LEGIONNAIRES' DISEASE, 1977

HEARING

BEFORE THE

SUBCOMMITTEE ON HEALTH AND SCIENTIFIC RESEARCH

OF THE

COMMITTEE ON HUMAN RESOURCES UNITED STATES SENATE

NINETY-FIFTH CONGRESS

FIRST SESSION

ON

FOLLOW-UP EXAMINATION ON LEGIONNAIRES' DISEASE

NOVEMBER 9, 1977

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WEDNESDAY, NOVEMBER 9, 1977

U.S. SENATE,
SUBCOMMITTEE ON HEALTH AND SCIENTIFIC RESEARCH
OF THE COMMITTEE ON HUMAN RESOURCES,
Atlanta, Ga.

The subcommittee met pursuant to notice at 9 a.m. in Auditorium B, Center for Disease Control, 1600 Clifton Road, Atlanta, Ga., Senator Edward M. Kennedy (chairman of the subcommittee) presiding.

Present: Senators Kennedy, Schweiker, and Javits.

Committee staff present: Robert Wenger, counsel; Lawrence Horowitz, professional staff member; and Spencer Johnson and David Winston, minority staff.

OPENING STATEMENT OF SENATOR KENNEDY

Senator KENNEDY. We'll come to order. First of all, I want to express on behalf of the Senate Health Committee our great appreciation to all of those here at this very fine Center for their kindness and their hospitality in greeting us and making this facility available, and cooperating in every possible way with the members of the Senate Health Committee.

This work of ours this morning is related to our legislative responsibilities that we'll be addressing in the early part of the next session. The Senate of the United States and the House of Representatives are in an interlude while the Conference Committee of the President's program on energy is being considered and will reconvene the Monday after Thanksgiving. We're taking this opportunity to try and understand by visiting a number of different facilities and different aspects of our health-care system what opportunities are available for us to strengthen a system which does provide such hope, which does provide such meaningful assistance to so many people in need.

What a joy it is to come to the Center here and see such a center of excellence and how reassuring it must be for all American people and certainly the employees and researchers, scientists and leadership and administrators in having this very fine Center. We are very much indebted to all of you and we feel very welcome and look forward to our hearing this morning to try and find out more information about the particular function of this Center and particularly Legionnaires' disease.

I want to make some brief opening comments. I think you have recognized my colleague, Senator Schweiker, who is the ranking Republican member of this committee, who has been enormously active and interested in every phase of health legislation. We'll be joined later this morning by Senator Javits, who is on a plane from New

York. I don't know whether he'll have the good fortune that we had last evening trying to get down here from Washington where we stopped off and spent about 4½ hours to get down here, but we're glad to be here in any event.

I want to thank Dr. Foege and his entire staff—him personally and all of his staff—for their welcome here today.

We're here today to discuss Legionnaires' disease, a mystery that has generated an enormous amount of public interest and concern. It is clear that despite the fact that we live in a complex and technologically sophisticated society, the American people are susceptible to the same fears that have afflicted civilization since time immemorial, the fears of the unknown. In this case the fear was generated by a killer disease for which there was no known treatment. It is unsettling to be living in a time when we have the know-how to put a man on the Moon and yet can see a mysterious "agent" sweep through a traditional American gathering, an annual convention, striking 182 people and causing 29 deaths.

It has become clear that Legionnaires' disease is not limited to Philadelphia. Recent outbreaks of the disease have occurred at Kingsport, Tenn.; Columbus, Ohio and Burlington, Vt. One cannot be insulated from the disease by avoiding one city or one hotel. Since July 1976, there have been over 350 confirmed cases of Legionnaires' disease and 75 deaths stretching across at least 24 States. It strikes sporadically and in clusters. We also know that it is not a new disease. The CDC has been able to document outbreaks as far back as 1965.

We hope this morning to get answers to some important questions concerning Legionnaires' disease.

It has been over 13 months since the outbreak in Philadelphia. CDC has devoted over 73,000 person-hours and expended over $1.5 million toward solving the mystery. What is the status of their efforts?

We need to put the disease in its proper perspective. Is Legionnaires' disease a deadly menace that can strike anywhere at anytime, an Andromeda strain, or simply a relatively common form of flu or pneumonia, that has captured the fancy of the press and the public?

We need to know the prospects for the future. When, if ever, will we be able to effectively control the disease?

Finally, we need to know what lessons have been learned from this disease about the ability of the Federal Government and State and local officials to protect the American people from other disease menaces that might strike.

So we look forward to our discussion and our testimony here this morning. Before calling on your distinguished Congressman, I'd like to ask my colleague, Senator Schweiker, if he'd like to say anything.

Senator SCHWEIKER. Thank you very much, Mr. Chairman. I too would like to thank Dr. Foege and the staff here for the excellent cooperation and assistance that I have always received from CDC both as the ranking Republican member of the Senate Health Subcommittee and also as a member of the Labor-HEW Appropriations Committee through which this unit of Government is funded.

I welcome very much the opportunity to be here today and to review the progress of the CDC in its attempt to identify the cause of the so-called Legionnaires' disease, to develop the means to prevent outbreaks, and to minimize the effect once an outbreak has occurred.

We all know the story of the epidemic which occurred in Philadelphia in the summer of 1976. What may not be as well known is that apparently Legionnaires' disease has been with us a long time, undiscovered, and that it had nothing whatever to do with either Philadelphia or the American Legion. In fact, as the senior Senator from Pennsylvania I am concerned that Philadelphia and the American Legion both took a bum rap.

Philadelphia in general, and the Bellevue Stratford Hotel specifically, suffered enormous financial damage because, through fear and ignorance, it was assumed that some mysterious plague was localized in that vicinity.

Dr. Joseph McDade's brilliant and methodical research at the CDC has given us the true answer: The probable cause is a bacteria of long-standing which apparently is prevalent throughout the world. Certainly we now know, outbreaks have occurred in 24 States including Illinois, Michigan, Tennessee, Ohio, Vermont, Virginia, Washington, D.C. to name a few, and as far away as Spain.

I would hope that this hearing will focus on the latest research information available regarding the cause, carriers, spread and prevention or treatment of Legionnaires' disease. In addition, we should address the question of how cooperation between health agencies at various levels can be developed in order to assure that the public health is protected and so that the climate of fear so damaging to Philadelphia can be avoided in the future.

We should also try to answer an even more basic question: Just how good is our disease detection system? Why did it take so long to work in this case? And how many other killer diseases are as yet undiagnosed or wrongly diagnosed? What can be done promptly to make sure another mystery disease doesn't strike us at an unprepared point again.

The very fact that we now know enough to ask these difficult questions is in itself a significant measure of the progress that CDC has made in this area of disease detection.

Thank you very much.

Senator KENNEDY. It is only appropriate that we start off with our distinguished Congressman from your district who we have the opportunity to know and we look forward to a word of welcome, Congressman.

Congressman LEVITAS. Thank you, Senator. I'd like to welcome you and the subcommittee, Senator Schweiker, and later in the morning, Senator Javits, to CDC.

We are very proud of this area and we're very proud of the center. You referred to it, Senator Kennedy, as a center of excellence, and it is indeed that. You also commented upon the quality of people who work here and as you were speaking, I could not but reflect that in this country we have established through our Federal initiatives centers in Florida, Texas, California, for space exploration, and we have gathered at those places the true experts in the world who can devote their talents and their energies to this frontier of space exploration. What we have done here in Atlanta at CDC in the field of health is the same. We have established at this place a center of excellence and have brought together the true experts in this field in the world.

You say that it is reassuring for the people of America to have CDC here and the work they are doing, and I suggest that it is reassuring for every person who inhabits the world today and in the future for what has been done and what will be done here. We are very proud of CDC and the work it does. I can tell you that as the Congressman representing this district, it is exciting not only to know what's going on here and the ramifications and potentials and the implications for the future but you have no idea what it means to bring this type of person, these people who have gathered here, into one's congressional district. It keeps you hopping. It's not just the ordinary type of person who doesn't ask questions, they make a profession of asking questions and they do it of Congressmen as well and on occasion, Senators, I will share a few of their questions with you.

Senator KENNEDY. If you'll help us with the answers, that'll be all right.

Congressman LEVITAS. Which brings me to the next point. I think your presence here is very important for CDC and for the work they do, because your very presence here focuses attention on the importance of their work and lets many people across the Nation, to whom the initials CDC are just flashed across the television screen from time to time, get an in-depth look at what is going on with the people here. The questions you are asking are the right questions, they need to be asked and they need to be answered and the people you will be speaking with today are the people in the entire world who can give you those answers.

I want to express my welcome, my appreciation for your presence. I wish I could participate with you in the hearings today. Unfortunately, I have some precommitments that will keep me away for the entire meeting, but I want you to know that we will be following, myself and my office, your efforts and any way we can be of assistance and cooperation with you in furthering the work of your committee and CDC, you can rest assured that we will be there working with you.

Thank you for this opportunity.

Senator KENNEDY. Thank you, Congressman Levitas, very much for your comments and words of welcome. We appreciate it. Thank you for being with us.

Our first panel—William Foege, the Director of the Center; David Fraser, Chief of Special Pathogens of your Epidemiology Bureau; Walter Dowdle, Director of Virology Division.

STATEMENTS OF WILLIAM H. FOEGE, M.D., DIRECTOR, CENTER FOR DISEASE CONTROL; DAVID FRASER, M.D., CHIEF, SPECIAL PATHOGENS BRANCH, BUREAU OF EPIDEMIOLOGY; AND WALTER DOWDLE, M.D., DIRECTOR, DIVISION OF VIROLOGY, BUREAU OF LABORATORIES, A PANEL

Dr. FOEGE. Thank you, Mr. Chairman. Dr. Fraser was the director of the investigation in Philadelphia and Dr. Dowdle is director of the virology lab where the isolation of the organism was made. I am happy to have them along this morning.

We do have a prepared statement, which with your permission, we will enter into the record. Instead of using the prepared statement, I would like to give a more informal chronology of what has gone on since 1965.

Senator KENNEDY. It will be so admitted and printed in its entirety.

Dr. FOEGE. Thank you.

On Friday afternoon, August 6, 1965, the Administrator of the St. Elizabeths Hospital in Washington, D.C., called CDC and asked for assistance. He said he had 34 cases of pneumonia with 3 deaths. Epidemiologists were dispatched to Washington, D.C., and they found the following: Clinically, an illness in the 34 patients that consisted of high temperatures—over half of them had temperatures of more than 104°—and this often progressed to pneumonia. The patients also had high white blood counts which was indicative of a bacterial disease, but it was not as high as ordinarily seen in bacterial pneumonia. Laboratory findings were negative for a wide variety of microorganisms and the pathologic examinations on patients who had died, did not reveal the cause of death.

Environmental samples were taken at that time, air and soil particularly. These were negative for any microbiological organisms. On the epidemiologic front, there were some interesting leads. The hospital consists of many buildings and the attack rate for this illness seemed to be highest for patients in the west part of the hospital. Furthermore, it was found that significantly higher attack rates were found in patients who slept near windows as compared to patients who did not and in patients who had ground passes so they could leave the building. It was then found that excavations had been done in July in order to put in an underground water sprinkler system. This lasted until the first week in August.

The cases started on July 27, but they declined rapidly about 1 week after the excavation work had stopped. By comparing the excavation work and the classic cases, it was estimated that an incubation period of 4 to 11 days was seen and that this represented airborne spread from a short term common source exposure.

Sera, or blood specimens, were taken on patients and kept in the serum bank at CDC. These consisted of paired blood specimens taken early in the disease and late in the disease.

It should be noted that there was no increases in pneumonia generally in Washington, D.C. There were no cases of the disease in staff members caring for patients. Therefore, there was no evidence of secondary spread, and particularly it should be noted that at St. Elizabeths Hospital in 1965, there was no air-conditioning system.

The investigators left the outbreak not knowing the cause of the disease.

Senator KENNEDY. How often does that happen? How many times do you go to do your review and are unable to find the cause of the disease?

Dr. FOEGE. CDC employees are involved in about 1,700 investigations a year in the United States and abroad. About 100 to 150 of these are major investigations requiring resources directed from Atlanta and often times we leave the outbreak without an agent, but thinking we know this was a viral enteritis or that this was a viral pneumonia. About once a year, we have an outbreak that leaves us totally confused.

We do not know what the agent is or the mode of spread. So it does happen, but not often.

Twelve years later, we now know that they were dealing with Legionnaires' disease.

Senator KENNEDY. Well now what would you say that—you leave what, one mystery a year, is that——

Dr. FOEGE. One major mystery a year where we simply don't know what has happened. In those cases we try to save specimens in the serum bank so that we can test them later when technology improves.

Senator KENNEDY. How many sort of mysteries remain unsolved, would you say?

Dr. FOEGE. We have about 10 or 12 major mysteries since the mid-1960's that we have no explanation for.

Senator KENNEDY. How virulent are those mysteries, how dangerous are they?

Dr. FOEGE. In general, these have turned out to be gastroenteritis outbreaks of one kind or another without high fatality rates. About half of these turn out to be gastroenteritis.

Senator KENNEDY. And what part of those were fatal? Of the 10 to 12, how many would you think would cause or could cause death?

Dr. FOEGE. I believe out of the 10 to 12, in only 1 or 2 were there fatalities.

Senator KENNEDY. OK. You mentioned in the St. Elizabeths outbreak that you take serum. What determines when you take serum and when you don't take serum?

Dr. FOEGE. In general when we do not have an answer we would save serum. We would collect serum in order to get an answer and if we did not get an answer we would save the materials.

Senator KENNEDY. So approximately how many different serums do you have here for different types of diseases? Over what period of time have you been collecting them?

Dr. FOEGE. Let me ask Dr. Dowdle.

Dr. DOWDLE. These have been collected essentially since the Center started back in the early 1950's. We have sera—I would say approximately 30,000.

Senator KENNEDY. How many in the defined areas, a particular kind of a topic, such as the Legionnaires' disease, for instance. Just tell me what the numbers are.

Dr. DOWDLE. I don't know that we have them broken down but the sera are collected in all outbreaks. Many sera are saved not only if there is a cause known but also if there is no cause known. These are well documented, they are stored and made available to anybody who feels like there may be a reason for attempting diagnosis after all these years.

Dr. FOEGE. We use this as a resource bank for looking at prevalance rates of some other conditions in previous years.

Senator KENNEDY. Let me ask, of the ones that still remain outstanding, do you have a continuing investigation going on each of those or when do you decide to close them down? When do you decide that you're not going to put the kind of effort into some—what helps make that decision of priorities? Is it where the public is, where the media is, where your Congressmen or your Senators are? How do you make these decisions?

Dr. FOEGE. We're not unaware of those pressures.

Senator SCHWEIKER. You're a real diplomat, Doctor.

Dr. FOEGE. I think it's safe to say we never close out an investigation. However, as I will say in a moment about Pontiac, we continued actively after the Pontiac, Mich., outbreak for 4 years because we kept getting tantalizing leads. They dried up and after 4 years we stopped doing active research, but we never really closed the investigation.

Senator KENNEDY. But just in the decisionmaking on priority—is it where there seems to be or appears to be an opportunity for breakthrough? How do you make the decision in your own organization? What I'm trying to drive at is it the virulence of the disease itself, or is it the widespreadness of the disease, is it the opportunity to try and deal with it effectively, how do you make decisions?

Dr. FOEGE. We would put the most attention obviously on the problems that seem to have the most impact on morbidity and mortality. With Legionnaires' disease, we probably put more resources into this particular problem than other problems in recent years because we didn't know the answer; it was a cause of fatalities and appeared to be a cause of a fair amount of morbidity around the country. So we would try to put the most attention on the diseases that have significant morbidity and mortality, particularly premature mortality, as with infants.

Senator SCHWEIKER. Dr. Foege, in the St. Elizabeth case you said patients who had slept near windows and those who had grounds passes had a higher incidence. What can you tell us about the air-conditioning system, if there was one, or the heating system?

Dr. FOEGE. There was no air-conditioning system in Philadelphia.

Senator SCHWEIKER. At St. Elizabeth.

Dr FOEGE. I'm sorry, at St. Elizabeth, there was no air-conditioning system.

Senator SCHWEIKER. No air-conditioning system? Was there an air-circulating system?

Dr. FRASER. There was no air-circulating system at that time.

Dr. FOEGE. It was the clue of sleeping by windows and grounds passes that led us to look into the excavation.

Senator SCHWEIKER. How extensive was that excavation? Was it the foundation? What was it?

Dr. FOEGE. It was for about 3 or 4 weeks in order to put an underground water sprinkling system on the grounds and while it was not throughout the grounds we do have mapped out where the excavations were and there is a geographic relationship between where the cases were and where the excavations were going on.

Senator SCHWEIKER. There is a specific definite relationship?

Dr. FOEGE. It was on the west side of the hospital and the highest rates of disease were on the west side of the hospital.

It was 3 years later, in 1968, July 1, when an employee of the Oakland County Health Department in Pontiac, Mich., developed illness with chills, fever, headaches, and muscle aches. It was not particularly unusual except the following day, on July 2, 66 additional employees out of a total of 100 employees developed the same symptoms. On the third day, July 3, an additional 22 employees and 15 visitors

developed these symptoms. Eventually a total of 144 cases were recognized, 95 out of the 100 employees and 49 of the 170 visitors.

CDC was again asked to investigate. We found clinically a disease where people rapidly, over 24 or 48 hours, developed symptoms but there were no deaths in Pontiac, Mich. There were no cases of pneumonia. Seventeen individuals had chest X-rays, and no abnormalities were found on those chest X-rays. Again there was a slight increase in white blood count in many of the patients. Epidemiologically, there was no unusual illness occurring in the community. This appeared to be related specifically to the health department building. Even more specifically it appeared to be airborne, related to the air-conditioning system.

CDC employees went to investigate the outbreak and they became sick. The CDC employees who went on a weekend when the air-conditioner was off did not develop the symptoms until an appropriate time after the air-conditioner was turned on Monday morning. The incubation period, unlike St. Elizabeth, turned out to be 24 to 48 hours, with the median 36 hours, and it was found that visitors coming to the health department had different attack rates depending on how long they were in the building. Visitors who were in the building less than 1 hour had an attack rate of 9 percent. If they had been there for more than 6 hours, they had an attack rate of more than 50 percent. In the first 3 weeks of June, there had been extensive regrading and paving outside the health department building and it is reported there were clouds of dust. In the last week of June torrential rains occurred and temperatures increased.

Engineers and industrial toxicologists examined the building and found that water collected in one part of the evaporative condenser of the air-conditioner and was leaking into the air intake of the air-conditioner. Cultures of the patients, of the air-conditioning system, of the water supply were all negative for microbiological organisms, but when guinea pigs were placed in cages by air-conditioner outlets, the guinea pigs did become ill and when some of the water in the air-conditioning system was given to the guinea pigs by means of an aerosol, they did get sick, but again no microbiological organisms could be recovered from the guinea pigs.

Studies were done to rule out trace metals and unusual chemicals. The building was closed, the air-conditioning system was cleaned, the building reopened and there were no additional problems.

Twenty-three consultants were called in by CDC from eight different universities and from four different Federal Government agencies. They all left concluding this was one more mystery. Again, a short term, common source appeared to be involved. Again, it appeared to be airborne, this time specifically related to the air-conditioner, but it was a clinically different illness than had been seen at St. Elizabeths with a much shorter incubation period.

Senator KENNEDY. Isn't that really the key in terms of viewing that particular incident at Pontiac? There were so many parts of that outbreak that were contrasted to the 1965 outbreak.

Dr. FOEGE. That's right. There was no reason after investigating Pontiac to even link it with St. Elizabeths. They appeared to be two different diseases.

For 4 years, studies continued because guinea pigs could be made sick but we couldn't find anything in the guinea pigs. For 4 years this continued. The tissues from the guinea pigs were retained in the freezer and sera gathered from the patients at Pontiac were retained. While the investigators left that outbreak not knowing what the problem was, we now know, some 9 years later, that a Legionnaire-like organism was involved in Pontiac, Mich.

Five years after Pontiac, in July 1973, 252 vacationers traveled from Scotland to Spain where they stayed at a single hotel. Ten of them developed pneumonia, three died. At that time, there was a joint Scottish-Spanish investigation made. They were unable to recover an agent; they were unable to determine the method of spread. But in July 1977, a person in Scotland, having read about Legionnaire's disease, sent a single blood specimen on one of the 1973 patients to CDC and we found a high titer for Legionnaires. I should incidentally mention that 5 months ago a traveler from Scotland went to Spain to the same hotel, developed pneumonia and died. Specimens from the lung of that patient have been sent to CDC and again this has been confirmed as Legionnaires.

Senator KENNEDY. What do you conclude on the return to the hotel in terms of Spain, do you draw any conclusions?

Dr. FOEGE. We can't at the moment.

Senator KENNEDY. Is there a residue or not—reservoir?

Dr. FOEGE. We don't know but we have sent an investigator from CDC who is currently working with the Scottish and Spanish health authorities to try to work up the 1973 outbreak and to determine the cause or the method of spread in 1977 case. We have someone there now.

Senator SCHWEIKER. Will we be able to check the hotel employees as we did at Bellevue?

Dr. FOEGE. That's right, we will be drawing blood specimens from employees to see what their past experience has been with this agent.

Senator SCHWEIKER. Any air-conditioning or excavation similarities there, or don't we know yet?

Dr. FRASER. At the hotel in Benidorm, Spain there is no air-conditioning system. It is on the Mediterranean coast and does not require air-conditioning. The town is a very popular resort town and one where there is a great deal of building of new hotels, especially in 1973.

Senator SCWEIKER. Excavations?

Dr. FRASER. Excavations for new hotels, and at that time many of the roads in the area of the hotel were unpaved and there was a great deal of dust.

Senator KENNEDY. Maybe it's too early to talk about it but in regard to the central chart, you're talking about excavation and you're talking about air-conditioning, you know, you might think that in some parts of the country where there is a good deal more excavation and development, perhaps more air-conditioning, that you might have somewhat more of the disease. If you look at that chart, you see before 1976 the principal clusters are generally up in the northern, northern central parts of the country. Look at the 1976–77 figures, again they're up in the northern part northeastern part of the country generally. The sporadic ones are pretty well scattered across the Nation but perhaps the greater concentration again in one corridor. So in examining

the epidemiological trends and developments, what kinds of conclusions do you draw from that, or do you draw any?

Dr. FOEGE. We will be coming to general conclusions, but let me say that it's hard to put that together. I suspect that the Pontiac outbreak might not have been detected except it was in the health department. I suspect the previous outbreak in Philadelphia would never have been known except someone reported this during the Legionnaires' outbreak of last year so that by chance two of those happen to be on the map.

Senator KENNEDY. Well what percent do you think we're getting reported and what percent not? What is your experience in that as researchers and epidemiologists?

Dr. FOEGE. We will give a very tentative estimate here today. We do it with hesitation because we're afraid we don't have as much information as we need; yet, we will give you what we have.

Senator KENNEDY. OK.

Dr. FOEGE. If you want that right now——

Senator KENNEDY. I don't want to interrupt your——

Dr. FOEGE. Let me say in general we feel there are about 3 million cases of pneumonia in the United States every year. Pneumonia is not a reportable disease so those statistics have to be from a lot of extrapolation. Of those 3 million cases, the question is how many are Legionnaires' disease. We have two small studies. These two small studies have been done by State health departments sending sera on pneumonia cases. We found in those two cases between one-half percent and 1½ percent of the cases were Legionnaires' disease. If those figures happen to carry through when we get better studies, this could mean as many as 15,000 to even 45,000 cases of Legionnaires' disease per year in the United States. But I repeat, we do this with a great deal of hesitation because we have only the two small studies.

Senator KENNEDY. Well let's take in terms of projections based upon past experience in terms of the fatalities, what can we expect, what can the American people expect?

Dr. FOEGE. This would mean between 2,000 and 6,000 deaths per year from Legionnaires' disease if we use a 15 percent mortality rate. We think this figure can be improved now with antibiotic therapy, however.

Senator KENNEDY. OK. Specifically now that's available, what can be done about it to try and protect the American people from this disaster, from death?

Dr. FOEGE. First I think we have a clinical treatment and that is a drug called erythromycin. We know from Philadelphia that the mortality rate in people who did not receive tetracycline or erythromycin was in the neighborhood of 20 percent. When they did receive tetracycline or erythromycin the fatality rate was about 10 percent. We do not know how much lower this can be brought by early diagnosis of the disease or by perhaps a combination of antibiotic therapy. We do have a clinical approach. I think it's important therefore that clinicians include this in their differential diagnosis and we're making an attempt to get this sort of clinical information out. I think it's important, to recognize outbreaks early in order to treat cases.

Senator KENNEDY. How much more potent is this type of flu than the other types of flu, pneumonia; how much stronger, how much more virulent is it?

Dr. FRASER. We can take a look at the other bacterial pneumonias such as pneumococcal pneumonia, which is the most common form of bacterial pneumonia in this country. The fatality rate from pneumococcal pneumonia, which has been treated with penicillin until the development of resistent strains, average about 5 percent. When that bacterium invades the bloodstream the fatality rate can rise as high as 20 percent. In general, the bacterial pneumonias have a higher fatality rate than the viral pneumonias.

Senator KENNEDY. Where does Legionnaires stack up?

Dr. FOEGE. The Legionnaires' disease fatality rate would be comparable to other bacterial pneumonias.

Senator KENNEDY. In terms of some of the layman's perception of this, how powerful is it. That's what I think they would like to know, given a range, if it's untreated versus whether it is treated. What can you tell us in comparison to other pneumonia generally?

Dr. FRASER. I think there are two comparisons that can be made, (1) the frequency at which the disease occurs and as Dr. Foege has said, we have only a first approximation of the frequency of Legionnaires' disease as it occurs across the United States, but pneumococcal pneumonia, which I mentioned, perhaps causes 200,000 to 400,000 cases a year and has a fatality rate not dissimilar from that of Legionnaires' disease.

Dr. FOEGE. So one would have only about a 10th of a chance of getting Legionnaires' disease as one would have of getting pneumococcal pneumonia.

Senator KENNEDY. What are the chances if they're treated or nontreated in terms of mortality, can you give us that?

Dr. FRASER. For Legionnaires' disease? For Legionnaire's disease, treatment with erythromycin has been associated with about 10 percent death rate whereas people not treated with erythromycin have about a 20 percent death rate, on the average. With pneumococcal infections, persons not treated with penicillin have had approximately a 70 percent death rate, whereas those treated now have a death rate ranging between 5 percent and 20 percent, depending on whether the bloodstream is invaded by the bacteria.

Senator KENNEDY. How is the average doctor out there working going to be able to know?

Dr. FOEGE. I think, in all honesty, the laboratory is not going to help the clinician right now because we can only make a diagnosis in retrospect by looking at tissues of people who have died or by comparing blood specimens obtained early in the disease and in the third or fourth week. Therefore, the clinician has to begin therapy on the basis of what he sees clinically.

Senator KENNEDY. Does this mean that all the doctors are going to give the erythromycin drug in times of pneumonia next year? Are you suggesting that?

Dr. FOEGE. No.

Senator KENNEDY. How are they going to know?

Dr. FOEGE. They will treat it by looking at the clinical picture, realizing that this is a pneumonia but without the production of sputum that one ordinarily sees with bacterial pneumonia and with X-ray evidence of a patchy infiltration. There are certain pneumonias that

will be confused with this, but I think they can narrow it down to a certain percentage of pneumonias that they would treat this way.

Senator KENNEDY. And what percent would that be, approximately? These are guesstimates, but you have obviously had enormous interest, we're trying to make the best judgment on it I think it's just generally of interest.

Dr. FRASER. There are other forms of pneumonia which can mimic some of the signs of Legionnaries' disease. One of these called mycoplasma pneumoniae is a fairly common cause of pneumonia in a somewhat younger age group than Legionnaires' disease.

This disease also is effectively treated with erythromycin and could be considered at the same time by a physician trying to diagnose a case. I would estimate that perhaps 10 percent or 20 percent of pneumonia cases should make the physician begin to think of Legionnaires' disease. He may be able to whittle it down to a smaller proportion in which he would actually use erythromycin.

Senator KENNEDY. We're delighted to be joined by Senator Javits who is our ranking member of the full Committee who is interested in all of these issues. We have just been hearing some very interesting testimony. Why don't we continue.

Dr. FOEGE. Let me continue then with September 1974, when there was a convention of the International Order of the Odd Fellows at the Bellevue Stratford Hotel in Philadelphia. In 1976 we learned of an illness at that convention and we have traced some of the members of that convention. We have in retrospect obtained clinical data from 20 cases and in those 20 cases, the incubation period ranged from 3 to 12 days. The illness again was marked by fever and pneumonia with patchy infiltration on X-ray. Two of the twenty patients died. We have been able to get sera from 11 of those cases and 19 controls and again the answer is that this illness was caused by a Legionnaires-like bacterium.

On August 2 of 1976——

Senator SCHWEIKER. Let me ask you, Doctor, is there any indication that there was excavation going on around the Bellevue at the time of that convention.

Dr. FOEGE. I don't know the answer to that.

On August 2, 1976, CDC was requested by the State of Pennsylvania to participate in an investigation of deaths and respiratory illness among 4,500 persons attending the 58th Annual Convention of the Pennsylvania American Legion. This outbreak has been reported in detail at previous hearings and in the media.

In summary, there were 182 cases and 29 deaths primarily among Legionnaires and an additional 39 cases and 5 deaths in nonLegionnaires who were outside the Bellevue Stratford Hotel or in that vicinity.

Senator SCHWEIKER. Are these the so-called Broad Street pneumonia cases? I know the CDC made two classifications initially.

Dr. FOEGE. Exactly. Those 39 cases are the Broad Street pneumonia cases.

Senator SCHWEIKER. Is your classification still valid, or should we combine those two. Just where do we stand on the breakout between Broad Street pneumonia and Legionnaires?

Dr. FOEGE. They should now be combined so that we're talking about 221 cases with 34 deaths of Legionnaires' disease.

Senator SCHWEIKER. So there's really no biomedical reason to separate them other than physically, one was on the outside at the exhaust of the air-conditioners as I recall.

Dr. FOEGE. That's right. There was no general increase in pneumonia deaths in the city or State at that particular time.

Investigators again found that the illness was an illness of chills and fever, high fever of 102 to 105. Most cases occurred between July 22 and August 4, 2 to 10 days after likely exposure. The cases of illness typically occurred in older age groups and over one-half of the patients had preexisting diseases. There was a nonproductive cough with chest pain frequently encountered and again over half of the patients had a slightly elevated white blood count, something that is often seen in bacterial diseases. They had patchy infiltrates on chest X-ray.

There were eight epidemiologic surveys conducted to try to identify cases and/or patterns. These included Legionnaires surveys through the 1,002 local posts, surveys of hotel guests, hotel employees, roommate surveys, hospital surveys and so forth. What was found was a significantly higher rate of illness in persons who had stayed at the Bellevue Stratford as we have heard and people who had actually been in the lobby. More specifically, there was a higher rate of illness in people apparently exposed on the 23d of July in the lobby or outside of the door on the street.

Senator SCHWEIKER. Is there a direct relationship as you said there was in Pontiac, the 1-hour versus the 6-hour? In other words, is there a clear time factor in the lobby for incidence of the disease?

Dr. FRASER. Yes; there is. There was a clear tendency for people who spent more time in the lobby of the hotel to be more likely to get sick.

Senator KENNEDY. May I ask, was this true about the employees that were in the lobby too?

Dr. FOEGE. The question is why were the employees not ill. In retrospect, of 61 employees, from whom we have blood specimens, 44 percent had antibodies to the agent of Legionnaires' disease at a level of 1 to 64 or greater. In fact, one out of six had fairly high levels, indicating previous exposure to Legionnaires' disease by these employees.

Senator SCHWEIKER. And that's why they weren't stricken at the same time.

Dr. FOEGE. This is one of the reasons why they did not get the illness in August.

Senator SCHWEIKER. Was the air-conditioning system that went to the lobby cover vented in other rooms or was there a single vent that only covered the lobby?

Dr. FOEGE. That was one of 60 air-handling units in the hotel and served the lobby specifically.

Senator SCHWEIKER. How did the exhaust on the Broad Street side where the Broad Street pneumonia developed, relate to the lobby air-circulating system, if at all?

Dr. FRASER. With each passage of air there is approximately a 30 percent loss of air out windows, out doors, out elevator shafts so that there is a relatively free exchange of air from the lobby of the hotel to the surrounding sidewalk.

Senator SCHWEIKER. But is there a mechanical tie-in to the exhaust over Broad Street where your other infectious cases picked it up promptly.

Dr. FRASER. There is not a mechanical exhaust from the lobby to Broad Street. There is an intake from several locations around the hotel and then the exhaust out of the building is passive.

Senator KENNEDY. Just to get back to the employees, obviously then there has been some kind of exposure to the employees over some period of time so that they can be developing these antibodies. Why did it develop that it just—this disease kind of hit just on those two conventions? It seems to me you've got it continuing on the employees with some kind of presence around and then you just have those two conventions of all the different conventions, as I understand, that took place both before and in the interim and following. They had a convention at one time, then the hotel was vacant and then they had them back again. It just took in that area. What can you tell us about analyzing that and what does it mean?

Dr. FOEGE. Your observation is correct. I don't think we have the answer. I'll let Dr. Fraser try.

Dr. FRASER. One point of evidence we have is that if we separate the hotel employees into those who began work prior to the Odd Fellows convention and those who began work after the Odd Fellows convention, we find that those who had started work before the Odd Fellows convention had a much higher frequency of antibodies than those who came to work later. I think we have evidence that exposure occurred at or before the time of the Odd Fellows convention, but we don't have any information that would let us know whether exposure from 1974 to 1976 occurred and whether it was constant or interrmittent. The two outbreaks that did occur were both in the summertime and it may be that exposure was not constant.

Senator KENNEDY. I suppose the thing that troubles people is whether this disease is smoldering around in other places, in other cities, other institutions, hotels, universities, schools, factories. That it just rises up through a mysterious set of circumstances bringing death to many people in some instances. What kind of assurances can you give that that isn't the case or can it be the case? Is it possible, is it unlikely?

Dr. FOEGE. It's a problem that people are being exposed to constantly. We do see it sporadically. As techniques get better, we'll find more and more cases. Occasionally something happens—perhaps it's excavation, something that combines excavation and air-conditioning or something we have not stumbled on yet—that exposes a large number of people. We have not determined what those factors are. I think with each outbreak we are collecting more information which will allow us at some point to be able to answer that question.

Senator KENNEDY. It seems to me it could be an important point. Everything you have said obviously is important here this morning and of interest, but the question is the degree of predictability or prevention that could be taken in these situations. We have seen it when it has exploded and caused a sizable number of deaths in terms of individuals. Yet we don't know if we have an effective drug in terms of treating it. We really don't know, as I understand what you have said here, how we can prevent it, avoid it or take the circumstances in various locations to assure that it won't bubble up again.

Dr. FOEGE. There may be some analogies here with histoplasmosis, a disease that when we first detected it was thought to be almost universally fatal. Now we know that many millions of Americans have had

histoplasmosis and that it is something that is constantly around, that people are exposed to, but occasionally something happens such as excavation, cutting down a tree, tearing down a chicken coop, that allows people to be exposed at one time—many people at one time. We think as the diagnostic tests improve we will find more and more subclinical illness or mild illness with Legionnaires' disease and that we may well find that case fatality rates are much lower than what we predicted this morning; but that doesn't answer your question about what it is that causes an outbreak. We don't know that.

Senator KENNEDY. I want you to continue, but what can you tell us from your research that triggers this from a benign situation into a very virulent situation? Can you tell us anything about that so that steps can be taken?

Dr. FOEGE. No. And in fact what I will say later is that this is an enigma in many ways because the organism does not follow the usual rules. It does not even seem to follow the usual rules in the illness it causes. Why in Pontiac should no one die and why in Philadelphia should many people die? Is it because we have a range of organisms in one family or is it because there are degrees of exposure which cause no serious illness in one case and life-threatening disease in another? Do the employees of the hotel have a smaller exposure over a period of time that gives them a Pontiac-like illness rather than a severe illness? We don't know.

