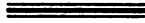


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A STUDY OF THE COMPLEMENT FIXATION AND WEIL-FELIX REACTIONS IN WILD RATS AS RELATED TO THE ISOLATION OF THE VIRUS OF ENDEMIC TYPHUS¹

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The epidemiological studies of Maxcy (1a) on endemic typhus in the southeastern United States suggested a rodent reservoir of the disease, and the investigations of Dyer, Rumreich, and Badger (2) established the rat flea as the transmitting agent. The wild rat was shown to be the reservoir of the disease by Mooser, Castañeda, and Zinsser (3). Confirmatory evidence of the rôle of the rat and the rat flea in the spread of the endemic (murine) form of typhus has come from many parts of the world.

Demonstration of typhus infection in wild rats suggested the use of the Weil-Felix reaction in testing rat serums with a view of determining its relation to typhus infection. Maxcy (1b) studied the test for the purpose of obtaining evidence incriminating the rat as the reservoir of the disease. He obtained positive Weil-Felix reactions in 3 percent of 1,700 wild rats captured in Savannah, Ga. Varying results have been obtained by other workers.

Rochaix, Sédallian, and Couture (4) obtained positive Weil-Felix results in 10.77 percent of 65 *M. decumanus* rats in Lyon, France (1/40-1/640); Panayotatou (5) in 43 percent of 50 rats in Alexandria, Egypt (1/50-1/1,000); Kritschewski and Solowiow (6) in 28 percent of 103 wild rats in Moscow (1/10-1/500); Epstein and Silvers (7) in 31 percent of 83 rats in Moscow (1/40-1/3,500); Nicolle and Sparrow (8) in 10 percent of 880 rats in Tunis (1/40-1/10,000); Suzuki (9) in 50 percent of 10 wild rats in Hamburg; Prica (10) in 26.6 percent of 75 wild rats in Zagreb (1/40-1/640); Palacios, Chávéz, Avendaño and

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Aguiló (11) in none of 530 rats in Santiago, Chile; Covell (12) in 8.8 percent of 524 rats in the Simla Hills, India (1/50-1/250 or over); Riding (13) none in 54 wild rats in Egypt (1/50 or over); Balteanu and Constantinesco (14) in 43.3 percent of 104 wild rats in Roumania (1/50 or over); Leccisotti (15) in 51 percent of 93 rats in Taranto, Italy (1/100 or over); Zwierz (16) in 16 percent of 560 rats in Warsaw; Marinelli and Saggese (17) in none of 48 rats in Naples.

Correlation between a positive Weil-Felix test and isolation of the virus by inoculation of emulsified rat brains has been noted by certain workers, while others report lack of correlation. The Weil-Felix test has been used as a screen test by some workers who employed brains from only those rats with a positive test for the inoculation of guinea pigs, using either individual or pooled brains. Positive results have not always been obtained from such material but one or more strains of virus have been isolated by Rochaiz, Sédallian, and Couture (4), Kritschewski and Solowiow (6), Epstein and Silvers (7), Nicolle and Sparrow (8), Suzuki (9), Covell (12), Wolff (18), Balteanu and Constantinesco (14), Zwierz (16), and Ruge (19).

Kritschewski and Solowiow (6), failing to isolate the virus from a rat having a positive Weil-Felix test, suggest that the positive Weil-Felix reaction was due to a previous attack. Raynal (20) also reports negative results in attempting to isolate the virus from a rat which gave a positive Weil-Felix test.

Nicolle and Sparrow (8) found that the Weil-Felix test did not always indicate active infection in the rats. On the other hand, one strain of virus was isolated from a rat showing a negative Weil-Felix reaction. They state that the Weil-Felix reaction is more fleeting in rats than in man but that the brain may be infective for a long period. Also, a positive Weil-Felix reaction is sometimes slow in developing in the rat and it is thus easy to miss the infective period. Although the Weil-Felix test was positive in only 10 percent of the 880 rats trapped at the port of Tunis, they consider that the entire rat population in that locality may have been infected. Lépine and Bilfinger (21) also suggest that epidemics of typhus occur in the rat population, basing their conclusion upon observations on the occurrence of cases of endemic typhus in Athens. When endemic typhus was occurring in that city in 1932-33, a large number of rats were found to be infected, but during the next year no cases occurred and only 1 strain of virus was isolated, although over 1,000 rat fleas were inoculated into guinea pigs. They consider that infected rats become immune and that epidemics in the rat population recur only when a new and nonimmune rat population is established.

THE COMPLEMENT FIXATION TEST

Since the complement fixation test has been found to be a valuable aid in the diagnosis of rickettsial diseases in human beings, and since it persists longer than the Weil-Felix test, a study of this reaction in the diagnosis of endemic typhus fever (murine) in wild rats should be of assistance to any epidemiological or control study. The basis for such a study was started by us in the spring of 1941 in Savannah, Ga., with a comparison of the results of the Weil-Felix and isolation techniques, and this later developed into a comparison of the results of the complement fixation, Weil-Felix, and isolation tests. The test was performed as previously described (22). Serums were diluted in twofold amounts, beginning with a 1:4 dilution. Serum dilution, antigen, and complement were used in 0.2-cc. amounts. One and one-third units² of complement were employed. Fixation was carried out in the 37° C. water bath for 1 hour. Sensitized cells made up of equal parts of washed sheep cells in a 2-percent suspension and hemolysin diluted to contain 2 units per 0.2 cc. were added, after which the test was incubated another hour, placed in the cold room overnight, and read the following morning.

WEIL-FELIX AND ISOLATION TESTS

The investigation of the value of the Weil-Felix test for the diagnosis of active endemic typhus fever in rats was made by comparing the results of this reaction in the serums of guinea pigs with the results obtained in the isolation of the virus when the brains of the same animals were inoculated into guinea pigs.

The wild rats used in the first 8 months of the study were trapped almost exclusively in the business district of Savannah, Ga.³ On receipt of the rats in a cotton cloth sack at the laboratory, the dead rats were discarded, and the live ones were partially etherized and then bled. The rats were then combed for ectoparasites, numbered, wrapped in paper, and placed in the refrigerator until the result of the Weil-Felix test was known. In this way, the brain of a rat found to have a Weil-Felix reaction could be inoculated singly into the guinea pigs.⁴

In the Weil-Felix test a formalized antigen of a typical Proteus OX-19 strain was employed. The usual serial dilutions of serums were made in saline and an equal volume of antigen added to make the first dilution 1:20. Incubation was at 37° C. for 20 to 24 hours, then

² Two full units of complement have been employed in the complement fixation test since the completion of the work.

³ Acknowledgment for trapping the rats is made to the Typhus Fever Control Testing Project, sponsored by the City of Savannah Health Department and the Georgia State Health Department, with the cooperation of the Work Projects Administration and the United States Public Health Service.

⁴ In 4 rats with a Weil-Felix reaction, this procedure was not followed.

a reading was made and recorded, using the usual 4+ system. During the first 8-month period a complement fixation test was run on a few rat serums.

For the isolation test, the brains of the rats were removed aseptically, emulsified with sterile saline in a mortar, and 4 cc. of this emulsion injected into each of two guinea pigs. All of the strains recovered were proved to be endemic typhus by the clinical picture, cross immunity tests, finding the rickettsiae in stained smears of the tunica vaginalis, and by finding typical typhus brain lesions.⁵ If no strains were recovered, all of the inoculated animals were reinoculated with a known endemic typhus fever strain and not one was found to be immune.

The results of this first phase of the work are summarized by months in table 1. From March 1941 through November 25, 1941, a total of 2,017 rats was bled and the brains of 1,998 inoculated into guinea pigs. With the Weil-Felix test, 1,997 rat serums were completely negative and 20 showed some reaction. The highest titer recorded

TABLE 1.—Results of Weil-Felix, complement fixation, and isolation tests in wild rats, Savannah, Ga., March 1941 through Nov. 25, 1941

Month	Number of serums tested	Number of rats reacting	Weil-Felix titer	Complement fixation titer	Number of brains inoculated		Number of strains isolated	
					Pools	Singly	Pools	Singly
March 1941	28	0	0	(¹)	14	14	4 1 (6)	1
April	309	3	1 2/40 3/160 1/80	(¹)	306	3	4 1 (4) 4 2 (6) 4 3 (5)	0
May	296	3	1/80 2/80 2/20	(¹)	290	6	4 1 (5) 4 1 (6)	0
June	326	1	3 3/320	1:32	323	3	4 1 (6) 4 1 (7)	1
July	395	6	1/320 3/320 1/320 2/320 3/640 2/320	1:512 1:512 1:128 1:1,024 1:64	389	6	4 1 (6) 4 1 (5)	0
August	293	3	1/40 2/320 2/80	1:1,024 1:64	291	2	4 1 (6)	0
September	170	2	3/80 2/80	1:512 1:128	167	3	0	1
October	139	2	1/320 1/80	1:2,048 1:512 1:512 1:128 1:32 1:32 1:512 1:64	127 (¹)	3	4 1 (2)	0
November	42	7	0	1:32 1:32 1:512 1:64	36	0	4 1 (3) 4 1 (6)	0
Total	2,017	32	20	18	1,958	40	17	3

¹ The numbers above the line indicate 1+, 2+, 3+, 4+.

