

# Q Fever in Los Angeles County

## Description of Some of Its Epidemiological Features

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Q FEVER has been found to occur in Los Angeles County, California, in an apparently endemic fashion, and this paper describes certain characteristics of the disease in that area.

Two naturally occurring outbreaks of Q fever are known to have taken place in the United States. The first appeared in Amarillo, Tex., in March, 1946,<sup>1</sup> and the second in Chicago, Ill., in August, 1946.<sup>2</sup> These two epidemics were alike in many respects; both were sharp outbreaks arising from occupational exposure of susceptible persons to stock being slaughtered or moving to slaughter. The attack rates were high in both instances, being over 50 per cent in the most heavily exposed groups, and the dates of onset of the cases were distributed over a 2 to 3 week period, the variation being chiefly accounted for by the spread in incubation period of the human disease.

It seemed clear from studies of the two outbreaks that infected cattle in Amarillo and infected calves or sheep in Chicago had been the source of human infection, and that transmission to slaughter-house workers had come from infected tissues and body fluids either by direct contact or by means of droplets of splattered fluids. Ticks had been very rarely seen on animals in either of these locations, and, in Chicago, cases did not tend to develop in persons associated with operations on hides, but instead were concentrated in personnel handling viscera.

Although the means by which the human beings had become infected was somewhat clarified by these studies, the manner of infection of the animals was not obvious, and it was not possible to gain a clear picture of the natural reservoirs of the disease in this country. For one reason the infectious source had long since been removed when the outbreaks occurred, and the epidemiological investigations were necessarily retrospective. The endemic area now found in Los Angeles County appears to provide suitable material for investigation of the natural reservoir problem.

The apparent lack of an insect vector in the two American outbreaks and their explosive and isolated nature seems to be different from the picture in Australia.<sup>3</sup>

### THE OUTBREAK IN LOS ANGELES COUNTY *General Description of Area—*

The cases which have been found have developed in the milk shed area of Los Angeles County. This zone is in flat land 10–30 miles southeast of the center of the city of Los Angeles. The climate is warm and dry and moderated considerably by the Pacific Ocean.\*

This dairy area is one of the most concentrated in the world. There is

\* Weather bureau records show that in Los Angeles since 1877 the average yearly rainfall has totaled 15.55 inches with 14.22 inches of this falling in the months from November through March. The average temperature for the same period has been 63.0° F. with monthly means varying from 55.6° in January to 71.4° in August. In 1946 the highest temperature was 95° and the lowest 38°.

little or no pasture available, and nearly all the feed is brought in from other places. The sources of the feed for the cows are scattered over thousands of miles. Although the chief item, hay, is trucked in from the nearby Imperial and San Joaquin Valley, grain comes from northwestern United States, soy beans from the mid-West, copra meal from the Philippines, and molasses from Hawaii.

Because of the high cost of feed and land, almost all of the cows are imported from areas where pasture is available. They are usually bought as at least 3 year old animals, or so-called "second calf heifers." Although most of them are raised in California in the San Joaquin and Sacramento Valleys, many come from Oregon, Washington, Idaho, Montana, Utah, and Colorado.

Because of the lack of pasture the cows are concentrated in pens at most dairies and the considerable manure which accumulates in the pens is removed by scraping it with a bull dozer to the center of the pen where it is loaded into trucks and hauled away to fertilizer plants.

The dairies themselves consist of pens, an open milking barn, a closed feed barn, and piles of baled hay protected on the top against rain. Although most of the population in the area is concentrated in towns of a few thousand, there are many residences quite close to the dairies, and there are occasional dairies in the towns. Over 400 dairies are to be found here, and few people can travel far from their homes without passing one or more of them.

#### *Methods of Investigation—*

Through the coöperation of local physicians the names of persons who had undergone recent febrile attacks were obtained. Cases of virus pneumonia were especially sought. These people were then visited, interviewed, and

blood samples were taken. As might have been expected in the spring, upper respiratory infection provided the principal group of illnesses to be differentiated from Q fever. This differentiation could be done in most cases by taking a history of the disease and asking specific questions about upper respiratory symptoms. The presence of sore throat, running nose, and severe cough were valuable in making a diagnosis of upper respiratory infection. The complement-fixation test was of great help in arriving at a diagnosis of Q fever.