Senator KENNEDY. In that sense, the mystery still remains, doesn't it?

Dr. FOEGE. That's right, very much so.

Senator SCHWEIKER. Is it my understanding that CDC did not get a chance to examine the air-conditioning filter, that it apparently had not been cleaned for some time at the Bellevue, is that correct? Was any effort made, successful or unsuccessful, to somehow get a sample or specimen from it?

Dr. FOEGE. It is correct that we did not examine the filter before it was cleaned. It was cleaned early in the investigation before anyone thought of airborne spread. The hotel was not trying to clean it in order to have it clean for us. It was part of their routine schedule to clean it. We did get plenty of specimens from the same duct even though the filter itself was clean when we examined it. So we don't think that's a major loss. We were able to get material from the duct.

Let me go back to answer a previous question that I can now answer for Senator Schweiker. There was no evidence of excavation in 1974 around the hotel.

Senator SCHWEIKER. That's the Odd Fellows in 1974?

Dr. FOEGE. There was no evidence of excavation.

Senator SCHWEIKER. You said, as I recall, there was a parking lot across the street in the spring of 1976 that was dug up?

Dr. FOEGE. In March 1976, across the street, a building was destroyed and a parking lot was made, but in 1974 there was no excavation.

Senator SCHWEIKER. All right.

Dr. FOEGE. To return to the epidemiological evaluation in Philadelphia, evaluation was done of the possibility of person-to-person spread, spread through the water system, food, alcohol, and so forth. Most of these could be ruled out. There was an association, however, with drinking water, but this did not seem to be significant in that 35

percent of the Legionnaire cases had not consumed water in the hotel, and the Broad Street pneumonia cases had not consumed water in the hotel. We were left with water and airborne spread as the two likely sources, and we have concluded that it must be airborne spread.

Environmental studies were done in Philadelphia by CDC, the State of Pennsylvania, the city of Philadelphia, Drexel University, Franklin Institute, and Philadelphia Academy of Natural Sciences. A wide variety of environmental specimens were taken. No significant clues were found in those studies. There were various defects found but nothing that would explain the disease.

By September 1976, we were left in Philadelphia with an illness similar to that seen at St. Elizabeths, but different from Pontiac fever. We were left with an incubation period similar to St. Elizabeths, different from Pontiac. We were left with a clinical and epidemiological pattern unlike that caused by any toxin known. We were left with apparent airborne spread, and specimens continued to be processed. Indeed, by late 1976, we had performed about 20,000 laboratory tests. All known microbiological human pathogens had been ruled out. Studies on over 30 metallic elements as well as organic toxic substances had been done. We now suspect this organism has been inserted thousands of times into hundreds of laboratories in the past years, and it has always escaped detection. All of the combined bacteriologic and pathologic experience of this century pointed away from this being a bacterial agent.

If I can refer to the small chart here, which shows by decades the discovery of important human diseases, you can see on the top the red items indicate the bacterial pathogens of man. Most of the important ones were discovered before the turn of the century. Very few have been discovered in recent decades and in fact until Legionnaires' disease, we had not had a new human bacterial pathogen since the 1950's. On the other hand, the blue area shows new viruses found and you can see that many new viruses have been found in recent decades.

If this was to be a new organism it should have been a new virus and everything pointed away from this being a bacterial agent. However——

Senator KENNEDY. Do I conclude correctly that given the nature of the tests to make this decision in terms of bacteria and viruses, that virtually defied all of the existing kinds of tests that are usually used here at the Center and generally within the research community, am I correct?

Dr. FOEGE. Absolutely.

Senator KENNEDY. The discovery was as a result of extraordinary vigilance on the part of researchers and a great deal of luck I would expect. Wouldn't you say that would be fair?

Dr. FOEGE. We would like to use the former.

Senator KENNEDY. The record says something like that.

Senator SCHWEIKER. Painstaking, methodical research.

Dr. FOEGE. By the end of 1976, people here were continuing to review their slides and their records, many people were including Dr. McDade and Dr. Shephard. Dr. McDade took a painstaking look at slides, which he once said was like looking for a contact lens on a basketball court 4 inches above the ground. He finally one day

found a small clump of bacteria. He then attempted to isolate this organism using unconventional techniques, using rickettsiae techniques. He injected material from the lungs of the patients with Legionnaires' into guinea pigs. He waited until the guinea pigs got sick; he took the spleens from the guinea pigs and injected them into eggs. He was able finally to find a new bacterium, and I emphasize a bacterium that doesn't grow on the usual bacterium medium, a bacterium that doesn't stain with the usual bacterial stains, a bacterium that grows inside cells unlike the usual bacteria. I think this was, in short, an unexpected but certainly a key finding in microbiology in the recent decades.

Now that we can confirm cases of Legionnaires' disease what has happened with the disease in the past year? We will summarize this on the chart.

In August and September 1977, in Columbus, Ohio, nine cases of Legionnaires' with one death were reported.

Between May and September in Burlington, Vt., 27 cases of Legionnaires' with 14 deaths were reported.

Between August and September in Kingsport, Tenn., 22 cases with 3 deaths were reported.

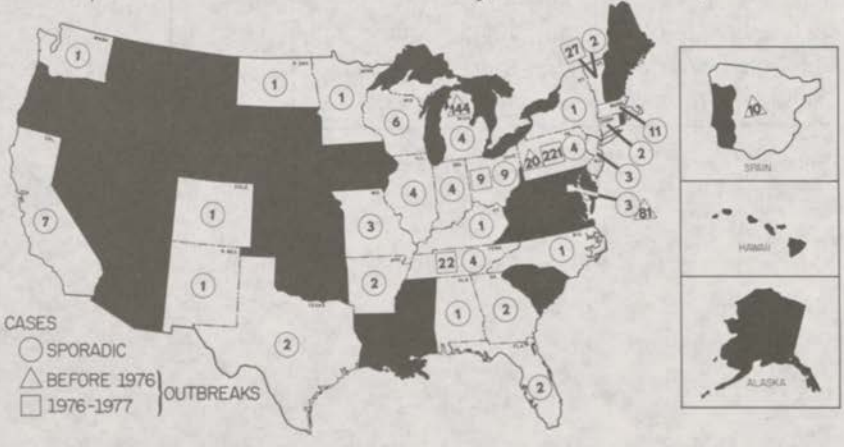
We have an additional outbreak to add to that chart which has just come to our attention. We have not had the opportunity to put it there. It is an outbreak that over the last 3 months has involved at least 13 cases, with 4 deaths in Nottingham, England. We have talked to the people there and they will be sending additional information. All we know at this time is that we can confirm the outbreak as being Legionnaires' disease.

In addition, there have been sporadic cases—83 cases with 21 deaths in 24 States. We will submit details of these cases for the record. In addition to that, there has been one case in Scotland in a person that was staying in Spain.

[Details of cases supplied for the record follows:]

Confirmed Cases of Legionnaires' Disease by State

(Sporadic Cases and Outbreaks) July, 1965-November, 1977



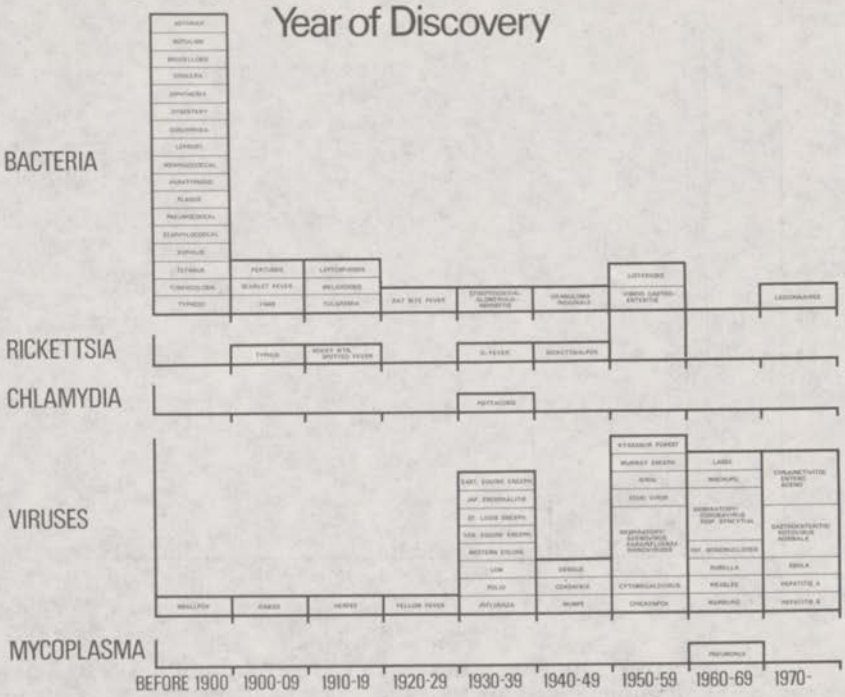
TIME LABORATORY TESTS REPORTED AS NEGATIVE AFTER RECEIPT OF INITIAL LEGIONNAIRES' DISEASE SPECIMENS

48 HOURS	5 DAYS	14 DAYS	3 MONTHS
MARBURG VIRUS	INFLUENZA	MYCOPLASMA	PNEUMOCYSTIC
LASSA VIRUS	STREPTOCCOCCI	SPIROPLASMA	RICKETTSIA
CHLAMYDIA	STAPHYLOCOCCI	Q FEVER	13 ADD. SPECIES
LYMPHOCYTIC CHORIOMENINGITIS	MENINGOCOCCI	PARAINFLUENZA VIRUSES	ENTAMOEBA
TYPHOID	PNEUMOCOCCI	ADENOVIRUSES	ASCARIA
PERTUSSIS	SALMONELLA	RESPIRATORY SYNCYTIAL VIRUS	TOXOPLASMA
TULAREMIA	SHIGELLA	HERPES VIRUS	CANDIDA
PLAGUE	HISTOPLASMA	MUMPS VIRUS	INTERFERING VIRAL AGENTS
RICKETTSIA	BLASTOMYCOSIS	MEASLES VIRUS	MYCOPLASMA
	CRYPTOCOCCUS	ENTERIC VIRUSES	CHLAMYDIA
	BRUCELLA	THERMOACTINOMYCES	RHINOVIRUSES
	COCCIDIOIDEMYCOSIS	LEPTOSPIRA	PICARNOVIRUSES
		CORONAVIRUSES	ARENAVIRUSES
		TIN	CADMIUM
		THALLIUM	MERCURY
		BERYLLIUM	ARSENIC
		CHROMIUM	ETHYLENE GLYCOL
		PARAQUAT	LOW VOLATILE HALOGENATED PHOSPHOROUS (thiophosphorus components)
		HALOGENATED SOLVENTS	
		COMMON LOW-VOLATILITE (pesticides, herbicides, flame retardants, etc.)	

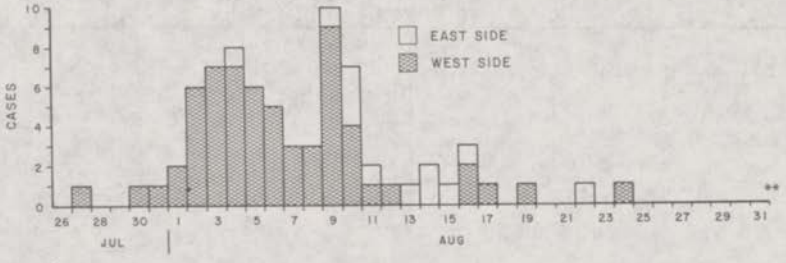
OUTBREAKS OF DISEASE ATTRIBUTED TO THE AGENT OF LEGIONNAIRES' DISEASE

LOCATION	DATE	CASES	DEATHS
Washington, D.C.	July–August, 1965	81	14
Pontiac, Michigan	July–August, 1968	144	0
Benidorm, Spain	July, 1973	10	3
Philadelphia, Penn.	September, 1974	20	2
Philadelphia, Penn.	July, 1976	221	34
Columbus, Ohio	July–August, 1977	9	1
Burlington, Vermont	May–September, 1977	27	14
Kinsport, Tennessee	August–September, 1977	22	3
Sporadic cases	August, 1976–present	83	21

Etiologic Agents of Important Human Diseases
Year of Discovery



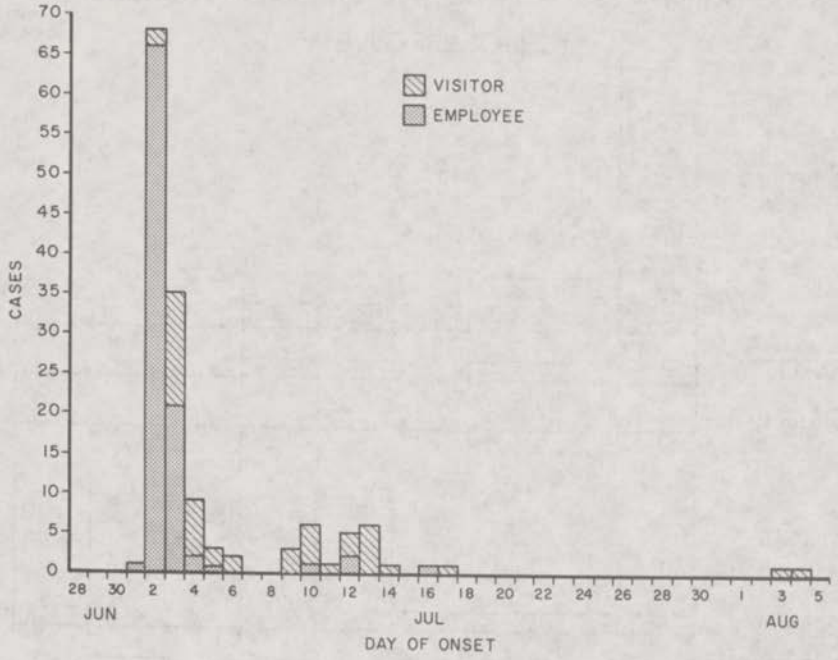
CASES* OF RESPIRATORY DISEASE, BY DATE OF ONSET, ST. ELIZABETHS HOSPITAL, 1965



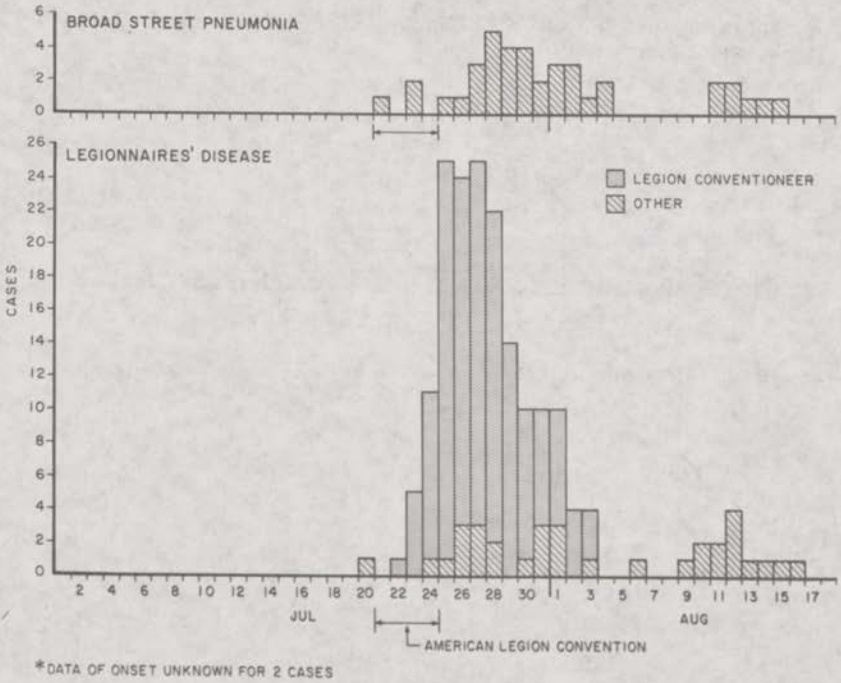
*74

**6 CASES IN SEPT (2 ON EAST, 4 ON WEST)-ONSET DATE UNKNOWN

CASES OF PONTIAC FEVER, BY DAY OF ONSET, OAKLAND CO. (MICHIGAN) HEALTH DEPARTMENT, JUNE 28-AUGUST 5, 1968

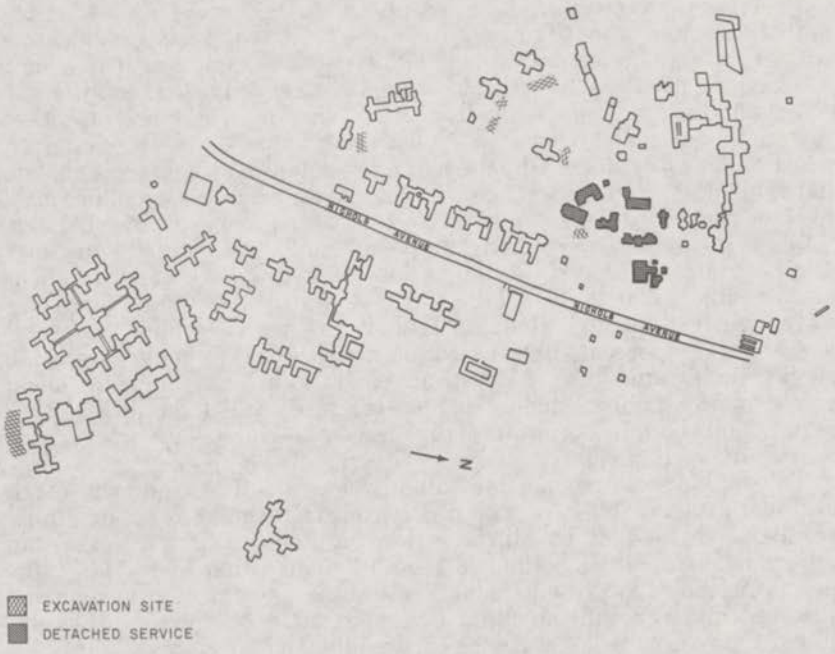


LEGIONNAIRES' DISEASE* AND BROAD STREET PNEUMONIA BY DATE OF ONSET, PHILADELPHIA, JULY 1 - AUGUST 18, 1976



*DATA OF ONSET UNKNOWN FOR 2 CASES

ST. ELIZABETHS HOSPITAL GROUNDS



Dr. FOEGE. What is the summary of our present knowledge? First, to look at the organism. As we have said, it is a vacterium that doesn't grow in usual bacterial media or stain with the usual bacterial stains and appears to grow inside cells and perhaps both inside and outside cells. It is a bacterium that is fastidious in its dietary habits. It requires a very narrow pH range for growth; it requires a very narrow temperature range; it requires iron; it requires cysteine; it does not grow on the usual media; it's pleomorphic; that is, it assumes different shapes and sizes. Toxonomically, we don't know where the organism fits in the bacterial world. As with many aspects of Legionnaires' disease, it simply doesn't fit the rules. We know that it is an organism hardy in the environment. For instance, we have done studies now to show that it survives and is viable for at least 5 months in tapwater.

What do we know about the frequency and severity of the disease? We have already given the indications that this may be as frequent as to cause 15,000 to 45,000 cases per year in the United States. We have already indicated that the fatality rates with proper treatment are about 15 percent, but it's too early to tell. We may be able to reduce the fatality rate if erythromycin is added early in the clinical course or if a combination of drugs were used. And I should add that experimental studies on guinea pigs have also shown erythromycin is a drug that will work.

To provide some perspective and advice on the direction of research and work on Legionnaires, we did ask on October 14 for a group of scientists to look at the information on Legionnaires' disease and advise us as to future action. It should be noted that historically, the accumulation of a substantial body of knowledge on a micro-organism, the epidemiology and the clinical characteristics of a given infectious disease has preceded, sometimes by decades, the development of effective therapy. Legionnaires' disease presents an almost unique exception in that we believe we already have reasonably effective treatment for the illness but our knowledge about the disease is still in its infancy. This paradox has created tremendous pressure on all of us to have rapid progress to learn about the organism. We asked the scientists on October 14 to provide some perspective on what should we do next and I will chronicle what we are now doing or what we are planning to do based on the advice of the scientists 3 weeks ago.

Dr. Sanford, who will be talking to you later, was part of this small group of scientists.

In the area of the laboratory we will continue to provide, of course, the diagnostic services for hundreds and even thousands of specimens. I might add that much of our basic research on Legionnaires' disease has slowed down in the last 6 weeks because of the many specimens that have had to be run from around the country.

We will provide training courses for States or other laboratories so that they will be able to diagnose Legionnaires' disease and to do research work, and we will, of course, provide reagents. We have shared this organism now with NIH, with Fort Detrick, with eight State health departments, and in early December we will be holding a course where we will have in excess of 100 laboratory workers to train in laboratory technique. At that time we will be giving the organism to additional laboratories that have biological safety equipment.

Senator JAVITS. Doctor, I notice with great interest the international implications of this work. To what extent are you seeking to mobilize

the international research community in respect to this particular disease?

Dr. FOEGE. We have been sharing the information on a routine basis with WHO people. We have had a large number of discussions with WHO people. The WHO has in its weekly epidemiologic record continued to print the latest information on this so that people around the world know what is happening with Legionnaires' disease. Until now, however, the only international outbreaks we have recognized are the ones we mentioned in England and Spain.

Senator JAVITS. I would like to strongly encourage you to pursue the international implications in your research effort. I think it would be a very suitable channel for you to laterally support the activities of this institution. I'd also like to raise one other concern—that is, the question of priorities. Priorities are very important. Lots of people die from lots of other things than Legionnaires' disease. It's very popular and glamorous right now, but it is by no means the greatest killer around. I hope we will keep this in mind as we allocate resources.

Dr. FOEGE. I appreciate those comments, and we have in the past been very conscious of working with other countries and with the international health organizations.

Senator KENNEDY. Just on this point earlier, after your session this fall——

Dr. FOEGE. In December?

Senator KENNEDY. December?

Dr. FOEGE. The training session for laboratory workers?

Senator KENNEDY. Yes. In how many other centers around the country will there be research?

Dr. FOEGE. We would expect within a period of months, maybe we're talking about 3 to 6 months to carry this out, that all State health departments could in fact be doing diagnostic work and we would expect that dozens of university centers would be doing research work.

Senator KENNEDY. How many laboratories will be able to confirm work on Legionnaires' disease?

Dr. FOEGE. I would expect over the next year that we might well find between 50 and 100 laboratories in this country that will have done necessary work to be able to confirm the diagnosis.

Senator KENNEDY. How many do it now?

Dr. FOEGE. At the present time eight State health departments are starting in this and three Federal agencies could be doing it.

Senator KENNEDY. You see the point is, if a doctor wants to check a particular question, where does he send it to?

Dr. FOEGE. At the present time most of the specimens have been coming here. The reason is we were concerned about the biologic hazards of this organism in the laboratory. For a period of time we were working on this to determine whether it is a hazardous agent. We have within the past 4 to 6 weeks decided that we can share the organism. We are sharing it and many more labs will be doing work with it within months, but at the present time most specimens are coming here to CDC.

Senator KENNEDY. No one has gotten sick from this disease here?

Dr. FOEGE. We have had no known illness with the agent for Legionnaires' disease in our laboratories.

Senator KENNEDY. Let the record show that people are nodding.

Senator SCHWEIKER. You said a few minutes ago as I recall that the Legionnaires' disease can survive under certain conditions for 5 months in tapwater?

Dr. FOEGE. That's right.

Senator SCHWEIKER. What is the comparable definition in terms of survivability in air? How do you define that?

Dr. DOWDLE. We have no knowledge of that. Presumably though, if it can stay that long in tapwater, it's a very hardy agent.

Senator SCHWEIKER. Well, since air-conditioning systems are suspect, don't we need some definition of this, or am I missing something?

Dr. FOEGE. We have not developed a technique to find this in air at the moment, that's the real problem.

Dr. FRASER. But the same laboratory where the studies are being done on the survival in water and its survival following disinfection with a variety of disinfectants will be working on the survival under extremely dry as compared to extremely wet conditions to see whether this would be an organism which could survive in air.

Dr. FOEGE. Let me also mention, Senator Schweiker, that the Pennsylvania State Health Department, of course, isolated this organism independently of CDC, and they have been doing diagnostic work with Legionnaires' disease for months.

Senator SCHWEIKER. And we'll be hearing from them.

Senator KENNEDY. I think you understand the thrust of the questions on this point of encouraging other facilities to do research and be able to make some decisions so that we can find doctors that are trying to treat the American people in different parts of the country and are able to get their own diagnosis on it. That obviously has to be done within the kinds of safeguards that you have outlined here, but I think it's a process that ought to move forward if it makes sense from obviously safety reviews so that the information would be available.

Dr. FOEGE. We totally concur. We cannot as yet say this is a totally safe agent in the laboratory, but we do know that with the precautions that we have used we have not had cases and therefore we are insisting on those same kinds of precautions in other laboratories.

Dr. DOWDLE. Just to add to that, one of the problems has been the complexity of the tests that are required for this organism. One of the major efforts of the CDC and now some of the other laboratories will be to develop second-generation tests so that one can then provide reagents which are not infectious and provide reagents which can be used in the smaller laboratory and in areas where there are fewer resources. This should be done very shortly and should be made available to a wide number of laboratories.

Dr. FOEGE. So one of the priorities here will be to develop such second-generation tests.

In addition, we will be doing continuing studies on the biochemical and morphological characteristics in order to try to classify this organism and figure out what is the relationship of the agent of Legionnaires' disease to other organisms.

We will continue studies on the antibiotic sensitivity of the organism to see if we can find better therapeutic approaches. We will assess disinfection and decontamination methods.

We will continue to obtain sera from people with illnesses of unknown cause to see whether there is a wider clinical spectrum. The

fact that in Pontiac there were no deaths and no pneumonias suggests to us there must be a wider clinical spectrum than what we are dealing with now.

We will continue to characterize the growth and microscopic changes at autopsy. We will continue to do studies on antigenic aspects of the organism to see whether there is a possibility of immunization in the future.

In the clinical area, we have established a register of cases at CDC to define the clinical entities. We have submitted articles for literature in order to alert clinicians as to what they can do in the clinical setting and what types of pneumonia should make them most suspicious of Legionnaires' disease.

We are monitoring therapeutic studies around the country to see what lowers mortality rates and we're studying various therapeutic approaches.

Epidemiologically we are beginning studies on the prevalence of Legionnaires' antibodies in various occupational groups; for instance, construction workers or laboratory workers or farmers or air conditioner repairmen. We are doing prevalence studies on antibodies in both pneumonia and nonpneumonia patients. We're doing prevalence studies in healthy persons and we're looking back to former times and particularly at tissue obtained at autopsies from earlier decades to see how far back can we definitively trace the disease.

We will continue studies on secondary transmission. At the moment, in general, we find no evidence of secondary transmission.

We will continue, of course, studies on outbreaks and sporadic cases and we have started a case control study of buildings and institutions to try to determine whether there are differences that cause this organism to spread under some circumstances.

Ecologically we will continue to evaluate the direct fluorescent antibody technique to see if it can be used on evironmental specimens.

We are assessing laboratory animals to see if they can be used as biological filters. We used guinea pigs in Pontiac as a biological filter. Are there other animals that can be used?

We are defining the capability of the agent to survive under different environmental conditions.

We are evaluating animal species to find out if there can be a possible animal reservoir and we are working on the development of an experimental animal model.

In summary, I would say that we have an organism that is a bacterium but one that remains invisible by traditional bacteriologic techniques and mimics some of the characteristics of rickettsiae in the lab and viruses clinically. It's an organism that causes pneumonia under some conditions but doesn't cause pneumonia under some other conditions. It's an organism that when it does cause pneumonia may mimic viral pneumonia but at the same time it leaves a few small tantalizing bacterial clues such as an increase in the white blood count. It's an organism capable of utilizing air conditioners in at least one instance, but not requiring it in others. It's an organism possibly related to excavation in some areas but not always.

While it is frustrating, nonetheless the definition of the organism, its epidemiology, its clinical characteristics and therapy is proceeding faster than with almost any other bacterial agent before. We have

been witnesses to a history-making epic in modern medicine and science. We can now continue to search for better ways to diagnose the disease, better clinical treatment of the illness, for an understanding of the natural history of the disease and for eventual prevention of the disease.

Thank you.

Senator KENNEDY. That's an excellent statement, very responsive to questions. I have just a few final questions but I'll yield to my colleagues.

Senator SCHWEIKER. Thank you, Senator Kennedy. Just a few miscellaneous questions, Dr. Foege. Page 17 of your prepared testimony, you make an observation about its gene structure, "* * * DNA studies of its gene structure have not yet found a near relative." I wonder, in a layman's words, if it's possible looking at that chart of agents there, what can you tell us about that gene structure with some of the other agents there? Are there any analogies of the other agents there? Does it more resemble bacteria structure even though it is dissimilar?

Dr. DOWDLE. The gene structure, of course, simply indicates relatedness to other organisms and this organism is related to a very large list, in fact, of organisms. Many of these have been ruled out on other characteristics. Frankly, I can't see the chart from here—these are bacteria, that we're referring to.

Senator SCHWEIKER. But you say it's dissimilar to bacteria, does that mean in gene structure it might be more similar to rickettsiae or viruses or what?

Dr. DOWDLE. I have a list right here. It's similar to some of the rickettsiae but it's more similar to some of the bacteria.

Senator SCHWEIKER. OK. Well, you're coming back to the definition—it defies definition so I guess that's really the answer.

Dr. FOEGE. But it's more clearly a bacterial agent than anything else.

Dr. DOWDLE. I think you have to keep in mind here that rickettsiae are also bacteria. They are simply given that term because they are different for other reasons. We tend to think of bacteria and think of rickettsiae, but rickettsiae are special bacteria, and the Legionnaires' disease agent will be, in fact, a special bacteria.

Senator SCHWEIKER. What about the other agents, under that same definition.

Dr. DOWDLE. Chlamydia would be close to that group as well. The viruses, for example, would not; mycoplasma would be far removed as well.

Senator SCHWEIKER. My other question, Doctor, is a broader one and I realize it is sort of a difficult one but having witnessed so closely the Philadelphia outbreak and its problems, what advice can you give us—I'm going to ask Dr. Bachman this, I know he has a stake here too and I value his judgment—what advice can you give us about responsibility in terms of Federal legislation delegating that to an outbreak of this kind? Should we be more specific in the Federal statutes now in pinpointing that since there seems to be sort of a never-never land as to where that definition is and where responsibility starts or stops? Is the present definition adequate to you, should it be improved in terms of responsibility of CDC in outbreaks such as occurred in Philadelphia?

Dr. FOEGE. I think the present Public Service Health Act is sufficient for these types of things. If there have been problems, they have been problem other than the mandate, because it does allow the CDC to cooperate with the State. We have never, in the history of CDC, run into a problem where States would not invite us in if there is a problem greater than State resources. We think the Public Health Service Act is sufficient.

Senator SCHWEIKER. Dr. Bachman is a very cooperative kind of guy and a good one. You don't foresee problems where there might be a potential conflict in a situation as panic-stricken as this one was? In other words, you don't anticipate that and therefore you say our present law really yields to the local authorities and State authorities, that it is adequate?

Dr. FOEGE. Yes; I think——

Senator SCHWEIKER. Dr. Bachman had a high degree of respect for CDC and a close relationship so there was no problem and I guess my question is, might we not have that problem in the future if we don't more clearly define responsibility and if we get an outbreak of the magnitude and experience the panic that was potentially inherent in the Legionnaires' disease case.

Dr. FOEGE. I think in 30 years we have not had a problem in that area, so I don't foresee that we will have one in the future. We are happy with the present arrangement.

Senator SCHWEIKER. That's all I have, Mr. Chairman, thank you.

Senator JAVITS. Dr. Foege, I think you credited yourself and the institution magnificently in the specialized ability you have demonstrated in dealing with this new problem. I still would like to ask you, however, the following. If this bacteria is new, as you have suggested, should we consider this some kind of a warning signal that perhaps a whole area or branch of science has been overlooked? As you say yourself, you didn't expect anything like this to hit you. Perhaps the research communities can be turned loose on in order to determine whether there are lots of other sleepers or whether we are in some new phase of disease. There is always the suspicion like the suspicion in air-conditioning that we pay a price for modern change. Maybe that price is paid through increases in danger of the disease. I notice you have some very distinguished doctors and scientists from my own State of New York, an advisory group on this particular problem, and we have the enormous National Institutes of Health in Washington. I think we might want to look at this as a possible warning. There may be some new threat to all of us in terms of illness which is uncovered by this tip of the iceberg.

Dr. FOEGE. I concur with you. This has turned out to be a catalyst. It makes us relook at microbiology in general. The second point, on sharing, I totally concur. In fact when we met with the scientists on October 14, one of our questions was, is it safe now to share and the conclusion of that group was, it is now safe for the organism to be used under certain safeguards in other laboratories. My feeling is that in the next year we will see real strides in our understanding of this organism because we will have so many university centers, so many health departments and research areas looking at the organism. I totally concur with the suggestion that we get as many people as we can working on this.

Senator JAVITS. Well now, you know, we can pry loose lots of things in the Congress. We may not be research scientists but we're action oriented. Do you think that this whole issue ought to be considered by research community in terms of whether or not it deserves some new mobilization of effort or some new reallocation of effort?

Dr. FOEGE. We would be more than happy to develop a symposium to do just that.

Senator JAVITS. I would strongly recommend that; I think that would be highly useful.

Now to pursue the other point of my question. I am satisfied as to the international mobilization of resources which will come through some such effort as I have described because I'm sure you will, in such a symposium, invite the resources of other countries.

The other point is, how do you in an institution like this determine what resources to allocate to Legionnaires' disease without starving other activities. This is a social question; we have had it in DNA and other problems.

Dr. FOEGE. I think one of the problems in answering this is the difficulty of deciding how much do you allocate to an emergency ahead of time when you don't know where it will lead. I look on Legionnaires' disease work at CDC at this point as being a capital investment because once we are able to get to a certain point of knowledge, we will not be putting anywhere near this amount of resources into it. On the other hand, I don't see how we can pull back. You're right, of course, that some things are not done or they are delayed. A great deal of the extra resource being put into Legionnaires' disease, I must say, is done after hours. It's not strictly accountable; people are not doing something during hours. We are spending money, but again I think this is a capital resource and we hope to see that soon the rest of the research community takes over that work and we will be involved in the ongoing Legionnaires' disease activities.

Senator JAVITS. I'm very interested in how you organize for this purpose. Do you have a board or a committee? Do you do it, do you decide alone, as the Director, what you're going to allocate and what is to be given a lower priority? To what extent do you enlist other authorities; for example, the authorities in HEW or the authorities in NIH? How is this organized, who makes the decision, and on what criteria?

Dr. FOEGE. On the basis of ongoing surveillance activities, disease control activities, we do in fact use a procedure of zero base budgeting from the division level on up. We also are very sensitive to our constituents; what are the State health departments telling us are the real public health problems in the State; and what are the local health departments doing. As a matter of fact, at the moment, we have a group of 15 non-CDC people who will be meeting in November to review our entire activities and give us their input. They will use for their basic material a solicitation which has gone out to over a thousand institutions and people in the United States interested in public health. These people have had an opportunity to say what they think the public health problems are and where the resources should go. In the meantime we're using internal procedures, but when we get to a problem like this—and every year we end up with something, such as

equine encephalitis or influenza, that involves an unexpected expenditure of resources—we do, in fact, have to cut back in other areas.

Senator JAVITS. Dr. Foege, I would strongly recommend, that as part of the work you are now doing in terms of evaluation and monitoring that you attempt to evaluate what happens when you allocate resources to an emergency of this kind. To what extent do you deprive other areas of attention. Such an effort would be very helpful to us. As I have said, I am personally very satisfied with the job you have done, but I do think it would be very helpful to us if we had an evaluation regarding how the priorities are determined bearing in mind that such decisions are both a scientific and a social decision.

