AN EPIDEMIC OF PNEUMONIC PLAGUE

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Dr. Kellogg calls on health authorities to wake from their apathy with reference to plague in California, and instead of restrictive measures to adopt an aggressive warfare. He points out that there is real danger to the country and urges adequate appropriations to exterminate the animal disease carriers while this may be done with certainty.

THE occurrence of a small epidemic of pneumonic plague in Oakland during the latter part of August and the first part of September, 1919, serves to remind us that the problem not only is with us still, but that it must be reckoned with in the future. This outbreak is of considerable interest, since it is the first instance of an epidemic of pneumonic plague on the western hemisphere. The great epidemic of Manchuria in 1911 is still fresh in our minds, and the work of Strong and Teague will be later referred to in a discussion of the possibilities of such a visitation in this country. In the report of the State Board of Health for the biennial period ending June 30, 1918, the writer made the following statement:

BUBONIC PLAGUE AND SQUIRREL ERADICATION

"The continued existence of bubonic plague among ground squirrels of California, after ten years of work for their extermination, should be a matter of general concern and should prompt us to redouble our efforts to eradicate them. California is definitely on the map as one of the endemic foci of this disease, others being Arabia, Manchuria and Thibet.

The work of squirrel eradication is being carried on by the United States Public Health Service in coöperation with the State Board of Health, and the amount of money being expended in the work averages about $60,000 per year, less than half of which is contributed by the state through funds appropriated to the State Board of Health. The work is carried on by intensive poisoning operations in those localities shown to be plague infected. This is determined by sending hunters over the area under investigation, examining in the laboratory squirrels shot, and concentrating poisoning operations in the places found to be infected. This method is made necessary by reason of the lack of funds to carry on more extensive work. In November, 1917, the Service surrendered charge of eradicative work in Merced, Stanislaus, San Benito and Monterey counties to the State Horticultural Commission, and has since confined its operations to the counties of Contra Costa, Alameda and San Mateo. Plague-infected squirrels were found in the latter group of counties which surround the bay of San Francisco, on which is located the city of San Francisco, which was the scene of a human plague epidemic in 1907.

Until plague-infected ground squirrels are entirely eradicated from California we shall always have a sword of Damo-

cles hanging over our heads. So long as infection persists among the ground squirrels, the possibility of an extension of the disease to the rats of the cities, and consequently to the human population, will exist. It may be one year, it may be five years, or it may be 20 years, before this lighting up of the virulence of the infection will occur, but we can surmise from the world history of plague and from its known tendency to slumber in endemic foci, such as we have in the vicinity of San Francisco Bay, that this will happen some time. We have now had a fair trial of the present method, extending over ten years, which is to spend just enough money to keep the disease in check, but not enough to exterminate it. The only rational plan is to proceed vigorously and to prosecute the work at such a rate that an entire ten years' allotment of funds is used up in a year or two. A reasonable basis would require an outlay of not less than $250,000 per year, with the expectation that two years would finish the work."

HISTORICAL.

Plague is primarily a disease of rodents, principally rats, and in some parts of the world of native animals, such as the tarbagan in Manchuria, the marmot in Arabia, and the ground squirrel in California. It persists endemically among these animals, occasionally extending to the human population, usually by way of an epizoötic among the rats, but sometimes by direct contact of humans with the wild animal harboring the infection. Whether the excursion of the disease from tarbagan or squirrel to the rat, then to the human, is a matter of chance, or whether it depends upon some temporary exaltation of virulence of the bacillus of plague is not known. The time interval between these human outbreaks is sometimes very long. It is believed that the disease lay dormant among the marmots of the west coast of Arabia during the many decades that elapsed between its disappearance from Europe and the beginning of the last pandemic in the early nineties.

Plague probably entered the United States in 1899, as the first recorded case on this continent was discovered in Chinatown, San Francisco, in March, 1900.* It had already appeared at the Hawaiian Islands on its westward march and was undoubtedly introduced into San Francisco by plague-infected rats from the Orient.

