas	Number of infected fleas expected	Number of infected fleas proved	Period of survival									
				1-4 days		5-12 days		13-20 days		21-28 days		29-36 days	
				Number of fleas infected	Number of feedings or chances to infect	Number of fleas infected	Number of feedings or chances to infect	Number of fleas infected	Number of feedings or chances to infect	Number of fleas infected	Number of feedings or chances to infect	Number of fleas infected	Number of feedings or chances to infect
X. cheopis: Lot 1	24	21.6	9	9	8	9	15	9	20	1	1	------	------
X. cheopis: Lot 2	41	28.7	23	23	17	21	27	20	26	14	14	3	6
X. cheopis: Lot 3	20	13.6	9	8	8	7	12	6	15	6	5	------	------
Total	85	62.0	41	40	33	37	54	35	61	21	20	3	6
D. montanus: Lot 1	20	19.0	15	15	21	14	36	11	30	8	17	6	8
D. montanus: Lot 2	18	14.4	4	4	4	4	10	3	6	2	4	2	2
Total	38	32.7	19	19	25	18	46	14	36	10	21	8	10
Grand total	123	94.7	60	59	58	55	100	49	97	31	41	11	16

From among 35 infected *X. cheopis* which survived from 13 to 20 days, 14 were killed. These were killed because they had failed to excrete infectious droppings, and it was believed from analogous experience with plague that they had therefore not become infected. Six of the 14 produced the infection upon the inoculation of the suspension of the individual fleas, though, as noted, they had not previously produced infectious droppings. In table 3, the data are recorded concerning the expectancy of infection among the fleas by lots, the number proved to be infected, and the number of feedings or chances to infect normal animals.

In considering the opportunities for the fleas to infect by biting, it was believed that those which might transmit the disease previous to the fifth day after feeding on an infected animal would have acted as mechanical vectors only; and the bites which occurred after the fourth day were regarded as those which would be more likely to transmit infection if an intrinsic development of the micro-organism occurred, comparable to that which occurs among fleas infected with plague. There were 58 bites and feedings by 59 infected fleas of the five lots during the first 4 days, and 254 additional bites by the fleas which survived more than 4 days. None of these bites was followed by the development of the disease in 46 mice which had received from 1 to as many as 14 bites.

Experience with the longevity of *Pasteurella pestis* within fleas previous to the transmission of the infection by the flea bite suggests that a period longer than the 29 to 36 days through which the fleas of this experiment were held might result in the transmission of tularemia by the bites of infectious fleas. However, fleas which carry *P. pestis* over long periods continue to excrete droppings which are infectious throughout the period previous to their transmitting the infection by biting. While in these experiments with 60 fleas which had been found to be infected, there were only two which excreted droppings after the twelfth day which produced the disease when injected subcutaneously into mice. One of these two continued to excrete infectious droppings until its death on the thirty-second day, and the injection of a mouse with the saline suspension of this flea produced the disease.

Twenty-five fleas of each species of lot 1 (category (e)), were placed in clean glass cages on normal guinea pigs, and were thus afforded opportunity to feed for a period of 32 days, but did not produce infection in the pig. Under the expectancy which had been determined 22+ of the *X. cheopis* and 23+ of the *D. montanus* should have contained the micro-organism. Neither the droppings nor the fleas of this experiment were inoculated because of the lack of control over them during the exposure of the fleas to the animal.

The methods of obtaining definite evidence of the presence of *Pasteurella tularensis* in living fleas appear to be either the cultivation of suspensions of their excreta on artificial media, or the injection of these suspensions into a white mouse, which is very susceptible to the infection. Neither of these methods is regarded as entirely satisfactory, but the difficulty of culturing the micro-organisms of tularemia in the presence of contaminating bacteria influenced the choice of the method of injecting the mouse. It will be noted in table 3 that the greatest discrepancy between the number of fleas which might be expected to be infected and the number determined

to be infected by this method, or by the inoculation of the suspension of the triturated flea, occurred in lot 2 of *D. montanus*. No satisfactory explanation for this marked discrepancy has been developed.

The discovery of the infection in six of the fleas of lot 2 of *X. cheopis* which were triturated and injected into an animal 16 days after they had fed on an infected mouse, and without having excreted infectious droppings during the intervening period, was contrary to the observations in all other instances. Here again, no satisfactory explanation on this apparent discrepancy has been developed.

DISCUSSION

The role of fleas (*X. cheopis* and *D. montanus*) in the transmission of tularemia has not been determined by these experiments. However, there is evidence that they ingest infected blood and harbor the micro-organism in a viable and virulent state for periods of 1 to 16 days, and in exceptional instances for 32 days, when maintained during the period by feeding on normal animals.