The other question I'd like to ask you is about the process which disseminates information like this to professionals throughout the country. You can have an outbreak, I gather, anywhere. How are doctors to recognize it and to know the treatment?

Dr. FOEGE. We have different mechanisms. With the Legionnaires' disease outbreak, for instance, we were called in on August 2. The first information on the clinical syndrome went out August 6, 4 days later in the Morbidity and Mortality Weekly report that we send out every Friday. So one source is this weekly record that goes to 70,000 people around the country. At the same time, we notified the World Health Organization and they have periodically put reviews of Legionnaires' disease into their Weekly Epidemiologic Record. In addition to this, we have, of course, used the medical literature, but I must say in addition I think the news media have done a good job in disseminating information. The question is often asked, did the news media help or hurt us in Philadelphia. I think on balance they helped, because for instance they so quickly got the word out to physicians practicing in other parts of Pennsylvania. It was through the news media that we learned about the outbreak that had occurred 2 years earlier. I think the news media have become part of our surveillance system now. In addition to this, our people have made numerous presentations at scientific meetings.

Senator JAVITS. Are you also organized to see that information regarding methodologies of treatment are disseminated properly?

Dr. FOEGE. We are disseminating this information through the Morbidity and Mortality Weekly report, and in addition we have summarized much of the material on Legionnaires' disease which has gone directly to State health officers, State epidemiologists and State laboratories.

Senator JAVITS. Again, I would strongly suggest that you include this in your total evaluation. I think this would be very helpful. Again, I would like to congratulate you and your institution for what I consider to have been extraordinary public service. Thank you, Mr. Chairman.

Senator SCHWEIKER. Dr. Foege, you recently announced a breakthrough in the immunization of pneumonia and my obvious question is, does this have any spinoff benefits to Legionnaires' disease? Do we know enough yet about it to say whether the technology and techniques, the kinds of pneumonia you are immunizing for, would be applicable to Legionnaires' disease at some point in the future?

Dr. FOEGE. I know of no direct spinoff benefits at this time. The original announcement was on pneumococcal vaccine and I think we

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are a long way from knowing whether it's even possible to think of a vaccine for Legionnaires' disease.

Senator SCHWEIKER. That's all I have.

Senator KENNEDY. Doctor, I think this obviously has been enormously informative for all of us here this morning. I think there are certain conclusions that we can make and a sense of hope obviously that we have in terms of treatment of this disease. I suppose from this meeting this morning we have to also caution ourselves about where it might break out next, what are the factors that change it from a rather benign factor into a virulent one. We see particularly in our region of the country, up in Vermont, where they had some 27 cases, 14 deaths, 6 or 7 of those people that contracted the disease were not located in a particular location so it was pretty widespread. You have seen on the charts those clusters which have been epidemic in terms of its impact in the various communities. Have you been successful isolating it and making recommendations on how it could be treated? We also must put that against the background of the change in various bacterial pneumococcus, the change that has taken place in terms that particular antibiotics and the use of antibiotics in terms of that particular substance and how it altered and changed. Isn't it possible that what we're talking about here this morning might be another changed substance from what it was back in 1965. May it not be a changed substance 10 years from now? I suppose all of these matters bring a sense of caution what we have heard this morning—obviously, a sense of caution about the future on this particular issue. We have seen obviously where there has been a partial solution to this issue, but there still remains a lot to be done both in terms of getting warnings out to the people, having proper notice of treatment, but also in the substance itself. I think we have a sense of hope but also a sense of caution.

I, too, want to join in commending you and the others here for work that has been done and the help that you have provided us.

Thank you very much.

[The prepared statement of Dr. Foege, follows:]

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STATEMENT

BY

WILLIAM H. FOEGE, M.D.

DIRECTOR

CENTER FOR DISEASE CONTROL

ON

LEGIONNAIRES' DISEASE

BEFORE THE

SUBCOMMITTEE ON HEALTH AND SCIENTIFIC RESEARCH

COMMITTEE ON HUMAN RESOURCES

UNITED STATES SENATE

Wednesday, November 9, 1977

Mr. Chairman and Members of the Subcommittee:

Welcome to the Center for Disease Control. We appreciate the interest you have traditionally shown in this Center and the confidence you have placed in us, and welcome the opportunity to describe for you our activities in the investigation of a previously unknown cause of human disease. With me today at the witness table are two persons who were intimately involved in that investigation. Dr. David Fraser is Chief of the Special Pathogens Branch in our Bureau of Epidemiology. Dr. Fraser has from the beginning directed the epidemiological efforts of the Center in this investigation. Dr. Walter Dowdle is Director of the Division of Virology in our Bureau of Laboratories. It was in his Division that the causative organism was initially isolated.

In July 1976, an unexplained epidemic of illness broke out in Pennsylvania. Within weeks, 29 people were dead; an additional 153 were sick. The disease was called Legionnaires' and its cause was a major public and medical mystery.

Thousands of hours were spent by investigators and scientists in an effort to unravel the mystery illness. Six months later the breakthrough came when a CDC rickettsiologist, using techniques generally used for identifying rickettsiae, was able to isolate the cause of the outbreak--a bacterium never before identified as a cause of human illness. Today we know that the Philadelphia outbreak was not unique. We know this bacterium has caused human illness and death in years gone by and that it continues to do so. We assume that the disease will be found in all 50 states, and perhaps in much, if not all, of the world. We shall provide testimony today and answer your questions in an attempt to describe fully the results of our investigation to date, and discuss what yet needs to be done to explain more fully the role of this organism in causing disease and death.

Let me begin, however, with a description of the Center for Disease Control, its capabilities and the resources that were focused on solving the mystery of Legionnaires' disease. CDC is the Department of Health, Education, and Welfare's primary focus for preventive medicine and disease control. The Center provides technical assistance in widely ranging aspects of preventive medicine, including field epidemiology, laboratory reference diagnosis, and consultations on many topics relevant to disease control. It conducts and collaborates in studies oriented toward improving the diagnosis and identification of disease, to developing and maintaining the surveillance of a wide range of important health conditions, to studying the ecology of many diseases in this country and elsewhere, and to determining the role of certain environmental factors in the causation of disease. Since becoming a part of the Center in 1973, the National Institute for Occupational Safety and Health has extended the scope of CDC's preventive medical responsibilities into the workplace.

One of the primary missions of CDC is to support the practice of public health in State and local health departments. Generally, CDC's assistance is provided directly to or through State and local health agencies. The Center extends the competency and the resources of these health agencies by providing supplementary professional manpower and technical capabilities to help them fulfill their statutory responsibilities for disease investigation and control. The Center does not act as an independent investigative body.

In addition to providing technical assistance and consultation, the Center assists State and local health departments with programs of tuberculosis

control, venereal disease control, immunization, and selected environmental health improvements such as lead-based paint poisoning control.

At the present time, the Center employs approximately 3,600 people, including 1,400 scientific and professional staff representing more than 100 different scientific specialties and subspecialties. Approximately half the CDC staff is located in our headquarters here in Atlanta. Most of the rest are on assignment in State and local health departments, assisting in regular programs of disease prevention and control and contributing to the overall surveillance of disease.

The Center is both a domestic and an international organization. Its international activities are generally related to programs of the World Health Organization for which the Center provides consultative services, laboratory reagents, and field personnel for periodic epidemiologic and laboratory investigations. The Center is widely recognized as an internationally unique organization because of the breadth and depth of its expertise in disease prevention and control; it is an organization that offers the capacity for immediate response to emergency health needs when its range of special talents become needed. Most countries would be unable to assemble the same range of resources or would find them scattered in a number of different governmental agencies and academic centers.

The epidemiological competency of the Center derives from its staff of 285 professional epidemiologists. The major field team of so called "disease

detectives" is its Epidemic Intelligence Service (EIS) formed in 1951 to provide epidemic aid and epidemiologic consultative services to the States and to strengthen the epidemiologic resources of the Nation.

Each year CDC investigates more than 1,500 outbreaks of disease both in the U.S., at the invitation of State health departments, and abroad. As examples of our international activities, currently we are investigating Lassa fever in Sierra Leone and cholera in Syria and in the Gilbert Islands in the South Pacific; a CDC epidemiologist has just returned from investigating an outbreak of an antibiotic-resistant strain of pneumococcus in South Africa. Domestically, in recent months CDC has worked on outbreaks of disease related to cruise ships, hospitals, restaurants, and schools, including waterborne diseases, bloodstream infections, foodborne disease, and measles.

The Center has approximately 625 professional laboratory staff covering 17 separate laboratory disciplines and functions. The laboratories serve the "disease control" capability of the Center in being able immediately to apply an exceedingly broad range of coordinated laboratory services for the investigation of disease. The laboratories have a continuing function which involves providing ongoing assistance to State and Federal health agencies and to those of other countries as well.

The laboratories provide reference diagnostic services, epidemic aid support, and training in laboratory methods and management through organized courses and by consultation. The Center administers a national laboratory improvement

program including research and development in laboratory methodology, development and evaluation of materials and reagents, and licensure and evaluation of interstate laboratories.

The laboratories maintain a competency which is nationally and internationally recognized for its depth in most disciplines applicable to the diagnosis and control of disease. For example, the specialty Divisions of the Bureau of Laboratories, one of the Center's eight bureaus and institutes, include bacteriology, clinical chemistry, toxicology, hematology, mycology, parasitology, virology, vector-borne diseases, and pathology, as well as those with functions which relate across discipline lines, such as laboratory training, licensure, and laboratory management. The Center has been designated as a WHO International Center for 23 diseases or health problems.

Since August 2, 1976, when CDC first became involved in investigating Legionnaires' disease, hundreds of persons from many parts of the Center have been involved. We estimate that more than 73,000 person-hours have been spent in the investigation. Additionally, we have consulted with other federal agencies, academic and scientific institutions, and individual consultants. To illustrate the range of consultation we have sought, we have included a listing of the individuals and institutions in Appendix
The most recent example was on October 14, when we met with seven consultants to seek their expert advice on future directions for the investigation. Consultants in attendance at that meeting were Jeremiah A. Barondess, M.D., Chief, Private Medical Service, New York Hospital - Cornell Medical Center;

Bernard D. Davis, M.D., Adele Lehman Professor of Bacterial Physiology, Director, Bacterial Physiology Unit, Harvard Medical School; Theodore C. Eickhoff, M.D., Head, Division of Infectious Diseases, University of Colorado Medical Center; Alexander D. Langmuir, M.D., Visiting Professor of Epidemiology, Department of Preventive and Social Medicine, Harvard Medical School; James O. Mason, M.D., Dr.P.H., Deputy Director of Health, Utah Division of Health; Jay P. Sanford, M.D., Professor of Internal Medicine and Dean, School of Medicine, Uniformed Services University of the Health Sciences; Morton D. Swartz, M.D., Chief, Infectious Disease Unit, Massachusetts General Hospital; and Ivan L. Bennett, Jr., M.D., Dean of the School of Medicine and Provost, New York University Center, who was chairman.

The investigation of Legionnaires' disease has been one of the most intensive, broadly-based, and well-publicized in recent years.

The disease first made national headlines and gained scientific interest and concern in August of 1976 following the 58th annual convention of the Pennsylvania American Legion.

That convention met in Philadelphia July 21-24, 1976, and was attended by 4,500 persons representing 1,002 local posts in Pennsylvania. On August 2, 1976, the Center for Disease Control received word from Dr. Sidney Franklin of the Veterans Administration Clinic in Philadelphia of deaths and respiratory illness among those who had attended the meeting. At the request of State and local health officials, CDC sent medical officers to Pennsylvania to help launch what was to become the largest and one of the most challenging scientific investigations in the Center's history.

Details of what happened have since become history--medical and otherwise. At least 182 cases, including 29 deaths, were identified. Additionally, there were 39 cases with 5 deaths of what was then called Broad Street pneumonia. It has since been shown that the Legionnaires' bacterium also was the causative agent for the Broad Street pneumonias.

Medical epidemiologists--local, State, and federal--set out on August 2 to find cases of the illness; to diagnose it, if possible; and to determine its cause.

Suspect cases in hospitals throughout the State were reported to the State Health Department, and by August 3 approximately 100 suspect epidemic cases were listed and a preliminary case definition was established--the first step in any such investigation.

On August 3, 4, and 5, Epidemic Intelligence Service Officers from CDC visited, interviewed, and examined the known cases to collect detailed clinical and epidemiologic information.

Leaving from Harrisburg, Pittsburgh, and Philadelphia, each of the EIS epidemiologists drove an average of 450 miles interviewing 10 patients in over six hospitals in less than 2 days. New cases were uncovered and previously listed patients excluded by strict application of clinical criteria. By the evening of August 5, an extensive line listing of clinical and epidemiologic information was available for approximately 140 patients. We are submitting for the record a complete report by Dr. David Fraser and his associates about the epidemiological findings of the Philadelphia investigation.

Through these face-to-face interviews, the adequacy of preliminary identification of cases was confirmed. In addition, reliable evidence was obtained showing that no secondary spread of the illness had occurred--a critical finding which determined future steps of the investigation.

Following the case finding efforts, it was possible to describe what has now become the classic clinical picture of a case of Legionnaires' disease. Earliest symptoms are a generally run-down feeling, muscle aches, and a slight headache. In less than a day there is usually a rapidly rising fever associated with chills. A dry cough is common early in the illness, often with the onset of initial symptoms. Abdominal pain and gastrointestinal symptoms also occur in many patients. By the time a patient sees his physician, two or three days after becoming ill, fever is usually 102-105 degrees F and chest x-ray shows a patchy pneumonia.

While epidemiologists searched the field for clues about their unknown challenger, scientists in CDC laboratories were at work on the painstaking, time-consuming search for a cause of the illness.

Bacteriologists, virologists, rickettsiologists, toxicologists, and many others searched blood, respiratory, fecal and tissue specimens to see if they could find the organism or substance responsible for the outbreak. Thousands of hours were spent by federal, State, and university scientists in an effort to uncover the cause.

Within 48 hours after receipt of the first specimens, laboratory tests showed that infections with known highly hazardous exotic agents were unlikely. Within 72 hours after receipt, tests for some of the more common bacterial and viral diseases, including influenza, were also reported to be negative. Tests for still other known and unknown infectious agents required weeks and even months to complete.

Because the initial microbiological studies on Legionnaires' disease failed to incriminate known pathogens, public speculation over the next few months shifted to possible toxic causes. CDC toxicologists and outside expert investigators pursued this possible cause. However, during this time CDC microbiologists and pathologists continued to perform numerous tests, re-examine previous findings, and follow up even the most remote leads.

One of these microbiologists, Dr. Joseph McDade, was responsible for performing the standard battery of tests for detecting rickettsiae in the original specimens during August and September. He had found no evidence of rickettsiae. However, in reviewing his slides and data 5 months later (in December), Dr. McDade and his Chief, Dr. Charles Shepard, still failed to find rickettsiae but noted that a small bacterium appeared with suspicious consistency in the tissues of guinea pigs that had been inoculated with post-mortem lung tissue from Legionnaires' disease in August, 1976. Since no pathogenic bacteria could be cultivated from these guinea pig tissues, they had been considered in August to be extraneous contaminants and of no consequence. Such contaminants are frequently encountered in testing for rickettsiae. Moreover, direct examination of numerous Legionnaires' disease lung tissue specimens by pathologists

throughout Pennsylvania, as well as expert consultants, had not revealed pathologic changes consistent with bacterial pneumonia. Pathogenic bacteria had not been observed by conventional tissue stains of human lung tissue, had not been isolated on conventional media, and had not been seen in the lung tissue from sick guinea pigs. In an effort to follow up all leads, no matter how inconsequential, Drs. McDade and Shepard attempted to cultivate the organism by an alternate method. They thawed the spleen tissue from the suspect guinea pigs, which had been stored at -70 C from August to December, and inoculated some of that tissue into embryonated eggs. When the eggs died five to seven days later, they were found to be teeming with bacteria. The scientists then examined the convalescent sera from Legionnaires' disease patients for evidence of antibodies to the agent found in the eggs. This was done by mixing serum from a suspected case of Legionnaires' disease with the organism found in the eggs. If the patient's serum contained antibodies specific for the organism, an observable reaction would take place, suggesting that the patient had the disease. An even stronger indication of disease would be to test paired serum specimens taken two or more weeks apart. If it could be shown that the reaction took place at much higher dilution (fourfold or more) in the second serum than in the first, this could be regarded as strong evidence that the patient has or had recently recovered from the disease caused by the test organism. Specimens from patients who died or recovered from Legionnaires' disease were subjected to this test. Control samples from non-suspect cases were also tested. Approximately 90% of the Legionnaires' samples reacted with the agent found in the eggs, indicating that the isolate was in fact the etiologic agent.

The control samples did not react. Later, Drs. McDade and Shepard isolated the same agent from three other autopsy specimens. Thus, the first important steps in establishing the etiologic relationship of the yolk sac isolate were taken.

The paradox, however, as to why all other workers had failed to implicate a bacterium still remained. Other CDC scientists joined Drs. McDade and Shepard in the investigation in an attempt to answer this perplexing question.

After several attempts, growth of the agent was finally obtained by placing a very heavy inoculum on one particular type of bacteriological medium. The growth took three or more days to become visible which is somewhat unusual as most bacteria will grow in two days or less. Once this growth was obtained repeatedly, studies were initiated to determine what the organisms' nutritional requirements were and to characterize the organism as fully as possible. It was also necessary to conduct studies to determine to which other bacteria or bacterial groups this agent was related. We now have partially characterized the Legionnaires' disease agent. It is a bacterium but unlike any we have previously encountered in medical bacteriology. We know what some of the necessary nutritional compounds are, and we have studied the chemical composition of the cells. We have also determined by two separate approaches which antibiotics will prevent or inhibit the growth of the Legionnaires' disease agent and which will not. We are currently engaged in further tests to determine how effective several different antibiotics are in protecting guinea pigs given an otherwise lethal dose of the agent.

Attention is also being focused on the development of a medium which can be used to isolate this organism from patients in the early stages of illness so that physicians can begin appropriate treatment early in the illness. Some progress has been made but it is a difficult problem and will undoubtedly take several more months before a reliable primary isolation medium can be obtained for isolation of the agent from specimens obtained from the respiratory tract of ill patients.

One final bit of laboratory evidence was lacking. That was the demonstration of this organism in the diseased lung tissues obtained from autopsies of patients who died from Legionnaires' disease. All previous attempts to detect the organism had failed. A systematic search for an appropriate stain was undertaken by CDC pathologists. Where all other tissue staining techniques failed, a little-used stain called Dieterle's, showed bacteria present in large numbers in lung tissue and to be involved in the disease process. A very specific reagent for detecting this organism in lung tissue has subsequently been prepared. This reagent is called a direct FA conjugate. It was prepared by harvesting the organism from the agar medium, inactivating the organism, and injecting rabbits to prepare an antiserum specific for the agent. This antiserum was then chemically conjugated with a substance that flouresces when observed under a microscope using ultra violet light. By applying this conjugate to either tissue sections or scrapings of lung tissue on a glass slide and observing for the bright fluorescence under the microscope, our microbiologists have established that the organisms observed by the pathologists are indeed the Legionnaires' disease organisms and not another bacterium.

The discovery of the etiologic agent of Legionnaires' disease was accomplished in the face of overwhelming odds. All of the combined bacteriology and pathology experience accumulated since the beginning of the century pointed away from this agent being a bacterium. Drs. McDade and Shephard could have easily dismissed their observations as evidence of accidental contaminants. Fortunately, they did not.

With the isolation of the organism and the further refinements in laboratory procedures, it was possible to learn more about the history and present activity of the Legionnaires' disease bacterium. Using serum from victims of earlier outbreaks of illnesses stored in CDC's serum bank, an international repository for serum from cases of many known and unknown diseases, the Legionnaires' organism has been implicated in the following unexplained outbreaks:

In July 1965 there were 81 cases of "pneumonia" and 14 deaths from an unexplained illness at St. Elizabeth's Hospital in Washington, D.C. The outbreak received local and regional public attention, and CDC was involved in an investigation of the outbreak.

Studies by CDC and others to find a cause were unsuccessful in 1965. Blood specimens from 26 patients in that outbreak were stored in CDC's serum bank. When the Legionnaires' disease organism was isolated, the St. Elizabeth's sera were tested against the new organism, and 22 of the 26 showed antibodies to the organism, implicating it as the causative agent in the 1965 outbreak.

In July of 1968, Michigan health officials contacted CDC to ask for assistance in the investigation of an outbreak of what was called Pontiac

fever, an unidentified illness which attacked employees of the Oakland County Health Department and visotors to the Health Department Building. There were 144 cases of the illness reported, including several among the CDC medical officers investigating the outbreak. There were no deaths and no pneumonia, but symptoms of the illness were similar--fever, myalgia, and headache. The incubation period was usually short, averaging 36 hours. Changes were made in the air conditioning system, and there were no additional cases. There was no evidence of person-to-person spread of the illness. Blood specimens from 37 of the patients were stored at CDC--32 showed positive antibody rise to the Legionnaire's organism in 1977.

Unknown to CDC until 1977, in July of 1973 a group of vacationers from Scotland traveled to Benidorm, Spain, where they stayed in one hotel. Ten of the 252 travelers developed pneumonia and of these, three died. There was a joint Scottish-Spanish investigation which turned up no agent and no method for spread of the disease. One blood specimen retained in Scotland since 1973 was sent to CDC in 1977 to be tested against the Legionnaire's organism. It showed a high level of antibodies reacting with the Legionnaire's organism. In 1977 a Scottish traveler went to the same hotel and died of "pneumonia." Tissue and serum were sent to CDC and proved to be positive to the Legionnaires' disease organism. CDC is participating in an investigation of these cases now.

During the 1976 investigation of the Legionnaires' outbreak, word began to come to CDC from many sources--including a telephone call from the wife of a member of the International Order of Odd Fellows, about an outbreak of illness during

an IOOF Convention in Philadelphia at the Bellevue-Stratford Hotel in September of 1974. A survey of some of those attending the convention was conducted in October of 1976. It showed that the attack rate, incubation period, and clinical features were all consistent with Legionnaires' disease. Of the 392 people responding to the questionnaire survey, 11 cases of an illness fitting the case description of Legionnaires' disease were identified. Odd Fellows members helped to identify and obtain clinical data from 20 cases of the illness. In February and March 1977, sera were collected from 11 cases and 19 Odd Fellows who were not ill. Investigation showed that the group with illness had antibodies to the Legionnaires' bacterium, while the group without clinical illness did not..

This year for the first time, we have had the ability to confirm cases of Legionnaires' disease through the usual channels of State health departments. Several clusters of Legionnaires' disease have been identified thus far this year.

In Columbus, Ohio, nine cases and one death were reported as a result of Legionnaires' disease in August and September. Five cases were in persons who had previously been patients or visitors at one hospital. Four other cases were in renal transplant patients at another hospital.

In August and September, 21 proven cases and three deaths were reported from Kingsport, Tennessee. There are an additional 30 to 35 suspected cases. Most proven or suspect cases were in persons who had been in an area hospital or nearby two weeks prior to becoming ill.

From July through September 1977, 27 proven cases with 15 deaths were reported from the Burlington, Vermont area. Five cases were among dialysis and renal transplant service patients and 16 had a malignancy. In addition, 20 other ill persons were listed as "highly probable" cases, on the basis of single sera, and of these two have died.

Since August, 1976, in addition to the "clusters" of cases, there have been 64 sporadic cases of the illness reported from 24 states. Among these there have been 16 deaths. We will submit for the record information on the age, sex, geographic location, date of onset and outcome for these 64 sporadic cases. As the information we have just discussed illustrates, we have learned a great deal about this unique organism. There is, however, much yet to be learned. Let me summarize what we now know about the Legionnaires' disease bacterium:

*The bacterium has been around for a long time. Though the first known evidence of its causing illness and death was in 1965, it is likely that it was around long before then.

*One likely mode of transmission is through the air. There may be other ways it is spread although there is at this time no evidence that it is ever transmitted from one person to another.

*It is likely that the natural home of the organism is somewhere in nature, rather than in the human population.

*The bacterium causes both outbreaks of disease and isolated cases. The outbreaks we are aware of occurred in the summer. The isolated cases have been seen throughout the year.

*In the cases that have been looked at so far the fatality rate has been high. Part of this is a reflection of the fact that fatal cases are more apt to be studied carefully. Antibody tests indicate that the bacterium may cause mild or inapparent infections, and the outbreak in Pontiac did not result in any deaths. Nevertheless, pneumonia caused by the bacterium of Legionnaires' disease can be serious, and in the Philadelphia and St. Elizabeth's outbreaks where a systematic search for all cases of pneumonia was possible, about one in six patients died.

*The current high mortality rate from this disease may be somewhat analogous to histoplasmosis. When this fungal disease was becoming recognized as a cause of human illness in the United States in the 1930's, it was thought that histoplasmosis was almost always fatal. It is now known to be very common, with severe illness and death the exception.

*The organism is unlike any bacterium we have hitherto encountered. Its behavior on bacteriologic media and its behavior in experimental animals is different from previously known agents of human disease. Moreover, DNA studies of its gene structure have not yet found a near relative.

*A small percentage of the pneumonia cases in this country are caused by the Legionnaires' bacterium. Much more work remains to be done before we can quantitate the amount of disease caused by this

organism. Our best guess at this time is that between 1/2% to 1.5% of the unexplained pneumonias may be caused by this organism. If that is so, from 15,000 to 45,000 cases and from 2,000 to 6,000 deaths may be caused by the Legionnaires' bacterium in a given year in the United States. As we learn more about this organism we will be able to give a more accurate estimate of the number of cases.

*There is good evidence that the disease is treatable. Erythromycin has been shown in preliminary work, both in the laboratory and in clinical cases, to be effective. There may be other drugs that are effective. The isolation of the Legionnaires' bacterium provides us with a new opportunity to identify cases of pneumonia susceptible to antibiotic therapy.

Though the agent responsible for Legionnaires' disease has been identified, there is much work still to be done.

Work will continue at CDC and elsewhere to make our knowledge of this disease and its agent as complete as possible. Our own activities, guided by our perception of needs as well as by the advice of consultants, will take the following directions:

Currently the Center is monitoring information from the States with identified outbreaks--Ohio, Vermont, and Tennessee. In each State, pneumonia cases seen at several hospitals are being monitored for evidence of Legionnaires' disease. Specimens are being collected from suspect cases in Vermont to be

used in determining a more rapid way to diagnose Legionnaires' disease. A comprehensive set of environmental specimens is being analyzed; air filters, water and dust from air conditioning systems; and animals trapped in the vicinity of the illness. Screening of these specimens is by microscopic and culture techniques developed by CDC scientists to look for the source of the bacterium in nature.

When the collection and testing of serum specimens from pneumonia cases in Vermont is completed, cases shown to be Legionnaires' disease will be compared to those whose pneumonia had another cause in an effort to identify activities and locations associated with developing Legionnaires' disease.

To trace the history of the disease in areas where recent epidemics have occurred, specimens from lung tissue from autopsies showing pneumonia are being identified from the months before the outbreaks. These will be tested for signs of Legionnaires' disease to determine how long the disease has been prevalent in these areas.

In laboratories throughout CDC efforts are being made to grow the organism under controlled conditions in order to speed the analysis process.

The improvement of agar and broth media for use in primary isolation of the organism from chemical specimens is an activity of high priority. Others are: developing and evaluating selective media for recovery of the agent from contaminated environmental or clinical specimens, checking the ability of the organism to persist under selected environmental conditions, testing methods to identify the organism in environmental specimens and to isolate it from

such specimens, and investigating the possibility that animals may serve as definitive reservoirs for the agent.

Other laboratory studies deal with diagnostic, therapeutic, and control measures. These include comparisons of various antibiotics in experimental infections in guinea pigs to see which are most effective in treating the illness; determining susceptibility of the agent to products used for disinfection and decontamination, and assessing the relative sensitivity and specificity of cultural, immunologic, and physiochemical tests for use in rapid diagnosis of an acute case.

A special group of epidemiologists is now working to define more clearly the extent of the Legionnaires' disease and to generate new hypotheses about the organism's reservoir and its mode of transmission.

State health laboratories routinely receive serum specimens drawn from patients with a variety of undiagnosed infections. Selected serum specimens of this sort have been forwarded to CDC from six state laboratories--Ohio, Florida, Connecticut, Delaware, Washington, D.C. and Maryland. CDC is testing the sera for antibodies to Legionnaires' disease to furnish a crude estimate of the proportion of apparently nonbacterial pneumonia that is caused by the Legionnaires' disease bacterium.

Surveillance of sporadic cases of Legionnaires' disease is being refined preparatory to a case-control study of this group. Other studies include a survey of possible prior exposure to the organism by healthy persons or

those involved in occupations of epidemiologic interest. Evaluation will also be made of the role of Legionnaires' disease in certain possible high-risk patient groups and pulmonary infections. Also to be evaluated is the specificity of serologic tests currently employed for diagnosis. We will continue to search for further data to rule out the possibility that interpersonal transmission may occur. The possibility that certain attributes may be characteristic of institutions associated with outbreaks of the disease will be considered as will other aspects related to building design and construction.

To assure national dissemination of information gleaned from these investigative activities, CDC has prepared, and will present, formal training courses to scientists on the laboratory diagnosis of this disease. The first of these courses will be given to a group of microbiologists on December 6-8, 1977, and subsequent presentations of the training will be given during the calendar year 1978.

As CDC has become familiar with the characteristics of the bacterium, the organism has been provided to additional laboratories around the country, including the National Institutes of Health, several State laboratories, and the U.S. Army Medical Institute for Infectious Diseases at Fort Detrick, Maryland. The organism is being made available to other qualified investigators and laboratory directors upon request.

Information on our findings has been disseminated through our own publications, other scientific and medical publications and at open scientific meetings.

Scientific publications are in various stages of preparation, and others will be submitted to various journals to further disseminate information. On an international scale, CDC has opened communication with scientists in other countries to share data, methods, and other information for use in their laboratories.

Mr. Chairman, much of the history of medical science consists of discoveries made in opposition to popular theories or practices of the time. A chance observation, the introduction of a new technique, or a new tool, or a new approach to an old problem often have opened the way for quantum leaps in our knowledge. We cannot at this time predict with accuracy the true significance of the discovery of the bacillus of Legionnaires' Disease. Whether it or similar agents may be involved in still other undiagnosed diseases of man and animals will take time to determine.

It should also be noted that historically, the accumulation of a substantial body of knowledge on the microbiology, epidemiology, and clinical characteristics of a given infectious disease has preceded -- sometimes by decades -- the development of effective therapy. Legionnaires' disease presents an almost unique exception, we believe we already have reasonably effective treatment for the illness, but knowledge about the disease is still in its infancy. This paradox helps create the tremendous pressure we all feel to make rapid progress in learning about Legionnaires' disease so as to exploit our therapeutic abilities to the greatest extent possible.

We have been witness to a history-making challenge to modern medicine and science--the discovery, identification, and earliest steps in clinical treatment of a disease which has long plagued man. We can now continue the gratifying search for better ways to diagnose the disease; for better clinical treatment of the illness and for eventual prevention of the disease.

Mr. Chairman, that concludes my statement. We shall be pleased to answer any questions which you and other members of the Subcommittee may have.

Senator KENNEDY. Our next panel, Leonard Bachman, who is the Secretary of Health of Pennsylvania and Jay Sanford who is the dean of the School of Medicine, Uniformed Services University of the Health Sciences.

Dr. Bachman, I understand you are under time constraints.

Dr. BACHMAN. Yes, I am.

Senator KENNEDY. We'll hear from you. When do you have to——

Dr. BACHMAN. I have a plane that leaves at 12:25 to make it back to Pittsburgh.

Senator KENNEDY. You'll be with us for a little while. We'll try and release you in 20 or 25 minutes. We'll ask our panel to focus on you.

STATEMENT OF LEONARD BACHMAN, M.D., PENNSYLVANIA SECRETARY OF HEALTH; AND JAY P. SANFORD, M.D., DEAN, SCHOOL OF MEDICINE UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES, A PANEL

Dr. BACHMAN. As Pennsylvania Secretary of Health, I have had a unique opportunity to observe the phenomenon known as Legionnaires' disease. I am pleased to have received an invitation from the committee to report my views on this problem from my perspective at the State level and with the experiences of the past 15 months.

The facts about Legionnaires' disease have been well reported, and are not much in dispute. From the beginning, however, there has been much controversy about the meaning of the facts. It is as though the public will not accept the reality that the health establishment still has gaps in its knowledge and capacity to deal with acute epidemic infectious disease. In fact, the great accomplishments in the field of infectious disease in the past 50 years have left the public with the erroneous belief that all infectious disease has been conquered.

However, practicing physicians have continued to confront patients with severe pneumonia, some of whom die and for which no causative agent can be established even after extensive studies during and after the disease. In my early years as a hospital house officer, we called these cases atypical pneumonia.

In the 1960's, the Center for Disease Control's epidemic intelligence service detected several clusters of severe pneumonia-like diseases at St. Elizabeths Hospital in Washington, and in Pontiac, Mich. After pursuing the known pathogens of pneumonia, the public health agencies shelved the inquiries in order to pursue the more immediate and pressing needs that confronted them.

And I'd like to stop here for a moment to say that that is typically the problem that all public health agencies have, Senator. I should mention almost on a weekly basis we have an executive committee meeting in our State health department to decide how we balance our resources. Should we take people off of this and put them on that, and it is a constant problem and one which we solve by weekly executive committee meetings made up of the heads of all the major divisions of the health department, and I must say there are lots of arguments and discussion and in the final analysis, the law permitting, I make the final decision, responsible to the legislature of course.

The cluster of cases that occurred in Philadelphia was different. The epidemic was detected not by the public health surveillance system, but by the alertness of the Pennsylvania adjutant general for the American Legion, a Mr. Edward Hope, who deserves a great deal of credit. He released the dramatic information to the press at the same time that it was being reported to the public health authorities. Because a world-wide public became involved with this epidemic in its earliest stages of the investigation and could not put the available data in perspective there followed the wildest kind of speculations. Many of these could not be immediately discounted because of the preliminary stages of the investigation.

The intense public interest generated by both the dramatic facts and the way they were presented by the news media put the public health agencies involved under unprecedented scrutiny and pressure. As for the public, it had difficulty sorting out facts from speculations, and from differentiating serious responsible speculation from uninformed guesses.

I might add here that one negative result of the publicity was the unwarranted shunning of Philadelphia in general and the Bellevue Stratford Hotel in particular. This cost the city many millions of dollars and forced the closing of a fine old hotel, a Philadelphia landmark.

The public interest and media attention also had some positive results. Some examples:

The Pennsylvania Department of Health continues its investigation of this outbreak to this day. The legislature appropriated a quarter of a million dollars and we have spent about $152,000, the balance of which is still encumbered.

CDC did not shelve the investigation after several fruitless months as it did at St. Elizabeths Hospital and at Pontiac, but continued its effort, and was rewarded in January with the discovery of a novel bacterial pathogen.

Senator KENNEDY. You don't draw a conclusion that the incidents took place in one hotel in a 2-year period and then it took place in terms of Spain in one hotel over a period of time? What kind of weight should we give?

Dr. BACHMAN. I think we should give it weight but as a member of the public, I would, for example—you indicated that this outbreak could occur anywhere at any time—I do not think that I would, for example, shun the Bellevue Stratford Hotel in Philadelphia because of this outbreak. I think the general public might have difficulty making that kind of decision because it doesn't have the perspective and background that I would in public health. The thing might be in the hotel that we stayed in last night across the street.

Senator KENNEDY. Don't say that.

Dr. BACHMAN. I wouldn't stay away from the Bellevue.

Senator SCHWEIKER. I commend you, I would certainly stay at the Bellevue, I'm not sure I would go to Spain though.

