

ENDEMIC TYPHUS FEVER IN SOUTHERN CALIFORNIA*

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GEOGRAPHICAL AND CHRONOLOGICAL DISTRIBUTION

TYPHUS fever first came to serious attention in California in 1916 when Mexican laborers, imported to work on railroads, brought the louse-borne disease into the State.^{1, 2} Most of the 31 cases occurred in labor camps, and the disease was controlled by delousing and sanitation procedures conducted by the State Board of Health with the coöperation of the United States Public Health Service. Since that time there have been no epidemics of typhus in California. Maxcy³ records the first case of endemic typhus in California as occurring in San Francisco in 1915 and the second in the same city in 1919. He records the first case in Los Angeles in 1920, followed by four cases in 1921.

The present paper deals with endemic typhus during the period 1922-1942, based upon detailed data on individual cases furnished to the authors by the California State Department of Public Health. The data from 1922 through 1939 were furnished to the senior author in connection with a study of the extension of endemic typhus fever in the southern United States.⁴ Since the data provided much more detail than could be presented in that report, it has seemed worthwhile to record it separately, and the California authorities have been kind enough to furnish similar data through 1942. Halverson⁵ has reported briefly on the trend of the disease through 1941.

Very recently, Beck, Bodily and O'Donnell,¹⁴ of the Virus Unit, Division of Laboratories, and the Bureau of Epidemiology, California State Department of Public Health, proved the existence of murine typhus in California by isolating a murine strain of Rickettsia from the brain of a rat trapped in a poultry plant located in a semi-rural district of San Bernardino County where a case of typhus had occurred in a woman employed as an egg packer. This is the first laboratory proof of the existence of murine typhus in California.

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Table 1 shows the distribution of reported cases by years and their allocation to the probable locality where the infection was acquired. The cases reported as typhus to the State Health Department totaled 216, but one of these in a four-year-old child at Needles, in San Bernardino County, has been omitted from the analysis because of doubt as to its true etiology.

Table 1 shows that of the 215 cases, 152 were allocated to Los Angeles County, 45 to San Diego County, two to Orange County, and one each to the counties of Santa Barbara, San Joaquin, San Francisco and Solano. Among patients allocated to San Diego County are five which apparently contracted the infection at one or another of the race tracks near or just across the Mexican border.

In addition to the counties specified above, seven cases have been allocated to the State of California in general because the source of infection could not be localized, and three cases have been allocated to Texas, one to Hawaii and two to Mexico.

At the foot of Table 1, it is shown that 17 of the 45 patients allocated to San Diego County apparently became infected in San Diego City, and that 125 of the 152 patients in Los Angeles County apparently became infected in Los Angeles City.

The above figures indicate that the problem of endemic typhus fever in California has been, up to the present, limited almost entirely to two southern counties, San Diego and Los Angeles. This is further emphasized by the facts that one of two patients in Orange County may have become infected in Los Angeles County, that the case in San Joaquin County had a negative Weil-Felix reaction, that the case in San Francisco County was a boatman who had visited ports in southern California, and that the case in Solano County was diagnosed only from clinical symptoms. All of these counties except Orange are in central California. Map 1 shows the southern part of California with the number of cases reported from each county in this area.

TABLE 1.—Typhus Fever Cases Reported in California 1922-1942 by Location of Probable Origin

COUNTIES	YEAR																	Total				
	'22	'23	'24	'25	'26	'27	'28	'29	'30	'31	'32	'33	'34	'35	'36	'37	'38		'39	'40	'41	'42
San Diego.....	..	..	..	..	..	..	1	..	..	..	..	..	..	..	5	6	7	4	3	6	13	45
Orange.....	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	1	..	..	..	..	..	2
Los Angeles.....	8	15	16	..	3	..	..	..	1	2	1	2	3	2	3	7	14	24	15	19	17	152
Santa Barbara.....	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	1	1
San Joaquin.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
San Francisco.....	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Solano.....	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	1
STATES																						
California.....	1	1	..	..	..	..	..	1	..	..	..	..	..	..	1	..	..	1	..	..	1	6
Texas.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	1	..	..	3
FOREIGN																						
Hawaii.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	1
Mexico.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	2
TOTAL.....	9	16	16	0	3	0	2	1	1	2	1	4	4	3	9	16	21	30	19	25	33	215
CITIES																						
San Diego.....	..	..	..	..	..	..	..	..	1	1	..	..	2	..	3	2	3	1	1	..	7	17
Los Angeles.....	8	14	15	..	2	..	..	..	1	1	..	2	2	2	6	6	12	20	9	13	11	125