Tularemia is reported to be readily contracted through the contact of specific infectious material with the mucous membranes, or with the abraded skin. Therefore, it would seem that ample opportunity for infection of animals was afforded by the hundreds of deposits, on the fur, of infectious flea droppings which could be introduced into the skin by the biting or scratching of the animal. Or, in event these droppings became pulverized, they could come in contact with the conjunctiva, or could be inhaled. Experiments conducted during these tests have shown that the droppings are infectious for at least 21 days after drying.

The exposure for 32 days of guinea pigs to fleas, among which it seems probable that at least 22 harbored the micro-organism for a period, and deposited many droppings on the fur of the animal, might be expected to afford opportunities for their infection through bites or contact with the droppings. However, the animals did not become infected.

After consideration of these several observations, it is concluded that the two species of fleas tested do not play an important role in the transmission of tularemia, and it is the opinion of the senior author that this conclusion may be extended to many species.

Tularemia occurs frequently among rabbits of North America, which are hosts to a genus of fleas (*Cediopsylla*) which have serrated mouth parts and which feed by attaching themselves to the host in a manner similar to that practiced by ticks. A small number of these fleas were tested and became infected, but they did not survive in sufficient numbers for transmission tests. Additional experiments to determine the role of these rabbit fleas in the transmission of tularemia are in progress.

SUMMARY

From 68 to 90 percent of *X. cheopis*, and 80 to 95 percent of *D. montanus* fleas became infected when given an opportunity to feed on tularemia-infected white mice.

The disease was produced by the inoculation of infected fleas or of their feces for varying periods (up to 32 days in *X. cheopis*).

Fleas killed immediately after infection and stored at room temperature as long as 5 days in dry condition, or for 7 days in saline, produced tularemia when triturated and injected into healthy mice.

Fifty-nine infected fleas (*X. cheopis* and *D. montanus*) biting 46 normal white mice 312 times failed to produce tularemia in the mice.

Twenty-five fleas each of *X. cheopis* and *D. montanus* that were exposed to tularemia-infected mice and then placed in clean cages with healthy guinea pigs did not produce the disease in animals over a period of 32 days.

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INCIDENCE OF HOSPITALIZATION, NOVEMBER 1945

Through the cooperation of the Hospital Service Plan Commission of the American Hospital Association, data on hospital admissions among about 10,000,000 members of Blue Cross Hospital Service Plans are presented monthly. These plans provide prepaid hospital service. The data cover about 60 hospital service plans scattered throughout the country, mostly in large cities.

Item	November	
	1944	1945
1. Number of plans supplying data	76	78
2. Number of persons eligible for hospital care	15,560,515	18,841,442
3. Number of persons admitted for hospital care	129,388	162,954
4. Incidence per 100 persons, annual rate, during current month (daily rate × 365)	101.4	105.3
5. Incidence per 1,000 persons, annual rate for the 12 months ended November 30, 1945	104.2	106.4
6. Number of plans reporting on hospital days	24	29
7. Days of hospital care per case discharged during month [1]	7.77	8.70

[1] Days include entire stay of patient in hospital whether at full pay or at a discount.

DEATHS DURING WEEK ENDED DECEMBER 22, 1945

[From the Weekly Mortality Index, issued by the Bureau of the Census, Department of Commerce]

	Week ended Dec. 22, 1945	Corresponding week, 1944
Data for 92 large cities of the United States:		
Total deaths	9,516	8,576
Average for 3 prior years	9,514	
Total deaths, first 51 weeks of year	423,335	423,147
Deaths under 1 year of age	577	568
Average for 3 prior years	574	
Deaths under 1 year of age, first 51 weeks of year	29,272	29,755
Data from industrial insurance companies:		
Policies in force	67,225,173	66,901,551
Number of death claims	13,511	12,991
Death claims per 1,000 policies in force, annual rate	10.5	10.2
Death claims per 1,000 policies, first 51 weeks of year, annual rate	10.0	10.1

PREVALENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

REPORTS FROM STATES FOR WEEK ENDED DECEMBER 29, 1945

Summary

For the second week the reported incidence of influenza declined. A total of 52,947 cases was reported, as compared with 68,551 last week, 3,466 and 126,488 for the corresponding weeks, respectively, of 1944 and 1943, and a 5-year (1940–44) median of 3,466. Increases were reported in only 2 of the 9 geographic areas—the East and West South Central. Increases occurred in 7 of the 13 States reporting more than 1,000 cases each, as follows (last week's figures in parentheses): *Increases*—Virginia 5,907 (4,796), South Carolina 3,243 (2,696), Kentucky 8,071 (6,816), Alabama 1,218 (1,205), Louisiana 7,255 (44), Oklahoma 1,176 (1,170), Idaho 1,151 (1,144); *decreases*—Wisconsin 1,034 (1,293), Kansas 2,586 (7,715), West Virginia 2,302 (7,219), Arkansas 1,924 (2,021), Texas 10,660 (14,496), Arizona 1,385 (1,608).