Dr. BACHMAN. Most microbiologists had hitherto believed that all bacterial pathogens had already been discovered; and of course, much more has been and continues to be learned about this new bacterium. Thus, another cause of atypical pneumonia has been defined and now can be treated more effectively.

In Pennsylvania, the State department of health immediately launched a full scale investigation when we first learned of this outbreak. During that first day we gathered all the epidemiological information available and enlisted the aid of the Federal Center for Disease Control. The Center volunteered its resources and directed a 20-member epidemiologic investigation team to Pennsylvania.

Within hours of receiving notification of the outbreak, a statewide news conference was conducted by our State health department to inform the public and the news media all we knew about the disease.

I immediately directed the department's field staff, and particularly our public health nurses, to contact all hospitals throughout Pennsylvania to locate additional Legionnaire cases. Hospitals were alerted to call the State health laboratory in Philadelphia relative to the collection of appropriate specimens. Specific orders were given that tissues from the deceased were to be preserved without formalin and kept refrigerated. State police and National Guard helicopter services were contacted to speed up transportation of specimens to labs in Philadelphia and Atlanta. In view of the resources at our disposal at the time, I feel the Pennsylvania Department of Health acted responsibly and averted what could very well have been a condition of State and nationwide panic.

The fact that we could tell a concerned public at a very early point in our investigation that the disease was not contagious, that no person-to-person spread was evident, went a long way to calm the situation.

The Pennsylvania Department of Health has learned a great deal about how to handle widespread emergencies as a result of the Legionnaires' disease that I think are valuable to all State health departments.

Basically, we learned that the traditional approach to the epidemiology of communicable diseases, and the usual resources, are simply not enough. To deal as well as possible with a public health crisis of this magnitude, there are several basic needs which must be filled.

First, a State must recognize under the Constitution its basic role and responsibility in protecting the health of the people within its boundaries. A State health department must be well funded and well staffed with top-flight epidemiologists and laboratory technicians. The individual States must be held responsible for this primary role and the Center for Disease Control and other Federal agencies should respect this role. I believe the role of the Center for Disease Control should be more clearly defined. For example, at what point does it take jurisdiction, if at all, during a disease outbreak.

Second, a State health department must have immediate two-way access to recognized experts in the field, to other State health departments, to departments with overlapping responsibilities, to CDC and to other Federal agencies and institutes. In Pennsylvania, we are now in the process of installing a TWX; that is, a teletypewriter system which will link our central offices, our field locations, our laboratories and the Center for Disease Control to provide virtually instantaneous communication. We discovered during Legionnaires' disease that telephones have two big drawbacks: In a crisis situation, it is easy to get wrong numbers, busy signals, and just plain crossed wires. Then when we did get through, for example, to CDC, we ran into problems

with message conveyance and return calls. With our new system we will have error-free transmission plus a written record. In a crisis situation, this would enable us in Harrisburg to communicate with our laboratory facilities in southeastern Pennsylvania, with CDC in Atlanta, and with any medical center in the world having a terminal—all instantly and all at the same time.

Senator SCHWEIKER. May I interrupt? You testified when the House committee held a hearing in Philadelphia and I believe you referred to a hot line service you were setting up then. Is this part of that or was the hot line you were referring to then for calling in to the health department on a 24-hour basis? Or is that part of that too?

Dr. BACHMAN. The hot line is part of it and so is this.

Senator SCHWEIKER. Explain how that works.

Dr. BACHMAN. The health department has a statewide hot line which is toll free and is all over the State and people can call in at any hour of the night or day. We only have people there during 14 hours, the rest of the time the calls are recorded. In addition to that, the top people in the health department and the field directors all have an officer of the day situation where the top leadership of the department can be contacted through a page system at any time.

Senator SCHWEIKER. So it's set up that if an outbreak should occur, say on a weekend or before a weekend, the system would be completely responsive to it in terms of the top echelon of the department?

Dr. BACHMAN. A lot better than it was before the Legionnaires' disease.

Third, a State health department must have a means of coordinating research and public information efforts to prevent duplication of activities, and to insure that all information released to the public is correct, up-to-date, and understandable to the public. During the seventies, public health has emerged as a viable source of news and State health directors must recognize this as a fact of life. In the public health sector, particularly with communicable diseases, what the public doesn't understand or doesn't trust can cause fear and sometimes even panic. It is up to the public health sector, both on the State and National levels, to allay these fears as quickly as possible. Here again, a better system of communications between the various agencies would help greatly.

In conclusion, one of the major lessons the Pennsylvania Department of Health learned from Legionnaires' disease is that if a public health agency is going to be successful, we must have the complete trust and support of the people. We can't assume this trust. We must earn it. And this means opening up our lines of communication, it means working with the news media and it means cooperating with the entire spectrum of agencies who are guarding the health of the Nation.

Thank you.

[The prepared statement of Dr. Bachman, follows:]

TESTIMONY OF LEONARD BACHMAN, M.D.
PENNSYLVANIA SECRETARY OF HEALTH

BEFORE THE SENATE SUBCOMMITTEE ON HEALTH AND SCIENTIFIC RESEARCH
CENTER FOR DISEASE CONTROL
ATLANTA, GEORGIA

WEDNESDAY, NOVEMBER 9, 1977

AS PENNSYLVANIA SECRETARY OF HEALTH, I HAVE HAD A UNIQUE OPPORTUNITY TO OBSERVE THE PHENOMENON KNOWN AS LEGIONNAIRE'S DISEASE. I AM PLEASED TO HAVE RECEIVED AN INVITATION FROM THE COMMITTEE TO REPORT MY VIEWS ON THIS PROBLEM FROM MY PERSPECTIVE AT THE STATE LEVEL AND WITH THE EXPERIENCES OF THE PAST 15 MONTHS.

THE FACTS ABOUT LEGIONNAIRE'S DISEASE HAVE BEEN WELL REPORTED, AND ARE NOT MUCH IN DISPUTE. FROM THE BEGINNING, HOWEVER, THERE HAS BEEN MUCH CONTROVERSY ABOUT THE MEANING OF THE FACTS. IT IS AS THOUGH THE PUBLIC WILL NOT ACCEPT THE REALITY THAT THE HEALTH ESTABLISHMENT STILL HAS GAPS IN ITS KNOWLEDGE AND CAPACITY TO DEAL WITH ACUTE EPIDEMIC INFECTIOUS DISEASE. IN FACT, THE GREAT ACCOMPLISHMENTS IN THE FIELD OF INFECTIOUS DISEASE IN THE PAST 50 YEARS HAVE LEFT THE PUBLIC WITH THE ERRONEOUS BELIEF THAT ALL INFECTIOUS DISEASE HAS BEEN CONQUERED.

HOWEVER, PRACTICING PHYSICIANS HAVE CONTINUED TO CONFRONT PATIENTS WITH SEVERE PNEUMONIA, SOME OF WHOM DIE AND FOR WHICH NO CAUSATIVE AGENT CAN BE ESTABLISHED EVEN AFTER EXTENSIVE STUDIES DURING AND AFTER THE DISEASE. IN MY EARLY YEARS AS A HOSPITAL HOUSE OFFICER, WE CALLED THESE CASES ATYPICAL PNEUMONIA.

IN THE 1960'S, THE CENTER FOR DISEASE CONTROL'S EPIDEMIC INTELLIGENCE SERVICE DETECTED SEVERAL CLUSTERS OF SEVERE PNEUMONIA-LIKE DISEASE AT ST. ELIZABETH HOSPITAL IN WASHINGTON, D.C. AND IN PONTIAC, MICHIGAN. AFTER PURSUING THE KNOWN PATHOGENS OF PNEUMONIA, THE PUBLIC HEALTH AGENCIES SHELVED THE INQUIRIES IN ORDER TO PURSUE THE MORE IMMEDIATE AND PRESSING NEEDS THAT CONFRONTED THEM.

THE CLUSTER OF CASES THAT OCCURRED IN PHILADELPHIA WAS DIFFERENT. THE EPIDEMIC WAS DETECTED NOT BY THE PUBLIC HEALTH SURVEILLANCE SYSTEM, BUT

BY THE ALERTNESS OF THE PENNSYLVANIA ADJUTANT GENERAL FOR THE AMERICAN LEGION, WHO RELEASED THE DRAMATIC INFORMATION TO THE PRESS AT THE SAME TIME THAT IT WAS BEING REPORTED TO PUBLIC HEALTH AUTHORITIES. BECAUSE A WORLD-WIDE PUBLIC BECAME INVOLVED WITH THIS EPIDEMIC IN THE EARLIEST STAGES OF THE INVESTIGATION AND COULD NOT PUT THE AVAILABLE DATA IN PERSPECTIVE THERE FOLLOWED THE WILDEST KIND OF SPECULATIONS. MANY OF THESE COULD NOT BE IMMEDIATELY DISCOUNTED BECAUSE OF THE PRELIMINARY STAGE OF THE INVESTIGATION.

THE INTENSE PUBLIC INTEREST GENERATED BY BOTH THE DRAMATIC FACTS AND THE WAY THEY WERE PRESENTED BY THE NEWS MEDIA PUT THE PUBLIC HEALTH AGENCIES INVOLVED UNDER UNPRECEDENTED SCRUTINY AND PRESSURE. AS FOR THE PUBLIC, IT HAD DIFFICULTY SORTING OUT FACTS FROM SPECULATIONS, AND FROM DIFFERENTIATING SERIOUS RESPONSIBLE SPECULATION FROM UNINFORMED GUESSES.

I MIGHT ADD HERE THAT ONE NEGATIVE RESULT OF THE PUBLICITY WAS THE UNWARRANTED SHUNNING OF PHILADELPHIA IN GENERAL AND THE BELLEVUE-STRATFORD HOTEL IN PARTICULAR. THIS COST THE CITY MANY MILLIONS OF DOLLARS AND FORCED THE CLOSING OF A FINE OLD HOTEL, A PHILADELPHIA LANDMARK.

THE PUBLIC INTEREST AND MEDIA ATTENTION ALSO HAD SOME POSITIVE RESULTS. SOME EXAMPLES ARE:

-- THE PENNSYLVANIA DEPARTMENT OF HEALTH CONTINUES ITS INVESTIGATION OF THIS OUTBREAK TO THIS DAY. THE LEGISLATURE APPROPRIATED $250,000 AND WE HAVE SPENT ABOUT $152,000, THE BALANCE OF WHICH IS STILL ENCUMBERED.

-- CDC DID NOT SHELVE THE INVESTIGATION AFTER SEVERAL FRUITLESS MONTHS AS IT DID AT ST. ELIZABETH HOSPITAL AND AT PONTIAC, BUT CONTINUED ITS EFFORT, AND WAS REWARDED IN JANUARY WITH THE DISCOVERY OF A NOVEL BACTERIAL PATHOGEN.

MOST MICROBIOLOGISTS HAD HITHERTO BELIEVED THAT ALL BACTERIAL PATHOGENS HAD ALREADY BEEN DISCOVERED; AND OF COURSE, MUCH MORE HAS BEEN AND CONTINUES TO BE LEARNED ABOUT THE NEW BACTERIUM. THUS ANOTHER CAUSE OF ATYPICAL PNEUMONIA HAS BEEN DEFINED AND CAN NOW BE TREATED MORE EFFECTIVELY.

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IN PENNSYLVANIA, THE STATE DEPARTMENT OF HEALTH IMMEDIATELY LAUNCHED A FULL SCALE INVESTIGATION WHEN WE FIRST LEARNED OF THIS OUTBREAK. DURING THAT FIRST DAY WE GATHERED ALL THE EPIDEMIOLOGICAL INFORMATION AVAILABLE AND ENLISTED THE AID OF THE FEDERAL CENTER FOR DISEASE CONTROL. THE CENTER VOLUNTEERED ITS RESOURCES AND DIRECTED A 20-MEMBER EPIDEMIOLOGIC INVESTIGATION TEAM TO PENNSYLVANIA.

WITHIN HOURS OF RECEIVING NOTIFICATION OF THE OUTBREAK, A STATEWIDE NEWS CONFERENCE WAS CONDUCTED BY OUR STATE HEALTH DEPARTMENT TO INFORM THE PUBLIC AND THE NEWS MEDIA ALL WE KNEW ABOUT THE DISEASE.

I IMMEDIATELY DIRECTED THE DEPARTMENT'S FIELD STAFF, AND PARTICULARLY OUR PUBLIC HEALTH NURSES, TO CONTACT ALL HOSPITALS THROUGHOUT PENNSYLVANIA TO LOCATE ADDITIONAL LEGIONNAIRE CASES. HOSPITALS WERE ALERTED TO CALL THE STATE HEALTH LABORATORY IN PHILADELPHIA RELATIVE TO THE COLLECTION OF APPROPRIATE SPECIMENS. SPECIFIC ORDERS WERE GIVEN THAT TISSUES FROM THE DECEASED WERE TO BE PRESERVED WITHOUT FORMALIN AND KEPT REFRIGERATED. STATE POLICE AND NATIONAL GUARD HELICOPTER SERVICES WERE CONTACTED TO SPEED UP TRANSPORTATION OF SPECIMENS TO LABS IN PHILADELPHIA AND ATLANTA. IN VIEW OF THE RESOURCES AT MY DISPOSAL AT THE TIME, I FEEL THE PENNSYLVANIA DEPARTMENT OF HEALTH ACTED RESPONSIBLY AND AVERTED WHAT COULD VERY WELL HAVE BEEN A CONDITION OF STATE AND NATIONWIDE PANIC.

THE FACT THAT WE COULD TELL A CONCERNED PUBLIC AT A VERY EARLY POINT IN OUR INVESTIGATION THAT THE DISEASE WAS NOT CONTAGIOUS, THAT NO PERSON-TO-PERSON SPREAD WAS EVIDENT, WENT A LONG WAY TO CALM THE SITUATION.

THE PENNSYLVANIA DEPARTMENT OF HEALTH HAS LEARNED A GREAT DEAL ABOUT HOW TO HANDLE WIDESPREAD EMERGENCIES AS A RESULT OF THE LEGIONNAIRE'S DISEASE THAT I THINK ARE VALUABLE TO ALL STATE HEALTH DEPARTMENTS.

BASICALLY, WE LEARNED THAT THE TRADITIONAL APPROACH TO THE EPIDEMIOLOGY OF COMMUNICABLE DISEASES, AND THE USUAL RESOURCES, ARE SIMPLY NOT ENOUGH. TO DEAL AS WELL AS POSSIBLE WITH A PUBLIC HEALTH CRISIS OF THIS MAGNITUDE, THERE ARE SEVERAL BASIC NEEDS WHICH MUST BE FILLED.

FIRST, A STATE MUST RECOGNIZE UNDER THE CONSTITUTION ITS BASIC ROLE AND RESPONSIBILITY IN PROTECTING THE HEALTH OF THE PEOPLE WITHIN ITS BOUNDARIES. A STATE HEALTH DEPARTMENT MUST BE WELL FUNDED AND WELL STAFFED WITH TOP FLIGHT EPIDEMIOLOGISTS AND LABORATORY TECHNICIANS. THE INDIVIDUAL STATES MUST BE HELD RESPONSIBLE FOR THIS PRIMARY ROLE AND THE CENTER FOR DISEASE CONTROL AND OTHER FEDERAL AGENCIES SHOULD RESPECT THIS ROLE. I BELIEVE THE ROLE OF THE CENTER FOR DISEASE CONTROL SHOULD BE MORE CLEARLY DEFINED. FOR EXAMPLE, AT WHAT POINT DOES IT TAKE JURISDICTION, IF AT ALL, DURING A DISEASE OUTBREAK.

SECOND, A STATE HEALTH DEPARTMENT MUST HAVE IMMEDIATE TWO-WAY ACCESS TO RECOGNIZED EXPERTS IN THE FIELD, TO OTHER STATE HEALTH DEPARTMENTS, TO DEPARTMENTS WITH OVERLAPPING RESPONSIBILITIES, TO CDC AND TO OTHER FEDERAL AGENCIES AND INSTITUTES. IN PENNSYLVANIA, WE ARE NOW IN THE PROCESS OF INSTALLING A TWX--THAT IS, A TELETYPEWRITER SYSTEM WHICH WILL LINK OUR CENTRAL OFFICES, OUR FIELD LOCATIONS, OUR LABORATORIES AND THE CENTER FOR DISEASE CONTROL TO PROVIDE VIRTUALLY INSTANTANEOUS COMMUNICATION. WE DISCOVERED DURING LEGIONNAIRE'S DISEASE THAT TELEPHONES HAVE TWO BIG DRAWBACKS: IN A CRISIS SITUATION, IT IS EASY TO GET WRONG NUMBERS, BUSY SIGNALS, AND JUST PLAIN CROSSED WIRES. THEN WHEN WE DID GET THROUGH, FOR EXAMPLE TO CDC, WE RAN INTO PROBLEMS WITH MESSAGE CONVEYANCE AND RETURN CALLS. WITH OUR NEW SYSTEM WE WILL HAVE ERROR-FREE TRANSMISSION PLUS A WRITTEN RECORD. IN A CRISIS SITUATION, THIS WOULD ENABLE US IN HARRISBURG TO COMMUNICATE WITH OUR LABORATORY FACILITIES IN SOUTHEASTERN PENNSYLVANIA, WITH CDC IN ATLANTA, AND WITH ANY MEDICAL CENTER IN THE WORLD HAVING A TERMINAL--ALL INSTANTLY AND ALL AT THE SAME TIME.

THIRD, A STATE HEALTH DEPARTMENT MUST HAVE A MEANS OF COORDINATING RESEARCH AND PUBLIC INFORMATION EFFORTS TO PREVENT DUPLICATION OF ACTIVITIES, AND TO ENSURE THAT ALL INFORMATION RELEASED TO THE PUBLIC IS CORRECT, UP-TO-DATE, AND UNDERSTANDABLE TO THE PUBLIC. DURING THE SEVENTIES, PUBLIC HEALTH HAS BECOME A VIABLE SOURCE OF NEWS AND STATE HEALTH DIRECTORS MUST RECOGNIZE THIS AS A FACT OF LIFE. IN THE PUBLIC HEALTH SECTOR, PARTICULARLY WITH COMMUNICABLE DISEASES, WHAT THE PUBLIC DOESN'T UNDERSTAND OR DOESN'T TRUST CAN CAUSE FEAR AND SOMETIMES, EVEN PANIC. IT IS UP TO THE PUBLIC HEALTH SECTOR, BOTH ON THE STATE AND NATIONAL LEVELS, TO ALLAY THESE FEARS AS QUICKLY AS POSSIBLE. HERE AGAIN, A BETTER SYSTEM OF COMMUNICATIONS BETWEEN THE VARIOUS AGENCIES WOULD HELP GREATLY.

IN CONCLUSION, ONE OF THE MAJOR LESSONS THE PENNSYLVANIA DEPARTMENT OF HEALTH LEARNED FROM LEGIONNAIRE'S DISEASE IS THAT IF A PUBLIC HEALTH AGENCY IS GOING TO BE SUCCESSFUL, WE MUST HAVE THE COMPLETE TRUST AND SUPPORT OF THE PEOPLE. WE CAN'T ASSUME THIS TRUST. WE MUST EARN IT. AND THIS MEANS OPENING UP OUR LINES OF COMMUNICATIONS, IT MEANS WORKING WITH THE NEWS MEDIA AND IT MEANS COOPERATING WITH THE ENTIRE SPECTRUM OF AGENCIES WHO ARE GUARDING THE HEALTH OF THE NATION.

THANK YOU. AT THIS TIME I WILL BE HAPPY TO ANSWER ANY QUESTIONS YOU MAY HAVE.

# # #

Senator KENNEDY. Thank you, Doctor. Let me ask you how you view the role of the media in terms of the whole program? You were under the spotlight, so to speak, from day one. What is your assessment in terms of looking back over this period of time about the aspects which were constructive, which were helpful, which were informative, and the others that might have raised new kinds of fears?

Dr. BACHMAN. In the first place, I believe that the ultimate progress that we made has been because of the media. I believe certainly that the Pennsylvania Department of Health would never have invested the effort and energy that we invested if we hadn't been under the kind of pressure and scrutiny of the media, and I believe the same thing is true of the CDC. I don't say that in any bad way. I think that's just the reality of life for those of us that run public agencies. So I think they deserve very high marks for keeping this in the eyes of the people.

I believe that you can look over some of the reporting and it was very good. Some of the reporting was so sophisticated that 5 or 6 or maybe 7 years ago, a physician would have trouble understanding it; and yet here was the general public being exposed to this very good information, and I think there should be a lot of praise for some of the very good reports that came out. As in any field of endeavor, some of the reporting was very irresponsible, taking wild speculations, quoting people who had various axes to grind who rise at a time of public crisis like that, and some of that did take the attention of the agency away from its true job. For example, I remember very vividly, the 20 or so EIS officers who came to the State, all very idealistic, all very capable young physicians who were very jealous of the amount of time that they had to put in dealing with the media, which they felt that they could better put in following the disease, and it was very hard to communicate with them and say you have this part of the responsibility, too; you have to sort of balance and allocate your resources also.

Senator KENNEDY. Let me ask just a question here and I hope we hear from Dr. Sanford. How do you relate what was done in terms of the health department in Pennsylvania, relating to the work that was done in CDC? Was it basically complementary; were you limited because of resources? How would you describe those different functions?

Dr. BACHMAN. The Pennsylvania Health Department runs a laboratory with 100 employees, and we think in terms of the pursuit of excellence that we can compete on a man-for-man basis with this marvelous institute here at CDC, but in no way do we have the depth, the depth of a team that they have here. We need them. We, by the way, have been able to complement their work; we tried not to duplicate when that wasn't required, but frequently in science it is good to duplicate, and our ability to duplicate their discovery of the organism in March after they discovered it in January and we discovered it independently using their techniques was, I think, extremely valuable to the investigation.

We are pursuing an investigation with our limited resources that is somewhat different than the CDC but which will be complementary, and I think as other State health departments and other research laboratories get the organism, you are going to find a variety of other directions. That's the way science is, it's the ability of different peo-

ple to look at the problem somewhat differently that allows the matrix to grow about any scientific problem, so I believe we need this institution, we could not get along without it in the States.

Senator SCHWEIKER. Along the same line as Senator Kennedy's question, you mentioned, I think to put it in perspective here, the legislature appropriated $250,000 for your efforts, and you had to decide, of course, how to spend that. What is your approach in terms of spending that money; where do you put the priority, how do you best utilize $250,000?

Dr. BACHMAN. That's a difficult research question; it's similar to your problem in the NIH, and they use the peer review as to where you should make an investment in science. Even though the problem is a massive problem, if the chances of a payoff are very remote, you may not want to put an investment—and you may want to put an investment where the chances of payoff are greater even though the problem isn't as large. And I don't think you can answer it simply. We're making our decisions based on the advice of some highly technical specialists that we have in our State laboratories about what they think the best area to pursue is. They're using electron microscopy, and they're trying to study the organism; and they feel, looking at what the CDC is doing, that this should be where we should use that money best; but I guess it could be criticized, we could be doing more epidemiological investigation as the CDC is doing. We don't have as many cases as the whole country.

Senator SCHWEIKER. With that limited resource, it's a pretty tough question to answer, I would think. I have another question. You touched on a question that was asked before, and I would like to elaborate on it. I believe on page 4 of your testimony you said, "I believe the role of the Center for Disease Control should be more clearly defined. For example, at what point does it take jurisdiction, if at all, during a disease outbreak." I think—and you feel the same way I do—this is a pretty critical question, and I wonder if you would expand a little on what your thoughts are here.

Dr. BACHMAN. First, I'd like to say that I believe—being in State government, I believe strongly in States' rights and I believe that the power—the public health power to promote, protect the public health is clearly a right reserved to the States under the reserve powers of the Constitution and I believe that that public power—public power should continue in the States. However, even as a representative of a large State with more resources than many of the smaller States, we must recognize there are certain things that we cannot do alone. There are also certain problems that are a threat to the entire country even though they are only occurring in one State, and I believe there should be some ultimate authority for the CDC to decide that a State effort is not enough and that this is clearly of national significance, but I say that very cautiously because I don't want to see our States run over again from the Federal Government. I'm not as optimistic——

Senator KENNEDY. Just on that point, I think generally there are many, many areas of States' rights. But I would think in communicable disease that if there's one—they don't know State boundaries in terms of trying to fashion it, they're not trying to say there isn't an important role in terms of State functioning, working closely and all the rest, but I'm just somewhat interested in a distinguished public

health official drawing that point on this kind of an issue. I want to move along——

Dr. BACHMAN. I have been in my post and at the top level of State government for the last 6 years and, Senator, I would say that this issue is at the heart of a tremendous amount of our public health problems. Without going into detail, let me say across the gamut of public health issues that I deal with, we've got terribly difficult problems with Federal and State relations.

Senator KENNEDY. But in the communicable disease, which is really all we're talking about here today, that is the only——

Dr. BACHMAN. Communicable disease is an area of public health. There are some of my county health departments that resent, to some extent, the State health department which has a clear State law giving us responsibility. So I think it is an issue.

Senator KENNEDY. I am amazed that you would make that point on an issue like communicable diseases. There's a whole range of health care issues, questions that we have to deal with but it really amazes me, we're talking about something that was clustered in Pennsylvania, has hit up in Vermont, and even in Spain, that we make an issue about the factor. This is a Center that is concerned about trying to reach out in every area of the country and every area of the world. I just think that this is an issue that is of common concern to people in Chicopee, Mass., and Athens, Ga. But as I say, you've got limited time; I'll let you make your final comment on that and I'll let it lay.

Dr. BACHMAN. I'll make a final comment if you'll allow—if you wish me to.

Senator SCHWEIKER. It's a hearing, go ahead.

Dr. BACHMAN. I think that right even at this hearing there is a different perspective and that this issue is a very real one. I'm not saying where I come down on it, but those of us in Pennsylvania and Philadelphia are concerned about the Bellevue Stratford Hotel there. We might look at this in a local area very differently. The public health authorities in Spain at that resort may look at this very differently than the way they're looking at it here in Atlanta. Even in communicable diseases there are these local perspectives that are real and it is an issue.

Senator KENNEDY. Well to go back, to extend it one point. I think the CDC has taken the rap off Pennsylvania and your department, which I don't think you could have done.

Dr. BACHMAN. I think so.

Senator KENNEDY. I think that's part of the strength, if they say it down here with all the expertise, the confidence people have on it and I'm sure in Pennsylvania they have on it, I think it is relieved of an important burden where if your local group had said it, I don't know whether that would have had the credibility and I think it's this kind of interaction that we are trying to see.

Dr. BACHMAN. I think you're quite right, they do relieve the burden. On the other hand, the question once you begin to relieve a burden in an agency, it then at some point begins to feel irrelevant and then the agency might just become very weak. So I believe you're right and it is a delicate question. But there are some things I'd rather they not relieve us, let us fight our own battles. In other things, we're glad to have them.

Senator SCHWEIKER. One final point on another matter if I may. You quite rightly, Dr. Bachman, paid tribute to Edward Hoak, the commandant of the Legion in Pennsylvania. I think the record should show that because I think he spurred all of us on, including those in the Senate and the House and yourself and took a very forthright, clearcut stand. I think, and I think the record should show that for a long period of time the Legion very much resented the name Legionnaires' disease. I was under a great deal of pressure in my capacity to persuade CDC to change the name of Legionnaires' disease and find another label. As you may know, the Legion has changed its position and now that they have found that it is a national and international disease and in many other hotels besides the Bellevue, they have decided that it is a tribute to their fallen comrades and they would like to keep the name. I think that is a wise choice, but I think it does show the impact, on a community, on a people, on a town, a hotel, when you experience that kind of thing. So I think the record should show they're going to be proud on behalf of those who died in Philadelphia, to have it called Legionnaires' disease.

Senator KENNEDY. Dr. Sanford.

Dr. SANFORD. Mr. Chairman, I have a prepared statement. In the interest of time, it might be advantageous to you and your colleagues if I make a few remarks and touch the high points in that statement.

Senator JAVITS. Dr. Sanford, before you start, I had a couple of questions of Dr. Bachman before he leaves.

Senator KENNEDY. That'll be fine.

Dr. BACHMAN. That'll be useful to me, then I would leave.

Senator JAVITS. How did you disseminate the medical treatment, the criteria for diagnosis, et cetera, to the medical and hospital profession of your State?

Dr. BACHMAN. We have a monthly bulletin that goes out to every—well every physician, every osteopath, and every dentist in the Commonwealth. In addition, on Legionnaires' disease, we have sent them special newsletters going into great detail. That would go to every physician. We also have a publication known as Pennsylvania's Health, which comes out on a quarterly basis and there have been extensive reports in Pennsylvania's Health. In addition, throughout the State there have been a number of symposiums, conferences sponsored by the Pennsylvania Lung Association which have been very useful in disseminating information.

Senator JAVITS. With respect to determining priorities, did you consult in any way with the State nonmedical authorities?

Dr. BACHMAN. I was in contact with the Governor on a daily basis and with other members of the cabinet. In fact I called all of the other cabinet officers who dealt with any kind of health problems and gave them a couple of briefings the first week. The legislature seemed to want to stay away from it, especially during that time. The little contact I had with them at that time was that this was an emergency and that they didn't feel they wanted to be involved at that time. Later on, of course, they became involved and they went ahead and appropriated money.

Senator JAVITS. I was thinking more about the advice as to what should be the priorities.

Dr. BACHMAN. The Governor was involved, the other cabinet members were, but it was particularly what I would call the executive committee of the health department.

Senator JAVITS. Primarily it was your decision and there was very little input?

Dr. BACHMAN. No; I find that in an emergency like that, the Governor had ideas, he's a very imaginative man, he had many ideas, some of which we agreed with and some we didn't, but when I disagreed with him, he never seemed to indicate that he wanted his ideas followed through rather than ours.

Senator JAVITS. In other words, wouldn't it be fair to say then, Doctor, that unless there was a responsibility imposed by some orderly process, procedure, or law, that the Governor would not be likely to participate?

Dr. BACHMAN. I think the law clearly gives him the authority to order or direct me, I'm appointed by him and responsible to him and his staff and he decided that they wanted to go in a different direction—and that occurs in non-Legionnaires' matters too—they have that ultimate responsibility and I will either go in that direction or if I so greatly disagree I have the prerogative I suppose of resigning.

Senator JAVITS. But it seems that the civil authorities, the nonmedical authorities, didn't show any particular desire to participate in that decision as to priorities?

Dr. BACHMAN. They did want to partcipate but not as to priorities. They did want to be kept informed and that was clear. The Governor—I notified him the first day and he wanted reports from me on a regular basis and I gave them. So he definitely wanted to be kept informed and he had ideas, some of which we thought were good, but I did not feel that he wanted to take over the direction of it.

Senator JAVITS. Well we're using words semantically which are important, but I'm only thinking about priorities. You established the priorities—you and your committee essentially—did you not?

Dr. BACHMAN. Yes.

Senator JAVITS. And there was no effective participation by the nonmedical authorities. That's neither bad nor good, it's just a fact.

Dr. BACHMAN. I would agree, but they just didn't have the background to participate.

Senator JAVITS. That's all I want to know. Of course we'll have to think about that, it's a very critical element in what happens. My last question is as to the availability of the treatment. I gather this particular drug came to the attention of your department and others later, after the emergency, is that correct?

Dr. BACHMAN. That's correct.

Senator JAVITS. What steps do you take to see that that is available?

Dr. BACHMAN. Erythromycin is a common drug.

Senator JAVITS. So there's no problem.

Dr. BACHMAN. No.

Senator JAVITS. Good.

Senator KENNEDY. Dr. Sanford. Thank you very much, Dr. Bachman.

Dr. SANFORD. Senator, I think it is important for you to recognize that I am here not representing either the Uniformed Services University or the Department of Defense, but rather as an individual who

is trained in infectious disease both in the laboratory and clinical point, as an individual who actually had only very tangential contact with Legionnaires' disease during that August of 1976.

I subsequently have served on two of the advisory groups which have been convened here at the Center.

What I'd like to do, and I'm not going to follow this prepared presentation, but rather to present two broad questions and finish with a hypothesis.

The first question is one which I think I have heard this morning on several occasions and that is, was there too much done, was the commitment of the resources from the Center for Disease Control and Pennsylvania Health Department into a problem which originally appeared only to involve some 182 persons, a justifiable commitment. What I'd like to do is to speak in terms of certain analogies which may put this into better perspective.

Dr. Foege has already mentioned the disease histoplasmosis, a disease which in the 1930's we thought was a uniformly fatal disease. With further investigation it was found that this is a disease whose organism is widespread throughout the center part of the United States, in the area of North Carolina, along the St. Lawrence River. We now know that there are literally millions of cases, only a very few of whom have fatal disease and that the organism, interestingly enough, resides in soil as he pointed out, and one may see small clusters of cases of what initially appeared to be a very serious disease we now recognize that it is common, have developed forms of therapy and forms of control.

Another example might be the summer of 1942 at Fort Bragg, North Carolina, an outbreak of disease that involved some 40 troops with a 10 percent attack rate. This disease was known as Fort Bragg fever. Some of the best minds in the United States at that time were brought in on this. Dr. Topping, who I believe subsequently served as Surgeon General of the Public Health Service, Dr. John Paul from Yale, Dr. Albert Sabin were involved in this investigation. They finally felt that it was of viral etiology, they had been able to transmit the disease to volunteers. It was only 9 years later that the late Dr. Joe Smadel, in looking at medical records, said, you know, that looks like it might be another bacterial disease, leptospirosis. He sent a note to his people who had stored the specimens. They tested them and one year later they demonstrated that in fact this bacterium known as leptospira was causing the disease. From this there emerged a means of potential control and means of therapy. Again, it is interesting that therapy may in fact involve one of the same drugs, erythromycin. Here we have a 10 year hiatus between occurrence of the disease, stored specimens and the development of an answer. A situation which I suppose looking in retrospect may be applied here, though I think there are major differences. At the bottom line, it clearly represents an important scientific breakthrough.

The second example I thought that I would give is one, Senator Javits, to which you referred, that is primary atypical pneumonia, which in the early 1940's was a very serious problem. There was a major epidemic that occurred in the winter of 1941, early in 1942 at Camp Claiborne, Louisiana. A commission was established which studied this, the commission actually was assigned to Fort Bragg.

Very extensive studies were carried forth, they were able to transmit the disease, to define the symptoms of it, but could not define much in terms of treatment or for that matter even prevention, but they understood it. It was some 10 years later that actually an organism was found. In 1955, with advances in technology, a virus known as adenovirus, type 4 was isolated. They went back to the specimens and clearly showed that a great number of the troops that had the disease then had in fact adenovirus, type 4. They subsequently showed that this is what they had transmitted to volunteers. Yet another 10 years later, Dr. Chanock at the National Institute of Allergy and Infectious Disease developed a vaccine. We are now, 30 years later, we have all of our basic trainees now receiving a safe live attenuated vaccine and frequency of the disease has been cut by more than 50 percent in military recruits. But here is a time schedule of 1941–42, 1955, 1965 and coming into the 1970's before a vaccine itself was applied or known to be safe and effective.

Senator KENNEDY. Senator Schweiker and I are going to have to catch a plane to go down to Miami to continue our field hearings. Senator Javits was good enough to indicate that he had some questions so he will continue after we depart.

In your presentation on page 5, you have some extremely important comments on the current situation and I am wondering if you would either read through that or summarize that material because I think it is directly related.