Complement-fixation serum tests were done with the technic described by Bengtson<sup>4</sup> with antigen prepared by method II<sup>5</sup> from yolk sacs infected with the Italian (Henzerling) strain of *Rickettsia burneti*. Results are given as the highest dilution at which 3+ to 4+ fixation was seen. Samples of blood collected in California were shipped by air mail to the laboratory in Bethesda, Md., where the sera and clots were separated. The clots were used when indicated for attempted isolation of rickettsiae. Certain precautions were taken for shipment, stoppers were fastened down securely with adhesive tape in order that they could not be loosened by the low pressures encountered in air transport, and the mailing containers were packed tightly with cotton in order to prevent breakage.

#### *The Diagnosis of Clinical Disease in Human Beings—*

Table 1 lists the clinical cases of Q fever found by preliminary investigations. The patients seen by physicians not familiar with Q fever were ordinarily diagnosed as "virus" or "atypical" pneumonia. Pneumonitis was demonstrated when roentgenograms were done.

The diagnosis of Q fever in each case was based on a typical clinical history with confirmatory laboratory findings. The typical clinical history was the same

TABLE 1  
Human Cases of Q Fever

No.	Age	Sex	Pneumonitis	Days of Fever	Date of Onset	Complement-fixation titer	Date. Sample taken	Remarks
1	62	F	By x-ray	?	11-20	128	5-25	No definite exposure to dairies recalled.
2	51	M	By x-ray	11	11-25	128	6-7	Had visited small farms.
3	31	M	By x-ray	21	12-28	128	5-27	Visited dairy occasionally.
4	35	M	By x-ray	10	2-6	128	4-28	Visited dairies frequently.
5	29	M	By x-ray	9	2-11	256	5-26	Visited dairy about 3 weeks before onset.
6	15	M	Physical findings and bloody sputum	21	2-23	512	4-28	Frequently played around dairy.
7	45	M	Physical findings	6	4-6	64	5-21	Had visited dairies.
8	32	F	Physical findings and bloody sputum	10	4-13	512	4-28	Home 100 yards from several dairies.
9	27	F	By x-ray	12	4-20	512	6-4	Home 100 yards from dairy.
10	30	M	By x-ray	12	4-24	123	5-22	Two dairies across street.
11	28	M	By x-ray	11	4-26	0	4-30	Visited dairy 1 27 days before onset.
12	50	M	By x-ray	12	5-1	128	5-21	Cows kept in field beside house.
13	35	F	Physical findings	6	5-10	64	5-17	Home 200 yards from dairy.
14	36	M	Physical findings	7	5-14	128	5-21	
15	26	F	No x-ray. No physical findings of pneumonitis	10	5-15	0	5-16	No definite exposure to dairies recalled.
16	30	M	By x-ray	8	5-20	512	6-5	Wife of Case No. 10.
17	39	M	By x-ray	10	5-22	0	5-28	Home 100 yards from several dairies.
						128	6-2	Home surrounded by dairy pens.
						128	6-9	

as has been described by others. The onset was acute with fever, headache, chills or chilly sensations, and body aches and pains. Cough was frequently complained of but was not a prominent symptom. The sputum which was sometimes produced was at times blood-tinged. Chest pain was common and was usually of a lateral distribution, although a feeling of substernal congestion was frequent. Physical examination of the chest often revealed little of note except perhaps suggestive findings. Respirations were elevated when pneumonic involvement was extensive. Roentgenography revealed a pneumonic process which was usually diagnosed as "atypical" pneumonia when patchy, and "early lobar" pneumonia when diffuse. The leucocyte count tended to be normal or slightly elevated. The illness ran a course of 1 to 3 weeks' fever with

prolonged convalescence especially in older patients. No deaths were found which could be attributed to Q fever.

Many of the patients had recovered when first visited and the criteria of diagnosis had then to be a typical clinical history and the presence of specific complement-fixing antibodies. When patients were seen in the acute stage, blood was obtained, so that a rise in antibody titer could be shown with a later specimen. In addition the clot from the acute stage blood was inoculated into guinea pigs in an attempt to isolate *R. burneti*. It is felt that the diagnosis was firmly established by the demonstration of a marked rise in antibody during the illness or by the isolation of the etiologic agents.

Isolation of *R. Burneti* into guinea pigs was successful in cases No. 8, 11, 14, and 16. The strains were also es-

established in yolk sacs of hens' fertile eggs by passage from guinea pigs.