The chronological distribution of reported cases is also of interest. Considering only the southern part of the State, only one case occurred in San Diego County prior to 1936. Beginning in that year, from three to seven cases occurred annually until 1942, when 13 cases were reported. In Los Angeles County cases increased from 8 to 16 in the years 1922 to 1924. With the exception of three cases in 1926, no more cases were reported until 1930. From then until 1936 from one to three cases were reported each year, after which the annual number has been larger, reaching a peak of 24 cases in 1939.

TABLE 2.—Cases of Typhus Fever in California 1922-1924 and 1925-1942 by Month and Season

Month	1922-1924		1925-1942		Total	
	No.	%	No.	%	No.	%
Jan. 1	7	17.1	9	12.6	10	4.7
Feb. 2			8		10	4.7
March ... 4			5		9	4.2
April 0	1	2.4	6	17.8	6	2.8
May 1			18		19	8.8
June 0			7		7	3.3
July 5	10	24.4	13	46	18	8.3
Aug. 3			14		17	7.9
Sept. 2			19		21	9.8
Oct. 11	23	56.1	32	75	43	30.0
Nov. 9			22		31	14.4
Dec. 3			21		24	11.2
Total ... 41			174		215	

The most interesting point in connection with the chronological distribution in Los Angeles County is the sudden cessation of occurrence in 1925, and the almost complete absence of cases until 1930 when a very gradual increase began. It will be recalled that in the winter of 1924-25 an epidemic of pneumonic plague occurred in the City of Los Angeles.⁶ In the control of that epidemic 210,000 rats were trapped and extensive rat proofing procedures were instituted. It seems probable that this campaign not only eliminated the rat and rat-flea sources of plague, but also reduced the corresponding sources of typhus to a level which prevented, for over a decade, the occurrence of more than a few cases in man. The increase beginning in 1937 was practically coincident with that in San Diego County, and also parallels the progressive increase in Texas and the southeastern states.^{4,7} The cessation of cases in 1925 also indicates the probability that most if not all of the cases in Los Angeles County from 1922 to 1924 were acquired from rat-fleas rather than from human lice.

In 203 of the cases the data indicated whether the infection was probably contracted in urban or rural areas; 185 indicated an urban source and 18 a rural source. This demonstrated that the problem in southern California, up to the present time, is predominantly an urban one, as in other parts of the country. The occurrence

of some rural cases, however, indicates that a further spread to rural areas similar to that in Georgia and Alabama may occur.

SEASONAL DISTRIBUTION

Table 2 shows the distribution of cases by month and season. Separate figures are presented for the years 1922 to 1924, and for 1925 to 1942. It will be seen that October is the month of highest incidence in both periods, with November ranking second. In both periods the autumn months show the highest incidence and the summer months the second highest. In the period 1925 to 1942 the spring months ranked third and the winter months fourth. In the period 1922 to 1924 a smaller proportion occurred in the spring than in the winter months, but the number of cases is too small to make this difference significant. This seasonal distribution conforms in general to that of murine typhus in the southern United States, and is quite the opposite from louse-borne typhus in temperate zones, where the incidence is highest in winter and spring. It supports the probability that most of the cases from 1922 to 1924 were flea-borne rather than louse-borne.

TABLE 3.—Cases of Typhus Fever in California 1922-1942 by Age Groups

Age Groups	Cases	%
0-9	1	0.5
10-19	20	9.5
20-29	49	23.1
30-39	57	27.0
40-49	30	14.3
50-59	33	15.6
60-69	20	9.5
70-79	1	0.5
Total	211	100.0

DISTRIBUTION BY AGE, SEX AND OCCUPATION

Table 3 shows the distribution of cases by ten-year age groups. Four cases of unknown age are omitted from this table. It will be seen that the largest percentage of cases occurred in the 30-39 age group, with the age group 20-29 ranking second, 50-59 ranking third, and 40-49 ranking fourth. This proportionate distribution of cases in age groups does not of course indicate the relative incidence of the disease in the corresponding age groups of population. Such an analysis, based upon the age distribution of the population, would probably show the highest incidence in later age groups. An analysis by sex shows that 73 per cent occurred in males and 27 per cent in females. This corresponds to the relative sex incidence in murine typhus in other parts of the country.⁸