Dr. SANFORD. I will try to summarize, Senator, and let me emphasize that what I am proposing is a hypothesis and I think it's important as a hypothesis which can be tested but like all hypotheses may be wrong. However, hypotheses form the basis of science and one has something then that we can test. The hypothesis certainly is compatible with all the information that you have heard and that we have heard and this is:

The organism which causes Legionnaires' disease, the Legionnaires' bacterium if you will, is most likely to be present in the soil. I think it may well be trapped in oil such as is used on air-conditioning filters. It may have a unique ability to survive and/or to grow in oil, but this is not necessary. It is present in the soil. It is then aerosolized through air-conditioning or other air-handling equipment into the lungs of susceptible individuals. Now whether a person develops disease or not would be determined (1) by the dose of the organism that they got, (2) by the condition of their lungs. I should point out that we know certain things reduce resistance to infection in the lungs, smoking we know does this, alcohol abolishes the immune functions of the lungs, a variety of medical conditions for which people might well be in hospitals, all interfere with these immune functions and it may well be that this is why we saw in Philadelphia the disease occurring among an older age group, many of whom were heavy smokers and you will recall from the studies that there was a close correlation with cigarette smoking and this may well have interfered with their lungs ability to handle this. I think the importance of looking at a hypothesis such as this is that it allows it to be tested.

As you heard the reports from Dr. Foege, one may find whether or not this present organism is present in soil, you may find means of

control, I would submit that if in fact air-handling equipment is important, that there are no policies whatsoever that exist in terms of air-handling equipment. This does not come as a medical device or anything. We have very strict regulation regarding dishwashing and other public health practices regarding public locations and yet there are none regarding air-conditioning. Perhaps from this we can develop a basis of knowledge which will allow rational control. Most important, I think the efforts thus far have done much to strip away some of the fear with the disruptive consequences of Legionnaires disease. Certainly this is true if we can find that the organism is relatively widespread and that there are unique circumstances underlying the outbreak in Philadelphia or St. Elizabeths or Pontiac.

I thank you for this opportunity.

Senator SCHWEIKER. How does that relate to the Spanish Hotel and St. Elizabeths which had no air-handling equipment?

Dr. SANFORD. I would relate it to St. Elizabeths by saying that the organism is present—I think present in the soil, I think the only thing that air-handling equipment may do, as you know commercial air-handling equipment normally has steel filters which you coat with oil so that they trap particulate matter better. As they tend to get clogged; you have air moving through there and generating small particles which people can inhale, and we know this is one of the best ways to deliver infectious organisms to people. This is why in the time of biological agents that one was thinking about delivering them by aerosols.

It can well represent changes in air-conditioning practices, is one speculation—I am purely speculating. It may well be that there is much more disease there, and because of the presence of air-conditioning in that part of the country for long periods that people were exposed just as Bellevue Stratford employees, and that that accounts for the differences unless you happen to be a transplant patient, and then you may be susceptible and acquire disease.

Senator KENNEDY. Well, I think as one of the distinguished researchers, we welcome your comment and your theory or your hypothesis. You would agree with us that there is still a lot of mystery left in this disease, would you not?

Dr. SANFORD. I think it's 99 percent mystery at this stage; yes, sir.

Senator KENNEDY. And although some important, enormously significant breakthroughs have been evidenced both here at this Center with the very distinguished work, and also in Pennsylvania, that this is going to continue to be a matter of concern both to this Center and certainly to States and to doctors as well as consumers in any period of the future—immediate future—and very extensive and strenuous preventive steps have to be taken. We certainly have to be alert to this problem; doctors have to be alert to it, this Center has to be alert to it, and we certainly work closely with this Center and with the medical profession on ways that we can.

We're going to have to excuse ourselves, but Senator Javits will continue. I want to thank you, Dr. Sanford; we will take your testimony.

I want to thank personally again all those here. We are hopeful now that you will remain, those that can, and continue with the hearing. Senator Javits will chair.

I don't think any of us could come to Georgia without feeling the extraordinary sense of sadness which has affected the people of Toccoa

in these last few days. We meet here and we're concerned about problems, health problems of the past, people that have suffered death, tragedies, families that have been impacted, but no one could come to your State without feeling the sense of sadness and loss of the people in a small community, many young people who had been studying the Bible, pursuing careers in religious beliefs, and I think all of us have been impressed as we have seen in the media and on television the extraordinary sense of resilience and faith exhibited by those individuals who suffered tragically. The father who I saw on television the other evening who lost his wife and three small children, I think it's a story of enormous tragedy and sadness, so I think it is only appropriate that we recognize that and of course extend our sympathy to the families and those who have been impacted.

We want to thank you very much, Doctor, and I'll ask Senator Javits to continue.

Senator JAVITS. Give us 1 minute, Doctor.

[Brief pause.]

Senator JAVITS. Dr. Sanford, let me, too, thank you for your testimony and also express my sympathy on behalf of the minority to the people of the State of Georgia for the tragedy in Toccoa.

I am very interested in the techniques of the Armed Forces respecting two of the matters about which I questioned the other witnesses; that is, how did the Armed Forces determine the priorities when faced with an emergency of this character, and to what extent is there participation by nonscientific communities in the decision as to what resources to allocate in meeting an emergency like this?

Dr. SANFORD. Senator, actually in terms of Legionnaires' disease, there is a commitment and involvement, but I would like to actually address the question directly. In the event of an emergency, there is usually at the highest level an assessment as to the magnitude, the impact, that this will have on the mission; and if it is believed that it then has a major impact on the mission of one of the units within the department and that it is health related, there is in existence a Department of Defense Health Council, the membership of which consists of the Assistant Secretary for Health Affairs, the three Surgeons General, a representative of the Joint Chiefs of Staff and a representative from the Uniformed Services University, of which I am a member. They then would look at this in terms of overall priority and make recommendations. Within the research establishment itself, there are groups of scientists who have the opportunity on a regular basis to review in detail a program. I have participated in two such reviews within the last month in terms of what priorities should be established for the allocation of resources, and these are based upon the information which is available as to the importance of the problem and the likelihood of being able to come forth with a solution.

Senator JAVITS. I appreciate your answer. Possibly such a process should be included in the public health legislation, because I deeply feel that the non-scientific input into the decision which is both scientific and social is critical. I appreciate very much the organization in the services which as always is extremely instructive as to how things can be better organized.

The other question I wanted to ask is, is there any problem about the distribution of the essential treatment information and the essen-

tial drugs in the Armed Forces? I would assume that's even less of a problem than it is in the civilian community.

Dr. SANFORD. There is no problem. The antibiotic agent, erythomycin, which you heard, actually as I recall was licensed in 1948 or 1949, it is a very widely used drug worldwide, and there are adequate resources. It's available in virtually any drugstore in the United States.

Senator JAVITS. Is there any interservice problem of cooperation in the Army, Navy, Air Force, Marines?

Dr. SANFORD. I would be naive to say that there was not or you wouldn't believe me if I said there was not some degree of competition. I think the services obviously do speak and collaborate, particularly in the health area and this Department of Defense Health Council is an effort in improving communications. It should be pointed out that representatives from the Army Research Institute of Infectious Diseases at Fort Detrick have been here at the Center, have worked with the people and actually have that organism there in that facility and since they have great expertise in the area of producing infections by aerosols and also one of the best if not the best facility in this country to handle hazardous organisms. Their program is to proceed to study this organism in higher animal species and see what one can learn which may shorten some of the lagtime. I know the degree of cooperation there is very close.

Senator JAVITS. I am also interested in the relationship with the armed services of other countries. For example, is there any medical element in NATO?

Dr. SANFORD. Yes, sir, there is.

Senator JAVITS. How do you relate to that?

Dr. SANFORD. Actually there are liaison medical officers in each of the individual NATO countries as well as in NATO headquarters, so that there is in fact reasonably close liaison on an ongoing basis.

Senator JAVITS. Is this a two-way channel? Do you learn from it and transmit through it?

Dr. SANFORD. Yes, sir. There are British, Canadian, and other NATO officers actually assigned in the Washington area that—whom we see on a very regular basis.

Senator JAVITS. Did that occur regarding Legionnaires' disease?

Dr. SANFORD. Senator, I do not know.

Senator JAVITS. What about feedback of information of this nature? What have we learned through the international AID activities of the United States?

Dr. SANFORD. None directly, sir. I think that Dr. Foege's comments about having material going into the World Health Organization epidemiologic record is the major channel for such information, but I am uninformed.

[The prepared statement of Dr. Sanford, and additional material supplied for the record follows:]

Statement

by

Jay P. Sanford, M.D.

Dean, School of Medicine
Uniformed Services University of the Health Sciences

Before

Committee on Human Resources
Subcommittee on Health and Scientific Research
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Mr. Chairman, and members of the Committee. I am Dr. JAY P. SANFORD, Dean, School of Medicine, Uniformed Services University of the Health Sciences. I am not here before you representing either the Uniformed Services University or the Department of Defense, but rather as a physician-scientist trained in microbiology and infectious diseases. I am happy to have the opportunity to appear before you to comment on Legionnaires Disease from the perspective as an individual who during August 1976 was not intimately involved at either the local, state or national level.

My presentation will be in the form of responses to two broad questions and an hypothesis.

The first question is did we do too much? Was the commitment of the considerable resources both from the standpoint of personnel, facilities and money to investigation of Legionnaires Disease which initially appeared to involve only 182 persons in Philadelphia justified from the overview of a national health or even infectious diseases problem. It would perhaps be advantageous to place Legionnaires Disease in the context of several similar problems to provide a perspective not yet possible with Legionnaires Disease.

In the summer of 1942 an illness was observed among troops at Fort Bragg, North Carolina with 40 cases being reported. A similar disease had probably occurred in Wren, Georgia in 1940. This disease appeared

in epidemic form with almost 10 percent of officers and men in a given company infected within a period of two weeks. A commission of experts which included Dr. Norman Topping of the U.S. Public Health Service, and Dr. John R. Paul of Yale School of Medicine, and with the assistance of Dr. Albert Sabin was assigned to study the disease, known as Fort Bragg Fever. Initial studies including volunteer transmission strongly suggested a viral cause. However, in 1951 Dr. Joseph Smadel in reviewing Fort Bragg Fever wondered if it might be caused by a leptospira; specimens which had been stored were tested and an unknown was unraveled. The following year, research investigators from the then Army Medical Service Graduate School successfully identified the causative agent as a type of bacterium, Leptospira autumnalis. This bacterium was known to cause disease elsewhere in the world, with somewhat differing symptoms. The result was an understanding which would enable prevention and possibly treatment. It should be noted that despite the concerted efforts of experts and a great deal of careful work that the investigations proceeded along the wrong track for a considerable interval, almost ten years. Yet the end result, the bottom line, represented an important scientific accomplishment.

Another example. As a result of the recognition of respiratory illnesses designated as "primary atypical pneumonia, etiology unknown" at Camp Claiborne, Louisiana, in the winter of 1941-1942, the Commission

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on Acute Respiratory Diseases was established by The Surgeon General of the Army. This group defined many clinical and epidemiological aspects of acute respiratory disease but did not identify, for the most part, specific causative agents. However, as a consequence of foresight in the storage of specimens from 1942-1946, more recently developed laboratory techniques could be and were applied. In 1955, it was shown that type 4 adenovirus had been an important cause of the acute respiratory disease and that this was the agent responsible for illness transmitted to volunteers. In 1965, an adenovirus type 4 vaccine was developed by Dr. Chanock and his associates which was shown to be safe and effective in protecting military recruits. Beginning in January 1971 these adenovirus type 4 and 7 vaccines have been administered to recruits at all 8 Army basic combat training posts with a 50 percent reduction in acute respiratory disease rate. Note that in 1941-1942 the problem was recognized. Not until 10 years later, was the causative agent unequivocally confirmed, and another 10 years passed before a safe effective vaccine was developed. The vaccine is now in use, with a great reduction in illnesses and military training costs.

If the Pennsylvania State Health Department and the Center for Disease Control had not initiated extensive clinical, epidemiological and microbiological investigations in Philadelphia in August 1976, an agent would not have been isolated in January 1977. If an agent had not

been isolated, the outbreak in Philadelphia which resulted in the closure of a major hotel would have remained Legionnaires Disease. However, it is now recognized that disease caused by this bacterium had previously occurred in patients at St. Elizabeth's Hospital in Washington, D. C. in 1965 and had caused disease in Pontiac, Michigan which was not associated with pneumonia. The subsequent clusters of cases as well as individual cases have indicated that the bacterium is widespread in the United States but that person-to-person transmission of the disease has not occurred. I would conclude that a great deal has been accomplished in Legionnaires Disease in a short time interval.

A second question might be, did we do enough? Has not the Center for Disease Control moved too slowly in its efforts? I have already pointed out that the progress has been quite rapid, at least in comparison with many other infectious disease problems. The progress which has been made had to proceed cautiously until the infectious hazard of the isolated bacterium was determined. At the time of the initial reported isolation of the bacterium on January 18, 1977, it was not at all clear as to how great a hazard this organism represented to laboratory workers. Since the mortality in Philadelphia was 16 percent, might serious infection occur in laboratory workers, as is a known potential problem with agents such as that causing Lassa Fever, which was also in the news. Until the potential hazard of the bacterium to laboratory workers had been defined, restriction of its distribution seems most prudent.

In conclusion, I should like to present a speculative hypothesis. It is that the bacterium which causes Legionnaires Disease is present in soil and that it may have the ability to survive and grow in oil. Collected and trapped in the oil used on commercial air conditioning filters, it may grow and then be sprayed as an aerosol. When inhaled by susceptible persons, it causes Legionnaires Disease. Factors which are known to decrease the resistance of the lungs to infection which include cigarette smoke and alcohol as well as medical conditions result in some individuals who are exposed developing disease, while others may not.

You must understand that my guess while consistent with presently known facts may be quite wrong, I present it to make these points:

1. The story is by no means finished.

2. Testing the hypothesis will require development of new techniques which might prove generally useful, not only with regard to Legionnaires Disease but elsewhere in medicine.

3. Verification of the hypothesis might:

    a. Point the way to rational control.

    b. Reveal other infections which are similarly transmitted.

    c. Strip away public fear, with its disruptive consequences such as the closing of hotels and the boycotting of cities.

If air handling equipment plays a role, then standards could be developed; at present there are standards for procedures such as glass washing in hotels but there are nonefor air handling equipment. On the

other hand, if air handling equipment does not play a role, establishment of standards to avoid a "non-hazard" are not justified. Only through the development of a body of knowledge, which is consonant with the clinical and epidemiological observations can rational control be developed and can the public reaction to what appears to be an Andromeda strain be avoided.

I thank you for the opportunity to appear before you and stand ready to answer any questions which you may have.

Sporadic Cases of Legionnaires' Disease

Reported to the Center for Disease Control Through November 4, 1977

Case No.	Age	Sex	City	State	Date Onset	Outcome
1	34	M	Detroit	Michigan	8/17/76	Survived
2	32	M	Shelbyville	Indiana	10/5/76	Died
3	39	F	Flint	Michigan	12/23/76	Died
4	60	M	Long Beach	California	1/1/77	Survived
5	67	M	Knoxville	Tennessee	1/17/77	Died
6	31	F	Burlington	Vermont	8/11/77	Died
7	43	M	Fountain Valley	California	3/25/77	Survived
8	44	M	Stowe	Vermont	3/1/77	Survived
9	57	M	Monmouth Junction	N. Jersey	3/18/77	Survived
10	61	M	Bellingham	Washington	4/5/77	Died
11	45	M	St. Louis	Missouri	5/10/77	Survived
12	53	M	Concord	Massachusetts	5/16/77	Survived
13	63	M	Boston	Massachusetts	8/20/76	Survived
14	56	M	Norwood	Massachusetts	5/12/77	Survived
15	58	F	Ostrander	Michigan	4/26/77	Survived
16	51	M	Springfield	Missouri	5/31/77	Survived
17	56	F	Natick	Massachusetts	9/7/76	Survived*
18	69	M	Oosberg	Wisconsin	5/3/77	Survived
19	31	F	Mebane	N. Carolina	7/1/77	Survived
20	45	M	Nantucket	Massachusetts	4/22/77	Survived
21	31	M	Merritt Island	Florida	6/2/77	Survived
22	51	M	Grosse Point Woods	Michigan	5/29/77	Survived
23	50	M	Jamesburg	New Jersey	5/26/77	Survived
24	53	M	St. Mary's	Philadelphia	3/27/77	Survived
25	59	M	Sedalia	Missouri	7/1/77	Survived
26	47	M	Washington	D.C.	6/15/77	Died
27	53	M	Peoria	Illinois	7/21/77	Survived
28	72	M	Bakersfield	California	1/6/77	Survived
29	55	M	Washington	D.C.	8/11/77	Survived
30	54	M	Indianapolis	Indiana	8/17/77	Survived
31	66	F	Kenosha	Wisconsin	8/26/77	Died
32	58	M	St. Helena	California	8/15/77	Survived
33	51	M	Silvis	Illinois	8/22/77	Died
34	46	F	Milwaukee	Wisconsin	8/12/77	Survived
35	62	M	New Brunswick	New Jersey	7/11/77	Survived
36	70	F	Philadelphia	Pennsylvania	7/18/77	Survived
37	50	M	Philadelphia	Pennsylvania	7/20/77	Survived
38	52	M	Bastrop	Texas	8/5/77	Survived
39	55	F	Albuquerque	New Mexico	8/31/77	Died
40	47	F	Grosse Point Farm	Michigan	8/21/77	Survived

41	61	M	Hot Springs	Arkansas	5/20/77	Died
42	46	F	Washington	D.C.	8/16/77	Survived
43	46	M	Melrose	Massachusetts	8/23/77	Survived
44	68	F	New York	New York	9/11/77	Survived
45	63	M	Dawson	Georgia	9/5/77	Died
46	60	M	Little Rock	Arkansas	7/21/77	Survived
47	37	F	Knoxville	Tennessee	9/20/77	Survived
48	31	M	Hyannis	Massachusetts	9/18/77	Survived
49	33	M	Newtown	Connecticut	8/2/77	Died
50	50	M	Nashville	Tennessee	9/19/77	Survived
51	35	M	Columbia	Tennessee	9/21/77	Died
52	60	M	Louisville	Kentucky	6/11/77	Died
53	69	M	Huntsville	Alabama	9/16/77	Died
54	51	M	Atlanta	Georgia	7/24/77	Survived
55	46	M	New Castle	Colorado	9/77	Survived
56	62	M	Milwaukee	Wisconsin	9/13/77	Survived
57	65	F	Attleboro	Massachusetts	8/23/77	Survived
58	42	M	Ipswich	Massachusetts	9/15/77	Survived
59	49	M	Gary	Indiana	9/2/77	Survived
60	53	M	Los Gatos	California	6/25/77	Died
61	65	F	Longview	Texas	9/29/77	Survived
62	43	M	LaCrosse	Wisconsin	9/8/77	Survived
63	67	F	Wellesley	Massachusetts	8/9/77	Survived
64	25	M	Boston	Massachusetts	6/3/77	Survived
65	67	M	Bismarck	North Dakota	9/77	Survived
66	54	F	Watertown	Wisconsin	9/23/77	Survived
67	**	M	**	Indiana	**	Survived
68	67	M	Toledo	Ohio	8/77	Survived
69	60	M	Bridgeport	Connecticut	9/13/77	Survived
70	63	M	Homestead	Florida	10/10/77	Survived
71	74	F	Cleveland	Ohio	8/76	Survived
72	81	F	Dayton	Ohio	5/77	Survived
73	40	M	Mayfield Heights	Ohio	8/30/77	Survived
74	75	M	Willard	Ohio	8/18/77	Survived
75	36	F	Marysville	Ohio	** /77	Survived
76	59	M	**	Ohio	9/29/77	Survived
77	75	F	**	Ohio	9/7/77	Died
78	71	M	Philadelphia	Pennsylvania	9/4/77	Survived
79	73	M	Youngstown	Ohio	** /77	Survived
80	64	M	San Anselmo	California	** /77	Died
81	53	M	Bourbannais	Illinois	9/19/77	Died
82	56	M	St. Anne	Illinois	9/21/77	Died
83	42	M	N. Hollywood	California	** /77	Died

* Patient died several months later of causes not directly attributed to Legionnaires' disease

** Confirmed by laboratory - epidemiologic data incomplete pending results of investigation by State.

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PUBLIC HEALTH SERVICE-CDC-Atlanta
EPI-76-101-2 March 21, 1977

TO: Director, Center for Disease Control

FROM: Bureau of Epidemiology and Bureau of Laboratories

SUBJECT: Legionnaires' Disease, Philadelphia, Pennsylvania

PREFACE

This report summarizes epidemiologic and laboratory investigations conducted between August 2 and December 31, 1976. Isolation of a bacterium-like agent that appears to be the cause of Legionnaires' disease was announced on January 18, 1977. The organism also appears to be antigenically linked to previous outbreaks of respiratory disease. The reader should recognize that this is a report of the status of the investigation prior to that discovery. A subsequent report will discuss the laboratory findings and the epidemiologic characteristics of persons with evidence of exposure to the bacterium isolated.

SUMMARY

An outbreak of 180 cases of febrile respiratory illness with 29 deaths occurred in Philadelphia in July and August 1976. One hundred forty-nine of the cases were in persons who had attended an American Legion Convention held at Hotel A and the remainder had all entered the hotel. Results of the epidemiologic investigation indicated that continuing common-source transmission occurred during the convention, and that age, delegate status at the convention, and spending time in Hotel A were determined to be risk factors for illness. No mode, place, or vehicle of transmission could be incriminated with certainty. The outbreak terminated spontaneously, and no spread to the City of Philadelphia was found.

INTRODUCTION

On August 2, 1976, Sidney Franklin, M.D., Veterans Administration Clinic, Philadelphia, Pennsylvania, telephoned Robert Craven, M.D., EIS officer, National Influenza Immunization Program, Atlanta, to inform him of 11 deaths among persons who had attended the American Legion Convention held in Philadelphia July 21-24. More than 40 other cases of febrile respiratory disease among conventioneers were known at this time. After discussions with Philip S. Brachman, M.D., Director, Bureau of Epidemiology, and J. Donald Millar, M.D., Director, Bureau of State Services, and with the invitation of William Parkin, D.V.M., Pennsylvania State Epidemiologist, Robert Sharrar, M.D., Chief, Communicable Disease Control, City of Philadelphia, and Eleanor Streiff, R.N., Pittsburgh City Epidemiologist, Dr. Craven, Philip Graitcer, D.D.S., EIS officer, National Influenza Immunization Program, and Theodore Tsai, M.D., EIS officer, Special Pathogens Branch, Bacterial Diseases Division, departed Atlanta the afternoon of August 2 for Pittsburgh, Philadelphia and Harrisburg, respectively. There Dr. Tsai joined H. James Beecham, M.D., EIS officer, Field Services Division, located at the Pennsylvania Department of Health and Dr. Graitcer joined with John Harris, M.D., Field Services Division located at the Philadelphia City Health Department, to initiate the investigation. At 9:30 P.M., August 2, David J. Sencer, M.D., Director, Center for Disease Control, convened a meeting to discuss further CDC response to the outbreak. Accordingly, on August 3, David W. Fraser, M.D., Chief, Special Pathogens Branch, Bacterial Diseases Division, Stephen Thacker, M.D., EIS officer located at the District of Columbia Health Department, David Heymann, M.D.,

EIS officer, Immunization Division, Edward Smith, M.D., EIS officer, Field Services Division located at the Florida State Health Department, Philip Rettig, M.D., EIS officer, Field Services Division, located at the Delaware State Health Department, and Cathryn Samples, M.D., EIS officer, Field Services Division, located at the Connecticut State Health Department, departed to Harrisburg; Michael Shasby, M.D., EIS officer, NIOSH, and James Marks, M.D., EIS officer, Field Services Division located at the Ohio State Health Department, departed to Pittsburgh; and Mark Goldberger, M.D., EIS officer, Field Services Division, assigned to the Maryland State Health Department, William Halperin, M.D., EIS officer, Field Services Division, located at the New Jersey State Health Department and Walter Orenstein, M.D., Medical Epidemiologist, Immunization Division, departed to Philadelphia to assist in the ongoing investigation. On August 4, Richard Keenlyside, M.D., EIS officer, Viral Diseases Division, Robert Gunn, M.D., EIS officer, Enteric Diseases Branch, Bacterial Diseases Division, Gregory Hayden, M.D., EIS officer, Immunization Division, Carlos Lopez, M.D., EIS officer, Parasitic Diseases Division, Marshall Goldberg, M.D., EIS officer, Cancer and Birth Defects Division, and James Shelton, M.D., Program Evaluation Branch, Family Planning Division, departed Atlanta for Philadelphia to further assist the investigation. On August 5, George Mallison, M.P.H., Assistant Director, Bacterial Diseases Division, departed Atlanta for Philadelphia to assist in environmental evaluation. On August 5, Stanley Martin, M.S., Chief, and Linda Asher, Statistical Assistant, Statistical Services Branch, departed Atlanta for Harrisburg and Dennis Bregman, M.S., Chief, Statistical Services, Viral Diseases Division, departed Atlanta for Philadelphia to assist in statistical aspects of the investigation.

BACKGROUND

The 58th Annual Convention of the American Legion Department of Pennsylvania was held in Philadelphia July 21-24, 1976. The headquarters of the convention was in Hotel A. During the same period, the 56th Annual Convention of the American Legion Auxiliary, Department of Pennsylvania, was held in Philadelphia, with headquarters in Hotel D. Persons who attended the conventions included American Legion delegates, members of the Ladies Auxiliary, family members, and other Legionnaires with no formal role at the conventions. Delegates were nominated to attend the convention by each of the 1,002 local posts--1 delegate for each post, plus 1 additional delegate for every hundred post members--and were then given credentials by the Department of Pennsylvania. The prime official activity of delegates was to vote for officers. Several months prior to the convention delegates could pre-register for hotel rooms by arrangement with state officials; most of those who did so registered at Hotel D.

The major official activities of the American Legion Convention are shown in Table 1. Numerous other official activities included committee meetings, a Women Legionnaires' luncheon, regional caucuses, and Past Department Commanders' breakfast. A major form of unofficial activity centered around hospitality rooms. Each of 13 candidates for major office reserved a room or a suite of rooms in Hotel A for entertaining delegates. Most of the hospitality rooms were open for 3 or 4 days of the Convention. Liquor--most commonly beer and whiskey with or without mixers--was served along with pretzels, potato chips, and other simple snacks. Ice was in short supply and often had to be purchased by the Legionnaires from an assortment of Philadelphia suppliers. Each district and many of the local posts had their own hospitality rooms, which were scattered throughout several hotels.

Each delegate was permitted to purchase for $3.50 a Delegate Souvenir Pack which contained the convention program, an admission ticket to the Commander's Ball, brochures concerning sightseeing opportunities, a souvenir ballpoint pen, a plastic credit card case, a pack of 6 Merit filter cigarettes and a metal and ribbon delegate badge. It was the last item that was generally considered the reason to purchase the souvenir pack, as it could be worn in future years as evidence that the Legionnaire had been a delegate to the 58th Annual Convention. One other souvenir, a glass mug, was given to persons who attended the Go-Getter's Breakfast.

TABLE 1

Calendar of Events of 58th Annual Convention
of American Legion, Department of Pennsylvania

July 21 -	10:00 A.M. -	Beginning of registration of delegates and alternates - Hotel A, 1st floor lobby
	8:00 P.M. -	Joint Auxiliary and Legion meeting - Hotel A Grand Ballroom
July 22 -	10:00 A.M. -	Opening session - Hotel A Grand Ballroom
	7:00 P.M. -	Testimonial dinner - Hotel D Ballroom
July 23 -	7:30 A.M. -	Keystone Go-Getter Club Continental Breakfast Hotel A Roof Garden, 18th floor
	10:00 A.M. -	58th Department Convention session - Hotel A Grand Ballroom
	6:30 P.M. -	Convention parade
	10:00 P.M. -	Dance - Hotel A Ballroom
July 24 -	9:30 A.M. -	Closing session - Hotel A Grand Ballroom

CASE FINDING

Information about cases was obtained through active and passive surveillance. Following recognition that an outbreak had occurred among attendees of the American Legion Convention, the State Health Department alerted district health departments to assist in the investigation. State health officials also notified the Pennsylvania Medical Society and Hospital Association of Pennsylvania of a potential statewide epidemic. They requested cooperation in reporting potential cases and made public their assumption of responsibility for conducting an investigation of the outbreak. The State Health Department was thus made the center for planning and data collection.

Public health nurses were instructed to search hospitals in their districts for hospitalized Legionnaires. They made daily rounds at local hospitals and reported preliminary clinical, epidemiologic, and demographic data to the State Health Department where patients that were possible epidemic cases were listed. Date of onset of illness, clinical description, association with the convention, and existence of secondary spread of illness were provided.

In Philadelphia a hot line was established and the public invited to report possible epidemic cases. Because the scope of the epidemic was not known at that time, in the city of Philadelphia reports of any illness with fever were listed as cases, regardless of association with the convention. Similar descriptive clinical, demographic and epidemiologic information was sought. A subset of those cases who had attended the convention was listed and these names communicated to the State Health Department where the primary case registry was maintained.

Local newspapers were also helpful in the first days of the investigation by their daily publication of lists of ill and dead Legionnaires. A few cases were first identified through this source. Search of obituary columns in local Pennsylvania newspapers for recent deaths of American Legionnaires provided names of several other cases.

Approximately one hundred suspect epidemic cases were listed by noon of August 3, and a preliminary case definition was formulated based on the apparent clinical pattern of fever and lower respiratory tract complaints and/or pneumonia. A case was thus defined as any person with cough and fever of 102 F or greater, or any fever and chest X ray evidence of pneumonia. Because of the frequency with which such symptoms may appear in the general public, an epidemiologic constraint of some association with the convention was loosely accepted. In practice at this time the cases which

were listed at the State Health Department consisted entirely of hospitalized persons who had attended the convention. In Philadelphia separate lists continued to be maintained of cases in the general population of the city and those with known association with the convention.

On August 3, 4, and 5, EIS officers visited, interviewed, and examined the known cases to collect detailed clinical and epidemiologic information. Our purpose was two-fold: 1) To obtain a reliable description of the clinical illness by obtaining a history, and conducting chart review, and abbreviated physical examination, and 2), To establish the importance of preliminary time, place, and person associations, suggestions for which were obtained from discussion with the Pennsylvania State American Legion Adjutant, Mr. Edward Hoak.

Leaving from Harrisburg, Pittsburgh, and Philadelphia, each of the EIS officers drove an average of 450 miles interviewing 10 patients in over 6 hospitals in less than 2 days. New cases were thus uncovered and previously listed patients excluded by strict application of the clinical criteria. By the evening of August 5, an extensive line listing of clinical and epidemiologic information was available for approximately 140 patients.

Through these face-to-face interviews the adequacy of our clinical criteria in preliminary identification of cases was confirmed. In addition, reliable evidence was obtained that secondary spread of illness was absent. The preliminary epidemiologic information indicated that cases were primarily in American Legionnaires who had attended the convention, although clinically compatible cases had occurred among non-Legionnaires who had entered or stayed overnight at Hotel A, the central hotel of convention activities. Reports from Philadelphia showed a clustering of cases in the downtown area and most were associated either with the convention or with visiting or residing in Hotel A. Therefore, for purposes of epidemiologic investigation, the case definition was refined by adding epidemiologic constraints: Cases must have attended the American Legion Convention or entered Hotel A after July 1.

Intensive investigation and reporting by the news media contributed to public awareness of the epidemic and local state and city health departments were inundated with unsolicited phone calls from citizens and physicians identifying potential cases. Telephone calls reporting cases were received by approximately 30 persons who included secretarial personnel, public health representatives, Philadelphia City police and EIS officers. Many calls were referrals from local health departments and had previously been screened for their plausibility as cases. A large number were direct calls from the public or physicians reporting potential cases. As the clinical and epidemiologic criteria of a case was formulated, non-medical personnel receiving phone calls were instructed to screen reports according to an algorithm constructed on the basis of these criteria (Appendix A). Specifically, if the clinical illness reported did not include fever (a necessary part of the case definition) the interview was concluded. If fever was present, the temperature was recorded, and responses were sought regarding presence of cough and abnormality on chest radiograph. If the clinical case criteria were met, the remainder of demographic, clinical, and epidemiologic information was obtained and the case referred to an EIS officer. If the clinical syndrome did not conform to the case definition, the form was discarded or if it warranted follow-up at a later date, it was filed as a "non-case." Repeated contacts were made with several hundred persons who were eventually excluded as cases.

EIS officers made follow-up phone calls to all persons who met the case criteria or for whom clinical details were not clear, e.g., results of chest X ray, highest recorded temperature. If the potential case was a Legionnaire, information regarding activity at the convention was obtained. The clinical history was verified and missing details requested of the patients' physicians or from hospital staff. The large volume of telephone calls to the state and city health departments was thus effectively triaged so that EIS officers were able to follow up only cases that were likely to be associated with the epidemic. One hundred eighty cases were identified through these combined case finding efforts.

CLINICAL ILLNESS

The typical illness began 6 days after the Legionnaire arrived at the convention and after he had returned home. Earliest symptoms were malaise, muscle aches, and a slight headache. Within less than a day there was a rapidly rising fever associated with chills. A non-productive cough was common early, often with the onset of initial symptoms. Abdominal pain and gastrointestinal symptoms also occurred in many of the patients. By the time a patient saw his physician, 2 or 3 days after onset of illness, fever was usually 102-105 F, and examination of the chest disclosed some râles without evidence of consolidation.

In most, the rest of the physical examination was normal. Chest X ray showed a patchy pneumonia. White blood cell count was moderately elevated with a left shift. In most, there were modest elevations of SGOT and alkaline phosphatase. Those from whom arterial blood gases were drawn were found to have moderate hypoxemia and hypocapnia. In most cases the illness progressed over the subsequent 2 or 3 days, and in the survivors there was a remittent fever that broke by lysis. Cough commonly became productive during the course of the illness but was rarely purulent. Upper and lower gastrointestinal bleeding was not uncommon but may have been related to the stress of illness. Erythrocyte sedimentation rates, when measured, were often over 80 mm per hour.

Of the 180 cases, 145 (81%) were hospitalized. Hospitalized patients (median age 51-60 years) were significantly older than those not admitted (median age 41-50 years); the sex distribution of hospitalized cases did not differ significantly from non-hospitalized patients. The case fatality rate was higher among hospitalized patients (19%), then in non-hospitalized patients (3%). Analysis of hospital charts of 94 cases, 65% of hospitalized cases, was carried out to obtain details of the clinical illness, and remaining descriptions are based on tabulations from abstracts of these cases.

Signs and Symptoms - Table 2. Systemic complaints of fever, malaise, chills, headache, and myalgia were common. Cough was present in the majority, but hemoptysis and purulence of sputum were less frequent. Chest pain and dyspnea were common. Diarrhea was often present, but abdominal pain and vomiting were seen less often.

TABLE 2

SYMPTOMS AND SIGNS OF LEGIONNAIRES' DISEASE FROM REVIEW OF HOSPITAL CHARTS OF 94 CASES

Symptoms	Initial	Total Present	Absent
feverishness	66	90	1
cough	38	68	16
malaise	36	59	11
chills	39	53	19
dyspnea	20	39	24
headache	26	35	34
myalgia	26	34	27
sputum	9	31	40
chest pain	11	31	32
diarrhea	14	31	44
vomiting	8	18	52
hemoptysis	2	13	48
purulent sputum	5	11	44
abdominal pain	4	11	48
conjunctivitis	1	3	53
hematemesis	0	2	56
epididymitis	1	1	55

TABLE 2 (Continued)

Signs	Initial	Total Present	Absent
râles	39	72	17
rhonchi	24	38	43
consolidation	5	20	58
obtundation	6	18	67
abdominal tenderness	7	18	68
hepatomegaly	4	9	76
stool heme	–	9	30
splenomegaly	1	3	80
focal signs	1	1	82

Physical findings were limited principally to the pulmonary system with râles and rhonchi frequently present. Evidence of consolidation was rare initially but developed in one-third of cases. Hepatomegaly was found in only 3 survivors but was present in 6 fatal cases.

One-fourth of patients when first seen had a temperature greater than 104 F and one-third a maximum temperature this high. Among patients who died, higher initial and maximum temperatures were found. A rapid pulse and respiratory rate were also predictive of death, although the pulse rate was commonly inappropriately low for the height of fever.