² Indicates strain recovered from these rats.

³ 1 rat out of pool of 6, 2 rats negative, 3 rats not done.

⁴ Figure in parentheses indicates number of brains pooled.

⁵ Not run.

⁶ All the histological examinations throughout the study were made by Dr. T. L. Perrin, Pathology Laboratory, National Institute of Health.

was a 3+ in the 1:640 dilution. Half of the positive serums gave complete agglutination around the 1:80 and 1:160 dilutions, while the remainder were complete at the 1:40 dilution. Out of the total serums, 34 were tested for complement fixation. Eighteen of these were positive and 16 negative.

Positive Weil-Felix reactions during this period were found almost every month but it appeared to us that the number of rats tested from any one place had to be large in order to find a reactor.

There was some evidence that a Weil-Felix reaction might indicate a recent infection. The failure to isolate strains from the six reactors during July is noticeable. However it had been observed previously that during this month we had little or no success in isolating strains. It was felt that this failure had some connection with weather conditions since stock strains of typhus fever always lost some of their typical characteristics during the hot summer months. Since only a few complement fixation tests were made on the rat serums in the pooled isolations, nothing can be deducted from the results. In one pool of six brains in November 1941, one rat had a titer of 1:512.

Of the 1,998 rat brains inoculated into guinea pigs, 40 were done singly and 1,958 in pools of from 2 to 8 brains. Twenty strains were isolated, 17 from the pools and 3 from those in the group inoculated singly. Not one rat in pools gave a Weil-Felix reaction. Two rats of the single isolations gave a Weil-Felix reaction, one a 4+ in the 1:160 dilution with a complement fixation titer of 1:32, and the other a 4+ in the 1:40 dilution with a complement fixation titer of 1:512. This left 18 Weil-Felix-reacting rats from which isolations were not obtained. Fourteen of these were in the single group and 4 in the pools.

It seemed apparent by this time that the results of the Weil-Felix test were not correlating closely with the results of the isolation tests and that the test was apparently missing infected or previously infected rats. As a few rat serums during this earlier period had given positive reactions with the complement fixation test, it was decided to study the three tests in a group of inoculated white rats as well as in the wild rats from the field.

EXPERIMENT WITH WHITE RATS

Weil-Felix, complement fixation, and isolation tests.—The white rats were stock rats, both male and female, sent to Savannah, Ga., from the National Institute of Health. Their weight at the start of the experiment was between 72 and 148 gm., and with few exceptions the rats all had gained weight by the time they were killed.

In this experiment four inoculated rats and one uninoculated control rat were killed each successive week for 10 weeks. Each group of five rats was kept together in a small iron cage. A typical endemic

strain of typhus fever was employed for the inoculation. Each rat was injected intraperitoneally with 0.5 cc. of testicular washings made by rinsing in salt solution the testicles removed from three guinea pigs killed at the height of the fever.

Each rat was bled before inoculation and the serum was submitted to a Weil-Felix and a complement fixation test. The rats were again bled just before they were sacrificed to secure the brain for the attempted virus isolation. The brain of each rat was removed aseptically and divided in half, one half was placed in formalin for histological examination and the other half ground up with 8 cc. of saline for inoculation into two guinea pigs. Each recovered strain was passed at least once in guinea pigs. These strains gave the typical clinical picture of endemic typhus in the guinea pig and all of the inoculated animals which were not sacrificed were found to be immune to a known endemic typhus strain. The brain of at least one guinea pig from each passage strain was examined histologically.

The lesions in the rat brains during the first 5 weeks of the study were never so abundant or typical as to enable the pathologist to report more than a suggestion of typhus. However, further study of rat brains suggests that if enough sections had been made and examined, typical lesions would in all probability have been found in most instances.

Inoculated rats in excess of those required for the 10-week study were allowed to survive in order that the persistence of the complement fixing antibodies might be studied. Five of these rats were bled to death 6 months after inoculation. Nine remaining rats were bled after 10 months, but were not killed at this time. The blood clots, after removal of the serum, were inoculated into guinea pigs, but no strains were recovered.

The data for the white rat experiments are summarized in table 2. It will be noted that 8 out of 65 normal rats tested before inoculation showed some reaction in the Weil-Felix test in the low dilutions of serum, while 5 of them were slightly positive in the complement fixation test. After inoculation, the Weil-Felix titer appeared and persisted to approximately the fifteenth day, but it disappeared completely by the twentieth day. However, with the complement fixation test very high titers were obtained which persisted throughout the 10-week period. At the end of 6 months the complement fixation titers had gone down somewhat although 1 rat still had an exceedingly high titer. By the tenth month the readings had dropped still further but they were not below significant titers.

TABLE 2.—Experiments on white rats¹

Rat No.	Weil-Felix titer		Complement fixation titer		Day after inoculation killed	Strain recovered
	Before inoculation	After inoculation	Before inoculation	After inoculation		
5 C.....	0	2/320	1:4	1:256	6	+
1 A.....	3/40	4/1,280	0	1:8, 192	8	+
1 B.....	1/20	2/80	0	1:4, 096	8	+
1 D.....	1/20	4/1,280	0	1:2, 048	8	+
1 E.....	0	0	0	0	8	0
8 C.....	0	2/640	0	1:4, 096	11	+
14 C.....	0	0	0	1:512	11	+
2 A.....	0	4/160	0	1:4, 096	15	+
2 B.....	0	1/20	0	1:2, 048	15	+
2 E.....	0	0	0	0	15	0
3 A.....	0	0	0	1:4, 096	20	+
3 B.....	0	0	0	1:8, 192	20	+
3 C.....	0	0	0	1:4, 096	21	+
3 D.....	0	0	1:4	1:2, 048	21	+
3 E.....	0	0	0	1:128	21	+
4 A.....	0	0	0	1:8, 192	28	+
4 B.....	0	0	1:4	1:512	28	+
4 C.....	0	0	0	1:1, 024	29	+
4 D.....	2/80	1/40	0	1:2, 048	29	+
4 E.....	0	0	0	1:512	29	+
5 A.....	0	0	0	1:2, 048	34	+
5 B.....	0	0	0	1:2, 048	34	+
2 C.....	0	0	0	1:4, 096	35	+
5 D.....	0	0	0	1:2, 048	35	+
5 E.....	0	0	0	1:256	35	+
10 A.....	0	0	0	1:2, 048	41	+
10 B.....	0	0	0	1:2, 048	41	+
10 C.....	0	0	0	1:2, 048	42	+
10 D.....	0	0	0	1:2, 048	42	+
10 E.....	0	0	0	0	42	0
7 A.....	2/20	0	1:8	1:4, 096	49	+
7 B.....	0	0	0	1:1, 024	49	+
7 C.....	0	0	0	1:1, 024	49	+
7 D.....	0	0	0	1:1, 024	49	+
7 E.....	0	0	0	1:256	49	+
6 A.....	0	0	0	1:2, 048	55	+
8 B.....	0	0	0	1:1, 024	55	+
13 C.....	0	0	0	1:512	55	+
13 D.....	0	0	0	1:256	55	+
8 E.....	0	0	0	0	55	0
13 A.....	4/40	0	0	1:2, 048	62	+
13 B.....	0	0	0	1:1, 024	62	+
2 D.....	0	0	0	1:1, 024	63	+
6 B.....	0	0	0	1:4, 096	63	+
6 E.....	0	0	1:4	0	63	0
9 A.....	0	0	0	1:2, 048	69	+
9 B.....	0	0	0	1:4, 096	69	+
9 C.....	4/40	0	0	1:2, 048	69	+
9 D.....	0	0	0	1:2, 048	69	+
9 E.....	2/40	0	0	0	69	0
6 D.....	0	0	0	1:512	182	+
8 A.....	0	0	0	1:512	182	+
11 A.....	0	0	0	1:512	182	+
11 B.....	0	0	0	1:4, 096	182	+
12 A.....	0	0	0	1:256	182	+
11 C.....	0	0	0	1:128	² 296	0
11 D.....	0	0	0	1:512	296	0
12 B.....	0	0	0	1:512	³ 296	0
12 C.....	0	0	0	1:128	⁴ 296	0
12 E.....	0	0	0	1:128	296	0
14 A.....	0	0	0	1:256	296	0
14 B.....	0	0	0	1:4	296	0
14 D.....	0	0	0	1:256	296	0
14 E.....	0	0	0	1:128	296	0
14 E.....	0	0	0	1:128	315	+

¹ Rats A, B, C, and D inoculated with 0.5 cc. testicular washings. Rats E not inoculated.² Not killed.³ Blood clots.⁴ Inoculated.