Table 4 shows the distribution of cases by general type of occupation. The largest single group comprises housewives. Their principal place of exposure would be expected to be in the home, and the same can be said of children and students, although in neither case can infection elsewhere be excluded. All of the other occupational classifications, which together comprise the great majority of the cases, indicate the probability of

infection in their occupational locations, although infection of some of these persons may have occurred in the home. Further examination of the data on the 58 female cases indicated that only a minority (25) were housewives, and eight were children and students, while 19 of the remainder were engaged in gainful occupations where they might have been exposed to rats.

TABLE 4.—Cases of Typhus Fever in California 1922-1942 by Occupation

Occupations	Cases
Housewives	25
Factories, Warehouses, Docks, Boats	24
Stores and Markets	21
Service Trades, Salesmen	21
Office, Professional, Teaching	17
Eating Establishments, Food Processing	14
Ranches, Farms, Horses	13
Children, Students	13
Railroad Workers, Laborers	10
Unemployed	9
Other	18
Unknown	30
Total	215

With reference to exposure to lice, the epidemiological data stated such possible exposure in 17 cases, but in 14 of these, possible exposure to rats was also indicated. It is interesting that the first mention of contact with rats is in connection with a case occurring in 1924, two years before the publication of Maxcy's paper⁹ suggesting a rat reservoir of endemic typhus. The second mention of rats is in connection with the 1932 case, after which contact with rats was frequently mentioned. Conditions favoring exposure to rat-fleas are, however, described in connection with many of the earliest cases.

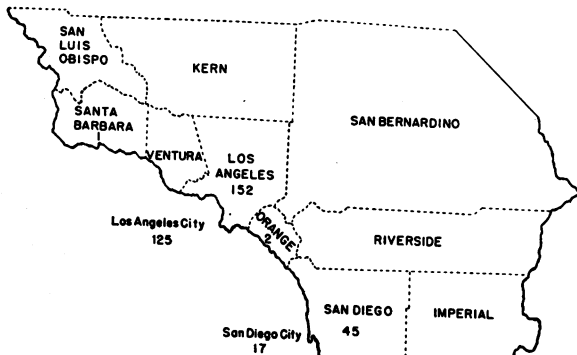


Chart 1.—Map of Southern California showing number of cases of typhus fever reported from each county, and from Los Angeles and San Diego cities, 1922-1942.

METHODS OF DIAGNOSIS AND CASE FATALITY

The Weil-Felix test was performed in 187 cases. In 40 of these the reaction was positive but the titer was not reported. In 135 the reaction was positive in a serum dilution of 1 to 160 or greater. In 9 it was positive in a dilution of less than 1 to 160, and in 3 it was negative. In 25 cases the data did not state whether or not the Weil-Felix test was performed. One case was proven by guinea pig inoculation and 1 case was stated to have been diagnosed on clinical symptoms alone.

There were 7 deaths in this series, or a case fatality rate of 3.2 per cent. The ages of the fatal cases were as follows: 27, 40, 47, 54, 57, 58 and 69. Except for the 27-year-old case, these conform to the usual age distribution of fatal cases of murine typhus in the United States.⁸ The 27-year-old case occurred in a Filipino in Solano County, north of San Francisco. The diagnosis was based entirely on clinical observations.

ADDITIONAL POINTS IN EPIDEMIOLOGY

In 13 instances more than 1 case occurred in the same household in the same year. In 10 of these instances there were 2 cases and in 3 instances there were 3 cases in the same household. The time intervals between the onset of cases in the same house ranged from 3 days to nearly one year.

In 2 additional instances personal contact was reported between cases at close intervals, the patients not living in the same house. One of these instances involved 4 men who became ill within 3 weeks; 2 of them were partners in a shoe store. The other instance involved a female attendant in the San Diego County Hospital who became ill after being in contact with a case in the hospital for a period of seven weeks.

Cases on ranches or farms, or connected with race tracks on the Mexican border, were reported only since 1936. This suggests that the reservoir of infection has recently spread into rural areas, partly from the large cities and partly from northern Mexico.