In August, 1908, the first evidence was secured of the extension of the infection to the ground squirrels of California, the supposition being that the point of contact was in the vicinity of the grain warehouses of Port Costa. Since that time the State Board of Health and the United States Public Health Service have jointly carried on a campaign of extermination and a systematic examination for infected animals with what funds were available for that purpose. Since 1908 sporadic human cases have occurred as follows, one at each of the places named:

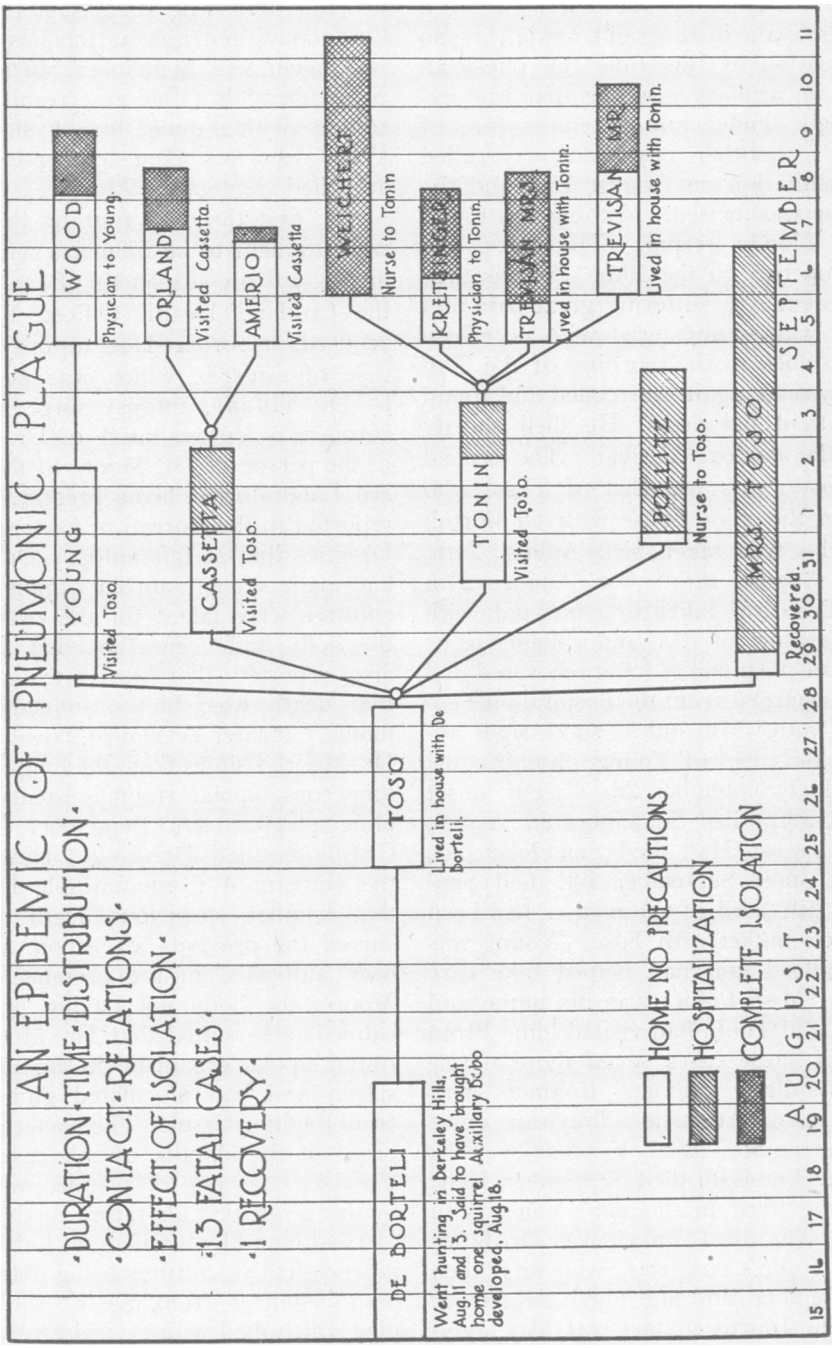
Los Angeles	August 11, 1908
Alameda County (rural)	September 24, 1909
Santa Clara County	August 31, 1910
Oakland	August 9, 1911
San Joaquin County	September 18, 1911
San Benito County	June 4, 1913
Contra Costa County	July 13, 1915

Following the apparent extermination of plague among the rats of San Francisco and Oakland, as a result of the work of those communities under the direction of the United States Public Health Service during the epidemic of 1907 and 1908, the usual feeling of security supervened, resulting in the complete cessation of rat exterminative measures in those communities.

PRESENT EPIDEMIC—(See Chart)

On August 15th, a man named Di Bortoli, residing at 960 Forty-fifth street, Oakland, was taken ill. His physician was called who found him with a temperature of 101.5°, a pain in his right side, with what he considered to be a congestion of the lower lobe of the right

*Kellogg, Journal A. M. A., May 19, 1900.