As can be seen in table 2, virus strains were recovered from the brains of all the inoculated white rats throughout the 10-week period and also after 6 months. It will be noted also that the control rats (E), although not inoculated, showed infection during the third, fourth, fifth, and seventh weeks, and in one after 10½ months. The only explanation we can give is that they probably contracted the infection from the other four inoculated rats by eating urine-contaminated food, by the inhalation of urine-contaminated dust, or perhaps through ectoparasites or insects. To our minds, the findings in the control rats help to establish the practicability and reliability of the complement fixation test in spontaneously acquired infection, as the isolation test checked with the complement fixation results in every case.

To check the results of a reinfection, eight of the nine rats bled at the 10-month period and one normal control rat were inoculated with 0.25 cc. of testicular washings made from a guinea pig with typical endemic typhus fever. Nineteen days later, with the exception of white rat 14B, which died the day after the reinoculation, they were bled and killed. Strains were recovered from the previously inoculated rats as well as from the fresh control rat 11 and the white rat 14E, which was not reinoculated.

The results of the reinoculation of the eight rats (table 3), showed a restimulation of the complement fixation antibodies. It appears from the height of the titers that the animals may have become reinfected, although it is known that the virus has been recovered from white rats 370 days after inoculation (Philip and Parker, 1938 (23)).

TABLE 3.—*White rats reinoculated*¹

Rat No.	Weil Felix titer		Complement fixation titer		Day after original inoculation	Day after reinoculation killed	Strain recovered
	Before reinoculation	After reinoculation	Before reinoculation	After reinoculation			
11 C.....	0	0	1:128	1:512	315	19	+
11 D.....	0	0	1:512	1:2,048	315	19	+
12 B.....	0	0	1:512	1:1,024	315	19	+
12 C.....	0	0	1:128	1:512	315	19	+
12 E.....	0	0	1:128	1:512	315	19	+
14 A.....	0	0	1:256	1:2,048	315	19	+
14 D.....	0	0	1:256	1:2,048	315	19	+
14 B.....	0	0	1:4	1:64	297	1	+
14 E.....	0	0	1:128	1:128	315	(²)	+
11.....	0	0	0	1:2,048	19	(³)	+

¹ Rats reinoculated with 0.25 cc. testicular washings on 296th day after original inoculation.² Not reinoculated.³ Control rat on reinoculation material.

The results with the white rats gave perfect correlation between the tests. The Weil-Felix test apparently indicated a recent infection, but gave no evidence of past infection, while the complement fixation test seemed to indicate infection, recent or past.

RESULTS OF THREE TESTS WITH WILD RATS IN SAVANNAH

From the last of November 1941 through October 30, 1942, the Weil-Felix, complement fixation, and isolation tests were compared, employing serums from wild rats. Technical procedures and the numbers of rats received made it impossible on some days to inoculate the brain of every rat received, although it is believed that a fairly adequate sample was obtained each day. The procedure of handling the rats was the same as described above except that the rat brains were removed and inoculated on the day that the rat was bled. Only the individual rat brain was used, and the brain was divided as was done for the white rats, one half being used for inoculation and the other half for the histological search for toxoplasma.

During this 12-month period 803 rat serums were tested with the Weil-Felix test with only 3 positive reactions (table 4). The 3 rats had Weil-Felix titers of 1/320, 2/320, and 4/80⁶ and complement fixation titers of 1:8,192, 1:128, and 1:128. In the latter 2 rats, isolations were made not only from their brains, but from the blood clots which indicate recent infection. The failure to obtain Weil-Felix-reacting rats through this period comparable to the year before is noticeable. Perhaps the actively or recently infected rats escaped capture or not enough rats were tested each month.

Out of the 803 rat serums, the complement fixation test was run on 744 with positive results in 329 (44.2 percent), negative results in 411, and 4 anticomplementary. The titers varied from 1:8 to 1:8,192 although the majority (91.7 percent) were in the range 1:32 through 1:2,048. The number of positive-reacting rats increased during the later months of the year. Whether this was an actual increase in infection is hard to state since some new city blocks were put into the trapping area during the study. However, it seems very probable that there was an increase since 2 rats with infected blood streams were found.

We were able to inoculate 311 rat brains during the course of this phase of the study. Twenty-seven isolations were made and 24 of the corresponding serums were positive by the complement fixation test. No complement fixation was run on 3 rats from which isolations were made, and in 1 rat trapped in June 1942 from which virus was isolated the complement fixation test was negative on 2 tests. Comparing the results in the wild rats with those obtained with the white

⁶ The figures above the line indicate 1+, 2+, 3+, and 4+.

TABLE 4.—Results of complement fixation, Weil-Felix and isolation tests in wild rats, Savannah, Ga., Nov. 28, 1941, through Oct. 31, 1948

Month	Number serums tested	Well-Felix positive	Complement fixation				Complement fixation titers										Brains inoculated				
			Number of serums tested	Number positive	Percent positive	Number negative	8	16	32	64	128	256	512	1,024	2,048	4,096	8,192	Number inoculated	Number positive	Number negative	
1941																					
November.....	3	0	2	66	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	2	
December.....	27	0	13	52	12	1	1	1	1	2	**3	**4	1	1	1	1	1	27	4	23	
1948																					
January.....	32	0	3	33.3	6	1	1	1	1	1	2	1	1	1	1	1	1	32	11	31	
February.....	37	0	9	39.1	14	1	1	1	1	2	**2	1	2	2	2	2	2	37	13	23	
March.....	31	0	12	46.1	14	1	1	1	1	2	**3	1	2	3	1	1	1	24	2	22	
April.....	46	0	16	38.3	28	2	2	2	2	2	3	3	3	3	1	1	1	35	1	34	
May.....	105	0	26	25.7	75	2	2	2	2	5	5	5	5	4	1	1	1	35	1	34	
June.....	120	0	25	21.2	93	2	2	2	2	**2	**5	6	7	2	1	1	1	30	3	27	
July.....	116	0	60	54.5	40	1	1	1	1	3	13	0	20	5	2	2	2	16	0	16	
August.....	89	0	48	55.1	39	1	**5	**4	**4	10	4	11	5	**3	2	2	2	32	4	28	
September.....	96	0	54	57.4	40	2	**10	6	**10	8	6	9	2	1	1	1	1	19	2	17	
October.....	101	0	61	61	39	5	5	7	7	10	12	12	7	2	2	2	2	19	2	17	
Total.....	803	3	329	44.2	411	2	10	35	24	41	63	51	66	22	14	1	1	311	37	364	

*Each asterisk indicates virus isolated from 1 rat.
 † Complement fixation not run on 3 positive rats, 1 in January and 2 in February.
 ‡ 1 positive rat gave negative complement fixation.
 § 1 serum anticomplementary.
 ¶ 3 serums anticomplementary.

rats where the positive complement fixation indicated the presence of virus transmissible to guinea pigs, the correlation between the isolations and the complement fixation test was not very good since only 24 (7.8 percent) virus isolations were made out of 307 positive-reacting rats when their brains were inoculated into guinea pigs.