A total of 364,672 cases has been reported since July 1, as compared with 32,345 and 343,574, respectively, in the corresponding periods of 1944 and 1943, and a 5-year median of 35,379. For the 52 weeks of the current year the total is 431,146, as compared with 367,868 and 421,155 for 1944 and 1943, respectively. For the last quarter of the current year, 354,962 cases were reported, as compared with 335,330 in the same period of 1943, which was the largest number reported for the corresponding period in any of the past 10 years. The peak of incidence in the epidemic of 1943–44 was reached in the first week of January, with a report of 126,610 cases.

Of the total of 162 cases of meningococcus meningitis reported, as compared with 127 last week and 187 for the 5-year median, 74 were reported as follows: Illinois and California 14 each, New York and Texas 13 each, and New Jersey and Pennsylvania 10 each.

The report of 25 cases of poliomyelitis in Wisconsin included delayed reports.

Deaths recorded for the week in 93 large cities of the United States totaled 11,384, as compared with 10,458 last week, 9,934 for the corresponding week last year, and a 3-year (1942–44) average of 11,549. The total for the 52 weeks of the year is 471,714, as compared with 468,773 last year.

Telegraphic morbidity reports from State health officers for the week ended December 29, 1945, and comparison with corresponding week of 1944, and 5-year median

In these tables a zero indicates a definite report, while leaders imply that, although none was reported, cases may have occurred.

Division and State	Diphtheria			Influenza			Measles			Meningitis, meningococcus		
	Week ended—		Median 1940–44	Week ended—		Median 1940–44	Week ended—		Median 1940–44	Week ended—		Median 1940–44
	Dec. 29, 1945	Dec. 30, 1944		Dec. 29, 1945	Dec. 30, 1944		Dec. 29, 1945	Dec. 30, 1944		Dec. 29, 1945	Dec. 30, 1944	
NEW ENGLAND												
Maine	2	0	0	3				4	35	0	0	0
New Hampshire	0	0	0	2			1		1	0	0	0
Vermont	1	0	0	44	7				13	0	0	0
Massachusetts	3	8	4				157	61	223	3	6	6
Rhode Island	1	1	0	8	21				3	0	0	0
Connecticut	4	0	0	13		1	11	20	20	2	2	2
MIDDLE ATLANTIC												
New York	7	14	14	[1] 71	[1] 3	[1] 15	499	57	542	13	29	19
New Jersey	3	4	4	163	5	17	26	17	150	10	12	8
Pennsylvania	8	14	14	22	1	1	354	28	533	10	13	10
EAST NORTH CENTRAL												
Ohio	44	5	7	123	3	14	14	9	47	8	7	5
Indiana	9	16	10	469	11	37	10	6	32	3	6	4
Illinois	7	8	19	56	11	24	303	18	84	14	16	8
Michigan [2]	19	11	10	5	2	6	174	11	99	5	10	4
Wisconsin	4	5	1	1,034	11	44	44	17	217	0	6	2
WEST NORTH CENTRAL												
Minnesota	4	4	2	2	1		3	71	71	1	3	0
Iowa	2	4	2	388		1	8	11	40	3	2	1
Missouri	5	3	3	52	7	7	55	3	11	4	6	6
North Dakota	0	7	2	679	3	17			16	0	0	0
South Dakota	2	1	2	2			3		1	1	0	0
Nebraska	0	1	1	144	5		5	8	8	0	0	0
Kansas	7	4	5	2,586	1	10	40	15	62	1	1	1
SOUTH ATLANTIC												
Delaware	0	1	0				2	5	4	0	1	0
Maryland [2]	11	10	3	105	1	5	11	4	9	0	2	2
District of Columbia	0	0	1	45	1	4	1		4	1	3	1
Virginia	7	10	14	5,907	279	432	29	16	103	2	6	6
West Virginia	15	1	2	2,302	15	17	6	4	16	6	0	0
North Carolina	20	14	14		7	7	17	15	136	4	3	3
South Carolina	9	2	7	3,243	417	440	36	4	45	0	0	1
Georgia	8	3	5	497	20	65	14		25	6	1	1
Florida	3	3	5	11	2	16	4		2	5	1	0
EAST SOUTH CENTRAL												
Kentucky	8	4	5	8,071	7	25	167		32	3	4	3
Tennessee	6	7	6	443	47	61	23	70	66	7	10	0
Alabama	12	14	13	1,218	71	194	3	4	5	6	6	3
Mississippi [2]	6	7	7							4	3	2
WEST SOUTH CENTRAL												
Arkansas	8	4	7	1,924	126	126	7	8	34	1	3	3
Louisiana	13	7	7	7,225	6	10	5	9	3	2	6	2
Oklahoma	2	8	8	1,176	71	120	7	3	4	1	0	0
Texas	33	56	50	10,660	2,121	2,121	50	71	66	13	9	3
MOUNTAIN												
Montana	0	7	2	472		15	2	3	41	0	1	1
Idaho	2	0	0	1,151	1	2	105	1	3	0	0	0
Wyoming	1	0	0	3	18	55	15	3	3	1	0	0
Colorado	5	2	5	278	25	69	25	6	59	1	0	0
New Mexico	2	1	1	3	1	1	6			1	0	0
Arizona	3	0	2	1,385	109	157		4	26	0	2	0
Utah [2]	0	0	0	369		55	27	10	10	2	0	0
Nevada	0	0	0	1			7	3		0	0	0
PACIFIC												
Washington	7	21	4			3	272	18	18	3	2	2
Oregon	7	7	3	307	14	18	29	37	55	1	2	2
California	21	32	24	285	15	60	146	237	168	14	14	12
Total	341	331	323	52,947	3,466	3,466	2,723	891	5,786	162	198	187
52 weeks	18,541	14,126	15,559	*431,146	367,868	367,868	128,683	602,397	602,085	7,999	16,059	3,774