Laboratory. The admission urinalysis showed 3+ protein or greater in 20% of patients, and microscopic hematuria occurred in 10%. Only 20% had an admission leucocyte count above 14,000/mm^3, but one-half had a left shift with greater than 5% band forms. The initial white cell count and the proportion of band forms were higher in those who died compared with survivors. A total white count less than 2,000/mm^3 was seen in 2 persons who died and 1 survivor; only 2 other cases had fewer than 6,000 WBCs/mm^3. Anemia and thrombocytopenia were not found. ESR was greater than 80 mm/hr in one-third of those in whom it was measured.

On hospital admission serum sodium was less than 130 meq/liter in one-fifth. A BUN greater than 20 mg% was seen in one-third of cases and was higher in those who died. Renal failure was treated with dialysis in 4 patients.

Liver function tests showed elevation of transaminases in about one-third of cases. Icterus was not seen and the majority of cases had a normal concentration of alkaline phosphatase. A high SGOT on initial presentation was predictive of death.

Lumbar punctures were performed in 7 of 18 patients with obtundation. CSF protein was less than 40 mg% in all cases, and no hypoglycorrachia was seen. Cell counts were normal in 3 patients and affected by a traumatic tap in 3. In 1 case 292 polymorphonuclear cells and 78 RBC/mm^3 were present, but the patient did not have clinical meningitis and recovered without specific therapy for meningitis. Presence of obtundation appeared to be related to hypoxia and high fever and in some cases uremia.

In 1 patient a diagnostic thoracentesis yielded serosanguinous fluid with a protein of 4.2 gm%; there were 12,000 RBCs/mm^3 present and 16,000 WBCs/mm^3, 98% of which were neutrophils.

Radiographs of the chest were abnormal in 90% (Table 3). Patchy areas of consolidation were most often seen although interstitial infiltrates often appeared alone or antedated consolidation. In nearly one-half of the most advanced chest radiographs abnormalities remained unilateral. Effusions when present were usually minimal and did not present management problems.

TABLE 3

RESULTS OF ABNORMAL ROENTGENOGRAPHS
IN 84 CASES OF LEGIONNAIRES' DISEASE

		Initial X ray	Most Advanced X ray
Laterality -	right	23	13
	left	24	19
	bilateral	37	47
Distribution -	diffuse	15	28
	lobar	22	16
	patchy	45	33
Quality -	interstitial	21	20
	consolidated	38	36
	nodular	4	5
	unspecified	20	17
Effusion -	present	5	11
	absent	75	62

Coding of abnormalities from descriptions in radiograph reports was difficult and the subleties of description of infiltrates could not be captured in this kind of analysis. Copies of chest X rays from 24 patients were sent to CDC and reviewed by Winthrop Davey, M.D., Director, Bureau of Training (formerly Professor of Internal Medicine, University of Michigan School of Medicine). These X rays may represent the most severe cases since 19 of the patients died and 21 (88%) were initially bilateral. In these the pneumonic process had the following characteristics: 1) It appeared to be centripetal, 2) It appeared to be interstitial early, but later was characterized by consolidation, air bronchograms, and was compatible with a great deal of exudate and fluid in the parenchyma, 3) Many demonstrated "coalescence" of the lung into circumscribed, almost nodular lesions.

The finding was compatible with rapidly progressing interstitial pneumonia (non-resolving) with later consolidation. (Nodularity may be the result of oxygen therapy.)

Clinical Course. Cough, respiratory distress, and a subjective feeling of illness continued for several days after onset and was treated with oxygen in the majority of cases. FiO_2 greater than 40% and mechanical ventilation were required in 20%; these requirements were (not unexpectedly) associated with death. Shock occurred in 14 of those who died and in none of those who recovered. Death occurred after a median of 7 days following onset of illness. In those who recovered, radiographic evidence of improvement appeared at a median of 10 days following onset of illness and lagged behind clinical resolution. Survivors were discharged a median of 2 days later, 9 days after admission. Arterial blood gases (ABG) were obtained from one-half of cases. A paO_2 less than 60 mmHg and $paCO_2$ less than 30 mmHg were seen in one-half of those in whom these were obtained. ABGs were consistent with a primary respiratory alkalosis in 10%; respiratory acidosis was uncommon, and ventilatory support was required primarily for hypoxemia without CO_2 retention.

Results of bacterial cultures are presented in Table 4. Of these blood cultures obtained prior to therapy with antibiotics, none were positive. No organism was consistently isolated from any site. The organisms isolated after initiation of therapy were typical of flora normally cultured from patients on antibiotics. In 2 cases hospital laboratories successfully isolated viruses--one a Herpes simplex and the other a parainfluenza strain identified at CDC as parainfluenza 3. Both isolates were from the respiratory tract.

TABLE 4

RESULTS OF BACTERIAL CULTURES IN 94 PATIENTS
HOSPITALIZED WITH LEGIONNAIRES' DISEASE

		Before Antibiotics			After Antibiotics		
		#	# +	%	#	# +	%
Cultures	BLOOD	90	0	0	81	2	2.4
Patients		39	0	0	36	2	5.3
	SPUTUM	40	10	20.0	71	34	32.4
		33	10	23.2	34	28	43.7
	URINE	31	0	0	34	6	15.0
		28	0	0	23	5	17.8
	STOOL	14	3	17.6	23	11	32.3
		9	2	18.2	17	9	34.6
	CSF	14	0	0	23	0	0
		4	0	0	4	0	0
	OTHER	0	0	0	6	6	100
		0	0	0	3	3	100

PATHOGENIC ORGANISMS IN POSITIVE CULTURES

	Before Antibiotics	After Antibiotics
Blood:		1 E. coli 1 yeast, unspecified
Sputum:	3 S. pneumoniae 1 β-hemolytic streptococcus 3 H. influenza 1 Candida sp. 1 S. aureus 1 Aspergillus sp.	14 Enterobacteriaceae 9 Candida sp. 6 yeast, unspecified 4 Hemophilus sp. 1 Bacteroides sp.
Urine:		1 S. faecalis 3 E. coli 2 yeast, unspecified
Stool:	2 yeast, unspecified 1 Citrobacter sp.	7 Enterobacteriaceae 3 Candida sp. 1 Entamoeba coli cyst
Other:		1 E. coli 4 yeast, unspecified 1 Candida sp.

Therapy. Twenty-three different antibiotics and 4 species of steroids were used in therapy of the patients, who were typically treated with an oral antibiotic when first seen in a physician's office or emergency room and in whom parenteral antibiotics were begun upon hospital admission. Patients were treated with as many as

10 different drugs in various combinations of route and dosage.

The case-fatality ratio was higher in those treated with cephalothin or steriods, but these patients had initial physical and laboratory findings which were found to reflect severe illness and probability of death, suggesting that these drugs were used in cases with more extreme illness. The case-fatality ratios associated with erythromycin or tetracycline therapy were relatively low (Table 5).

TABLE 5

EFFECT OF ANTIBIOTIC THERAPY ON MORTALITY
IN 124 PATIENTS WITH LEGIONNAIRES' DISEASE

	Tetracyclines given	No Tetracyclines given	
Fatalities	2	25	$P_{fe} = .02$
Survivors	28	69	

	Erythromycin given	No Erythromycin given	
Fatalities	2	25	$P_{fe} = .10$
Survivors	23	74	

Other associations found not to correlate with prognosis were hospitalization in a facility with housestaff training programs in internal medicine, family or general practice; history of smoking or alcoholism; and presence of allergies.

In a survey conducted in December and described in Appendix B, follow-up clinical information was obtained by interviewing 56 persons who had been hospitalized and were known to have had a temperature greater than 102 F and evidence of pneumonia on chest roentenograph. At the time of the survey one-half of the patients felt they had not recovered from their illness. Fatigue was the primary complaint and when compared with age-matched controls patients felt greater dyspnea compared with the previous year. The frequency of cough and quantity of sputum production of cases compared with controls were not different from their previous state of health. In only 1 case, was a patient rehospitalized since July; this was for therapy of a previously diagnosed carcinoma. Patients when compared with controls made more physician visits but these were primarily follow-up visits.

TIME, PLACE, PERSON

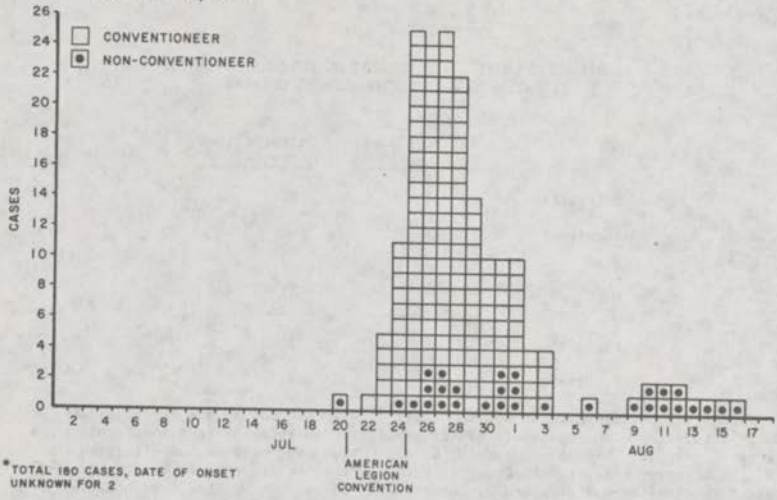
Demographic characteristics of cases. Of the 180 cases, 141 were males. Ages ranged from 3 to 82 years. Seventy-six percent were 40-69 years old with a mean of 54.5 years. One hundred forty-nine had attended the American Legion Convention, 125 as delegates, 17 as family members, 4 as members of the Auxiliary and 3 as non-delegate Legionnaires. One case was in a hotel employee. Of the other 30 cases, 7 had attended the Eucharistic Congress held August 1-8, 1976, 2 a Candlemakers' Convention held July 17-21, 1976, and 1, a Magicians' Convention held July 14 to 17; the others had no convention association. Eighty-four of the total cases and 75 of the Legionnaire cases had stayed overnight at Hotel A.

The epidemic curve showed a rapid upswing in cases from July 22-25, followed by a plateau through July 28 and a somewhat slower decline through August 3; a smattering of cases were observed until August 16 (Figure 1).

21-248 O - 78 - 7

The 149 cases in Legionnaires showed dense clustering in a narrow time interval, whereas the 31 cases in non-Legionnaires were fairly evenly spread from July 20 through August 16.

Fig. 1 LEGIONNAIRES' DISEASE*, BY DATE OF ONSET, PHILADELPHIA, JULY 1-AUGUST 18, 1976



Epidemic curves were similar for those above or below 60 years of age; with or without pre-existing chronic medical illness; who stayed at Hotel A or elsewhere; and, for Legionnaires who came from the eastern, central or western parts of Pennsylvania. Fatal cases tended to have onset after an incubation period slightly shorter than did non-fatal cases (Table 6). The first death was on July 27 and the greatest number of deaths in 1 day occurred on August 1. Eighteen deaths occurred by August 2.

TABLE 6

LEGIONNAIRES' DISEASE CASE-FATALITY RATIO, BY INTERVAL FROM ARRIVAL IN PHILADELPHIA TO ONSET OF SYMPTOMS

	Interval from arrival in Philadelphia to onset* (days)		
	≤ 5	6 - 10	≥ 11
Survived	48	56	18
Died	10	8	0
CFR (%)	17.2	12.5	0

*Excludes Philadelphia residents.

There were 29 deaths among the 180 cases giving an overall case-fatality ratio (CFR) of 16.1%. The CFR were similar for males (17.0%) and females (12.8%). Also, the CFR were similar for delegates (17.5%), other conventioneers (18.2%) and non-conventioneers (10.3%), and for those who did (15.5%) or did not (16.1%) stay at Hotel A. The CFR was highest for residents of Hotel E, 32%. Older age was associated with an increased CFR: Those over 60 years of age had twice the relative risk for death as those less than 60. Although preexisting cardiopulmonary disease or malignancy carried a relative risk for death of 1.7, prior illness as recorded in hospital records had no significant effect on CFR (Table 7).

TABLE 7

LEGIONNAIRES' DISEASE CASE-FATALITY RATIO, BY PREEXISTING ILLNESS* AND AGE

	With preexisting illness			< 60 Years	
	Fatal	Surviving		Fatal	Surviving
< 60 years	4	15	With preexisting illness	4	15
≥ 60 years	8	12	Without	8	50
	Without preexisting illness			≥ 60 Years	
	Fatal	Surviving		Fatal	Surviving
< 60 years	8	50	With preexisting illness	8	12
≥ 60 years	7	20	Without	7	20
	Mantel Haenszel p = .10			Mantel Haenszel p = .31	
	All Cases			All Cases	
	Fatal	Surviving		Fatal	Surviving
< 60 years	12	65	With preexisting illness	12	27
≥ 60 years	15	32	Without	15	70
	P_{fe} = .04			P_{fe} = .11	
	Relative risk = 2			Relative risk = 1.7	

* Malignancy and cardiopulmonary disease (excluding simple hypertension) recorded in hospital charts.

Denominators. No accurate information existed on the number of Legionnaires who had attended the convention in Philadelphia. Estimates ranged from 2,274 (the number of delegates who cast votes at the convention) to 10,000. An enumeration of conventioneers was needed for the calculation of an incidence rate of illness. To determine this number and to identify well Legionnaires whose experiences at the convention could be compared with those who were ill, a census of conventioneers (Legionnaire census) was attempted. A packet of 2-page questionnaires (Appendix C) was delivered to the commanders of each of the 1,002 local American Legion posts in Pennsylvania on August 9. Each commander was asked to identify those persons in or associated with his post who had attended the convention, to deliver a form to each person, and to retrieve completed questionnaires. Completed forms were returned to Harrisburg and carried to Atlanta for analysis. In the Legionnaires' census, 3,683 forms were returned by Legionnaires who had attended the convention (Tables 8,9).

Of the 3,580 who listed their convention status, 1,849 (51.6%) were delegates so that it may be estimated that approximately 4,500 persons attended the convention ($\frac{2,274}{1,849} \times 3,580$). The mean age of conventioneers whose age was known was 50.5 years, and 80.0% were between 40 and 69 years of age; the average age of delegates of known age was 53.5 years. Of all conventioneers 62.4% were male, compared with 90.0% of delegates (Tables 8,10).

TABLE 8

LEGIONNAIRES' DISEASE ATTACK RATE,
BY AGE AND SEX

Age (years)	Attack Rate (%)	No. of Respondents	No. of Cases
< 40	1.8	610	11
40 - 49	3.1	805	25
50 - 59	4.1	1428	58
60 - 69	6.7	538	36
> 70	7.5	254	19
Unknown	0	48	0
	4.0	3683	149
Sex			
Male	5.4	2292	123
Female	1.9	1380	26
Unknown	0	11	0
	4.0	3683	149

TABLE 9

LEGIONNAIRES' DISEASE ATTACK RATES
BY CONVENTION STATUS AND HOTEL OF RESIDENCE

Convention Status	Attack Rate (%)	No. of Respondents	No. of Cases
Delegate	6.8	1849	125
Auxiliary	0.6	701	4
Family Member	6.3	268	17
Non-Delegate	0.4	762	3
Unknown	0	103	0
	4.0	3683	149
Hotel	**% I11**	**No. of all Respondents**	**No. of Cases**
A	6.5	1161	75
D	2.0	1046	21
E	4.7	403	19
F	3.8	312	12
G	3.8	104	4
Other	3.3	210	7
Home	2.7	294	8
Unknown	2.0	153	3
	4.0	3683	149

TABLE 10

LEGIONNAIRES' DISEASE ATTACK RATES
IN DELEGATES, BY AGE, SEX, AND HOTEL

Age (years)	% Ill	All Delegates	Case Delegates
< 40	3.7	160	6
40 - 49	5.1	392	20
50 - 59	6.2	843	52
60 - 69	9.8	315	31
≥ 70	13.1	130	17
Unknown	0	9	0
	6.8	1849	125
Sex			
Male	7.2	1664	120
Female	2.8	181	5
Unknown	0	4	0
	6.8	1849	125
Hotel			
A	9.0	688	62
D	4.5	400	18
E	4.1	194	8
F	5.5	291	16
G	4.3	70	3
Other	10.6	66	7
Home	8.3	121	10
Unknown	5.3	19	1
	6.8	1849	125

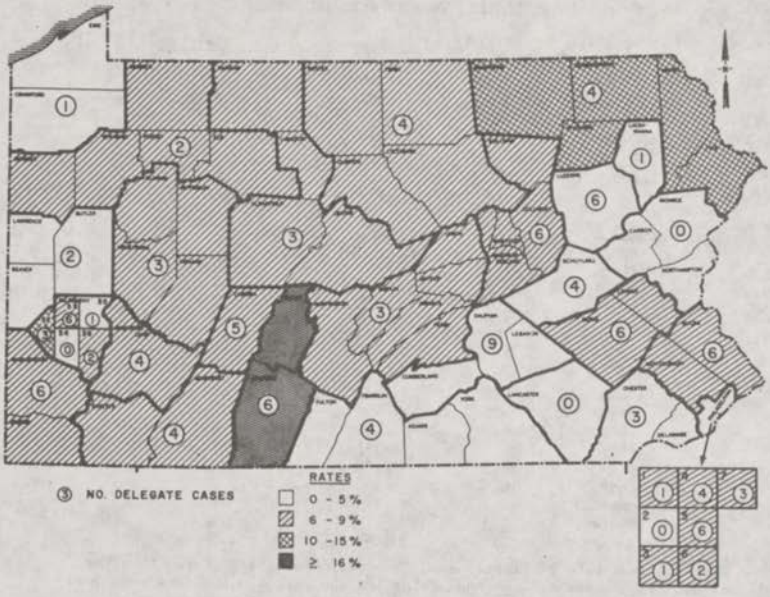
The incidence rate of illness among conventioneers, calculated from the Legionnaires' census, was 4.0%. Among delegates the rate was 6.8% and among non-delegate Legionnaires 1.3% (Table 9). Incidence rates by age and sex are given in Table 10. Attack rate increased progressively with increasing age. This effect was seen in all Legionnaires, delegates alone and the subset of delegates who stayed at Hotel A (Tables 8,10,11). The homes of cases were scattered throughout Pennsylvania, and the rates of illness were similar to Legionnaires coming from the east, west, and central parts of the state (Figure 2). The attack rates by American Legion district was calculated for delegates; numerators were obtained from the case list and denominators from the convention voting roster, the most complete source of such information for delegates.

TABLE 11

LEGIONNAIRES' DISEASE ATTACK RATES BY
AGE IN DELEGATES WHO RESIDED AT HOTEL A

Age (years)	% Ill	All Delegates staying at Hotel A	Case Delegates staying at Hotel A
< 40	6.8	44	3
40 - 49	5.6	160	9
50 - 59	8.1	320	26
60 - 69	12.0	108	13
> 70	20.4	54	11
	9.0	686	62

Fig. 2 LEGIONNAIRES' DISEASE CASES AND ATTACK RATES, BY AMERICAN LEGION DISTRICT, PENNSYLVANIA, 1976



All of the 17 family members who were cases were females with the exception of a 3-year-old boy whose Legionnaire family was ill with upper respiratory complaints that did not meet the case criteria. The mean age of the family member cases, 51.4 years, was significantly greater than that of well family members who answered the Legionnaires' census, 40.2 years, $p < .01$. Only 2 of the 17 family member cases (12%) returned a questionnaire in the Legionnaires' census, compared with 72 (58%) of 125 delegate cases, suggesting that completion rates in family members were lower than that of delegates. If there was a 4-fold underestimation of the denominator in family members, their actual attack rate would have been approximately 1.6%, a rate similar to that of auxiliary and other non-delegates.

Other hotel guests. To assess the rate at which illness meeting the clinical criteria was occurring in hotel guests other than Legionnaires in Philadelphia, a telephone survey was made of random samples of guests registered at 4 hotels between July 6 and August 7. The hotels surveyed included the headquarters hotel of the American Legion Convention (Hotel A) and Hotel D where the Auxiliary was headquartered, as well as a center city hotel where few Legionnaires stayed (Hotel B) and a hotel on the periphery of the city where no Legionnaires stayed (Hotel C). Table 12 gives the number of persons selected in the sample, the number successfully interviewed, and the number who meet the clinical criteria. The overall completion rate was 67%, however, there were considerable differences in completion rate within time periods for each hotel and between hotels. From the available data it appears that illness meeting the clinical criteria was rare except in Hotels A and D in the week of the American Legion Convention. Five persons who met the clinical criteria for a case of

Legionnaires' disease occurred in Hotels B and C during the weeks surveyed, 2 during the week prior to the American Legion Convention and 3 during the week of the convention. Three of the 5 entered Hotel A and met epidemiologic criteria for Legionnaires' disease. These 3 included:

1) A 35-year-old man who stayed at Hotel C on July 18 and entered Hotel A on the same day. On August 12 he developed fever of 102 F, cough, chills, and diarrhea. No chest X ray was taken.

2) A 38-year-old woman who stayed at Hotel B, but attended the Magicians' Convention at Hotel A on July 15. She developed chills, headache, myalgia, cough, and a temperature of 102 F on July 20. No chest X ray was taken.

3) A 56-year-old Legionnaire male who stayed at Hotel B from July 21-25, but attended the American Legion Convention at Hotel A. He developed fever of 104 F, chills, cough, myalgia, headache, and a chest X ray documented pneumonitis on August 2.

TABLE 12

ILLNESS RESEMBLING LEGIONNAIRES' DISEASE IN RANDOM SAMPLES OF GUESTS IN 4 PHILADELPHIA HOTELS, BY WEEK OF REGISTRATION, JULY 6-AUGUST 7, 1976

Hotel	7/6 - 7/10	7/11 - 7/17	7/18 - 7/24	7/25 - 7/31	8/1 - 8/7
A	0/142/155*	0/130/159	15/180/200	0/106/152	0/88/147*
B	-	1/70/85	2/100/160	0/95/140	0/78/160
C	-	1/90/151	1/84/150	0/92/151	0/58/154
D	-	-	5/144/200	-	-

*Number ill/number interviewed/number chosen for survey.

There was no evidence of an epidemic associated with hotel residence continuing after the American Legion cohort. For Hotel A in the week of July 18-24 a supplementary sample of 80 persons were chosen who had no known association with the convention. Including the supplementary group, illness in conventioneers was more common than in non-conventioneers among registrants in Hotel A on the nights of July 21-23 (Table 13).

TABLE 13

ILLNESS RESEMBLING LEGIONNAIRES' DISEASE IN RANDOM SAMPLE OF CONVENTIONEER AND NON-CONVENTIONEER GUESTS REGISTERED IN HOTEL A, JULY 21-23, 1976

	Legionnaires	Non-Legionnaires
Ill	15	1
Well	95	46

Illness other than that which meets the clinical criteria of Legionnaires' disease was common in persons who stayed at Hotels A and D during July 18-24 (Table 14). The weeks of July 11-17 and 18-24 seem to be associated with a higher incidence of other illness in all hotels surveyed when compared with 1 week earlier and 2 later weeks. Minor illness characterized by fever and cough did not cluster in any one of the 4 hotels surveyed during July 18-24.

TABLE 14

NUMBER OF ILL PERSONS* WITH ANY ILLNESS, SYNDROME OF FEVER AND COUGH, SYNDROME MEETING CASE CRITERIA, DISTRIBUTED BY HOTEL AND TIME, 4 PHILADELPHIA HOTELS, 1976

Hotel	July 6-10	July 11-17	July 18-24	July 25-31	August 1-7	Total	Legend
A	1 0.7%	6 4.6%	2 1.1%	3 2.8%	0 0.0%	12 1.9%	Persons with any fever and cough not meeting clinical criteria
	15(0)/142 9.8%	22(0)/130 16.9%	51(15)/180 20.0%	10(0)/106 9.4%	5(0)/88 5.7%	103(16)/646 13.5%	Persons with any illness (those meeting clinical criteria)/registrants surveyed
B	- -	3 4.2%	1 1.0%	1 1.0%	0 0.0%	5 1.5%	
	- -	13(1)/70 17.1%	13(2)/100 11.0%	9(0)/95 9.5%	2(0)/78 2.6%	37(3)/343 9.9%	
C	- -	2 2.2%	3 3.6%	0 0.0%	0 0.0%	5 1.5%	
	- -	14(1)/90 14.4%	13(1)/84 14.3%	3(0)/92 3.3%	6(0)/58 10.3%	36(2)/324 10.5%	
D	- -	- -	2 1.4%	- -	- -	2 1.4%	
	- -	- -	24(5)/144 13.2%	- -	- -	24(5)/144 13.2%	
TOTAL	1 0.7%	11 3.8%	8 1.6%	4 1.4%	0 0.0%	24 3.0%	
	15(1)/142 9.8%	49(2)/290 16.7%	101(23)/508 15.3%	22(0)/293 7.5%	11(0)/224 4.9%	198(26)/811 21.2%	

*Random subjects selected from registration lists.

Hotel employees. To determine if illness was affecting employees of the headquarters' hotel, 3 surveys of employees were performed. In the first, an approximate 25% random sample of employees of Hotel A was selected for telephone questioning from a list of employee addresses and telephone numbers provided by the hotel management. Of the 143 employees with whom contact was attempted, responses were obtained from 101. Four employees refused, and 38 were not at home, had telephones disconnected, or could not be reached. Public health advisors from the City Health Department were used to contact and interview employees. All telephone calls were made on August 7, 1976, with a standardized form (Appendix D). The average age of employees interviewed was 44.3 years. Sixty-two percent were between 40 and 69 years of age, and 66% were male. Of the employees contacted, 46.5% were lobby or restaurant workers (bellmen, cashiers, waiters, desk clerks, elevator operators). One employee, an air conditioner repairman, met the case criteria with a temperature of 102 F and cough beginning July 24 that required him to miss work 4 days. His 2 children, 3 and 4 years old, had colds beginning July 27, and his wife became ill on August 2. He did not see a physician or have a chest X ray. Nine other employees in the sample who worked in different locations in the hotel had minor colds but did not meet the case criteria.

A review was made of unscheduled employees' absences since July 1 and each employee who missed 2 or more days was interviewed concerning illness that might meet the case criteria. Only 1 employee had such an illness and that was the air conditioner repairman cited above. To explore further the possibility that exposure in the lobby might be associated with illness, an attempt was made to interview all persons who worked in the lobby of Hotel A. Thirty-three employees were interviewed, and it was estimated that this represented 90% of all lobby employees. Four had not worked during the period July 19-25 and had remained well. Of the remainder, 20 were employees of the hotel and 9 others worked at stands within the lobby (airline tickets, newspaper, etc.). Of the 20 employees of Hotel A, 4 had had fever or minor respiratory illness but none could be considered cases. Eight of the 15 whose ages were known were over 40 years of age; the mean age of the group was 43 years. Of the 9 workers at concession stands, 1 was ill with a mild respiratory illness; the mean age of this group is unknown.

Other illness in Philadelphia. Thirty-eight persons who met the clinical criteria of a case were identified who were not considered cases because they had neither attended the American Legion Convention nor entered Hotel A but had been within 1 block of the hotel sometime between July 1, 1976, and the onset of their illness. These cases are called Broad Street pneumonia for comparison with cases of Legionnaires' disease and were discovered using the same surveillance systems. The epidemic curve of Broad Street pneumonia showed 2 broad groupings in July 27-August 4 and August 10-12 (Figure 3), and resembled the curve of non-Legionnaire cases in Figure 1. Ages of persons with Broad Street pneumonia ranged from 19-76 years with a mean of 49.3 years. Twenty-three cases were in males. Five cases were fatal. In 9 cases, the persons were known to have walked on the same side of Broad Street as Hotel A, in 14 on the other side of the street, and in 1 on both sides; information is not available on the other 14. Five cases admitted to some contact with Legionnaires during the convention; 8 had attended the Eucharistic Congress.

To determine if illness resembling Legionnaires' disease was occurring apart from the American Legion Convention and Hotel A, 2 surveys were done of illness seen in Philadelphia hospitals. In the first, 3 hospitals serving center city Philadelphia (Graduate Hospital, Pennsylvania Hospital, and Thomas Jefferson University Hospital) permitted the review of emergency room and admission records of patients seen after July 1, 1976. Six EIS officers, 2 for each hospital, reviewed these records for persons who met the clinical criteria of a case but who were not considered cases of Legionnaires' disease. In Figure 4 is shown the distribution in time of these illnesses between July 1 and August 9. No evidence of an unusual incidence of disease is seen about the time of the outbreak of Legionnaires' disease.

Fig. 3 BROAD STREET PNEUMONIA COMPARED WITH LEGIONNAIRES' DISEASE, BY DATE OF ONSET, PHILADELPHIA, JULY 1 – AUGUST 18, 1976

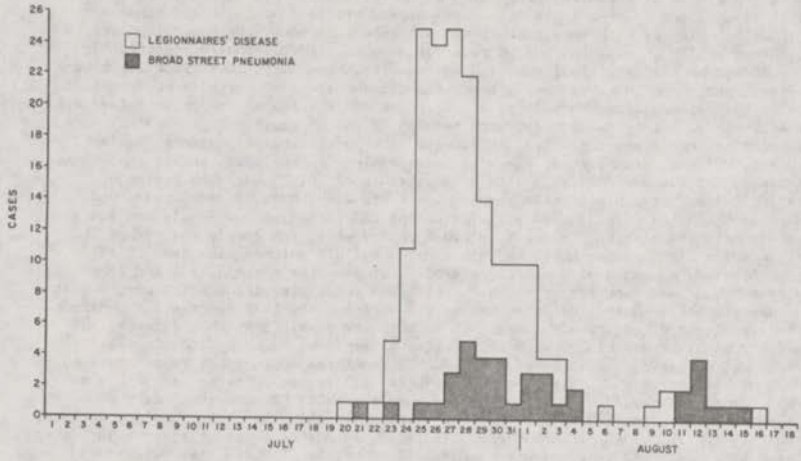
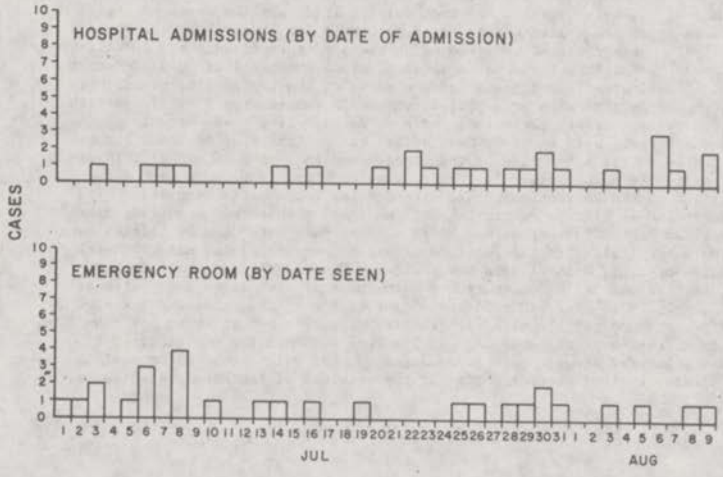


Fig. 4 ILLNESS RESEMBLING LEGIONNAIRES' DISEASE SEEN IN 3 CENTER CITY PHILADELPHIA HOSPITALS JULY 1-AUG. 9, 1976



The Philadelphia City Health Department has received from local hospitals a listing of all emergency room visits by final diagnosis for the last several years. As a second measure of illness occurring in Philadelphia apart from the American Legion Convention, the emergency room records of 11 Philadelphia hospitals were scanned for diagnoses of "pneumonia." Only persons 18 years old and over were included. Data for 1976 were collected by EIS officers who visited individual hospitals to inspect forms that had not yet been submitted to the City Health Department; data for 1974 and 1975 were available at the City Health Department. The distribution of "pneumonia" visits at the 11 hospitals is shown in Figure 5. For 1974-1975, the number of visits per week ranged generally between 10 and 20 for the period July 1-September 15 and then rose thereafter. For 1976, a rise above 20 cases per week began on August 2, the first day of intense publicity about Legionnaires' disease, and the case count remained high compared to previous years until early September. Whether this increase in emergency room diagnoses of pneumonia represented a true increased incidence of disease, greater utilization of emergency rooms by persons with that diagnosis, or a changing threshold among physicians for diagnosing pneumonia is not known, but there was no increase in the number of persons diagnosed on death certificates in Philadelphia as having died from pneumonia or influenza (Figure 6).

Fig 5 EMERGENCY ROOM VISITS FOR "PNEUMONIA" IN 11 PHILADELPHIA HOSPITALS

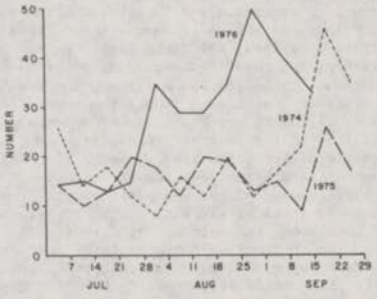
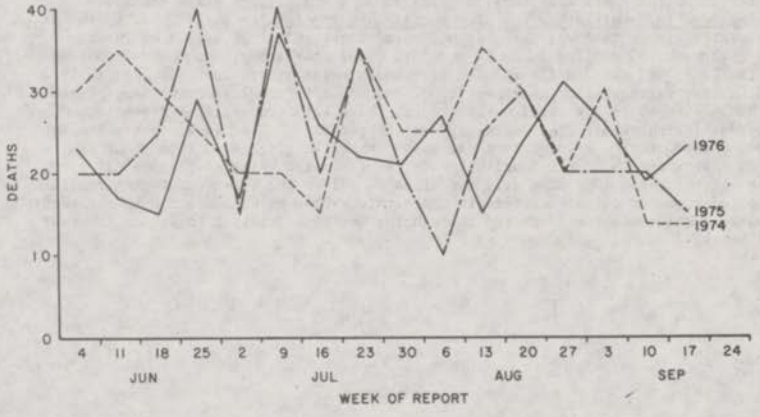


Fig. 6 PNEUMONIA AND INFLUENZA DEATHS, BY WEEK OF REPORT, PHILADELPHIA, 1974-1976



Environmental survey. Investigation of various parts of the inanimate environment of Hotel A were carried out in August to determine if changes in the physical environment of the hotel may have taken place in temporal association with the Legionnaires' Convention. Samples were obtained from the environment in and around the hotel for subsequent laboratory study and evaluation.