COMPLEMENT FIXATION AND WEIL-FELIX TESTS ON WILD RAT SERUMS IN FOUR OTHER SOUTHERN CITIES

Since the Typhus Control Unit⁷ of the Public Health Service was expanding its program during the present study, it was possible to procure, through their cooperation, rat serums from the wild rats trapped in Orangeburg, Sumter, and Charleston, S. C., and Birmingham, Ala. The rat bloods were obtained in the Keidel or vacuum tube type of ampule rather than with a syringe. The blood samples were mailed to the laboratory where the serum was removed and the tests performed as above described. No attempts were made to make virus isolations from the brains of any of the rats. The blood clots of three rats with Weil-Felix reactions, two from Sumter and one from Orangeburg, were inoculated into guinea pigs with negative results. The results of these studies are summarized in tables 5, 6, and 7. Since there were so many positive complement fixation results only the total number of rats with the same titer were listed in the titer columns.

In Orangeburg, S. C., 240 rat serums were received over a 6½-month period. Fourteen (5.8 percent) were positive by the Weil-Felix reaction and 53 (22.1 percent) were positive in the complement fixation test. Six rats reacting in the Weil-Felix test were negative by complement fixation. It will be noted that the number of positive complement fixation results dropped considerably in June and July as compared with April and May. A probable explanation for this was the fact that the trapping was partially discontinued in the center and done more at the outskirts of the city. Evidence of an increased typhus incidence among rats from the business district or even from certain business establishments has been noted in most of the cities studied.

From Sumter, S. C. (table 6), 199 rat serums were tested over a period of 4½ months. Fifteen (7.5 percent) gave some reaction to the Weil-Felix test and 134 (67.3 percent) were positive by the complement fixation test. All of the Weil-Felix-positive rats were positive also by the complement fixation test. It would appear that the rat population of this place was highly infected as the number of positive reactors remained at a high point throughout the test period.

⁷ We are indebted to the members of this Unit, to the members of the Georgia State and Savannah City Health Units, the City Health Units of Sumter, Orangeburg, and Charleston, S. C., and Birmingham, Ala., and the State Health Departments of South Carolina and Alabama for their cooperation in this study.

TABLE 5.—Results of complement fixation and Weil-Felix tests in wild rats, Orangeburg, S. C.

Month	Number of serums tested	Weil-Felix test	Complement fixation test				Complement fixation titers										
			Number of serums run	Number positive	Percent positive	Number negative	8	16	32	64	128	256	512	1,024	2,048	4,096	8,192
<i>1943</i>																	
April.....	10	*2/40 *2/40	10	7	70	3											
May.....	100	*3/40 *2/20 *3/20 *4/20	100	27	27	73		**2	*4	2				1	**3	1	
June.....	26	*1/20 *1/20	26	4	15.4	*21			1						*3		
July.....	29	*1/3/80 *1/3/20	29	3	10.3	26								1	2		
August.....	30	*1/20	30	7	23.3	23		1	1	1	1				1		
September.....	28	14/20 14/20 11/20	28	2	7.1	26									*1	1	
October.....	17	0	17	2	11.7	15									1	1	
Total.....	240	14	240	63	22.1	186		3	8	3	1	8	13	8	4	2	2

* Asterisks indicate reaction in both Weil-Felix and complement fixation tests for rats tested in any one month.

† Negative complement fixation.

*1 serum anticomplementary.

* Blood clot inoculated. No isolation.

TABLE 7.—Results of complement fixation and Weil-Felix tests in wild rats, Birmingham, Ala., and Charleston, S. C.
BIRMINGHAM, ALA.

Month	Number of serums tested	Weil-Felix	Complement fixation			Complement fixation titers											
			Number of serums run	Number positive	Percent positive	Number negative	8	16	32	64	128	256	512	1,024	2,048	4,096	8,192
1948																	
July.....	3	0	3	2	66.6	1		1									
August.....	11	*3/20	11	6	54.5	5											
September.....	19	*4/40	19	7	36.8	12		1			1						
		*3/40						2	**3		1						
October.....	27	13/20	27	5	18.5	22					1	2	2				
Total.....	60	4	60	20	33.3	40		1	3	3	2	3	5	3			

CHARLESTON, S. C.

1948																	
September.....	68	*2/20	62	58	92	4											
		*1/20															
		*2/60															
October.....	58	*1/40															
		*2/20															
		*2/20															
		*4/46															
Total.....	121	8	120	97	80.8	23		3	3	6	9	22	19	23	9	2	

*Asterisks indicate reaction in both Weil-Felix and complement fixation tests for rats tested in any one month.
! Negative complement fixation.

From Birmingham, Ala. (table 7), 60 rat serums were tested over a period of 3½ months. Four (6.6 percent) were reactors in the Weil-Felix test and 20 (33.3 percent) were positive in the complement fixation test. One Weil-Felix reactor failed to give a complement fixation reaction but 3 were positive.

In Charleston (table 7), 121 serums were tested during a period of 2 months. Eight (6.6 percent) were Weil-Felix positive and 97 (80.8 percent) were positive by the complement fixation test. One serum of the Weil-Felix group was not run and 1 serum failed to give a reaction, while the other 7 gave positive reactions in the complement fixation test. The total number of positives by the complement fixation test for this area was exceedingly high.

DISCUSSION

Serological data compiled from 5 cities show that 3,430 rat serums were tested by the Weil-Felix reactions, of which 1,392 were also submitted to the complement fixation test. Of the grand total, 64 (1.9 percent) were positive by the Weil-Felix test. However, out of 1,392 serums tested by the complement fixation reaction, 651 (46.7 percent) were positive, while 51 of these (3.6 percent) were positive by the Weil-Felix test.

A total of 1,958 rat brains from Savannah were inoculated, by pools, into guinea pigs, and typhus fever was transmitted 17 times, indicating at least 0.87 percent of infection among these rodents, while among 350 brains inoculated singly there were 30 (8.5 percent) isolations. The complement fixation test was positive in 25 out of 26 of the 30 serums giving positive isolations. Four of these 30 serums were not tested by complement fixation and 1 was negative. The titers of these positive serums varied from 1:32 to 1:8,192.⁸ The results in wild rats differed from those found in experimentally infected white rats in that a complement fixation reaction in the latter was constantly accompanied by the presence of demonstrable virus, at least up to 6 months after inoculation. The explanation of this possible difference is not to be found in weather alone for both sets of serums were collected during the cool months of the year. The white rat may be more susceptible to typhus virus than is the wild rat, as indicated by the work of Maxcy (1c), and thus conceivably more brain involvements develop in white rats with a correspondingly longer duration of infection in the tissue. It appears that the wild rats develop antibodies to the same degree as do white rats since comparable titers are observed. Positive serology probably persists longer than does demonstrable virus just as it does in human beings after recovery.

⁸ The fact that serums of 129 rats trapped in a negative typhus area (California) showed completely negative complement fixation results indicates that any positive reaction by this test means typhus infection.

The Weil-Felix test in the white rats indicated a recent infection. With wild rats only 5 out of 30 isolations had a positive Weil-Felix reaction with the titers 1:80, 1:80, 1:160, 1:320, and 1:320. The results indicate that demonstrable virus is correlated much more often with a positive complement fixation reaction than it is with a positive Weil-Felix reaction.

The results of these tests as a whole indicate that the complement fixation test is the most practical means for detecting past or present endemic typhus infection among wild rats. There is abundant evidence to indicate that the reservoir of endemic typhus from which man becomes infected is among rats. Therefore, from the standpoint of time and expense, control measures aimed at preventing the spread of typhus fever among human beings may be effectively evaluated by the complement fixation test applied to the rodent population. Infection, whether past or present, may easily be detected by this means.

Apparently the Weil-Felix test is positive for a comparatively short time following infection; therefore, a negative test is of no great significance as an indication of freedom from infection.

Infected rats in cities are usually found in certain establishments, such as those of poultry dealers, in grocery stores, warehouses, grain stores, and the like, where a readily available food supply encourages a concentration of rats.

The majority of the rats trapped in these studies were Norway (*R. rattus norvegicus*) rats. The number of rats of other species caught were 5 black rats (*R. rattus rattus*) and 7 gray rats (*R. rattus alexandrinus*). Two of the black rats and 5 of the gray rats had positive complement fixation titers, but no Weil-Felix reactions. No isolations were attempted from them. Although the size of the rats which were bled varied from half-grown to full-grown, the tendency was to pick out full-grown adults because of the ease of bleeding. Three hundred and eight males and 307 females were found positive with the complement fixation test. In the Weil-Felix reactors, there were 18 positive among males and 22 in females. Successful virus isolations were made from 16 male and 11 female rats.