[1] New York City only. [2] Period ended earlier than Saturday.

* Delayed reports: Washington, influenza, week ended Dec. 15, 226 cases; Dec. 22, 54 cases.

Telegraphic morbidity reports from State health officers for the week ended December 29, 1945, and comparison with corresponding week of 1944 and 5-year median—Con.

Division and State	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever[2]		
	Week ended—		Median 1940–44	Week ended—		Median 1940–44	Week ended—		Median 1940–44	Week ended—		Median 1940–44
	Dec. 29, 1945	Dec. 30, 1944		Dec. 29, 1945	Dec. 30, 1944		Dec. 29, 1945	Dec. 30, 1944		Dec. 29, 1945	Dec. 30, 1944	
NEW ENGLAND												
Maine	0	0	0	28	58	14	0	0	0	1	1	1
New Hampshire	0	1	0	2	20	9	0	0	0	0	0	0
Vermont	0	0	0	3	6	8	0	0	0	0	0	0
Massachusetts	1	0	0	114	251	246	0	0	0	2	2	2
Rhode Island	0	0	0	5	17	9	0	0	0	0	0	0
Connecticut	1	0	0	28	61	29	0	0	0	0	0	0
MIDDLE ATLANTIC												
New York	3	30	2	233	406	285	0	0	0	2	2	2
New Jersey	1	1	1	56	109	95	0	0	0	2	0	1
Pennsylvania	2	0	0	197	251	180	0	0	0	4	3	3
EAST NORTH CENTRAL												
Ohio	1	4	2	221	242	225	0	0	0	13	2	2
Indiana	1	0	0	54	144	122	1	0	1	1	1	0
Illinois	5	5	3	117	255	182	0	0	1	0	0	1
Michigan [3]	5	0	1	147	214	160	0	0	0	0	2	2
Wisconsin	[4] 25	3	3	99	114	114	0	2	0	0	1	0
WEST NORTH CENTRAL												
Minnesota	3	0	0	38	62	62	0	0	0	0	1	0
Iowa	0	2	2	26	64	62	0	0	0	0	0	0
Missouri	3	3	0	41	69	57	1	0	0	1	0	0
North Dakota	0	2	0	12	11	11	0	1	0	0	0	0
South Dakota	0	0	0	9	10	22	0	0	0	0	1	0
Nebraska	0	0	0	18	34	24	1	0	0	0	0	0
Kansas	1	1	1	47	111	65	0	0	0	1	1	0
SOUTH ATLANTIC												
Delaware	0	0	0	4	3	3	0	0	0	0	0	0
Maryland [2]	0	1	0	23	117	53	0	0	0	0	3	3
District of Columbia	0	0	0	9	60	26	0	0	0	0	0	1
Virginia	0	0	0	68	80	50	0	0	0	2	2	4
West Virginia	0	1	1	24	28	46	0	0	0	0	0	0
North Carolina	0	0	0	20	48	49	0	0	0	1	0	0
South Carolina	2	1	1	14	5	10	0	0	0	1	1	0
Georgia	4	0	0	14	17	22	0	0	0	0	0	2
Florida	2	0	0	10	1	9	0	0	0	2	0	1
EAST SOUTH CENTRAL												
Kentucky	0	1	1	49	51	51	0	0	0	0	0	2
Tennessee	0	1	0	20	83	70	0	0	0	6	0	1
Alabama	3	1	0	8	11	20	0	0	0	5	2	2
Mississippi [2]	0	2	1	6	41	11	1	0	0	0	1	0
WEST SOUTH CENTRAL												
Arkansas	1	0	0	7	22	8	1	1	1	2	0	0
Louisiana	0	0	0	25	17	8	0	0	0	3	0	4
Oklahoma	0	0	0	16	21	21	1	1	1	2	2	1
Texas	2	0	2	74	94	57	0	0	1	7	8	6
MOUNTAIN												
Montana	3	0	0	15	13	13	0	0	0	0	0	0
Idaho	0	1	0	6	40	17	0	0	0	0	0	0
Wyoming	0	0	0	4	10	4	0	0	0	0	0	0
Colorado	1	0	1	47	57	26	0	0	0	0	0	0
New Mexico	0	1	0	11	23	10	0	0	0	3	0	1
Arizona	0	0	0	8	14	9	0	0	0	0	0	0
Utah [3]	1	1	1	15	41	41	0	0	0	0	0	0
Nevada	0	0	0	0	2	0	0	0	0	0	0	0
PACIFIC												
Washington	7	4	1	40	65	42	0	0	0	0	2	1
Oregon	2	0	1	30	26	9	0	0	0	0	1	1
California	6	9	2	149	260	116	0	0	0	0	4	3
Total	[4] 86	76	42	2,211	3,759	2,858	6	5	17	61	43	80
45 weeks	13,734	19,272	9,769	172,389	190,316	140,475	349	390	863	4,875	5,392	6,703