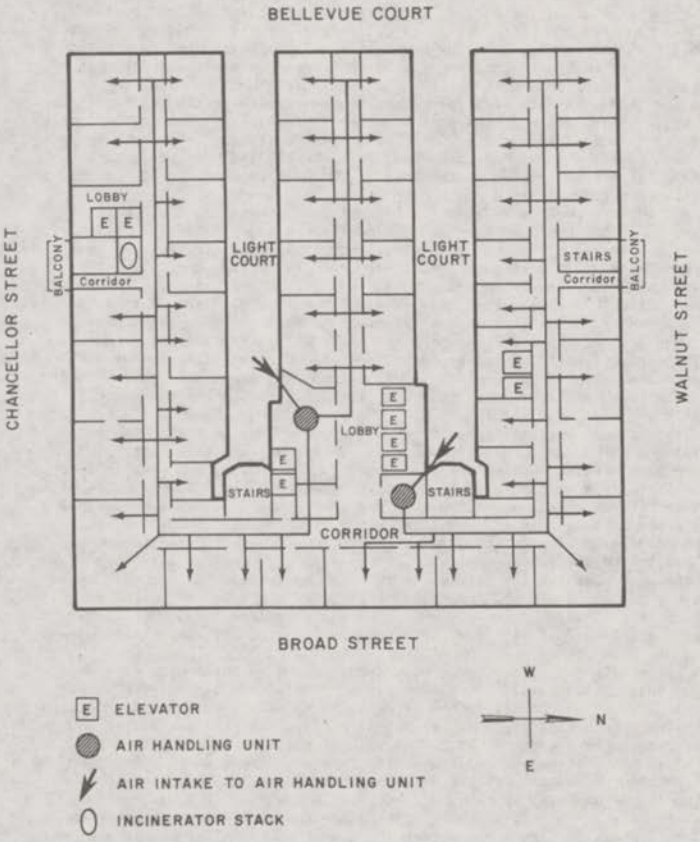
General description of the hotel - Hotel A was constructed in 1904. It had been extensively modified and renovated since original construction, particularly with respect to systems for cooling and ventilating the areas used by hotel guests. Hotel guests were housed in approximately 700 rooms on floors 2 through 16. The 17th floor of the hotel was a service area, and the 18th floor had a series of meeting rooms. There were 4 floors between the lobby and the 2nd floor, the first level containing guest rooms: the lobby floor which is slightly above street level included a registration desk, several shops and airline offices, ladies' and men's rooms, 2 restaurants and lounges, a kitchen, and 2 function rooms; the main mezzanine floor included the upper part of some rooms on the lobby floor, and a number of administrative offices; the first floor included offices, meeting rooms, and the hotel ballroom; and the first mezzanine floor included the upper part of a number of meeting rooms, including the ballroom, and some offices. There were 3 floors below the lobby floor: a kitchen floor; the next floor known as the basement which included a number of locker and other rooms; and the floor below this, the subbasement which contained an incinerator, an engine room with air-conditioning water chillers, an electric distribution area, 2 large air exhaust fans ventilating most of the subbasement (and a smaller exhaust fan above the water chillers), a wine cellar, a laundry, sewage pumps, and water pumps. The subbasement was approximately 60 feet below the level of the surrounding streets; the top of the hotel was approximately 350 feet above the surrounding streets.

Guest rooms were typically 17 feet x 13 feet with an adjacent bathroom and closet. Two to 4 windows in each room with a separate bathroom window could be opened to the outside street or light well. Larger suites comprising 2 or 3 rooms with 2 bathrooms were located at the northeast and southeast corner of each floor (Figure 7) and at the convention were often rented as hospitality rooms.

The incinerator stack, the vent from the 2 large exhaust fans in the subbasement, air intakes for 5 air-handling units (AHUs) serving the 18th floor of the hotel and the air conditioning cooling tower were located on the roof of the hotel. In service areas above the 18th floor, there were elevator head machinery and service rooms for 10 of the hotel elevators, storage areas, and 2 potable water tanks.

Systems for ventilating and air conditioning the Hotel - Hotel A had a central, chilled-water system that was used to cool most of the building, including guest floors 2 through 15, meeting rooms on the 18th floor, the lobby, and the 3 floors between the lobby and the 2nd floor. The air-conditioning system was installed in 1954, when 2 Carrier refrigeration machines (800 "ton" and 600 "ton" capacity) were placed in an "Engine Room" in the hotel subbasement. These chillers utilized freon 11 refrigerant (trichloromonofluoromethane), which produced chilled water (potable water with added chromates to help control corrosion) that was circulated throughout the hotel to approximately 60 air-handling units (AHUs) in the building (Figure 7); most but not all, of these AHUs also were installed in 1954. The air-conditioning chillers were cooled by water circulated through a separate system to condense the refrigerant; this cooling water was itself cooled through the use of a "cooling tower" on the roof of the hotel.

Fig. 7 TYPICAL FLOOR OF HOTEL A SHOWING VENTILATION SYSTEM



The chilled water system was designed with an automatic makeup to replace (from the potable water system) water lost from the system due to leakage at pumps or valves. The system was controlled by a float valve in a chilled water expansion tank in a service area above the 18th floor of the hotel. The automatic makeup system had been inoperative for an unknown period prior to the outbreak due to a faulty float valve in the expansion tank. Therefore, since the system gradually lost water over time, the chilled water pipes at the highest level of the hotel had

become filled with air. The highest AHU in the hotel served the "Rose Garden" meeting room on the 18th floor; when this AHU lost its cooling ability the hotel engineering staff knew that the expansion tank was empty and they used a garden hose to refill the expansion tank by a connection between a valve on the cooling tower makeup water system (potable water) and a valve on the AHU serving the Rose Garden. The hose was sometimes left in place after the chilled water system was filled, which created a potential "cross connection." This cross connection was first seen during an inspection of the hotel on August 7, 1976. The hose was immediately disconnected at that time, a backflow preventer installed, and the float valve in the expansion tank was replaced. Until the installation of the backflow preventer, had the hose been left in place with the valves at both ends left open, if the pumps supplying water at the point of the cross connection with the potable water system failed, and if the 2 check valves leaked, it is conceivable that a low-pressure condition in the potable water system could have caused chromate treated water from the chilled water system to be drawn into the potable-water system of the hotel. There is no record or indication that such a situation ever occurred.

Only chilled water was circulated to the AHUs in the hotel during the late spring, summer, and fall when they were used to cool the hotel. All but 2 of the AHUs in the hotel operated by "rough" (low-efficiency) filtering air mixtures consisting of approximately 3/4 recirculated air and 1/4 outside air, cooling the air, and circulating it to the interior space of the hotel served by that AHU. Two AHUs in the hotel supplied 100 percent recirculated air: One unit was located over the registration desk in the hotel lobby to assist other units in cooling the lobby, and the other was located above the air-conditioning chillers in the subbasement of the hotel. The recirculating AHU in the hotel lobby had 2 metal filters that had lower efficiency and were cleaned by a different method than other filters in other hotel AHUs; there were no filters used in the recirculating AHU above the air-conditioning chillers.

The filters in all but the lobby AHU were washed with hot water and re-oiled with non-reclaimed, SAE 30-weight lubricating oil (Citgo, NJ) at the beginning of the 1976 air cooling season (AHUs were first turned on for cooling purposes in 1976 on April 15). There is no record whether these filters had been recleaned or re-oiled since April 1976. However, the air filters in the AHU in the lobby were cleaned on August 6, and probably they were cleaned more than 1 time earlier in 1976 as well. The cleaning procedure for the filters from this AHU consisted of dipping them in a solution of "Oakite" followed by re-oiling with the same oil used for all other filters in the hotel. Recleaning the filters in this AHU apparently had not been based on a schedule but rather upon complaints from hotel lobby employees of poor flow of cool air when the air filters became clogged. The lobby employees had registered such a complaint the week following the convention and accordingly this filter was cleaned on August 6.

Review of hotel purchasing records and discussions with hotel engineering personnel revealed that approximately 300 pounds per month of freon 11 had been leaking from the larger (800 "ton") chiller in the hotel subbasement during the 1976 cooling season. These leaks most probably were through defective seals on the chiller and through safety devices on the unit. With the exception of 2 days, the 600 "ton" chiller was not run during the summer 1976 cooling season. Freon that leaked from the 800 "ton" chiller, presumably in the gaseous state, apparently was ventilated out of the subbasement of the hotel by a 9,000 cubic feet per minute (CFM) exhaust-air fan located above the air-conditioning chillers in the engine room. This exhausted air was discharged about 20 feet above street level on the Chancellor Street side of the hotel. A piped safety vent system from the 2 chillers also discharged out of the hotel on the Chancellor Street side, at a location only approximately 3 feet from the location of the exhaust discharge from the 9,000 CFM fan. It is possible that some of the air ventilated out of the hotel by this fan may have been recirculated back into the subbasement through an air shaft opening immediately adjacent to the point of exhaust. However, it is unlikely that this occurred since the exhausted air was warm and was being forced up and out of the hotel. The remainder of the subbasement (other than the engine room) was ventilated continuously by 2 large fans exhausting

approximately 70,000 CFM through an air shaft that extended up through the hotel, discharging on the roof.

There were other air exhausts from the hotel. There were smoke exhausts from 4 function rooms on the lower floors of the hotel that were used when needed at times when these rooms are occupied. In addition, 4 other exhaust fans ventilated into the bottom of the hotel "light courts" (Figure 7) from a hotel kitchen, a ladies' room, and a dishwashing room.

On guest floors from 2 through 15, there were 2 AHUs on each floor, 1 each located on either side of the central corridor near the entrances to the main hotel elevators. For each floor the AHU on the elevator side of the central corridor supplied cool air to all the rooms on that side of the floor (approximately one-third of the total rooms on the floor); the other AHU furnished cool air to the remainder. The air intakes (one per AHU) providing outside air ducted into each of the AHUs on each floor were located in the 2 "light courts" of the hotel. The air intakes were covered with grilles or gratings that were not readily accessible to hotel guests, and there were no bird droppings or feathers near these air intakes, evidence that birds had not roosted near them.

The rooms on the 16th floor of the hotel were cooled by individual airconditioners. In addition, other "single" air-conditioning units were located in the hotel to serve various shops, airline offices, other offices, and one public hotel room on the main floor.

On hotel floors 2 through 15 (Figure 7), air was supplied to each guest room through a supply-air duct system running above a false ceiling in the halls of that floor. Supply-and return-air grilles were located in each guest room of the hotel on these floors; a thermostat that operated pneumatic dampers was placed in each room to control temperatures by opening and closing the supply-air grille. Air is returned from guest rooms to AHUs in a plenum surrounding the supply-air ducts within the space above the false ceiling of the halls. Approximately one-fourth of the cooled air supplied to guest rooms leaked from windows or through walls of the building; this lost air was replaced by the air drawn in through air intakes in the "light courts."

All thermostats in guest rooms of the hotel were operated by tubing with pressed-fit pneumatic fittings, and no welding was done on these systems.

Elevators - There were 4 main elevators in the lobby of the hotel, 2 others on the Walnut Street side of the hotel, 2 service elevators, 2 ballroom elevators, 1 supply elevator, and 1 elevator for incinerator ashes. The top and the bottom of the first 10 of these 12 elevators, and both levels of the elevator heads of each of the 10 were inspected. No unusual characteristics of elevator operation or maintenance were noted or revealed in discussions with hotel personnel or individuals responsible for contract maintenance of the hotel elevators.

Water supply - Potable water was supplied to the hotel through the municipal system of the City of Philadelphia. This water was pumped from the subbasement to 2 steel tanks located approximately 30 feet above the 18th floor of the hotel in a service area. The top of each of these tanks was open to the air on each end of the filling valves. At the time of the epidemic and until August 7, 1976, it was possible for anyone to have access to the water tanks through 2 back stairs from the 18th floor through 2 unlocked doors.

The water tanks were kept full by flow valves that signalled low water levels and turned on basement pumps to maintain the tank at the full level.

On August 7, 1976, it was noted that there was a potential cross connection between the hotel chilled-water system and piping supplying the potable water tanks in the service area next to the tanks (vide supra). Representatives of the Philadelphia Water Department determined subsequently that this cross connection had apparently been present intermittently for years, and that it had been used regularly to refill the tank at the highest position in the chilled-water system when this water system tank was low.

A circulating, hot-water system was provided to guest rooms in the hotel. In addition, there were 4 fire standpipes extending up to the 18th floor of the hotel. These standpipes contained potable but stagnant water, which did not move from the

standpipes except during the rare occurrence of a fire or yearly when the fire valves on each floor on each standpipe were checked to see that they operated.

Ice - The hotel had about 20 ice machines in service areas not available to guests. In addition, there were 4 ice machines that were capable of manufacturing 1,000 to 1,400 pounds of ice per day located for guest use on floors 3, 6, 9, and 13. It was reported by members of the hotel staff that all ice produced by these machines was immediately used up as soon as Legionnaires arrived in the hotel at the time of the convention. More ice was used by the Legionnaires during their convention than was available from these 4 machines and little was purchased from the hotel room service; rather, large quantities of ice, mostly as bagged cubes, but some as block ice, were purchased from many sources around Philadelphia and brought into the hotel for use in cooling beverages during the convention.

The principal ice plant serving the City of Philadelphia was inspected, and no problems that might have influenced the quality of the ice were found.

Steam - Steam was purchased by the hotel for use in the hotel laundry, for cooking in jacketed cookers in the kitchen, and for occasional winter use in air-handling units during very cold winter weather.

Sewage - Sanitary waste from the hotel on all floors above the lobby drained by gravity into the sewage system of the City of Philadelphia. These wastes were not treated within the hotel. Wastes from the kitchen level of the hotel and from the basement and subbasement of the hotel drained to sumps below the subbasement where they were pumped, using an air-injection system, up to street level to the sanitary sewers of the City of Philadelphia.

A continuous leak of "clear-looking" water was observed in the subbasement of the hotel under Chancellor Street beginning some time in the early summer of 1976. It was found in late September that this leak consisted of water from steam leaking from a pipe supplying the hotel and from a leak in a brick sanitary sewer 3 feet below Chancellor Street (repaired on September 29, 1976). The leak was localized to an area behind the incinerator in the subbasement of the hotel.

Hotel incinerator - The only incinerator of the hotel was operated 6 days a week to burn paper and other similar waste generated by hotel operations, both by administrative offices and by guests. The incinerator was inspected and approved yearly by Air Management Services (AMS), Philadelphia Health Department. The incinerator, located in the subbasement, consisted of a hand-fed chamber followed by a washer and an afterburner. It was operated by a hotel employee who began work at the hotel on July 12, 1976. During an inspection of the incinerator and the incinerator operation by the AMS during the afternoon of August 26, 1976, it was noted that the incinerator had not been operated with the afterburner except during incinerator charging; this was improper because the afterburner should have been used until all fire was out in the burning chamber to reduce the amount of smoke produced. The hotel was asked to begin operation of the incinerator correctly at the time of the August 26th inspection. It was observed on numerous occasions in August that noticeable quantities of white and grey smoke were being discharged from the incinerator stack at the top of the hotel during daylight hours.

Housekeeping - Housekeeping in hotel and guest areas consisted mainly of cleaning bathrooms each day, vacuuming carpets in guest rooms and in corridors, and changing bed linens and towels. Each day during housekeeping procedures, a sulfamic acid tablet was placed into the toilet in each bathroom to deodorize and clean the toilet; residue from this tablet (which colored the water blue) was flushed down with the first flush of the toilet. Carpets in guest rooms were seldom shampooed. Windows throughout the hotel were washed by 2 persons continuously working on contract for the hotel.

Pest control - Pest control in the hotel was performed by a contract firm that visited for 3 to 4 hours twice a week, on Tuesday morning and Friday evening. This activity was conducted primarily in the lobby and lower floors of the hotel, mainly in food-and-drink-preparation areas, locker rooms, and serving areas. The operation of the pest control personnel was observed in detail during each of the 2 service periods in a week in August, and no unacceptable practices were noted. Relatively

non-toxic pesticides were used (diazinon and pyrethrum with piperonyl butoxide) and there was no evidence that they were either incorrectly or over-zealously applied. Only 2 rooms used by guests in the hotel were sprayed for pests during July 1976; one guest's room was treated on July 8 for reported mosquitoes and the room of a permanent resident on July 12 for an unknown reason.

Laundry - Sheets, towels, pillowcases, and certain uniforms used by the hotel staff were laundered in the hotel laundry. No special or unusual procedures were noted in laundry operation, and the laundry had been using the same chemicals and procedures, supervised by the same personnel, for many years.

Hotel food service - During the time of the Legionnaires' Convention, almost no food was sold to individuals attending or participating in the convention, either in the dining areas of the hotel or through room service. An inspection of the food service operation in the hotel was made by the Philadelphia Health Department in August 1976; some minor deficiencies were found, and they were immediately corrected.

Ionizing radiation - For approximately 2 hours during a working day in August 1976 following the outbreak an individual wearing a radiation monitor sensitive to 1 mr walked throughout the guest area of the hotel. There was no evidence of ionizing radiation during this time within the sensitivity of the measuring device used.

Areas around hotel - On August 13, 1976, the subway concourse and the subway below the concourse in front of Hotel A was inspected in detail with members of the staff of the Southeastern Pennsylvania Transportation Authority (SEPTA). It was observed that the large quantities of air move up and down from the subway concourse into the area in front of Hotel A through a system of ventilation grilles, but no characterization of the air currents was attempted. No fans are used for such ventilation, but the piston-action of trains moving back and forth in the subway and temperature differentials causes air to flow continuously. A series of bathrooms, record rooms, offices, and a transformer room were all located in the subway concourse area on the side of the concourse nearest the hotel, but no unusual activities took place in these rooms, and they were not used to store any potentially hazardous chemicals.

Record of spraying of trees in front of Hotel A, and samples of the chemicals used in the spraying were obtained from the firm that contracted for the work. Prior to the epidemic, the trees were last sprayed on June 2, 1976. There were rumors of fires in the street area near Hotel A at the time of the outbreak. There was no evidence of any fires, except in a small trash container on South Broad Street about 2 blocks from the hotel; this trash container was observed to be smoking each day for a few minutues in mid-August.

Although there was a strike of refuse handlers in Philadelphia at the time of the epidemic, refuse from around Hotel A was regularly collected during the strike by contract carriers. Thus, there was no accumulation of trash in the streets near the hotel; rodenticides were not known to be used in the area around the hotel at the time of the epidemic, either as part of the routine or from any need that might have arisen because of the strike.

There are 5 working incinerators, all licensed, within 3 blocks of Hotel A. AMS investigated the operation of these 5 incinerators in detail during the week of October 11, 1976. No unusual characteristics in operation of any of these incinerators were noted, and ash samples were taken from all 5.

Weather records - Weather records in Philadelphia indicated the southwesterly or westerly wind direction usual for Philadelphia in July, changed on July 22 first to the northwest and then to an easterly direction; by the end of the 23rd, the wind direction was generally southerly and returned to a westerly direction on the 24th. Wind speed was slightly higher than average on the 22nd and above average on the 23rd and 24th. There was a relatively heavy afternoon shower (about 1.5 cm of precipitation) on the 23rd. A temperature inversion occurred for approximately a day and a half beginning on July 22 ending around noon on the 24th. This inversion was accompanied by slightly higher levels of "reactive hydrocarbons" and carbon monoxide sampled by the AMS in their regular air monitoring programs in the area around Hotel A.

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FURTHER STUDIES

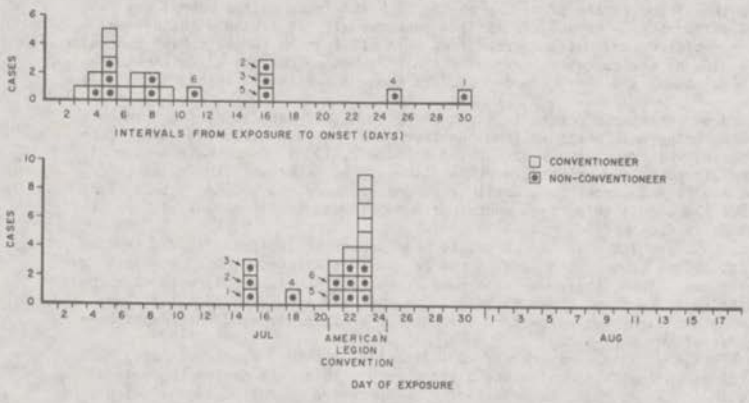
Hypotheses for the place and vehicle of spread were generated by interviews of patients, friends, and other Legionnaires, and phone calls from the public. In addition, several investigations were specifically designed to generate additional hypotheses:

a. Single day hotel exposure survey
b. Conference call among 4 patients
c. Interviews with employees, lobby personnel and persons who frequented the neighborhood of Hotel A.
d. Survey of a number of hospitality room hosts.
e. Interviews with persons who became ill first.

Single day exposures. Ill persons (cases) who were known to have spent only 1 day in the hotel were asked to describe in detail all activities during their day of exposure in order to find common factors between them and other cases. Interviews were held over several sessions in order to stimulate memory. In 2 cases, walks were conducted with the person 2 weeks after the convention through the hotel area to further improve recollection.

In 20 cases the patients had 1 day of exposure, 12 of whom were non-conventioneers. Date of exposure (Figure 8) ranged from July 15 to July 23. Six of the 8 Legionnaire cases were exposed on July 23 while 3 of the 12 non-Legionnaires were exposed on that date.

Fig. 8 INCUBATION PERIOD OF LEGIONNAIRES' DISEASE FROM SINGLE-DAY EXPOSURES



In the Legionnaire cases, ages ranged from 48 to 64 years with a median of 56 years with 6 males and 2 females. In the non-Legionnaire cases ages ranged from 32 to 72 years with a median age of 49 years; 5 males and 7 females were affected in this group. Four representative cases with 1 day of exposure are presented below; 2 Legionnaires and 2 non-Legionnaires.

Case 129 - This 52 year-old man was not a Legionnaire but visited Legionnaire friends at Hotel A with his wife on July 22. He arrived in the downtown area on the evening of July 22 and parked in a garage approximately 2-3 blocks from the hotel. After parking he met with his lawyers and later had 2 drinks at a pub across the street from the garage. He then walked to Hotel A, spent approximately 10-15 minutes on the sidewalk in front of the hotel, on top of the subway steps. He then walked

inside and waited by the lobby information desk for his wife to use the mezzanine bathroom. They then left the hotel and walked to Hotel E, stayed 15 minutes in the lobby and returned to Hotel A. He met some friends in front of the hotel, walked inside and took the main elevator to Room 922-3, one of the hospitality rooms. He remained there 2 hours, had 2 whiskeys neat and no food. His wife had 2 beers and no hard liquor. They then left the hotel and drove home.

On July 27, 5 days after exposure, symptoms of fever, chills, myalgia, headache, cough and vomiting developed and he was hospitalized on July 31 with a temperature of 103.6 F; a chest X ray showed infiltrates at both lung bases. He made an uneventful recovery.

Case 4 - This 52 year-old man, a Legionnaire, arrived at Hotel A on July 23 at approximately 12 noon. He stood outside for a while looking for a friend, then entered and searched the main lobby. He then waited on top of the steps outside the hotel's main entrance for 20 minutes until his friend arrived. He then walked around the main lobby and took the lobby elevator to the ballroom floor where he registered, picked up packets, and looked at some displays. Following registration, he proceeded to the main ballroom to his 9th district caucus. After the caucus, he met some friends from his old district and went to a nearby restaurant for lunch where he had 2 glasses of beer and a beef sandwich. On returning to the hotel he went to the lobby men's room and then to his caucus in the Red Room. After the meeting, he and his friend went to a hospitality room on the 8th floor. He had 2 beers - then walked to the lobby, mingled on the front steps of the hotel for a while, and went to a steak house for dinner. Following dinner he joined his district in marching in the parade and following the march, stayed by the reviewing stand, watching the parade and later watched from the sidewalk in front of the hotel. After the parade, he had a beer across the street; he then tried to enter the dance, but was unsuccessful without tickets. He went to the hotel lounge where he had scotch on the rocks and then left for home.

On July 27 chest pain, myalgia, and fever developed followed by headache, cough, shortness of breath and abdominal pain, and he was hospitalized on August 3. Chest roentgenographs showed a left central pneumonia and his temperature rose to 103 F on the day of admission.

Case 94 - This 60 year-old man, a delegate to the convention, attended on July 23 only. He arrived for the Go-Getters breakfast at 7:30 a.m., held at the roof garden of Hotel A. He drank coffee with milk and sugar, ate Danish pastry and remained at the breakfast approximately one-half hour and then went with a friend to a hospitality room at Hotel F where he had a gin and tonic. He then ate breakfast at a local restaurant where he had 2 eggs, toast with butter, home fries, and coffee. At approximately 10-11 a.m. he left from Hotel F to take the subway home. He returned there between 8:30-9:00 p.m. where he had a screwdriver with ice at a 20th floor hospitality room.

At 10 p.m. he walked to Hotel A and attended the dance in the Grand Ballroom. After leaving the dance, he attended a district hospitality room where he consumed several mixed drinks with ice and Lebanon bologna. He made several trips between the dance and the hospitality room and consumed a few more drinks. Approximately 1 a.m. he left for home. During the course of the day he spent approximately 4 hours in Hotel A and 10 minutes in its lobby.

On July 28 symptoms of fever, headache, chills and vomiting developed, and he was hospitalized on July 31. Examination of the chest disclosed râles and his temperature rose to 103 F, although his chest roentgenograph remained clear.

Case 72 - This 70 year-old woman was in Hotel A on July 23. She went to see the parade with her husband. After watching the parade from the sidewalk in front of Hotel A, she ate at a local restaurant. She then entered Hotel A, walked through the lobby, and used the toilet facilities. She was in the hotel for less than one-half hour and then left for home.

On July 31, fever, chills, and myalgia developed and she was hospitalized. Chest roentenograph showed a pneumonitis on the right side and she developed a maximum temperature of 103 F.

The interval between apparent exposure and onset of illness varied from 3 to 30 days (Figure 8). Fourteen of the 20 cases clustered between 3 and 9 days with a median of 5 days. Thirteen of the 14 cases were exposed on July 22 or July 23. The other 6 cases (numbered in 2 graphs of Figure 8) were atypical in that they were all non-conventioneers, were exposed between July 15 and July 21, and had "incubation periods" between 11 and 30 days, suggesting they may represent different illnesses from the others.

Conference Call. On August 6, a conference call was set up with 4 recovering Legionnaire patients and several investigators to explore common observations and exposures. The patients offered their own hypotheses and their conversation suggested the need for further investigation of the parade, the dance on July 23, consumption of ice and alcohol, and activity in the lobby.

Observer Interviews. Lobby personnel in Hotel A were asked about activities during the convention. They related that sparklers were set off in the lobby during the parade on July 23 but otherwise no unusual events were recalled. Interviews with local newspaper stand sales people, an attendant in a local parking lot and a woman known locally as the "Pigeon Lady" were not revealing.

Hospitality Rooms. To determine activities in the hospitality rooms and sources of food and drink used in them, a list of 50 persons who sponsored hospitality rooms was obtained from the manager of Hotel A. Nineteen of the 50 individuals were interviewed, including the 13 who ran hospitality rooms for the candidates for statewide or regional office. (Appendix E)

In most rooms, simple snacks--typically pretzels, potato chips, and luncheon meat--were served with bear and hard liquor. Three rooms had homemade food. Most food and liquor was purchased at the Legionnaires home location. None of those questionned in this survey admitted to serving homemade liquor. Ice was purchased from several local distributors. Two rooms were noted to have bad odors on several days.

Earliest Cases. In the earliest cases persons were interviewed about activities in the convention area and details of their illness. The earliest case was in a 38-year-old woman who attended the Magicians' Convention at Hotel A. She was registered at Hotel B and entered Hotel A on July 14 and 15. About July 20 she developed a sore throat accompanied by headache, chest pain, fever, chills, cough, and muscle aches. She was confined to bed for 3 days but did not see a physician during her illness. Her highest temperature was 102 F. She had no chest X ray and treated herself with aspirin and a cough remedy. When seen by her physician on August 26 she was healthy.

The first case in a Legionnaire was in a 47-year-old woman, who attended the American Legion Convention as an auxiliary. She arrived in Philadelphia on July 20 and was registered at Hotel D. About 8:30 that evening she went to Hotel A to a hospitality room on the 14th floor, where she ate cheese, bologna, potato chips, and pretzels and drank bourbon and Squirt, a soft drink, with ice cubes and no water. She smoked cigarettes but said that the room was not smoky. On July 21 she attended the joint Auxiliary and Legion meeting at 8 p.m. and that evening visited several other hospitality rooms. The next day she became ill with cough, sore throat, and headache which she treated with erythromycin. She did not take her temperature until August 2 when it was 103 F. She saw her physician that evening and a chest X ray taken August 3 showed no pneumonia. She has since recovered completely.

HYPOTHESIS TESTING

Hypotheses were often initially evaluated through arbitrary patient interview or by judging plausibility in the light of known environmental and clinical data and then were tested in a number of surveys:

1. The Legionnaire census previously described included a 2-page questionnaire (Appendix C) delivered by hand to most Legionnaires. Twenty-three persons initially thought to be typical cases because of high fever, chest X ray showing nonlobar pneumonia, and a WBC count with a shift to the left (> 5% bands in the differential) were interviewed by telephone. In addition, in approximately 40 more Legionnaire

cases the patients failed to fill out the initial form and were telephoned on August 17. In all, completed forms were obtained on 3,683 Legionnaires including 123 cases. A true completion rate is not available but an estimate can be made from delegate rates; 1,849 delegates responded to the questionnaire while 2,274 voted at the convention. Therefore, an estimate of the completion rate is 81%. No evaluation was made of non-respondents, except those known to be cases. This cohort survey will be referred to as the Legionnaire census (LC).

2. A case control survey designed after completion and analysis of the cohort study was intended for all surviving male Legionnaires on the case list and a random sample of 202 males chosen from the Legionnaire survey who indicated they had been well since the convention (controls). Interviews were completed by telephone on August 17 with 147 control Legionnaires (73%) and 113 case Legionnaires (91%). This survey will be referred to as the ultimate (U) survey (Appendix F).

3. Two systematic samples were chosen of 200 registrations of guests staying any night from July 20 to July 24 at Hotels A and D, respectively. In addition, 80 non-conventioneers who were registered at Hotel A on July 23 were also selected for interview. Interviews were completed by telephone with 220 Hotel A guests and 144 Hotel D guests. This survey will be referred to as the AD survey (Appendix G).

4. Legionnaires who became ill and persons from 2 control groups were asked in person or by telephone about restaurants and convention events attended. A subgroup were asked about cigarette smoking. The first control group consisted of a 1/18 systematic sample of Legionnaires who registered several months early for hotel rooms at the convention and the second comprised conventioneers from an arbitrary sample of Legion posts selected from the eastern, central, and western parts of the state. Completion rates in interviewing were 50-60%. This survey will be referred to as the HCCS survey (Appendix H).

5. Roommates of case and control Legionnaires at Hotel A were queried about illness. Fifty-nine roommates of cases and 69 roommates of 68 controls were interviewed. This will be called the Roommate survey.

6. An attempt was made to survey 56 case and 56 control Legionnaires in December. The cases were chosen from hospitalized surviving delegates known to have temperature of 102 F or higher and radiographic evidence of pneumonia. Legionnaires were questioned about preference for different alcoholic drinks and mixers, and attempts were made to obtain histories of alcohol and water consumption during the convention. Additional questions were asked about snack food preference, smoking habits, and persistence of symptoms since the convention. Fifty-two case and age matched control pairs were interviewed in person. This survey is called the December survey (Appendix H).

The following presentation of the results of these 6 surveys are arranged by hypothesis tested: 1) common source, or 2) person-to-person spread; if common source, 3) point source, or 4) a continuing risk; 5) place of exposure; and 6) mode of spread. An analysis by age of responses to questions in these surveys showed that attendance at some meetings, alcohol consumption, and other responses were affected by age. An age adjustment in questions where it may have confounded the analysis did not result in any change of statistical association with illness with the exception of hospitality room C (vide infra).

Person-to-person vs. common source. From the Ultimate survey, completed on August 17, 24 days following the end of the convention, none of the 140 adult contacts and 53 child contacts of Legionnaire cases interviewed, had developed illness which met the clinical criteria for a case. Similarly among family contacts of well conventioneers, none of 143 adults and 68 children had developed illness since the convention that met the clinical criteria.

There was no clustering of cases in rooms as might be expected if person-to-person spread occurred. Roommates of cases had an attack rate of 8.5% and those of controls an attack rate of 7.2%. In addition, when roommates of cases were ill, the intervals between onsets of illness in the first and second case in a room did not cluster around the incubation period of the illness. We had incomplete information about the relationship of roommates to family member cases, e.g., spouses, mothers, or sisters, or the convention status of their roommates. In only 1 instance did

cases occur simultaneously in a family member and her roommate.

An estimate of crowding in hospitality rooms was obtained using the square footage of each suite provided by the hotel and estimates of guests per day attending given by the host during the hospitality room survey. There were no differences in attack rates between Legionnaires who attended crowded rooms compared with those who attended uncrowded rooms.

Point common source vs. continuing common source. In the Legionnaire census the number of hours spent in Hotel A each day of the convention was determined. Delegate cases spent more hours in Hotel A on the average than did controls even after correction for total days of attendance at the convention. The difference in hours in Hotel A was significant only for delegates who stayed elsewhere (Table 15). There was, however, no significant difference in mean hours spent in Hotel A by case and control delegates for any 1 day of the 4-day period 7/21-7/24. No day was therefore implicated as particularly high risk. Presence in Hotel A at multiple times on July 23 including 12:00 a.m. - 8:00 a.m., 10:00 a.m. - 2:00 p.m. and 4:00 p.m. - 6:00 p.m. were significantly associated with illness for non-residents of Hotel A; because similar questions were not asked about other days, the importance of this finding in regard to a continuing source of exposure is unknown.

TABLE 15

MEAN HOURS THAT ILL AND WELL DELEGATES SPENT IN HOTEL A, BY HOTEL OF RESIDENCE

Hotel of Residence	Ill	Well	
A	56.5 ± 22.2*	51.6 ± 22.9	(z = 1.26, p = .21)
not A	16.7 ± 9.1	12.3 ± 8.6	(z = 2.78, p < .01)

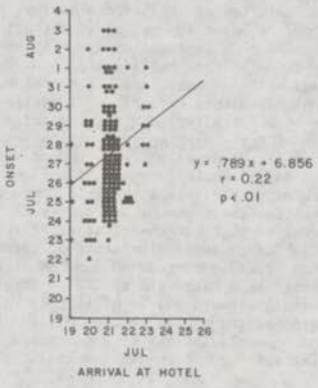
*Mean ± standard deviation.

The distribution of intervals from date of arrival at the convention to the onset of illness in Legionnaires is shown in Figure 9. The date of onset is directly related to date of arrival at the convention, implying continuing risk of exposure over several days.

Place of exposure. When responses of all ill and well Legionnaires were compared, attendance at many convention activities, including the opening session, Go-Getters breakfast, 58th Department Annual Meeting, closing session, and several hospitality rooms was associated with illness. These associations with the typical activities of delegates were not unexpected because delegates formed the group at highest risk of disease. To avoid the confounding effect of the high risk for delegates, most subsequent analysis of places of exposure and modes of spread is restricted to Legionnaire delegates.

From the Legionnaire census (Table 10), 62 (50%) of 125 ill delegates resided at Hotel A compared with 356 (35%) of 1,006 well delegates; the difference

Fig. 9 CORRELATION OF DATES OF ARRIVAL AT HOTEL AND ONSET OF LEGIONNAIRES' DISEASE FOR 145 CONVENTIONEERS



was significant at the .01 level. No other hotels were associated. The age distribution of delegates staying at Hotel A was not significantly different from delegates staying elsewhere. As mentioned before, ill delegates residing at other hotels spent significantly more time in Hotel A than did well delegates residing in other hotels (Table 15). Cases in family members did not cluster by hotel of residence.

Sites and activities outside Hotel A not associated with illness among delegates included time spent outside in front of the hotel; use of Chancellor Street or the alley in back of the hotel; watching the parade or specifically watching it from the sidewalks in front of Hotel A; or attending restaurants in the vicinity of the hotel. More case delegates than controls watched the parade from an open window but only 18 case delegates watched the parade from an open window, and among Hotel A registrants, the difference was not statistically significant. Within the hotel, illness among delegates was not associated with residence by floor, residence by corridor, seating in the grand ballroom, use of lobby rest rooms, use of lobby elevators, attendance at major convention meetings and functions, or attending any ballroom event.

Hospitality rooms - Attendance at hospitality rooms was analyzed through 3 surveys. Among delegates responding to the Legionnaire survey, significantly more cases attended hospitality room A on the 14th floor than did controls. All other rooms showed no significant differences between case and control delegates. Among delegates who stayed at Hotel A, no hospitality room was significantly associated with illness. The replies of Legionnaires registered at Hotel A surveyed in the AD survey showed conflicting results. Attendance at hospitality rooms B and C was found to be significantly associated with illness; in hospitality room C the association with illness was present only after adjustment for the age of its attendees. Total hours spent in hospitality rooms on each day showed no significant differences between cases and controls in the U survey. Also, Legionnaire cases with onset of illness within 5 days of entering Hotel A spent similar amounts of time in hospitality rooms as did those with longer incubation periods. The mean number of hospitality rooms attended by delegates determined from the Legionnaire census was 2.8 for ill delegates and 1.8 for well. This was significant at the P = 0.013 level. The difference was observed among delegates not staying at Hotel A and not among delegates who stayed at Hotel A (Table 16). Seven of 12 family members who were cases and from whom information was available attended no hospitality rooms.