SUMMARY

The complement fixation, Weil-Felix, and virus isolation tests were compared as a means for the diagnosis of endemic typhus fever in experimentally infected white rats and naturally infected wild rats.

In the white rats the correlation between the complement fixation and virus isolation tests was 100 percent insofar as tested, i. e., to 6 months following infection. Among wild rats from infected areas, the complement fixation test showed a high percentage of positive results. However, in this instance, correlation between the com-

plement fixation and the virus isolation results was poor since positive serological findings apparently persisted much longer than transmissible virus. No titer range could be established as indicating present infection. In nontyphus areas the results of the complement fixation test were uniformly negative.

A positive Weil-Felix test apparently indicates a recent infection since the reaction in white rats experimentally infected disappeared between the fourteenth and twentieth day following inoculation. However, accurate information on this point in regard to the wild rats was not obtained. In any case positive Weil-Felix reactions were infrequent among the rats in the areas studied.

The complement fixation reaction as applied to rat control programs should be a valuable aid in preventing the spread of endemic typhus to human beings.

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DEATHS DURING WEEK ENDED DECEMBER 16, 1944

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

	Week ended Dec. 16, 1944	Correspond- ing week, 1943
Data for 92 large cities of the United States:		
Total deaths.....	9,311	11,524
Average for 3 prior years.....	9,975	
Total deaths, first 50 weeks of year.....	447,238	458,555
Deaths under 1 year of age.....	605	673
Average for 3 prior years.....	683	
Deaths under 1 year of age, first 50 weeks of year.....	30,753	33,256
Data from industrial insurance companies:		
Policies in force.....	66,898,392	66,100,314
Number of death claims.....	12,841	12,211
Death claims per 1,000 policies in force, annual rate.....	10.0	9.6
Death claims per 1,000 policies, first 50 weeks of year, annual rate.....	10.1	9.6

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 23, 1944

Summary

A total of 172 cases of meningococcus meningitis was reported for the week, as compared with 201 last week, 361 for the corresponding week last year, and a 5-year median of 34. During the past 5 weeks 876 cases have been reported, as compared with 831 for the preceding 5 weeks and 1,398 for the corresponding period last year. Of the current total, 20 cases occurred in New York, 17 in Texas, 11 each in Michigan and California, and 10 in Virginia. Since March 4, the weekly incidence has been continuously below that of last year. In that period a total of 10,788 cases has been reported, as compared with 13,969 for the corresponding period last year.

Of the total of 89 cases of poliomyelitis reported (as compared with 85 last week, 39 for the corresponding week last year and a 5-year median of 48), 37 occurred in New York (last week 27). No other State reported more than 6 cases.

The high incidence of scarlet fever during the first half of the year has resulted in cumulative figures to date in excess of those for the corresponding period of any previous year since 1937. A total of 120,351 cases was reported from February 5 to July 15, as compared with 74,945 for the corresponding period last year. In recent weeks the incidence has again been slightly above the corresponding 5-year medians. To date, a total of 186,557 cases has been reported, as compared with 218,448 for the same period in 1937.

Figures below those for last week and the corresponding medians were reported for influenza, measles, typhoid fever, and whooping cough. A total of 355 cases of diphtheria was reported, as compared with 416 last week and a 5-year median of 281.

Deaths registered for the week in 90 large cities of the United States totaled 9,216, as compared with 9,266 last week and a 3-year (1941-43) average of 9,904. The total to date is 453,666, as compared with 468,574 for the corresponding period last year.

Telegraphic morbidity reports from State health officers for the week ended December 23, 1944, and comparison with corresponding week of 1943 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 1939-43	Week ended—		Median 1939-43	Week ended—		Median 1939-43	Week ended—		Median 1939-43
	Dec. 23, 1944	Dec. 25, 1943		Dec. 23, 1944	Dec. 25, 1943		Dec. 23, 1944	Dec. 25, 1943		Dec. 23, 1944	Dec. 25, 1943	
NEW ENGLAND												
Maine.....	0	1	1	62	1	3	91	46	0	4	1	
New Hampshire.....	0	0	0	-----	-----	1	2	4	0	1	0	
Vermont.....	0	0	0	-----	-----	4	1	25	1	1	0	
Massachusetts.....	5	7	4	-----	-----	52	340	294	4	17	3	
Rhode Island.....	1	0	0	19	35	1	10	96	21	0	0	
Connecticut.....	0	1	0	1	832	2	13	6	61	3	7	
MIDDLE ATLANTIC												
New York.....	12	14	20	11	1,475	115	39	653	395	20	43	
New Jersey.....	1	6	7	3	351	12	12	473	51	4	24	
Pennsylvania.....	9	10	10	3	63	-----	7	455	678	6	34	
EAST NORTH CENTRAL												
Ohio.....	10	13	13	3	6,986	12	11	1,294	46	6	12	
Indiana.....	4	7	8	1	677	20	1	85	33	0	22	
Illinois.....	1	4	17	2	437	14	21	147	64	9	28	
Michigan ¹	19	6	7	4	304	2	14	539	206	11	15	
Wisconsin.....	1	8	0	18	1,832	31	13	455	164	5	12	
WEST NORTH CENTRAL												
Minnesota.....	16	7	2	-----	16	2	3	442	31	6	2	
Iowa.....	8	2	2	-----	11,463	3	20	33	69	0	1	
Missouri.....	6	0	5	-----	100	5	4	35	13	1	24	
North Dakota.....	16	3	2	10	1,443	26	3	230	12	1	0	
South Dakota.....	0	3	4	-----	39	2	2	9	7	2	0	
Nebraska.....	0	1	1	11	51	2	3	3	8	0	0	
Kansas.....	20	5	5	2	975	269	7	25	70	2	5	
SOUTH ATLANTIC												
Delaware.....	1	0	0	-----	-----	-----	0	12	5	1	0	
Maryland ²	10	3	8	7	696	8	4	36	3	8	10	
District of Columbia.....	0	0	0	-----	845	3	2	25	3	1	2	
Virginia.....	3	5	12	181	7,584	203	5	93	41	10	6	
West Virginia.....	0	3	6	17	3,747	18	14	83	6	1	1	
North Carolina.....	6	9	28	7	76	11	18	96	96	3	1	
South Carolina.....	12	7	6	377	1,958	421	2	41	21	0	1	
Georgia.....	16	5	7	33	1,405	178	4	68	18	2	4	
Florida.....	1	8	4	-----	114	11	0	10	2	5	5	
EAST SOUTH CENTRAL												
Kentucky.....	3	3	3	3	2,220	18	1	9	12	4	7	
Tennessee.....	12	7	11	16	982	56	7	51	43	4	5	
Alabama.....	7	9	11	36	1,573	222	3	56	20	2	5	
Mississippi ²	8	0	5	-----	-----	-----	-----	-----	1	2	1	
WEST SOUTH CENTRAL												
Arkansas.....	6	16	11	71	4,090	97	1	35	35	0	0	
Louisiana.....	14	10	10	11	148	9	5	2	2	2	6	
Oklahoma.....	13	2	6	88	2,022	119	8	9	9	4	4	
Texas.....	53	20	36	1,509	9,392	1,236	44	59	59	17	4	
MOUNTAIN												
Montana.....	1	0	0	1	2,654	106	1	126	26	1	4	
Idaho.....	0	0	0	2	12	1	4	0	2	0	0	
Wyoming.....	0	2	1	15	814	66	1	12	12	1	0	
Colorado.....	8	8	8	25	1,041	47	10	116	79	2	0	
New Mexico.....	2	0	0	1	28	3	2	4	5	3	1	
Arizona.....	0	3	2	154	731	126	3	8	8	1	0	
Utah ³	0	0	0	-----	5,723	688	14	10	19	3	1	
Nevada.....	0	0	0	-----	906	-----	0	0	0	0	0	
PACIFIC												
Washington.....	17	2	1	-----	3,200	4	40	18	182	3	5	
Oregon.....	10	2	2	18	2,201	100	20	62	45	1	3	
California.....	23	12	15	17	3,066	131	202	87	87	11	24	
Total.....	355	234	281	2,717	83,973	5,997	658	6,532	4,608	172	361	
51 weeks.....	13,766	13,489	15,413	364,402	293,567	264,194	160,506	594,435	500,085	15,861	17,459	

¹ New York City only.