[2] Period ended earlier than Saturday.

[3] Including paratyphoid fever reported separately, as follows: Maine 1; Massachusetts 2; New York 1; Ohio 10.

[4] Includes delayed reports.

Telegraphic morbidity reports from State health officers for the week ended December 29, 1945, and comparison with corresponding week of 1944 and 5-year median—Con.

Division and State	Whooping cough			Week ended Dec. 29, 1945							
	Week ended—		Median 1940–44	Dysentery			Encephalitis, infectious	Rocky Mt. spotted fever	Tularemia	Typhus fever, endemic	Undulant fever
	Dec. 29, 1945	Dec. 30, 1944		Amebic	Bacillary	Unspecified					
NEW ENGLAND											
Maine	9	21	21								
New Hampshire	7	7	7								1
Vermont	52	34	17								
Massachusetts	93	94	125			4					2
Rhode Island	17		8								
Connecticut	17	71	38			4					1
MIDDLE ATLANTIC											
New York	213	206	328	4	5		2		1		2
New Jersey	97	65	85	8							
Pennsylvania	86	153	153								2
EAST NORTH CENTRAL											
Ohio	55	87	104						3		
Indiana	18	15	15			2					
Illinois	51	51	120	1					1		3
Michigan [3]	64	55	163								1
Wisconsin	36	67	110								3
WEST NORTH CENTRAL											
Minnesota		15	30	5							
Iowa		12	16								
Missouri	3	20	13			2					1
North Dakota		4	4								
South Dakota	6	12	2								
Nebraska	1		2								
Kansas	7	28	28								2
SOUTH ATLANTIC											
Delaware	1	9	2								
Maryland [3]	7	61	55						2		
District of Columbia	8	2	11								
Virginia	34	33	36			34			3	1	
West Virginia	5	10	13								
North Carolina	20	35	76	1					1	1	
South Carolina	44	23	33	2	13					3	
Georgia		2	4							11	
Florida	2	1	6							1	
EAST SOUTH CENTRAL											
Kentucky	11	8	24						10		
Tennessee	24	31	24						6	1	1
Alabama	5	4	21				1			9	1
Mississippi [3]									1		
WEST SOUTH CENTRAL											
Arkansas	1	23	17	3	3				1	1	4
Louisiana			1	1						4	
Oklahoma	3	3	3	1	2						
Texas	83	136	136	8	230	36				11	1
MOUNTAIN											
Montana	1	2	3								
Idaho	42	1	1								1
Wyoming	1	7	3								
Colorado	12	6	14	5	1						
New Mexico			12	1	4						
Arizona		7	14				1				
Utah [3]	6	3	16								2
Nevada	5										
PACIFIC											
Washington	25	16	27								4
Oregon	8	9	7								1
California	30	121	128	1			1			1	1
Total	1,210	1,570	2,530	41	266	74	5	0	29	44	34
Same week, 1944	1,570			42	737	94	10	1	45	72	58
Average, 1942–44	1,830			2b	349	127	13	[4] 0	33	[4] 58	
52 weeks: 1945 [3]	123,554			1,958	24,700	10,525	620	467	818	5,167	4,804
1944	95,610			1,899	25,032	9,140	635	455	719	5,337	3,829
Average, 1942–44	149,980		[4] 176,415	1,741	18,419	7,731	632	[4] 452	816	[4] 3,729	

[3] Period ended earlier than Saturday.
[4] 5-year median 1940–44.

WEEKLY REPORTS FROM CITIES

City reports for week ended December 22, 1945

This table lists the reports from 89 cities of more than 10,000 population distributed throughout the United States, and represents a cross section of the current urban incidence of the diseases included in the table.