#### *Epidemiological Features of the Clinical Cases in Human Beings—*

Table 1 shows that the age of the clinical cases studied varied from 15 to 62 years. Twelve males were involved, as compared to 5 females. The cases occurred from November, 1946, to May, 1947, and were still occurring in October, 1947. It seems reasonable to assume that Q fever has been occurring here for some time. As yet no seasonal incidence is apparent.

The striking feature of the epidemiology is its peculiar relationship to dairies. It can be seen that in all of the cases except two a history was obtained of having visited dairies or of having lived near them. And, as has been mentioned, it is difficult to travel far in this region without passing cow pens. Yet none of the patients had been actually employed by a dairy, and most of them had probably not come within 10 to 20 feet of a cow, so that their contact with cows was more remote than that of the dairy workers which are considered next.

#### *Serologic Studies of Persons Not Clinically Ill With Q Fever—*

We have examined sera of many persons from outside the laboratory in the past and our experience has been that

until actual cases of Q fever were encountered in epidemics, the sera were uniformly negative. The sera of patients undergoing Q fever have given clear-cut results, most patients developing antibodies to high titer during the course of their illness. However, the results on sera of persons from the milk shed area were distinctly different, as will be seen from examination of Tables 2, 3, and 4.

TABLE 2

*Complement-fixation for Q Fever on Sera of Dairy Workers*

No.	Time in Area	Time Worked in local dairies	Titer
1.	29 yrs	29 yrs	16
2.	24 yrs	24 yrs	0
3.	22 yrs	22 yrs	8
4.	18 yrs	18 yrs	0
5.	15 yrs	15 yrs	0
6.	14 yrs	12 yrs	0
7.	12 yrs	12 yrs	0
8.	10 yrs	10 yrs	0
9.	7 yrs	7 yrs	0
10.	1½ yrs	1½ yrs	16
11.	1½ yrs	1½ yrs	32
12.	1 yr	1 yr	0
13.	1 yr	1 yr	32
14.	8 mos	8 mos	32
15.	6 mos	6 mos	0
16.	8 mos	6 mos	8
17.	2 yrs	1½ mos	0
18.	—	—	4
19.	—	—	8
20.	—	—	4

Table 2 shows the results of complement-fixation tests with sera of dairy workers. Twenty samples were tested, and 10 found positive in some dilution. Since these men had probably acquired

TABLE 3

*Complement-fixation for Q Fever in Persons Ill with Oother Diseases*

	Total Sera	Number Negative	Number Positive	End Titer			
				4	8	16	32
Residing within 100 yards of a dairy	8	4	4	1	0	1	2
Not residing within 100 yards of a dairy	6	6	0	0	0	0	0

TABLE 4

*Complement-fixations for Q Fever on Specimens Submitted for Routine Serologic Test for Syphilis*

Source	Total specimens submitted	Number negative	Number positive	End Titer			
				4	8	16	32
Milk Shed, L. A. County	166	161	5	2	2	1	1
District of Columbia	96	96	0	0	0	0	0

their antibodies in the course of their work, the results indicate the rate of exposure, since some of them had developed antibodies in less than one year's experience. The dairy workers with negative sera could have become so after having been positive at an earlier date, so that it is possible that more of them had been positive at one time or another. We have observed that after laboratory-acquired Q fever in human beings the sera revert to negative in the course of several years.

Table 3 shows the complement-fixation results with sera gathered from persons who had been ill with diseases which were presumably not Q fever. Although they gave histories of upper respiratory infections, blood samples were obtained and their sera were examined for Q fever antibodies. Though the number is small, the results show that sera of people living near the dairies, but not in actual contact with the cows may also show Q fever antibodies. Some of those with positive serology said they had never visited the dairy near which they lived.

In Table 4 are shown the results on sera obtained from the Los Angeles County and the District of Columbia laboratories. They were in both cases routine sera found negative in serologic tests for syphilis. Those from Los Angeles County were selected because the donor's residence had been given in the general milk shed area. Actually most people living in this area do not

live close to the dairies, since the human population is concentrated in towns, and the dairies are for the most part distributed about the countryside. Of the 166 specimens examined, 5 were found positive in low dilution. The 96 sera from the District of Columbia were all negative. The incidence of positive sera from the Los Angeles County milk shed is low, 3.0 per cent, but none were expected from previous experience.

The results of Tables 2, 3, and 4, when considered together, show that positive complement-fixations for Q fever can be expected in this area on sera of persons not undergoing obvious attacks of Q fever. Although some of the persons with positive sera were not questioned about previous illness, many were questioned at some length, and no definite history of Q fever could be obtained.