² Period ended earlier than Saturday.

³ Cumulative total changed by corrected reports.

Telegraphic morbidity reports from State health officers for the week ended December 23, 1944, and comparison with corresponding week of 1943 and 5-year median—Continued

Division and State	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever ²		
	Week ended—		Median 1939-43	Week ended—		Median 1939-43	Week ended—		Median 1939-43	Week ended—		Median 1939-43
	Dec. 23, 1944	Dec. 25, 1943		Dec. 23, 1944	Dec. 25, 1943		Dec. 23, 1944	Dec. 25, 1943		Dec. 23, 1944	Dec. 25, 1943	
NEW ENGLAND												
Maine.....	0	0	0	52	22	19	0	0	0	0	1	1
New Hampshire.....	0	0	0	8	2	6	0	0	0	0	0	0
Vermont.....	0	0	0	4	4	4	0	0	0	0	0	0
Massachusetts.....	5	3	1	283	210	210	0	0	0	0	0	0
Rhode Island.....	0	0	0	27	9	3	0	0	0	0	0	0
Connecticut.....	1	0	0	46	30	30	0	0	0	0	2	1
MIDDLE ATLANTIC												
New York.....	37	1	1	298	265	284	0	0	0	7	1	6
New Jersey.....	0	0	0	104	79	92	0	0	0	0	2	0
Pennsylvania.....	2	1	1	192	163	218	0	0	0	3	0	6
EAST NORTH CENTRAL												
Ohio.....	3	1	1	264	220	231	1	0	1	3	1	2
Indiana.....	0	0	0	60	76	76	0	0	1	0	1	1
Illinois.....	0	2	2	135	136	236	0	3	1	0	0	2
Michigan.....	4	0	0	158	86	155	0	0	0	0	4	2
Wisconsin.....	2	0	1	122	141	141	0	0	0	1	0	0
WEST NORTH CENTRAL												
Minnesota.....	2	0	1	69	96	78	0	0	0	0	0	0
Iowa.....	0	0	1	36	97	70	0	0	0	0	0	0
Missouri.....	3	0	0	54	46	66	1	0	1	1	0	4
North Dakota.....	2	0	0	12	6	13	1	0	0	0	1	0
South Dakota.....	0	0	0	13	19	19	0	0	2	0	0	0
Nebraska.....	0	0	0	25	36	25	1	0	0	0	0	0
Kansas.....	0	0	0	100	60	82	1	0	0	0	0	0
SOUTH ATLANTIC												
Delaware.....	0	0	0	4	3	18	0	0	0	0	1	0
Maryland.....	1	0	1	114	47	43	0	0	0	1	1	1
District of Columbia.....	0	0	0	37	16	12	0	0	0	0	0	1
Virginia.....	3	0	1	75	40	38	0	0	0	3	1	3
West Virginia.....	0	0	1	33	38	41	0	0	0	1	0	0
North Carolina.....	1	1	0	37	36	68	0	0	0	0	0	0
South Carolina.....	0	0	0	14	5	10	0	0	0	2	0	1
Georgia.....	0	0	0	27	13	23	0	0	0	1	0	1
Florida.....	1	0	0	8	6	6	0	1	0	3	4	0
EAST SOUTH CENTRAL												
Kentucky.....	1	0	0	32	43	54	0	0	0	2	4	2
Tennessee.....	0	0	0	58	38	58	0	0	0	0	1	2
Alabama.....	0	0	0	21	13	22	1	1	0	1	0	1
Mississippi.....	0	0	0	22	10	9	0	0	0	1	0	0
WEST SOUTH CENTRAL												
Arkansas.....	1	0	1	8	4	5	0	0	0	0	0	3
Louisiana.....	1	1	1	10	6	8	0	0	0	0	3	3
Oklahoma.....	1	1	0	56	30	24	0	0	0	1	5	1
Texas.....	3	1	3	91	36	39	0	1	1	6	3	4
MOUNTAIN												
Montana.....	1	0	0	12	39	30	0	0	0	0	0	0
Idaho.....	0	0	0	51	7	7	2	0	0	0	0	0
Wyoming.....	2	0	0	18	4	11	0	0	0	0	0	0
Colorado.....	0	0	0	70	35	35	0	0	0	3	0	0
New Mexico.....	0	0	0	26	2	6	0	0	0	2	1	2
Arizona.....	0	1	1	15	5	4	0	0	0	0	0	1
Utah.....	2	6	1	58	82	15	0	0	0	0	0	0
Nevada.....	0	2	0	1	2	0	0	0	0	0	0	0
PACIFIC												
Washington.....	1	2	1	110	74	44	0	0	0	1	2	0
Oregon.....	3	6	1	37	79	11	0	0	0	1	2	1
California.....	6	10	8	235	196	107	0	0	0	3	1	5
Total.....	89	39	48	3,362	2,712	2,776	8	6	37	47	42	89
51 weeks.....	19,193	12,358	10,017	186,557	137,454	137,454	385	730	1,351	5,350	5,418	8,433

² Period ended earlier than Saturday.

³ Including paratyphoid fever reported separately as follows: New York, 3; Florida, 1; Texas, 1; Colorado, 1.

Telegraphic morbidity reports from State health officers for the week ended December 23, 1944, and comparison with corresponding week of 1943 and 5-year median—Continued

Division and State	Whooping cough			Week ended December 23, 1944								
	Week ended—		Median 1939-43	An-thrax	Dysentery			En-ceph-alitis, infec-tious	Lep-rosy	Rocky Mt. spotted fever	Tula-remia	Ty-phus fever
	Dec. 23, 1944	Dec. 25, 1943			Ame-bic	Bacil-lary	Un-specified					
NEW ENGLAND												
Maine.....	54	6	19	0	0	0	0	0	0	0	0	0
New Hampshire.....	2	0	7	0	0	0	0	0	0	0	0	0
Vermont.....	10	10	23	0	0	0	0	0	0	0	0	0
Massachusetts.....	126	54	194	0	0	3	0	0	0	0	0	0
Rhode Island.....	24	7	15	0	0	1	0	0	0	0	0	0
Connecticut.....	39	12	43	0	0	0	0	0	0	0	0	0
MIDDLE ATLANTIC												
New York.....	202	125	351	0	4	11	0	1	0	0	0	1
New Jersey.....	69	61	130	0	0	0	0	1	0	0	0	0
Pennsylvania.....	93	66	250	0	0	0	0	0	0	0	0	0
EAST NORTH CENTRAL												
Ohio.....	92	38	133	0	0	0	0	1	0	0	7	0
Indiana.....	0	23	22	0	0	1	0	0	0	0	4	0
Illinois.....	47	54	89	0	1	0	0	0	0	0	10	0
Michigan ¹	56	75	191	0	1	1	0	0	0	0	0	0
Wisconsin.....	87	94	137	0	0	0	0	0	0	0	0	0
WEST NORTH CENTRAL												
Minnesota.....	8	12	42	0	0	0	0	0	0	0	0	0
Iowa.....	0	18	18	0	0	0	0	0	0	0	0	0
Missouri.....	7	4	12	0	0	0	0	0	0	0	0	0
North Dakota.....	11	31	7	0	0	0	0	0	0	0	0	0
South Dakota.....	3	0	1	0	0	0	0	0	0	0	0	0
Nebraska.....	6	3	2	0	0	0	0	0	0	0	0	0
Kansas.....	32	15	39	0	0	0	0	0	0	1	1	0
SOUTH ATLANTIC												
Delaware.....	1	2	4	0	0	0	0	0	0	0	0	0
Maryland ²	53	28	49	0	0	0	0	0	0	0	3	0
District of Columbia.....	7	3	9	0	0	0	0	0	0	0	0	0
Virginia.....	37	60	59	0	0	0	84	0	0	0	5	1
West Virginia.....	18	13	14	0	0	0	0	0	0	0	0	0
North Carolina.....	81	48	48	0	0	0	0	0	0	0	1	9
South Carolina.....	23	41	29	0	0	9	0	0	0	0	1	4
Georgia.....	5	0	10	0	0	0	0	0	0	0	1	29
Florida.....	5	20	5	0	2	0	0	0	0	0	0	6
EAST SOUTH CENTRAL												
Kentucky.....	9	47	47	0	0	0	0	0	0	0	5	0
Tennessee.....	4	19	19	0	0	0	1	0	0	0	2	3
Alabama.....	12	12	12	0	0	0	0	0	0	0	0	19
Mississippi ².....	.....	.....	.....	0	0	0	0	0	0	0	0	4
WEST SOUTH CENTRAL												
Arkansas.....	12	22	22	0	0	9	0	1	0	0	0	0
Louisiana.....	4	1	5	0	0	0	0	0	0	0	1	3
Oklahoma.....	8	0	3	0	0	0	0	0	0	0	0	0
Texas.....	108	151	128	0	49	378	37	0	0	0	0	31
MOUNTAIN												
Montana.....	9	6	6	0	0	0	0	0	0	0	0	0
Idaho.....	12	1	1	0	0	0	0	0	0	0	0	0
Wyoming.....	20	0	3	0	0	0	0	0	0	0	0	0
Colorado.....	17	22	22	0	0	0	0	0	0	0	0	0
New Mexico.....	0	8	11	0	1	1	4	0	0	0	0	0
Arizona.....	4	20	10	0	0	0	26	1	0	0	0	0
Utah ³	8	8	14	0	0	0	0	0	0	0	0	0
Nevada.....	0	0	0	0	0	0	0	0	0	0	0	0
PACIFIC												
Washington.....	23	20	20	0	0	0	0	0	0	0	0	0
Oregon.....	3	18	18	0	0	0	0	0	0	0	0	0
California.....	90	42	137	0	1	7	0	0	0	0	0	1
Total	1,541	1,320	2,455	0	59	421	152	5	0	1	41	111
Same week, 1943.....	1,320	.....	.....	0	26	406	43	11	1	1	15	82
Same week, 1942.....	2,455	.....	.....	0	13	66	17	3	0	1	28	77
51 weeks, 1944.....	94,040	.....	.....	40	1,857	24,295	9,032	624	32	454	674	5,265
51 weeks, 1943.....	175,128	.....	.....	65	2,104	17,968	7,387	680	30	434	787	4,475
51 weeks, 1942.....	175,284	.....	175,128	78	1,184	11,948	6,379	552	45	452	886	4,204