	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
NEW ENGLAND												
Maine:												
Portland	0	0	------	0	-------	0	0	0	1	0	0	------
New Hampshire:												
Concord	0	0	------	0	-------	0	2	0	0	0	0	------
Vermont:												
Barre	0	0	------	0	-------	0	0	0	0	0	0	------
Massachusetts:												
Boston	2	0	------	0	17	1	11	1	26	0	1	30
Fall River	0	0	------	0	-------	0	2	0	2	0	0	1
Springfield	0	0	------	0	-------	0	0	0	5	0	0	2
Worcester	0	0	------	0	4	0	10	0	6	0	0	10
Rhode Island:												
Providence	0	0	------	0	1	0	2	0	7	0	2	1
Connecticut:												
Bridgeport	0	0	------	0	-------	0	2	0	2	0	0	1
Hartford	0	0	1	0	-------	0	1	0	4	0	0	4
New Haven	0	0	3	0	-------	0	2	0	1	0	0	2
MIDDLE ATLANTIC												
New York:												
Buffalo	0	0	3	0	2	1	7	0	4	0	0	26
New York	7	0	95	4	60	10	96	5	100	0	1	57
Rochester	0	0	------	0	2	0	5	0	2	0	0	11
Syracuse	0	0	------	1	169	3	2	0	11	0	0	8
New Jersey:												
Camden	1	0	1	1	-------	0	0	0	0	0	0	3
Newark	0	0	27	1	1	0	14	0	7	0	1	25
Trenton	0	0	2	1	-------	0	2	0	2	0	0	------
Pennsylvania:												
Philadelphia	3	0	65	2	53	6	21	0	27	0	0	33
Pittsburgh	2	0	9	8	-------	1	11	0	6	0	0	2
Reading	0	0	1	0	3	0	4	0	4	0	0	10
EAST NORTH CENTRAL												
Ohio:												
Cincinnati	5	0	------	1	6	0	13	0	16	0	0	------
Cleveland	1	0	22	1	1	1	20	0	8	0	0	15
Columbus	7	0	8	8	3	0	4	0	10	0	0	3
Indiana:												
Fort Wayne	0	0	------	0	1	0	4	0	0	0	0	------
Indianapolis	5	0	------	0	7	1	9	0	13	0	0	7
South Bend	0	0	------	0	1	0	0	0	2	0	0	------
Terre Haute	0	0	------	0	-------	0	1	0	0	0	0	------
Illinois:												
Chicago	1	0	10	7	182	10	49	1	45	0	1	18
Springfield	2	0	------	0	-------	0	6	0	3	0	0	------
Michigan:												
Detroit	8	1	4	2	48	1	15	2	37	0	0	35
Flint	0	0	------	3	39	0	6	0	5	0	0	------
Grand Rapids	0	0	------	0	4	0	0	0	5	0	0	------
Wisconsin:												
Kenosha	0	0	------	0	-------	0	0	0	0	0	0	1
Milwaukee	0	0	1	0	3	3	3	0	11	0	0	21
Racine	0	0	1	1	2	0	0	0	1	0	0	2
Superior	0	0	------	0	1	0	0	0	0	0	0	1
WEST NORTH CENTRAL												
Minnesota:												
Duluth	1	0	------	0	-------	0	1	0	2	0	0	1
Minneapolis	4	0	------	1	-------	0	5	0	10	0	0	1
St. Paul	2	0	------	3	-------	2	1	0	4	0	0	7
Missouri:												
Kansas City	0	0	5	3	33	0	19	0	12	0	0	5
St. Joseph	0	0	------	0	8	0	0	0	1	0	0	------
St. Louis	0	0	33	3	5	1	3	1	9	0	0	2