#### *Serologic Studies on Sera of Cows—*

We have previously examined, by the complement-fixation test for Q fever, bovine sera from two general areas. Nearly sixty sera of beef cattle from Texas and states adjacent to the Texas Panhandle were found negative last year, and more than sixty sera from Maryland milk cows were found negative at the same time.

It was possible to sample the cows at 9 different dairies in the Los Angeles milk shed area and to study the blood sera for complement-fixing antibodies for Q fever. The dairies were distributed across the milk shed area. Table 5

TABLE 5

*Complement-fixation Results on Sera of Cows from Several Dairies in Area*

Dairy No.	Number of sera	Number Negative	Number Positive	End Titers							
				4	8	16	32	64	128	256	512
A	9	9	0	0	0	0	0	0	0	0	0
B	13	11	2	0	1	0	0	1	0	0	0
C	12	11	1	0	0	0	1	0	0	0	0
D	20	18	2	0	2	0	0	0	0	0	0
E	16	10	6	0	0	2	2	1	1	0	0
F	15	12	3	0	0	0	0	0	1	1	1
G	15	14	1	0	0	0	1	0	0	0	0
H	15	14	1	0	0	0	0	1	0	0	0
I	15	10	5	0	1	1	0	1	1	1	0
Total	130	109	21	0	4	3	4	4	3	2	1

gives the results. In all, 130 sera were examined and 21 were found positive, 10 of them in dilutions of 1:64 or higher. The incidence of positives, 16.2 per cent, found in this survey varied from one dairy to another and was highest in dairy E and lowest in dairy A. The significance of the difference in the rates is probably not great, and there was some evidence that Q fever infection was present in all of them. For example, in dairy A several of the dairy workers were found to have positive sera. Other dairy workers of Table 2 were employed at dairies E, F, G, H, and I, and the patient in Case 11 visited dairy I 27 days before he became ill.

#### DISCUSSION

Although only 17 cases are listed in Table 1, it is likely that many more cases have occurred in the Los Angeles area. The complete reporting of Q fever must depend upon increased awareness of its presence by the physicians of the area, and the adequate use of laboratory diagnostic facilities. Most of the persons listed in Table 1 were patients of a few physicians who were especially interested in discovering cases.

The patients listed in Table 1 as having undergone clinical illness with Q fever did not have intimate contact with cows, and this point merits comment since it tends to cause confusion. Many people deny contact with cows except when they have touched them. As has been stated the "contact" of the persons in Table 1 arose from their living near dairies or having visited them within the incubation period of the disease.

None of the clinical cases found developed in dairy workers, yet evidence for the frequent infection of dairy workers was obtained by serological studies. Half of the 20 dairy workers sampled showed complement-fixing antibodies for Q fever rickettsiae, and it seems likely that others of them had been in-

fectured at one time or another, since positive to negative conversion may take place within a few years. Many of those having antibodies for Q fever did not give histories of illness particularly suggestive of Q fever. It thus appears that the dairy workers had undergone mild or inapparent attacks of Q fever. Mild attacks are known to occur.<sup>2, 6, 7, 8</sup>

An apparent inconsistency arises from these considerations, that is, the persons with what was apparently the greatest exposure seemed to escape clinical illness. This situation could have arisen from sampling methods, since if mild Q fever were common and severe Q fever rare in this area, and if exposure to the disease were not too greatly concentrated in the dairy workers, the severe cases could have been found in non-dairy workers simply because of their numerical superiority. An alternative explanation also appears possible, namely, that the exposure of the dairy workers is such that it tends to result in the mild disease rather than the severe form.

The complement-fixation results in Tables 2, 3, and 4 indicate that there has been considerable past exposure to Q fever in certain groups of persons in this area. This has apparently resulted in immunity in many cases. In addition it gives rise to difficulties in making a definite diagnosis of Q fever in a particular illness, since the demonstration of complement-fixing antibodies for Q fever rickettsiae in a single specimen taken in the course of a febrile illness is not sufficient to establish the etiology of the fever as being *R. burneti*. In this study, in order to investigate illness which had taken place in the near past we made the diagnosis of Q fever on a single positive serum when the patient had undergone an attack of "atypical" pneumonia. However, whenever the patient could be seen in the acute stage, a sample of blood was taken then, thus making it possible to establish the diagnosis of Q fever with considerable cer-

tainty by demonstrating a rise in antibody in the course of the disease, or by isolating *R. burneti* from the patient's blood, or by both means.