AN EPIDEMIC OF PNEUMONIC PLAGUE
·DURATION·TIME·DISTRIBUTION·
·CONTACT·RELATIONS·
·EFFECT OF ISOLATION·
·13 FATAL CASES·
·1 RECOVERY·
DE BORTELI
Went hunting in Berkeley Hills, Aug.11 and 13. Said to have brought home one squirrel. Axillary Bubo developed, Aug.18.
TOSO
Lived in house with De Borteli.
YOUNG
Visited Toso.
CASSETTA
Visited Toso.
ORLANDI
Visited Cassetta.
AMERIO
Visited Cassetta.
WOOD
Physician to Young.
WEICHERT
Nurse to Tonin
KREITINGER
Physician to Tonin.
TREVISAN MRS.
Lived in house with Tonin.
TONIN
Visited Toso.
TREVISAN MR.
Lived in house with Tonin.
POLITZ
Nurse to Toso.
MRS TOSO
Recovered.
HOME NO PRECAUTIONS
HOSPITALIZATION
COMPLETE ISOLATION
AUGUST
SEPTEMBER
15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11

lung. A diagnosis of influenza was made. Di Bortoli felt somewhat improved for two days and then developed a severe pain in the right axilla. Upon examination at this time the physician found an axillary swelling that was exceedingly tender and a temperature of 100.5.° Another physician was called in consultation on August 15th and the swelling was incised. Nothing was found but a bloody serum. The bubo was again opened on the 19th. At this time the patient was suffering great pain and heroin was administered with no effect. At 4 o'clock in the morning of the 20th the physician again was called and found the patient pulseless. He died shortly after the doctor's arrival. The second case to develop was that of Toso, who lived in the same house with Di Bortoli and who was taken sick August 25th, dying August 28th. On August 29th Mrs. Toso was taken to a hospital, with a temperature of 105°, and a diagnosis of influenza-pneumonia. She recovered and was discharged from the hospital on September 6th. In quick succession appeared the cases of Young, onset August 29th, died September 2d; Casetti, onset August 30th, died September 2d; Tonin, onset August 31st, died September 3d; Pollitz, onset September 1st, died September 4th. All of these cases had been in direct contact with Toso. Young was his landlord and had helped take care of him; Miss Pollitz was his nurse and Casetti and Tonin had visited him. From three of these cases seven more developed by direct contact. Contacts with Tonin were: Augustine Trevisan, onset September 5th, died September 8th; Assunta Trevisan, died September 10th; these two lived in the same house with Tonin. The third contact was Dr. Kretsinger, Tonin's physician, who was taken ill September 5th and died September 8th. The fourth contact was Mrs. Weichert, Tonin's nurse, who was stricken September 6th and died September 11th. The cases originating from contact with Casetti were: Amario, his cousin, who rode in the ambulance with him to the hospital, and who died September 7th. Orlando visited him at the hospital; he was taken sick September 5th and died September 8th. One case resulted from contact with Young, his physician, Dr. Wood, who was taken sick September 5th and died September 9th.

The first three or four of this series were thought to be influenza with pneumonia, but the suspicions of Dr. Crosby, the Oakland Health Officer, becoming aroused, he ordered an autopsy in the case of Amario, which was performed by Dr. Tiffany, autopsy surgeon of the coroner; a representative of Dr. Crosby, in the person of Dr. Moore of the Western Laboratories, being present. It was reported to the Bureau of Communicable Diseases that at this autopsy Dr. Moore had made slides from the organs, but no cultures were taken for the reason that the body had been embalmed. It was also reported that the conclusion was that death was due to influenza-pneumonia. It later developed, however, that Dr. Moore's slides from the lungs showed numerous bipolar staining bacilli resembling plague. On September 11, Dr. Crosby notified Dr. Kelly, Director of the Bureau of Communicable Diseases, that another suspicious death had occurred the previous afternoon, and had been autopsied in the presence of Dr. Moore, the body not having been embalmed. He stated that Dr. Moore had found bipolar organisms in the lungs and spleen and had inoculated guinea pigs from the lung tissue. The bacteriological proof of the identity of this case (Mrs. Trevisan), as one of plague, was made by the Hygienic Laboratory of the Board of Health and by the Federal Laboratory, independently; cultures being obtained in both instances from one of the guinea pigs which died with typical gross lesions of plague, following the inoculation by Dr. Moore with material from the human case. The post mortem findings, as de-

scribed by Dr. Moore in this case, were as follows, which description applied, according to the statement of Dr. Tiffany, the coroner's autopsy physician, to the other cases of the series which were autopsied by him:

No petechia were observed on the skin surfaces of the body. There was marked bilateral hydrothorax, both pleuras containing a considerable quantity of clear, straw-colored fluid, no blood or pus being evident. Pericardium contained from 100 to 150 cc. of dark straw-colored fluid; no blood. There was a bilateral, lobular pneumonia diffused over both lungs; on incision surface very moist and a thin bloody fluid exuded freely. Kidneys showed evidence of an acute parenchymatous nephritis, spleen from 10 to 12 inches long, being fully four times its normal size. Its substance was soft dark purple in color, of almost semifluid consistency. Peribronchial lymph nodes were enlarged, soft and hemorrhagic; no enlargement of lymph glands noted elsewhere in the body. Smears from the lung and spleen were made which showed upon examination, after staining with carbol-thionin, numerous typical bipolar staining organisms.

Although only one case has been positively identified as plague, the clinical history of the other cases, and the description of the post mortem findings, taken in connection with the very clear history of contact, as worked out by Drs. Force and Kelly of the Bureau of Communicable Diseases, leaves no room for doubt as to the identity of the entire series as cases of pneumonic plague; the first one of the series, Di Bertoli, being a case of bubonic plague with a supervening pneumonia, which was communicated in the usual manner, i.e., droplet infection and personal contact with the other victims, who contracted the pneumonic type by reason of the mode of entry of the virus. There is considerable doubt as to the identity of a case of plague in Miss Pollitz, the nurse to Toso, because the reported clinical history might give rise to the suspicion of another cause of death, chronic nephritis being the assigned cause and no post mortem examination having been made.

Some question might also be raised in the case of Mrs. Toso, the sole basis of such question being the fact that she recovered. This is not a valid objection, as the recovery of pneumonic plague cases is not an unknown occurrence, although the mortality in this form of the infection is very high.

Another interesting incident was the sending of a specimen of sputum from the case of Dr. Wood to a reliable laboratory in San Francisco, which made the report of type identification of pneumococci, but made no mention of the presence of bipolar bacilli.

The finding of bipolar organisms in this sputum apparently excited no suspicions at the laboratory. The sudden termination of the series of cases in the fourth generation of infections was probably due to the hospitalization of all the cases with complete isolation and careful medical asepsis, which no doubt was more careful than would have usually been the case with pneumonia, because there was a feeling of alarm caused by the rapidly fatal character of the preceding cases. In this connection it may be profitable to discuss some of the future probabilities considered in the light of the apparently easy checking of this epidemic. Certain conclusions reached by Teague and Barber* in their work in Manchuria throw some light on this question.

The Manchurian epidemic, occurring during the winter of 1910 and 1911, was wholly of the pneumonic type and within three months 50,000 people died from the disease. In searching for reasons as to why this particular epidemic should be exclusively of the pneumonic type, whereas the great number of cases in India had been of the bubonic form,

*Philippine Journal of Science, 1912, page 157.

Teague and Barber observed that the most noticeable difference prevailing in the two instances of epidemic prevalence was one of temperature. In Manchuria, during the entire season of the epidemic, the temperature ranged around 30° below zero C., whereas, in India the temperature was in the neighborhood of 30° above zero C. Following the lead indicated by this difference in temperature, they carried out a series of experiments with plague and other cultures and experimental animals. The following is quoted from a summary of their article:

"Hence, it seems probable that the plague bacilli contained in fine droplets of pneumonic plague sputum would suffer death from drying in a few minutes unless they were suspended in an atmosphere with an extremely small water deficit. Infection in pneumonic plague follows the inhalation of droplets of pneumonic sputum, and obviously the longer these droplets remain suspended in the air, the greater is the danger of infection. As has just been stated, these fine droplets disappear very quickly except when they are suspended in an atmosphere with a very small water deficit. Such an atmosphere is, under ordinary circumstances, of common occurrence in very cold climates, whereas, it is extremely rare in warm ones. Hence, since the droplets of sputum persist longer, the plague bacilli remain alive longer in the air, and there is a greater tendency for the disease to spread in cold climates than in warm ones.