City reports for week ended December 22, 1945—Continued

	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
WEST NORTH CENTRAL—continued												
North Dakota:												
Fargo	1	0	------	0	-------	0	0	0	1	0	0	------
Nebraska:												
Omaha	0	0	------	2	2	0	7	0	4	0	0	------
Kansas:												
Topeka	0	0	8	0	15	0	3	0	3	0	0	------
Wichita	0	0	------	0	2	1	5	0	7	0	0	2
SOUTH ATLANTIC												
Delaware:												
Wilmington	0	0	------	1	5	0	8	0	0	0	0	------
Maryland:												
Baltimore	15	0	61	2	2	0	20	0	11	0	0	21
Cumberland	0	0	------	1	-------	0	1	0	1	0	0	------
Frederick	0	0	------	0	-------	0	0	0	1	0	0	------
District of Columbia:												
Washington	1	0	6	1	2	0	13	1	12	0	0	6
Virginia:												
Lynchburg	1	0	850	0	-------	0	1	0	7	0	0	------
Richmond	0	0	1	2	1	0	4	0	5	0	0	------
Roanoke	0	0	------	0	-------	1	0	0	4	0	0	------
West Virginia:												
Charleston	0	0	2	0	-------	0	0	0	0	0	0	------
Wheeling	0	0	2	0	-------	1	0	0	1	0	0	------
North Carolina:												
Raleigh	0	0	------	0	-------	0	2	0	0	0	0	2
Wilmington	0	0	------	0	-------	0	2	0	0	0	0	2
Winston-Salem	0	0	------	0	-------	0	4	0	2	0	0	4
South Carolina:												
Charleston	1	0	41	0	-------	0	0	0	2	0	0	------
Georgia:												
Atlanta	0	0	107	3	-------	1	3	0	0	0	0	------
Brunswick	0	0	------	0	-------	0	0	0	0	0	0	------
Savannah	1	0	11	0	-------	0	1	0	5	0	0	------
Florida:												
Tampa	0	0	------	0	-------	0	2	0	1	0	0	------
EAST SOUTH CENTRAL												
Tennessee:												
Memphis	1	0	2	3	7	1	8	0	5	0	0	1
Nashville	2	0	------	1	6	0	2	0	3	0	0	4
Alabama:												
Birmingham	1	0	90	2	-------	0	4	0	3	0	1	------
Mobile	0	0	33	1	-------	0	0	0	0	0	0	------
WEST SOUTH CENTRAL												
Arkansas:												
Little Rock	2	0	17	0	-------	0	1	0	3	0	0	------
Louisiana:												
New Orleans	5	0	5	4	5	1	7	2	6	0	0	------
Shreveport	0	0	------	0	-------	0	2	0	3	0	0	------
Texas:												
Dallas	3	0	3	1	-------	2	6	0	10	0	0	1
Galveston	1	0	------	0	-------	0	0	0	0	0	0	------
Houston	8	0	------	0	-------	2	10	0	8	0	0	1
San Antonio	2	0	6	0	-------	1	6	0	0	0	0	2
MOUNTAIN												
Montana:												
Billings	0	0	------	0	-------	0	2	0	0	0	0	------
Great Falls	0	0	------	0	-------	0	0	0	0	0	0	------
Helena	0	0	------	0	-------	0	0	0	0	0	0	------
Missoula	0	0	115	0	-------	0	0	1	3	0	1	------
Idaho:												
Boise	0	0	------	0	-------	0	1	0	0	0	0	------
Colorado:												
Pueblo	0	0	------	0	1	0	2	0	2	0	0	------
Utah:												
Salt Lake City	0	0	------	1	9	0	1	0	2	0	0	------

City reports for week ended December 22, 1945—Continued

	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
PACIFIC												
Washington:												
Seattle	0	0	-----	0	-----	0	6	0	0	0	0	-----
Spokane	0	0	1	1	13	0	0	0	1	0	0	2
Tacoma	0	0	-----	0	44	0	0	1	3	0	0	13
California:												
Los Angeles	1	0	74	5	13	1	4	7	45	0	0	15
Sacramento	1	0	-----	0	3	0	1	0	0	0	0	4
San Francisco	2	0	1	0	19	2	5	0	10	0	0	1
Total	100	1	1,727	82	805	55	497	22	585	0	8	426
Corresponding week, 1944	85	-----	66	30	152	-----	403	-----	1,064	0	12	403
Average, 1940–44	70	-----	2,476	[1] 123	[2] 1,487	-----	[1] 668	-----	940	2	13	812

[1] 3-year average, 1942–44.
[2] 5-year median, 1940–44.

Anthrax.—Cases: Boston 1.
Dysentery, amebic.—Cases: Boston 1; New York 1; Chicago 2; Detroit 1; Brunswick 1; Los Angeles 1; San Francisco 1.
Dysentery, bacillary.—Cases: Bridgeport 1; New York 7; Rochester 1; Detroit 2; Charleston, S. C., 2; Los Angeles 2.
Dysentery, unspecified.—Cases: San Antonio 13.
Rocky Mountain spotted fever.—Cases: New York 1.
Tularemia.—Cases: Chicago 1; Wichita 1; Memphis 1.
Typhus fever, epidemic.—Cases: Atlanta 2; Savannah 1; Tampa 2; Little Rock 2; New Orleans 1; Houston 1; Los Angeles 6.

Rates (annual basis) per 100,000 population, by geographic groups, for the 89 cities in the preceding table (estimated population, 1943, 34,057,700)