Q fever in the cows of this area appears to be common as judged by the results of the complement-fixation test. It does not appear possible to state definitely that the cows are the source of human Q fever infection since the possibility remains that the same source infected both cows and human beings.

The origin of most of the cattle in other regions suggests the possibility that the infection giving rise to the positive complement-fixations might have been acquired outside the Los Angeles area. However, 3 of the cows positive by complement-fixation were born and raised in the area; their titers were all low (1:8), but such titers seem to be significant, since the cow sera studied heretofore have been completely negative.

The negative results with bovine sera from the Texas Panhandle and adjacent areas and from Maryland were obtained in the course of investigations of an agglutination test using *R. burneti* suspensions as test antigen. Derrick, Smith, and Brown have reported 13 of 879 Australian dairy cows showing agglutinins for Q fever.<sup>9</sup> However, the agglutination test as we performed it appeared unreliable and of 500-600 bovine sera studied about 60 per cent gave positive agglutination tests. We concluded that the agglutination results we saw were most likely nonspecific and not related to past infection with *R. burneti*.

It would be of interest to know when Q fever infection appeared in Los Angeles County, but it seems that we have little evidence on this point. The first case of Q fever in Table 1 was in a patient whose illness started November, 1946. It is quite possible that cases have been occurring for some time, and it is doubtful if the presence of infection would have become known now had it not been for the recent interest in Q

fever because of outbreaks elsewhere in the country.

It should be noted that few if any ticks are present on the cows in the Los Angeles milk shed, and that the fly population is kept low by DDT spraying of barns and the frequent removal of manure.

#### SUMMARY

1. Q fever has been found occurring in an apparently endemic manner in the milk shed area of Los Angeles County. Most of the cases lived near or visited dairies.

2. Serological studies revealed that many people who did not give histories of clinical attacks of Q fever showed complement-fixing antibodies for Q fever. Half of the dairy workers and people living near dairies showed specific antibodies.

3. Of 130 sera of cows in the area 21 showed antibodies for Q fever, some in high titer.

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presence of Q fever in the area was discovered.

Much help was freely given by the personnel of the Los Angeles County Health Department. The cooperation of the local physicians is greatly appreciated, as is the assistance of the dairy owners.

#### ADDENDUM

Since this paper was submitted for publication, Huebner, Jellison, Beck, Parker, and Shepard have published the results of further

investigations at Los Angeles. *Pub Health Rep.*, 63:201 (Feb. 13), 1948.

They report the finding of *R. burneti*, the causative agent of Q Fever, in the raw milk of 4 dairies in Southern California. Pasteurization results under field conditions, while incomplete, apparently rendered naturally infected milk non-infectious for guinea pigs. Available epidemiological evidence does not indicate that the drinking of milk was the cause of a majority of the cases thus far studied.

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## Silver Nitrate Still the Preferred Drug in Ophthalmia Neonatorum

In the April issue of the *Woman's Home Companion*, Miriam Zeller Gross, in an article entitled, "Can Present Laws Blind Your Baby?" proposed that the use of silver nitrate be discarded as a method of preventing the infection of eyes of the new-born. She proposes that penicillin be substituted because of its proved value and proved harmlessness.

Among the protests of the scientific accuracy of the article is a report released by the New York Academy of Medicine, on request for an opinion by the Commissioner of Health of New York City. He had some months ago asked the opinion of the Academy about the wisdom of amending the New York City Sanitary Code requirements for silver nitrate.

A digest of Academy opinion follows:

In preventing infection of the baby at birth, both penicillin and silver

nitrate are safe to use when the solutions are prepared carefully and applied properly, a committee of specialists reported. There is no evidence that 1 per cent or even 2 per cent solutions of silver nitrate, which are those used in the prophylaxis of ophthalmia neonatorum, have ever damaged vision.

Bacteria that cause gonorrhoea and pneumonia are most likely to cause blindness in the baby, and the concentration of penicillin most effective to halt the growth of these bacteria is not yet known.

In view of the present available evidence of the relative effectiveness of silver nitrate, silver acetate, and penicillin in the control of ophthalmia neonatorum, it would seem that existing laws requiring the use of silver nitrate should not at the present time be revised by the substitution of penicillin for silver nitrate.