"In harmony with the above ideas, we find that the only great epidemic of pneumonic plague of modern times occurred ir Manchuria during the winter of 1910 to 1911, when the atmospheric temperature was many degrees below zero Centigrade. The disease spread with amazing rapidity. Furthermore, although during the past fifteen years there have been millions of plague cases in India, and 2 to 5 per cent of these have been cases of plague pneumonia, yet this form of the disease has not assumed epidemic proportions. The largest epidemic of pneumonic plague in India (1,400 deaths) occurred in Kashmir, in northern India, at an elevation of 1,524 meters above the sea level during very cold weather."

The above conclusions were based on a series of experiments on the effect of drying on the viability of plague and other organisms and on the length of life of these organisms suspended in droplets of moisture under varying conditions of humidity and temperature.

Adopting the conclusions of Teague and Barber, then, we may conclude that under the circumstances of temperature and low humidity existing in Oakland at the time of this outbreak, conditions were not favorable for the transfer of infected droplets, carrying plague bacilli from one person to another, excepting under conditions of the closest contact. The drying and consequent death of the bacillus was so rapid that the ordinary measures of prophylaxis, which were easy of application, sufficed to check the progress of the infection when all existing cases were being cared for in hospitals. With the same line of reasoning, we can surmise that if a different condition of temperature and humidity existed, the result would have been far different, and we are justified in drawing the conclusion that this epidemic teaches that we have still another danger to be looked forward to from the continued existence of plague among the ground squirrels in California. We have, heretofore, been accustomed to think principally of the possible occurrence of an epidemic of the bubonic type following the extension of the disease to the rat population of some of our cities. The gravity of the situation is enhanced considerably when we realize the possibilities of a human case in the incubation stage of the disease following contact with squirrel plague, journeying to some eastern state in the winter time and developing an infection such as that of Di Bortoli, in the proper climate setting

for the development of a pneumonic epidemic which could easily be found in some of our eastern states in winter. The prospect of the consequences that could follow such a set of circumstances is not at all reassuring.

The State Board of Health took immediate action upon receipt of the first information suggesting the true nature of the cases, and was ably assisted by Dr. Crosby, the health officer of Oakland. The city council of Oakland promptly made an emergency appropriation, following similar action by the Governor of California, and a corps of inspectors and rat catchers, jointly paid by the Oakland city health department and the State Board of Health, was put into the field. Embalming of all bodies before authentic information as to the cause of death was obtained was immediately stopped and a system of inspection of bodies of persons dying under circumstances that might by any possibility be attributed to plague in any form was established. To insure that no case might be overlooked, the death certificates were scrutinized and countersigned by a deputy detailed for that purpose. The medical profession of the bay region was advised by special letter as to the exact situation and physicians were urged to report immediately all cases of pneumonia and all cases of acute infection of any sort, the diagnosis of which was not perfectly clear. All such cases were visited for the purpose of making a clinical and bacteriological examination.

It is very evident that the medical profession of the Pacific coast should be continually on its guard for cases of plague which may occur at any time so long as the infection exists among the rodents of the state. It should be remembered that in the early period of plague epidemics the first cases are very apt to be overlooked and mistaken for other conditions. The bubonic and septicemic form is frequently mistaken for typhoid fever, pyogenic infections, etc. All cases with acute enlargement and tenderness of the lymphatic glands should be looked on with suspicion, and bacteriological examination made wherever possible. The pneumonic form is particularly hard to identify, excepting by bacteriological tests. On the Pacific coast bacteriologists should be on the constant lookout for the presence of bipolar staining bacilli in the sputum of pneumonia cases.

SUMMARY

1. The third visitation of human plague in California occurred in Oakland, in August and September, 1919.

2. This epidemic was of the pneumonic type, the first instance of this form appearing epidemically on this hemisphere.

3. The epidemic was promptly checked by the adoption of measures of isolation.

4. The endemic prevalence of plague among ground squirrels of California constitutes a permanent menace not only to the State of California, but also to the whole of the United States.

5. The measures of extermination, which are at present being conducted by the State of California, as represented by the State Board of Health and the federal government, and as represented by the United States Public Health Service, should be financed to such an extent as to permit an extensive campaign of extermination that would offer some hope of the conclusion of the work within a period of one or two years.

6. The pneumonic type of plague is probably not a serious menace on the Pacific coast, owing to climatic conditions; but could readily become a serious matter in other parts of the United States by extension from the Pacific coast under the proper climatic conditions.