	Diphtheria case rates	Encephalitis, infectious, case rates	Influenza		Measles case rates	Meningitis, meningococcus case rates	Pneumonia death rates	Poliomyelitis case rates	Scarlet fever case rates	Smallpox case rates	Typhoid and paratyphoid fever case rates	Whooping cough case rates
			Case rates	Death rates								
New England	5.2	0.0	10.5	0.0	58	2.6	83.6	2.6	141	0.0	7.8	133
Middle Atlantic	6.0	0.0	94.0	8.3	134	9.7	75.0	2.3	75	0.0	0.9	81
East North Central	17.6	0.6	28.0	14.0	181	9.7	79.1	1.8	95	0.0	0.6	63
West North Central	15.9	0.0	91.5	23.9	129	8.0	87.5	2.0	105	0.0	0.0	36
South Atlantic	31.1	0.0	1766.9	16.3	16	4.9	99.7	1.6	85	0.0	0.0	57
East South Central	23.6	0.0	737.7	41.3	77	5.9	82.6	0.0	65	0.0	5.9	30
West South Central	60.3	0.0	89.0	14.3	14	17.2	91.8	5.7	86	0.0	0.0	11
Mountain	0.0	0.0	1872.0	16.3	163	0.0	97.7	16.3	114	0.0	16.3	0
Pacific	6.3	0.0	120.2	9.5	145	4.7	25.3	12.7	93	0.0	0.0	55
Total	15.4	0.2	265.1	12.6	124	8.4	76.3	3.4	90	0.0	1.2	65

PLAGUE INFECTION IN SAN LUIS OBISPO COUNTY, CALIF.

Under date of December 17, 1945, plague infection was reported proved on December 13 in a pool of 200 fleas from 26 ground squirrels, *C. beecheyi*, collected on a ranch at Santa Margarita, San Luis Obispo County, Calif.

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended December 1, 1945.—During the week ended December 1, 1945, cases of certain communicable diseases were reported by the Dominion Bureau of Statistics of Canada as follows:

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Chickenpox		30		287	361	74	67	61	129	1,009
Diphtheria		1	5	50	6	2	2	2		68
Dysentery, bacillary				7						7
German measles				7	20		2	5	3	37
Influenza		5			34	1			5	45
Measles		4		194	1,021	1	8	10	72	1,310
Meningitis, meningococcus					2		1			3
Mumps		2	1	184	105	19	2	54	37	404
Poliomyelitis					1				3	4
Scarlet fever		15	9	163	129	13	6	23	25	383
Tuberculosis (all forms)		7	4	100	55	34	2	2	18	222
Typhoid and paratyphoid fever				20	3				1	24
Undulant fever					2					2
Venereal diseases:										
Gonorrhea	5	21	28	106	146	61	42	43	100	552
Syphilis	4	11	10	190	111	18	9	17	37	407
Whooping cough		9	3	241	71	9	1	7		341

CUBA

Habana—Communicable diseases—4 weeks ended December 8, 1945.—During the 4 weeks ended December 8, 1945, certain communicable diseases were reported in Habana, Cuba, as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Diphtheria	13	0	Tuberculosis	9	4
Malaria	9	0	Typhoid fever	14	2

Provinces—Notifiable diseases—4 weeks ended December 1, 1945.—During the 4 weeks ended December 1, 1945, cases of certain notifiable diseases were reported in the Provinces of Cuba as follows:

Disease	Pinar del Rio	Habana [1]	Matanzas	Santa Clara	Camaguey	Oriente	Total
Cancer	0	1	4	11	0	14	30
Diphtheria	2	25	1	2	1	1	32
Hookworm disease		21					21
Leprosy	0	4	0	2	1	1	[2] 9
Malaria	5	18	5	2	23	116	169
Measles	0	0	0	0	1	0	1
Meningitis, cerebrospinal	1	0	0	0	0	0	1
Poliomyelitis	0	0	0	1	0	0	1
Rabies, human	0	1	0	0	0	0	1
Tetanus, infantile	1	0	0	0	0	0	1
Tuberculosis	11	29	14	32	23	64	173
Typhoid fever	24	41	4	30	24	52	175

[1] Including Habana City.
[2] Includes 1 case for the week ended December 1 for which the province was not given.

JAMAICA

Notifiable diseases—4 weeks ended November 17, 1945.—For the 4 weeks ended November 17, 1945, cases of certain notifiable diseases were reported in Kingston, Jamaica, and in the island outside of Kingston, as follows:

Disease	Kingston	Other localities	Disease	Kingston	Other localities
Cerebrospinal meningitis	1	1	Paratyphoid fever		1
Chickenpox	11	14	Scarlet fever	4	
Diphtheria	8	12	Tuberculosis, pulmonary	32	92
Dysentery, unspecified	14	13	Typhoid fever	11	167
Erysipelas	1		Typhus fever	1	1
Leprosy		1			

REPORTS OF CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER RECEIVED DURING THE CURRENT WEEK

NOTE.—Except in cases of unusual incidence, only those places are included which had not previously reported any of the above-mentioned diseases, except yellow fever, during the current year. All reports of yellow fever are published currently.

A table showing the accumulated figures for these diseases for the year to date is published in the PUBLIC HEALTH REPORTS for the last Friday in each month.

Typhus Fever

Belgian Congo.—For the week ended November 10, 1945, 186 cases of typhus fever (murine type) with 13 deaths were reported in Belgian Congo.