The 3 cases allocated to Texas were in persons who apparently were exposed in traveling by motor car to California. The case allocated to Hawaii was in a white woman who crossed the Pacific from Shanghai, stopped in Honolulu, and was ill upon arrival in San Francisco. The first case allocated to Mexico was in a woman who became ill 3 days after returning by automobile from Mexico City. The second case was in a mining engineer who was ill on arrival from Mexico. Both of these may have been louse-borne cases.

One case occurred in a Russian Jew, age 32, who stated that he had had typhus in Russia 20 years previously. This is of interest in view of the opinion of Zinsser¹⁰ that Brill's disease in the northeastern seaports of the United States represents an exacerbation of Old World typhus in individuals who acquired the louse-borne disease previous to emigration to this country.

COMMENT

The data reported in this paper indicate that the problem of typhus fever in California is still limited primarily to Los Angeles and San Diego Counties, particularly to the large cities, and that there is an increasing problem in those areas, the largest number of cases to date having been reported in 1942. The locally acquired disease is entirely the murine variety and probably has been so almost entirely since 1922 or before. Within the last few years a larger proportion of the cases than previously have occurred outside the cities

of Los Angeles and San Diego, indicating that the rats in rural areas are acquiring a high incidence of infection.

The State of California and many of its cities, with the coöperation of the United States Public Health Service, have carried on efficient rat control programs for the control of plague for many years. This has undoubtedly been responsible for the relatively small number of cases of endemic typhus which have occurred, for the postponement of the increase of cases in California beyond the time when the increase in Texas and the southeastern states began, and for the present confinement of cases to the southern part of the state. The reasons for the recent increase in Los Angeles and San Diego and the spread to rural areas are probably an increase in the proportion of rats infected with typhus, and an increase in the proportion of rats infested with the so-called tropical rat-flea, *Xenopsylla cheopis*, one of the most efficient vectors of murine typhus⁷ as well as of plague. This species of flea has been found on rats in most localities where it has been sought in connection with cases of endemic typhus. Within recent years it has been found in a number of northern cities in the United States.¹¹ Since the only possible control of the flea is through the control of the rat, it is probable that the only method of preventing a further increase of endemic typhus in man and its extension to other cities and rural areas is through more intensive rat control measures. Rat-proof construction of new buildings, supplemented by the relatively inexpensive methods of vent stoppage and elimination of rat harborage in old buildings, developed by the Georgia State Department of Health¹² and the United States Public Health Service,¹³ will probably be required in order to reduce the rat population to a point where endemic typhus in man will rarely occur.

SUMMARY AND CONCLUSIONS

1. An analysis is presented of the occurrence of endemic typhus fever in California. The disease to date has occurred almost entirely in the southern portion of the state, the chief endemic areas being Los Angeles and San Diego Counties, and particularly Los Angeles and San Diego cities.

2. The locally acquired disease is the murine type and has probably been so almost if not entirely since 1922. This is indicated by the sudden disappearance of the disease in 1925 following the vigorous rat-control campaign in Los Angeles in connection with the epidemic of pneumonic plague. It is also indicated by the seasonal, sex and occupational distribution of cases, the low case fatality rate and the general absence of human lice on patients.

3. The recent occurrence of a larger proportion of cases in rural areas, particularly associated with hog ranches and race tracks, suggests that the disease in rats is becoming more prevalent in rural areas.

4. Although the incidence of human cases of

murine typhus in California is not yet alarming, its increase in recent years emphasizes the necessity for the continuation of vigorous rat-control measures in the cities and thickly populated rural areas of southern California, and also in cities farther north which may become endemic foci in the future.

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MADUROMYCOSIS OF THE ANKLE

REPORT OF CASE

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IN North America Maduromycosis (Madura foot, mycetoma) has been a rare and little-known disease, in contrast to India and the Dutch East Indies where it is prevalent and well-recognized. Because (larger) numbers of men from the United States will be exposed to infection by the fungi which give rise to Maduromycosis, it seems appropriate at this time to report a case recently seen in a U. S. Naval Hospital.

REPORT OF CASE

R. R. R., CK3c, Filipino, aged 40 years. Entered hospital, Oct. 25, 1943.

Complaint: Swelling inner aspect of left ankle, seven months.