¹ Period ended earlier than Saturday. ² 5-year median, 1939-43. ³ Cumulative total changed by corrected reports.

WEEKLY REPORTS FROM CITIES

City reports for week ended December 16, 1944

This table lists the reports from 83 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	Pollomyelitis 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	3	0	0	1
New Hampshire:												
Concord.....	0	0	0	0	0	0	0	0	4	0	0	0
Massachusetts:												
Boston.....	6	0	0	0	46	4	21	4	80	0	1	21
Fall River.....	0	0	1	0	0	1	1	0	0	0	0	0
Springfield.....	0	0	0	0	2	0	0	0	3	0	0	4
Worcester.....	0	0	0	0	1	0	9	0	9	0	0	19
Rhode Island:												
Providence.....	1	0	0	0	0	0	1	0	13	0	0	17
Connecticut:												
Bridgeport.....	0	0	0	0	0	0	1	0	4	0	0	0
Hartford.....	0	0	0	0	3	0	0	0	4	0	0	1
New Haven.....	0	0	0	0	0	0	0	0	5	0	0	25
MIDDLE ATLANTIC												
New York:												
Buffalo.....	1	0	0	0	0	0	4	0	3	0	0	2
New York.....	12	0	1	9	19	71	15	19L	0	0	3	103
Rochester.....	0	0	0	9	2	1	1	2	0	0	0	16
Syracuse.....	0	0	0	0	0	1	2	1	8	0	0	13
New Jersey:												
Camden.....	3	0	0	0	0	1	1	0	3	0	0	0
Newark.....	0	0	2	0	2	1	3	0	9	0	0	4
Trenton.....	0	0	1	0	0	0	3	0	3	0	0	0
Pennsylvania:												
Philadelphia.....	0	0	3	2	8	3	18	0	74	0	0	20
Pittsburgh.....	2	0	1	2	1	2	13	0	22	0	0	2
Reading.....	0	0	0	0	1	0	1	0	1	0	0	0
EAST NORTH CENTRAL												
Ohio:												
Cincinnati.....	3	0	0	0	0	0	13	0	25	0	0	7
Cleveland.....	1	0	0	0	2	1	0	2	52	0	0	18
Columbus.....	0	0	1	1	1	0	0	8	0	0	0	9
Indiana:												
Fort Wayne.....	2	0	0	1	1	0	1	0	6	0	0	0
Indianapolis.....	3	0	0	0	2	3	6	0	17	0	0	0
South Bend.....	1	0	0	0	1	0	0	0	4	0	0	0
Terre Haute.....	0	0	0	0	1	0	4	0	2	0	0	0
Illinois:												
Chicago.....	1	0	1	1	4	5	19	0	95	0	0	32
Springfield.....	0	0	0	0	3	0	3	0	4	0	0	0
Michigan:												
Detroit.....	8	0	0	1	5	6	9	2	73	0	0	15
Flint.....	0	0	0	0	0	0	0	0	5	0	0	0
Grand Rapids.....	0	0	0	0	1	0	0	0	1	0	1	1
Wisconsin:												
Kenosha.....	0	0	0	0	0	0	0	0	1	0	0	14
Milwaukee.....	2	0	1	1	1	1	10	0	22	0	0	0
Racine.....	0	0	0	0	0	0	0	0	2	0	0	2
Superior.....	0	0	0	0	0	0	0	0	2	0	0	1
WEST NORTH CENTRAL												
Minnesota:												
Duluth.....	4	0	0	0	1	0	3	0	7	0	0	0
Minneapolis.....	4	0	0	0	2	0	3	0	11	0	0	2
St. Paul.....	0	0	0	0	1	0	6	1	8	0	0	10
Missouri:												
Kansas City.....	0	0	0	0	1	2	15	0	19	0	0	4
St. Joseph.....	0	0	0	0	1	0	0	0	1	0	0	0
St. Louis.....	0	0	2	4	1	1	17	3	26	0	0	5

City reports for week ended December 16, 1944—Continued

	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles, cases	Meningitis, meningococcus, cases	Pneumonia deaths	Polomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
WEST NORTH CENTRAL—continued												
North Dakota:												
Fargo.....	0	0	1	0	0	0	1	1	1	0	0	0
Nebraska:												
Omaha.....	7	0	0	0	7	0	7	0	14	0	0	0
Kansas:												
Topeka.....	0	0	0	0	0	0	0	0	8	0	0	5
Wichita.....	0	0	0	0	0	0	1	0	8	0	0	0
SOUTH ATLANTIC												
Delaware:												
Wilmington.....	1	0	0	0	0	0	4	0	4	0	0	0
Maryland:												
Baltimore.....	1	0	2	1	0	2	24	0	45	0	0	62
Cumberland.....	0	0	0	0	0	0	2	0	1	0	0	0
Frederick.....	0	0	0	0	0	0	0	0	1	0	0	0
District of Columbia:												
Washington.....	0	0	1	0	3	0	7	1	49	0	3	3
Virginia:												
Lynchburg.....	0	0	0	0	0	0	1	0	6	0	0	0
Richmond.....	0	0	0	0	0	2	1	0	7	0	0	0
Roanoke.....	0	0	0	0	0	0	0	0	0	0	0	0
West Virginia:												
Charleston.....	0	0	0	0	0	0	0	0	1	0	0	0
Wheeling.....	0	0	0	0	16	0	1	0	2	0	0	2
North Carolina:												
Raleigh.....	0	0	0	0	0	0	3	0	0	0	0	4
Wilmington.....	2	0	0	0	0	0	4	0	4	0	0	10
Winston-Salem.....	0	0	0	0	1	0	2	0	3	0	0	1
South Carolina:												
Charleston.....	0	0	31	0	1	0	3	0	4	0	0	0
Georgia:												
Atlanta.....	0	0	12	0	0	0	7	0	3	0	0	1
Brunswick.....	0	0	0	0	0	0	2	0	0	0	0	0
Savannah.....	0	0	7	1	0	0	2	0	1	0	0	0
Florida:												
Tampa.....	0	0	0	0	0	0	5	0	2	0	0	0
EAST SOUTH CENTRAL												
Tennessee:												
Memphis.....	1	0	0	2	9	1	8	0	7	0	0	4
Nashville.....	0	0	0	1	0	0	3	0	8	0	0	1
Alabama:												
Birmingham.....	0	0	4	1	0	0	7	0	3	0	0	0
Mobile.....	0	0	0	1	1	0	2	0	2	0	0	0
WEST SOUTH CENTRAL												
Arkansas:												
Little Rock.....	0	0	1	0	1	0	0	0	0	0	0	4
Louisiana:												
New Orleans.....	2	0	10	2	6	0	13	0	18	0	0	0
Texas:												
Dallas.....	2	0	0	0	0	0	2	0	11	0	0	0
Galveston.....	0	0	0	0	0	0	1	0	0	0	0	0
Houston.....	2	0	0	0	1	0	0	0	3	0	0	0
San Antonio.....	2	0	1	0	2	0	6	0	5	0	0	0
MOUNTAIN												
Montana:												
Billings.....	0	0	0	0	0	0	1	0	1	0	0	1
Great Falls.....	0	0	0	0	0	0	3	0	5	0	0	0
Helena.....	0	0	0	0	1	0	1	0	1	0	0	2
Missoula.....	0	0	0	0	2	0	1	0	0	0	0	0
Idaho:												
Boise.....	0	0	0	0	0	0	0	0	0	0	0	0
Colorado:												
Denver.....	1	0	3	0	2	2	5	0	27	0	0	4
Pueblo.....	1	0	0	0	0	0	3	0	2	0	0	0
Utah:												
Salt Lake City.....	0	0	0	0	0	0	1	0	6	0	0	1

City reports for week ended December 16, 1944—Continued

	Diphtheria cases	Enecephalitis, infectious, cases	Influenza		Measles, cases	Meningitis, meningococcus, cases	Pneumonia deaths	Pollomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
PACIFIC												
Washington:												
Seattle.....	0	0	-----	1	11	0	0	1	12	0	0	3
Spokane.....	1	0	-----	0	1	0	3	0	0	0	0	3
Tacoma.....	0	0	-----	0	1	0	1	0	9	0	0	2
California:												
Los Angeles.....	7	0	11	4	10	3	4	0	48	0	0	7
Sacramento.....	0	0	-----	0	2	0	2	0	5	0	0	2
San Francisco.....	1	0	-----	0	15	11	18	0	27	0	0	6
Total.....	84	0	96	29	207	75	422	33	1,212	0	8	496
Corresponding week, 1943	85	-----	5,673	231	1,821	-----	925	-----	935	0	14	374
Average, 1939-43.....	86	-----	1,771	101	1,236	-----	587	-----	884	3	17	899

¹3-year average, 1941-43.

²5-year median, 1939-43.

Dysentery, amebic.—Cases: Boston, 1; New York, 2; Chicago, 1; Kansas City, Mo. 1.

Dysentery, bacillary.—Cases: Hartford, 3; New York, 25; Rochester, 1; Syracuse, 2; Los Angeles, 7.

Dysentery, unspecified.—Cases: Richmond, 3; San Antonio, 12.

Tularemia.—Cases: Columbus, 1; Indianapolis, 3; St. Louis, 2; Topeka, 2.

Typhus fever, endemic.—Cases: Boston, 1; New York, 2; Charleston, S. C., 4; Atlanta, 3; Savannah, 3; Tampa, 1; Nashville, 3; Birmingham, 1; Little Rock, 1; New Orleans, 3; San Antonio, 2.

Rates (annual basis) per 100,000 population, by geographic groups, for the 88 cities in the preceding table (estimated population, 1945, 34,294,700)

	Diphtheria case rates	Enecephalitis, infectious, case rates	Influenza		Measles case rates	Meningitis, meningococcus, case rates	Pneumonia death rates	Pollomyelitis 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.....	18.4	0.0	0.0	2.6	137	13.1	89.3	10.5	328	0.0	2.6	231
Middle Atlantic.....	8.3	0.0	3.2	2.3	14	13.4	54.2	7.9	146	0.0	1.4	74
East North Central.....	12.8	0.0	1.8	3.0	15	10.3	39.5	3.0	198	0.0	0.6	60
West North Central.....	29.8	0.0	6.0	8.0	23	6.0	105.4	9.9	205	0.0	0.0	52
South Atlantic.....	6.5	0.0	86.6	2.3	34	6.5	111.1	1.6	217	0.0	4.9	137
East South Central.....	5.9	0.0	23.6	29.5	59	5.9	118.0	0.0	118	0.0	0.0	30
West South Central.....	24.2	0.0	36.2	6.0	30	0.0	66.5	0.0	112	0.0	0.0	12
Mountain.....	7.9	0.0	23.8	0.0	40	15.9	119.1	0.0	334	0.0	0.0	64
Pacific.....	14.2	0.0	17.4	7.9	63	22.1	44.3	1.6	174	0.0	0.0	36
Total.....	12.8	0.0	14.6	4.4	32	11.4	64.3	5.0	185	0.0	1.2	76

TERRITORIES AND POSSESSIONS

Hawaii Territory

Plague (rodent).—A rat found in Kukuihaele area, Honokaa, Hamakua District, Island of Hawaii, T. H., was proved positive for plague on November 14, 1944.

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended December 2, 1944.—
 During the week ended December 2, 1944, 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.....		19	1	172	312	89	68	65	72	798
Diphtheria.....		9	8	85	6	8	1	4	1	122
Dysentery (bacillary).....				2					1	3
German measles.....				40	11		8	10	10	79
Influenza.....		5			42	2			15	64
Measles.....		1		119	86	19	33	6	81	345
Meningitis, meningococcus.....			1					1		3
Mumps.....		1		225	30	8	1	39	31	335
Poliomyelitis.....		1								1
Scarlet fever.....		4	38	138	137	11	10	34	45	417
Tuberculosis (all forms).....		4	1	233	43	5		46	11	343
Typhoid and paratyphoid fever.....			2	3					2	7
Veneral diseases:										
Gonorrhoea.....		26	26	92	149	38	24	27	50	432
Syphilis.....	3	7	14	196	96	12	6	22	25	363
Whooping cough.....		30		210	64	9	11	16	78	418

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.

(Few reports are available from the invaded countries of Europe and other nations in war zones.)

Plague

Algeria.—For the period November 11–20, 1944, 4 cases of suspected plague were reported in Algeria. For the period November 21–30, 1944, 4 cases of plague were reported in Algiers, Algeria.

Bechuanaland.—For the period October 27 to December 5, 1944, 230 cases of plague with 113 deaths were reported in Bechuanaland, which presumably include the 171 cases of plague previously reported.

Madagascar.—For the period November 1–10, 1944, 2 fatal cases of plague were reported in Madagascar. For the period November 11–20, 1944, 6 fatal cases of plague were reported.

Morocco (French).—For the period November 21–30, 1944, 7 cases of plague were reported in French Morocco.

Peru.—During the month of November 1944, 1 case of plague with 1 death was reported in Libertad Department, and 5 cases of plague with 2 deaths were reported in Lima Department, Peru.

Smallpox

French Guinea.—For the period December 1–10, 1944, 120 cases of smallpox were reported in French Guinea.

Venezuela.—Telegraphic information dated December 14 and 15, 1944, reports smallpox (alastrim) in Venezuela as follows: Guarico State—Mellado District, 57 cases, 2 deaths; Palo Seco, Municipality of Calabozo, 4 cases; Miranda State—Santa Rita, 13 cases. During the month of November 1944, 44 cases of smallpox (alastrim) were reported in Caracas and vicinity, Venezuela.

Typhus Fever

Chile.—For the period October 8 to November 4, 1944, 46 cases of typhus fever with 10 deaths were reported in Chile. Provinces reporting the highest incidence are as follows: Santiago, 17 cases, 5 deaths; Antofagasta, 7 cases, 1 death; Valparaiso, 6 cases.

Morocco (French).—For the period November 21–30, 1944, 89 cases of typhus fever were reported in French Morocco, of which number 68 cases were reported in the military area of Agadir and frontier districts, 13 cases in Casablanca region, and 5 cases in the region of Fez.

Turkey.—Typhus fever has been reported in Turkey as follows: Week ended December 9, 1944, 71 cases; week ended December 16, 1944, 98 cases.

Yellow Fever

Ivory Coast—Daloa.—On December 15, 1944, 1 case of suspected yellow fever was reported in Daloa, Ivory Coast.

Venezuela—Barinas State—Camp Morita.—According to telegraphic information dated December 13, 1944, 2 confirmed cases of yellow fever were reported in Camp Morita, near Barinas, Barinas State, Venezuela.