TABLE 16

MEAN NUMBER OF HOSPITALITY ROOMS ATTENDED
BY ILL AND WELL LEGIONNAIRES

	Ill	Well	
All delegates	2.6	1.8	p = .013
Delegates residing at Hotel A	2.6	2.6	NS
Delegates residing at other hotels	2.5	1.4	p < .001

Lobby - In the Ultimate Survey both cases and controls were asked to give the hours spent in the lobby on each day of the convention. The mean number of minutes spent in the lobby of Hotel A by cases (delegates and non-delegates) was greater than for controls both for residents of Hotel A (258.8 and 141.9, respectively) and for Legionnaires who stayed elsewhere (133.1 and 65.7, respectively).

Case delegates spent more time than did controls in the lobby of Hotel A both among residents of Hotel A (p = .05) and among delegates who stayed elsewhere (p < .001)(Figures 10 and 11). Corrected for total time spent in Hotel A the association does not remain for residents of Hotel A but does for non-residents. The association between time spent in the lobby of Hotel A and illness in non-residents of Hotel A is most pronounced on July 21 and July 23.

Fig 10 CUMULATIVE PERCENTAGE OF TIME SPENT IN LOBBY OF HOTEL A, BY LEGIONNAIRE DELEGATES, NOT RESIDENT AT HOTEL A

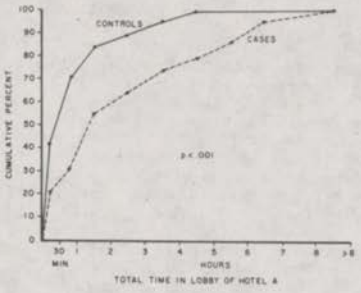
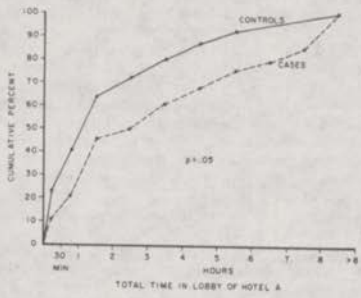


Fig 11 CUMULATIVE PERCENTAGE OF TIME SPENT IN LOBBY OF HOTEL A, BY LEGIONNAIRE DELEGATES, RESIDENT AT HOTEL A



Mode of Transmission. Investigation of the mode of transmission included the following general categories: food, fomites, animals, ice, alcohol, water, and air.

Food - There are many food establishments in the area of Hotel A. Twenty-eight restaurants and bars in the local area were selected for testing. One group of 5, including the Hotel A coffee shop and dining room, were tested using Legionnaire cases and the HCCS control groups. The remainder of restaurants were tested using the AD survey. No restaurant was found to be significantly associated with illness.

Two main American Legion events were associated with the distribution of food, the testimonial dinner, and the Go-Getters breakfast. There were no significant differences in attendance between case and control delegates for either event and no difference in the proportion of case and control delegates at the Go-Getters breakfast.

The December survey disclosed no differences between cases and controls in preferences for snack foods known to have been served in hospitality rooms during the convention.

Fomites - There was no significant differences between case and control delegates in purchase of the delegate pack as determined from the Legionnaire census or between case and control Legionnaires for the smoking of Merit cigarettes from the AD survey.

Free beer mugs were distributed to attendants of the Go-Getters breakfast. No significant differences between case and control delegates for obtaining or drinking from the mug were noted.

Cigarette smoking as a risk factor was evaluated through 3 surveys, but most systematically in the December survey. In 17 case-control pairs, the case delegate smoked cigarettes at the time of the convention and the control delegate did not (Table 17). In 5 case-control pairs the converse was true. The relative risk of illness associated with smoking was 3.4 and was significantly different from unity ($\chi^2 = 5.5$, McNemar). Survey of Philadelphia resident cases indicated no 1 cigarette brand predominated. The average number of cigarettes smoked was greater in cases than in controls. Cigar or pipe smoking was not associated with illness.

TABLE 17

HISTORY OF CIGARETTE SMOKING AMONG CASES AND CONTROLS AT THE AMERICAN LEGION CONVENTION, PHILADELPHIA, JULY 1976

Controls	Cases		Total
	Smoker	Non-smoker	
Smoker	14	5	19
Non-smoker	17	16	33
Total	31	21	52

Animals - Cases and controls were asked about proximity and contact with pigeons, particularly sick or dead pigeons because of the compatibility of the illness with psittacosis and the large number of birds in the area. No relationship (Ultimate survey) was found. Similarly, no increased contact with swine in cases versus controls from the HCCS survey was noted.

Ice - From the Legionnaire census no relation was found between illness and ice consumed in soft or mixed drinks, or purchasing ice in blocks or cube forms. From the December survey, no relation was found between illness and consumption of ice from the hallway machines in Hotel A.

Alcohol - Alcohol consumption was assessed in the Legionnaire census and the December survey. Respondents to the former were asked to give the average number of alcoholic drinks including beer they drank each day during the convention and to class them in 3 categories, 0, 1-4, and $\geq$ 5 per day. No significant differences between cases and controls were found for delegates. Nine Legionnaire cases, including 5 delegates, of 90 questioned indicated they had had no alcoholic drinks during the convention. No association was found in the December survey between illness and preference for beer, type of hard liquor or mixer or homemade liquor.

Water - In the Legionnaire census, delegates were asked whether they drank any water at Hotel A. Forty-five of 69 delegate cases drank water compared with 469 of 976 well delegate controls, a significant difference at the 0.01 level. The relationship holds even when corrected for the number of days delegates spent at the hotel. Fifty-three (62%) of 86 Legionnaire cases queried remembered drinking water at Hotel A. The association of water consumption with illness in delegates was also seen in the Ultimate survey; although there was a 14% inconsistency in the answers of persons who answered both surveys, this was not a statistically significant difference. The relationship of water consumption and illness remains among Hotel A delegate residents in the Ultimate survey but not in the Legionnaire census. Water consumption was associated with illness despite statistically controlling for total days spent in the hotel (Table 18), but not after controlling for hours spent in the lobby of Hotel A.

Consumption of water in mixed drinks was further evaluated. Drinking water in mixed drinks was significantly associated with illness among delegates, and specifically among delegate residents at Hotel A. The relationship was maintained when controlled for total number of hospitality rooms visited or for total hours spent in the hotel. However, only 51% of delegates who stayed at Hotel A recalled drinking water in mixed drinks there (Table 19).

Several aspects of water consumption were not associated with illness. Water consumption at Hotel A was not associated with illness for delegates who did not stay at Hotel A, and no association was seen among delegates between stated normal daily water consumption and illness. Neither water drunk from room taps nor water fountains could be implicated. Consumption of water from stainless steel water containers used at many convention events was not associated with illness.

TABLE 18

HISTORY OF DRINKING WATER AT HOTEL A AMONG ILL AND WELL DELEGATES, CORRECTED FOR NUMBER OF DAYS SPENT AT AMERICAN LEGION CONVENTION

Days at Convention	Water drunk at Hotel A	Ill	Well
0 - 3	yes	5	101
	no	6	150
4	yes	26	268
	no	13	257
5 - 7	yes	14	98
	no	5	97
Total	yes	45	467
	no	24	504

Mantel Haenszel: $z = 2.45$, $p = .014$

TABLE 19

HISTORY OF USING WATER FROM HOTEL A IN A MIXED DRINK AMONG ILL AND WELL DELEGATES, BY HOTEL OF RESIDENCE

Hotel of Residence	Water in Mixed Drink	Ill	Well	
A	yes	19	114	$\chi^2 = 4.16$, $p < .05$
	no	18	231	
not A	yes	9	123	non-sig.
	no	25	502	
Total	yes	28	237	$\chi^2 = 7.08$, $p < .01$
	no	43	733	

LABORATORY

Specimen collections. The Bureau of Laboratories, Commonwealth of Pennsylvania coordinated local collection of specimens from all persons. District health officials were instructed to obtain throat washings and acute sera from suspected cases. Specimens were collected by either public health nurses on hospital or home visits or cooperating local physicans. District officials arranged for immediate delivery of specimens by state police helicopter to the State Laboratory in Philadelphia. Specimens were then distributed by the CDC and the State Laboratory for processing.

Initial arrangements for obtaining pathologic specimens were made on August 13, by EIS officers who contacted physicians caring for terminally ill patients. EIS officers in Harrisburg, Philadelphia, and Pittsburgh were specifically assigned the responsibility of maintaining communication with pathologists, and advising them about the kinds and quantity of tissues required and arranging for prompt transport, usually by air to the state laboratory or CDC. In several instances EIS officers or health officials were present at autopsies to ensure proper collection of tissue.

Available autopsy material was collected from patients who had died prior to active investigation of the epidemic from pathology laboratories. The State Commissioner of Health ruled that any suspected death from Legionnaires' disease was to be a medical examiner's case. In 10 of the 11 deaths that occurred after our involvement in the epidemic an autopsy was performed.

State and city health officials organized a collection of convalescent sera from epidemic cases and approximately 50 household contacts. Public health nurses made home and hospital visits to collect the specimens 3 weeks after onset of illness. State officials also collected serum specimens from 60 well Legionnaires in the Harrisburg area, half of whom had attended the convention and half of whom had not. EIS officers obtained serum specimens from 60 hotel employees 3-1/2 weeks after the convention.

After specimens had been collected in the field, most were sent in duplicate to the Pennsylvania state laboratories and CDC. In most cases specimens arrived in good to excellent condition for purposes of histologic and microbiologic examination. For the most part fresh tissues were received on both dry and wet ice. These were dispensed in the appropriate condition to toxicology, microbiology, and pathology laboratories by the Virology Division, Bureau of Laboratories, which supervised cataloging and distribution of specimens. Formalin-fixed tissues from early cases were requested of hospitals in Pennsylvania by the Pathology Division, Bureau of Laboratories. Serum specimens collected by state health officials were shipped separated and frozen to CDC and the state health laboratories.

A large number of samples of the inanimate environment associated with either the convention or Hotel A were taken. These samples included freon 11 used in compressors in the hotel; dust from the interior top of the elevators, from the area below the elevators, and both levels of the elevator heads; samples of pest control chemicals used in the hotel and around the hotel; samples of all housekeeping supplies known to be used by the hotel; incinerator ash samples; samples of oil and Oakite solutions used for treating air-conditioning filters in the hotel; samples of water from drinking fountains in the hotel, water taps in the hotel, melted ice, and water placed in stainless steel containers used for dispensing drinking water in large meetings and used by the Legionnaires during the convention; samples of chilled water and cooling-tower water from the hotel; the 2 metal air filters from the recirculating AHU in the hotel lobby; pigeon droppings from the 18th floor; dust from AHUs; sulfamic acid tablets; chemicals used in elevator maintenance; firecrackers; mugs given to the Legionnaires; and cigarettes, hats, and other items given to the Legionnaires.

Microbiology. Attempts were made using techniques of direct observation, isolation, and serology to identify infections with bacteria, fungi, viruses, mycoplasmas, spiroplasmas, rickettsiae, and chlamydiae. Standard techniques in current use in each laboratory, as well as special techniques were employed. In Table 20 are assembled the numbers and types of tissue specimens examined and the techniques employed in direct observation. Tables 21 and 22 provide similar information for primary isolation attempts and serologic tests.

The results of direct observation of tissues by electron microscopy in negatively stained and thin sections showed the occasional presence of bacteria which were attributed to normal flora or superinfection. No other microbial agents could be identified in the specimens examined. Fluorescent antibody (FA), Gram, and Gimenez stains did not show any microbial agents to be present with the reagents employed except for 1 patient with secondary Candida infection whose lung stained positively for Candida with FA.

Culture for bacteria resulted in the isolation of a number of organisms found in normal flora and otherwise formed no particular pattern of isolation. Cultures for mycoplasma and spiroplasma were negative. Yeast recovered on primary isolation consisted predominantly of Candida which is frequently recovered from the respiratory tract of severely ill patients on broad spectrum antibiotics.

No viral agent was isolated in the cell cultures, eggs, or animals employed. Confirmation of the absence of any agent in cell culture which might produce resistance to infection with a second virus was obtained by challenge with Coxsackie A-9 in the terminal (3rd) blind cell culture passage. Three guinea pigs died of mixed bacterial infection after inoculation with lung suspension from 1 patient; the bacteria were typical of those found in patients on antibiotics or in postmortem overgrowth, and the original material when passed through a bacterial filter was not pathogenic for guinea pigs. Final identification of these agents is still underway. Culture for viral agents by the Bureau of Laboratories, Commonwealth of Pennsylvania was equally unfruitful.

TABLE 20

LEGIONNAIRES' DISEASE: DIRECT OBSERVATIONS ON PRIMARY SPECIMENS FOR DETECTION OF MICROBIAL AGENTS

Tests	Number of Tests: Nasal/ Throat/ Sputum	Lung	Rectal	Totals: Patients	Tests
Direct staining					
Fluorescent Antibody:					
Histoplasmosis		7		3	7
Cryptococcosis		6		2	6
Sporotrichosis		6		2	6
Salmonella			8	8	8
B. pertussis	16	5		17	21
F. tularensis		7		3	7
Y. pestis		4		2	4
Marburg virus		6		2	6
Lassa virus		6		2	6
Influenza A		6		2	6
Chlamydia		10		5	10
Lymphocytic choriomeningitis virus		6		2	6
Candida		1		1	1
Gimenez		10		5	10
Gram		7		3	7
Electron Microscopy					
Neg. staining		9	5	8	14
Thin section		13		8	13
Indirect FA		30		5	30
Indirect RIA		30		5	30
Direct FA		30		5	30
Direct RIA		30		5	30

TABLE 21

LEGIONNAIRES' DISEASE: PRIMARY ISOLATION ATTEMPTS FOR MICROBIAL AGENTS

Culture Systems	Number of Tests: Nasal/ Throat/ Sputum	Bronchi/ Trachea/ Lungs	Rectal	CSF	Urine	Totals: Patients	Tests
Virology							
Eggs, all./amn.	25	23		1	1	30	50
Eggs, yolk	1	9				3	10
PMK	21	21	8	1	2	28	53
Vero	23	22		1	1	28	47

TABLE 21 - (Continued)

Culture Systems	Number of Tests: Nasal/ Throat/ Sputum	Bronchi/ Trachea/ Lungs	Rectal	CSF	Urine	Totals: Patients	Tests
HELF	25	22	8	1	2	30	58
HEK	19	21			1	25	41
Rhabdo	9	9	8			9	26
PMK agar	7	4	2			5	13
McCoy (UDR treated)		11				11	11
Hep-2	20	20				30	40
Mice:							
Newborn IC/IP	14	11	11			19	36
3-week IC		10				5	10
Guinea pigs		3				8	3
Mycoplasma	11	20				20	31
Spiroplasma	7	12				13	19
Bacteriology							
Blood agar	17	22	8			25	47
MH agar	16	11	2			20	29
Blood pep. dig.	16	22	2			25	40
Brucella agar	16	22	2			25	40
Glu-cyst. blood	16	22	2			25	40
MacConkey	17	22	9			25	48
SS agar	17	22	9			25	48
Bis. sulfite	16	22	9			25	48
BHI broth	14	17	8			23	39
Selinite	6	1	1			7	8
Cornmeal		13				9	13
VCN		13				9	13
Anaerobic		5				3	5
Aerobic		6				3	6
TOTALS (Tables 20 & 21)							
Patients						33	
Tests	349	667	102	4	7		1,129

Serum specimens from serial bleedings were examined for complement fixing (CF), fluorescent (FA), and immunoprecipitating (IP) antibodies to a large variety of antigens. None showed significant (four-fold or greater) increases in antibody to these antigens except 1 patient who developed seroconversion by CF to M. pneumoniae. Two other patients had positive CF responses to Blastomyces, but no IP antibodies were present suggesting a non-specific response. In most cases the first serum specimen was collected in the first week of illness, the second 2 to 3 weeks later, and in many a third specimen after 6 weeks.

Paired sera from 6 cases were also tested in indirect and direct FA and radioimmunoassay for evidence of antigen in lungs from 5 patients. No specific antigen/antibody was found. Serial sera from 7 patients showed a sustained rise in IgG, IgA and IgM in 6, 5 and 4 patients, respectively; 3 showed rises to all classes. In none of these, however, did the absolute level of immunoglobulin rise above the upper range of normal.

TABLE 22

LEGIONNAIRES' DISEASE: SERÓLOGIC TESTS

Tests	Serum Pairs (2 or more sera/person)
Complement Fixation	
Influenza A	64
Influenza B	64
Chlamydia	64
M. pneumoniae	64
Histoplasmosis	64
Blastomycosis	19
Parainfluenza 1	58
Parainfluenza 2	58
Parainfluenza 3	58
Adenovirus	58
RSV	58
Herpes virus	58
Mumps virus	12
Measles virus	12
Coronavirus:	
OC43	58
229E	12
Rickettsia burnetii	64
Coccidioidomycosis	20
Immunofluorescence	
Chlamydia	12
Pneumocystis	20
Rickettsia:	
rickettsii	12
sibirica	12
parkeri	12
conorii	12
rhipicephali	12
montana	12
australis	12
akari	12
prowazekii	12
typhi	12
canada	12
364-D	12
Tillamook	12
Enzyme-linked immunosorbent assay	
Chlamydia	12
Indirect hemagglutination	
Entamoeba histolytica	20
Ascaris	20
Toxoplasma	20
Immunoprecipitation	
Histoplasmosis	22
Blastomycosis	20
Coccidioidomycosis	21
Candida	7
M. faeni	8

TABLE 22 - (Continued)

Tests	Serum Pairs (2 or more sera/person)
T. vulgaris	8
T. candidus	6
RID IgG	11
IgM	11
IgA	11
Total pairs	64
Total tests	1,250

Toxicology. The clinical symptoms exhibited by the victims were non-specific and could have been caused by 1 of a variety of toxins, either organic or inorganic. The analytical investigation to identify the causative agent therefore consisted of 2 phases: 1) Analysis of specimens by general screening methods to allow the detection of a wide spectrum of possible toxins, and 2) Analysis of specimens for a limited number of specific compounds, chosen because of the known similarity of their toxicity to the clinical pattern observed in cases of Legionnaires' disease. The expertise of many well known toxicologists in the forensic, environmental, and academic sectors was used in choosing the specific compounds to study.

Biological samples tested included lung, liver, kidney, and adipose tissue collected at autopsies and serum and urine specimens for both fatal and non-fatal cases. Control specimens were obtained from autopsies of Philadelphia and Pittsburgh residents who were not related to the epidemic, as well as from selected individuals from other areas. Controls were carefully characterized by age, occupation, place of residence, and smoking habits.

Liver, lung, and kidney samples were analyzed for abnormal concentrations of a wide variety of elements by one or more of the following techniques: 1) Atomic absorption spectrophotometry; 2) Neutron activation; 3) Electron induced X-ray fluorescence; 4) Proton induced X-ray fluorescence. The analysis by the latter 2 methods are underway in 4 different laboratories in the United States and are incomplete. Atomic absorption spectrophotometry was utilized to analyze various tissue samples for thallium, tin, beryllium, chromium, and nickel. The neutron activation technique was used to analyze lung, liver, and kidney tissues for approximately 30 elements. Comparison of these data with published norms for the various elements showed only 1 unusual result; a high cadmium value (80ppm) in 1 of 3 case kidneys analyzed. The individual was a heavy smoker which could account for the high cadmium value.

In addition to our analysis for metals, the Commonwealth of Pennsylvania contracted with 2 laboratories to perform analyses for nickel, the Jefferson Physical Laboratory, Harvard University, and the University of Connecticut, Connecticut School of Medicine. No abnormally high levels of any heavy metal were detected in hair specimens analyzed by Paul Horowitz, Ph.D., at the Harvard facility. F. W. Sunderman, Jr., M.D., University of Connecticut, reported that the nickel level in lung, liver, and kidney of 6 cases and 2 cases of Broad Street pneumonia were elevated but not conclusively when compared to tissues from 4 controls and established published norms. Dr. J. R. Chen, State University of New York, reported similar findings in the preliminary proton induced X-ray fluorescence data. Ambiguities in the levels of nickel found could have originated from contamination of tissue that might have occurred during autopsy and sample preparation, but it could also be due to individual variations in normal environmental exposure and excretion of the various elements. Defining an adequate normal value for a given person is extremely difficult because of the individual and environmental variations.

Because of the known toxicity of paraquat, a specific effort was made to analyze for this herbicide. High pressure liquid chromatography and ultraviolet spectrophotometry were used to analyze lung and urine samples. A method was developed for the analysis which has a lower detection limit of 0.25 micrograms per gram of sample. No paraquat was detected in any specimen analyzed. The method used for these analyses would have also detected many other organic compounds with similar ionic characteristics, e.g., (tertiary ammonium), but no compound of this type was consistently found in the case samples.

In the wide spectra screening for organic compounds, homogenized tissue samples were extracted with a variety of organic solvents under both acidic and alkaline conditions. The extracts were fractionated on florisil and/or silica gel columns, fractions concentrated and analyzed by gas chromatography and mass spectroscopy. In addition, selected samples (especially adipose tissue) were analyzed by gas chromatography for organic volatile components using headspace and special extraction techniques. A variety of columns (nonpolar and polar) and detectors (general and specific) were used for the various gas chromatographic analyses. Careful comparison of case and control data did not show a definitive pattern for any unusual components(s) that might be related to the epidemic.

Sera from 9 cases were analyzed by gas chromatography. Common environmental contaminants, including the chlorinated hydrocarbons DDE and DDT, were detected in all samples. However, in 2 serum specimens from surviving cases, an additional component was detected at levels estimated to be below 10 parts per billion. This component was not present in any of the control serum specimens and does not represent any known prescribed medication for the 2 individuals or any known pesticide. Mass sprectra identification of this compound could not be obtained because of the very limited sample size. Furthermore, the compound could not be found in the adipose tissue of any cases as would be expected with such a nonpolar substance. The compound remains unidentified due to its low concentration. The absence in adipose tissue and limited occurrence among the various specimens tested suggests that this compound is unlikely to be the epidemic agent.

Urine from 6 cases was analyzed by high pressure liquid chromatography using an ion exchange column to detect unusual chemicals that might be excreted by the victims. Interpretation of the data was difficult due to the presence of numerous metabolites of drugs the individuals were receiving. Preliminary results did not show a consistent pattern among the various cases.

The oil (SAE 30) coating the air conditioning filter taken from Hotel A was analyzed by high pressure liquid chromatography and showed a normal distribution of molecular species conforming closely to published data. Gas chromatographic-electron capture analysis of this oil detected no unusual electrophilic or halogenated compounds. Ice, drinking water, and water taken from the cooling system of Hotel A was analyzed by neutron induced X-ray fluorescence and found to contain no unusual metal contaminants. To assess its potential pulmonary toxicity, samples of the cooling water from the hotel were also fed to mice. None of the mice fed water from the cooling system or a laboratory prepared solution of sodium dichromate of equal concentration died spontaneously or developed pathological features of pneumonitis, hepatitis or nephritis.

It is conceivable that an alkylating agent could cause a clinical illness similar to that observed in this epidemic. Once compounds of this type enter the body they react with various functional groups of protein and nucleic acids and can no longer be detected in their original form. They would, however, alter the nucleic acid, amino acid or protein profiles of the exposed individuals and, therefore, analysis of these constituents could indicate exposure to this type of toxin. This type of analysis is presently being performed on several cases and controls.

Pathology. Autopsies were performed on 24 of the 29 persons who died, and CDC obtained pathologic specimens from 23 of them. In order to develop a unified and expert interpretation of the pathologic findings, a panel of pathologists was convened at CDC for preliminary review and discussion of the available case material. After examining 10 Legionnaires and 3 Broad Street pneumonia cases, they concluded that a characteristic pattern of lung injury was present in most cases.

The typical pattern of pulmonary injury was acute diffuse alveolar damage consisting of hyaline membrane formation, regenerating alveolar epithelium, sparse interstitial round cell infiltrate, and intra-alveolar proteinaceous debris. This lesion was found in 5 of 8 cases from which adequate material was initially available and also seen in all 3 cases of Broad Street pneumonia examined.

An unusual triad of hepatic changes was observed and consisted of periportal fine fat vacuolation, hepatocellular degeneration, and cholangiolitis. Three of 10 Legionnaire cases and 1 of 3 Broad Street cases exhibited these changes.

Diffuse alveolar damage is a well described pattern of injury with no specific single etiology. It may occur as a consequence of shock, infection, and exposure to a number of toxins, including oxygen. Gastrointestinal ulcerations were observed in 6 of the 13 patients and may have been related to stress of illness. No acute lesions were consistently found in examination of kidneys of 10 cases.

Pathologic material from 10 additional fatal cases of Legionnaires' disease has been sent to the pathology panel for their further consideration.

DISCUSSION

If. Between July 22 and August 3, 1976, there seemed to be a remarkable incidence of febrile respiratory disease among persons who had attended the American Legion Convention from July 21-24. The absence of cases prior to July 22 may be partly explained by less efficient, retrospective case finding and by a potential bias against attending the convention among persons ill in the first 3 weeks of July. However, these factors cannot explain the halt in reported cases in conventioneers after August 3, despite intensive case finding which continued through the middle of August. From the age distribution of the Legionnaire group attending the convention (Table 2) and recent mortality statistics from Pennsylvania*, it can be estimated that 60 deaths per year or 1.2 per week would be expected among the conventioneers. The excess number of deaths (26) that occurred in conventioneers between July 27 and August 16 is further evidence of the occurrence of an epidemic.

The observation that males, delegates, and those who stayed at Hotel A were at greatest risk of illness suggests that these 3 characteristics are associated with some activity that involved exposure. A likely possibility would be a social activity in or around Hotel A. The association of risk with increasing age may also suggest that exposure involved some activity popular among older delegates, but might as well suggest an increasing susceptibility to the agent with advancing age.

Outside the group attending the American Legion Convention there is not good evidence that an epidemic occurred. The distribution of cases in non-conventioneers is consistent with improved case finding after the middle of July coupled with a relatively stable occurrence of illness. Some of the fluctuations in numbers of non-conventioneer cases seen may reflect variations in the numbers of persons entering Hotel A. For example, the cluster of cases with onset August 9-16, reflects in part the large number of persons who attended the Eucharistic Congress August 1-8. The rate of illness in non-conventioneers who stayed in Hotels A or D during the convention week was not different from that in persons who stayed in Hotels B or C, again suggesting that the outbreak was essentially limited to the convention group. The distribution of cases of Broad Street pneumonia in time closely resembles that of Legionnaires' disease in non-conventioneers. The pathologic similarities of Legionnaires' disease and Broad Street pneumonia suggest the possibility that the agent of Legionnaires' disease may have caused at least some of the cases of Broad Street pneumonia but because the pathology is not specific, it is possible that the similarities are coincidental. A pending survey of the pathology of hospitalized fatal cases of pneumonia from Philadelphia in early July may permit an estimate of the likelihood of such a coincidence.

The bulk of evidence suggests no outbreak of febrile respiratory disease in Philadelphia outside the immediate Broad Street area. Although the diagnosis of

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* 1974 Natality and Mortality Statistics, Pennsylvania Annual Report. Department of Health, Harrisburg. March 15, 1976.

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pneumonia was made more frequently in August than in July in 11 Philadelphia hospital emergency rooms, the increase began precisely on August 2, the day of the first massive publicity of Legionnaires' disease and more than 1 week after the peak incidence of cases of Legionnaires' disease itself. The persistence of high numbers of diagnoses of pneumonia for several weeks despite the fall off in cases of Legionnaires' disease, paralleled the continuing publicity and further suggests this as a reporting (or diagnostic) artifact. The more objective negative data from 3 center city hospitals and from pneumonia and influenza death certificates are further evidence of the absence of a generalized outbreak.

Where. The place of exposure cannot be defined with certainty but the most plausible hypothesis is that exposure occurred in Hotel A. This may be a reasonable first hypothesis because Hotel A was the headquarters for the American Legion Convention. In addition, however, such a hypothesis is consistent with the observation that: 1) Of delegates, those who stayed at Hotel A had a significantly higher rate of illness than those that did not, and 2) Of those delegates who did not stay at Hotel A, those who fell ill spent more time on the average in Hotel A than did those who stayed well. Several possible sites of exposure outside the hotel (sidewalk, alley, Chancellor Street, etc.) were not associated with illness, while time spent in the lobby of the hotel was a statistically significant risk factor. This suggests the hypothesis that exposure occurred in the lobby of Hotel A. In all the surviving cases and in 28 of 29 fatal cases persons are known to have been in the lobby of Hotel A; information is not available on the 1 remaining fatal case. Against the hypothesis that the lobby was the site of exposure is the absence of significant illness in employees who worked in the lobby. However, most of these employees were much younger than the Legionnaires, and it has been shown that risk of illness was markedly increased with increasing age. After previous or chronic exposure to an infectious or toxic agent, hotel employees could have become immune or tolerant. The absence of serious illness in hotel lobby employees therefore does not eliminate the possibility that exposure occurred there. It is unlikely that the place of exposure was in any of the main convention function rooms because attendance at those functions was not associated with illness. Similarly bedrooms were unlikely places of exposure since roommates of cases were not at increased risk of illness and because there was no geographic clustering of bedrooms of cases in Hotel A. Hospitality rooms were suspected as a site because of the large amount of informal congregation there. Because no hospitality room was said to have been visited by more than half of the cases and because, even with aggregation in hospitality rooms according to known sources of food or ice, there was no striking association between attendance and illness, they are unlikely to have been the sites of exposure.

When. The observation that illness occurred equally frequently among conventioneers from all parts of Pennsylvania suggests that exposure occurred during the convention, not before people arrived or after they left. The single day exposures suggests that exposure occurred on July 23 but whether it occurred only on that day or also occurred before or after is less clear. The linear correlation between date of arrival and date of onset is evidence that exposure occurred on more than 1 day. An alternative explanation of the correlation is that persons who arrived earlier had a heavier exposure on July 23 and therefore, a shorter incubation period and an earlier onset date. This alternative explanation seems strained. The 2 cases in conventioneers who were exposed for only 1 day on July 21 and July 22 may represent different, milder illness.

This 54-year-old delegate was a Philadelphia resident who nevertheless stayed at Hotel E during the convention. He went to Hotel A only once, for 1-1/2 hours on July 21, when he visited 2 hospitality rooms. He had a highball in each of the rooms but no food. He used the lobby bathroom and water fountain and spent 10-15 minutes in front of the hotel before leaving. He became ill on July 26 with weakness and shortness of breath and was hospitalized 4 days later with a temperature of 100.6 F and a small pulmonary infiltrate and effusion. He made an uneventful recovery.

The other was a 63-year-old male delegate who drank only ice water during his 5-hour stay in Hotel A on July 22 while attending a committee meeting and 1 hospitality room. He became ill on July 25 with fever and chills. He saw his physician on

July 28 who found a normal temperature and physical examination. Chest X ray taken August 3 was normal. The patient recovered eventfully without antibiotics.

The conventioneer who became ill on July 22 had an atypical illness with sore throat and had a negative chest X ray. Her illness may have been coincidental and unrelated to the epidemic. The observed incubation period of 3-9 days in conventioneers with 1 day of exposure fits well with the epidemic curve if it is assumed that exposure could occur throughout the 4 days of the convention and not just on a single day.

How. The mode of spread is not known. It is clear from the studies of families who did not come to the convention that secondary person-to-person spread was unusual or nonexistent. The possibility that the initial exposure at the convention was person-to-person is not ruled out entirely, but the uniform attack rate across districts, and the absence of association between crowding in hospitality rooms and illness or between seating in the Grand Ballroom and illness mitigate against the possibility. The failure to implicate a common meal at the convention, the street vendors, or any of the local coffee shops or restaurants argues against a foodborne outbreak. The simplicity of foods served in the hospitality rooms, the fact that they were purchased from many different sources, and the failure to strongly implicate the hospitality rooms epidemiologically are also evidence against foodborne spread.

The possibilities of spread by air or by water are suggested from the data available. The possibility of a waterborne illness is raised by the cross-connection found between the air-conditioner water and potable water at the top of the hotel and by the accessibility of the potable water tank. The epidemiologic implication of water is inconsistent: Cases were more likely than controls to state they drank water at Hotel A, but there was no difference in stated typical daily water consumption; water in mixed drinks was said to be used by more cases than controls but the difference was significant only for those who did not reside in Hotel A. The strongest argument against the implication of water as the vehicle is that 35% of ill delegates and 38% of all cases queried said they never drank water at Hotel A. Among delegates no association was found between illness and consumption of water or ice in any form. Also, most of the lobby employees asked said they often drank water from the fountain in the lobby, and illness was rare in this group.

If the exposure was airborne, the association of illness and time spent in the lobby might be explained. The dysfunction of the air handling system that serves the center of the lobby 2 weeks after the convention might indicate that the system was working imperfectly earlier. The cleaning of the filters on August 6 may have inadvertently limited the ability of investigators to identify a toxic or microbiologic agent in the air handling system. An airborne agent might also have affected non-Legionnaires who were in the hotel only transiently and had no other apparently significant exposure; it might have exposed persons walking near the hotel who did not enter it. The relatively low attack rate may rule against an airborne agent to some degree.

What. The cause of Legionnaires' disease has not been identified. Few infectious or toxic agents are known that characteristically cause no symptoms at the time of exposure, have an incubation period averaging 5 or 6 days, and result in an acute, severe multi-system illness with high fever and pneumonia predominating. Epidemiologic evidence implies that less severe illnesses if they occurred at all were uncommon. Considering the characteristic lung pathology, the clinical laboratory findings, spectrum of chest X-ray findings, and the lack of secondary spread, shortens the list of known candidate agents further. Several infectious agents that were seriously considered can be eliminated because of the lack of demonstrated antibody rise in well-spaced serum specimens: Influenza A, Coxiella burnetii, Chlamydia psittaci, Histoplasma capsulatum.

Paraquat causes considerable fibrosis in the lungs, not seen in cases of Legionnaires' disease and rarely is associated with significant fever; further, specific assays for paraquat were negative. Nickel carbonyl usually has an incubation period of less than 36 hours and also rarely causes fever above 101 F. Pathological findings often show a heavy infiltration with fibroblasts. Cadmium and zinc

fumes can cause high fever and pneumonia with no immediate symptoms and a prolonged incubation period but elevated levels of these metals have not been consistently found in toxicologic analysis of specimens for cases of Legionnaires' disease. Perfluoroisobutylene gives symptoms at the time of exposure and in 2 reported fatal cases had an incubation period of less than 24 hours. Phosgene, the alkylating agents, and related compounds, are extremely difficult to detect in tissue, serum or urine, but they usually give symptoms immediately on exposure or within a few hours, do not cause a primary febrile disease, and may be associated with a late depression of the white blood cell count, not seen in these cases.

In summary, we are left at this time with a common source outbreak of a serious illness characterized by an incubation period of 3-9 days, high fever, and diffuse pulmonary damage that affected preferentially older male Legionnaire delegates who stayed in Hotel A. Time spent in the lobby of the hotel and drinking water in the hotel was associated with increased risk of illness suggesting the disease might have been water or airborne. Exposure seems to have occurred over 2 or more days. The illness resembles an infectious disease, but there is no secondary spread and microbiologic studies have been negative. No toxin is known that causes just this pattern or disease and toxicologic studies are also negative so far.

ADDENDUM

A microbiologic agent that resembles a bacterium has been isolated by Joseph E. McDade, Ph.D. and Charles C. Shepard, M.D., Leprosy and Rickettsia Branch, Virology Division, Bureau of Laboratories, from 4 of 6 ill persons associated with the outbreak (1,2). The bacterium was first isolated from lung tissues of fatal cases by inoculation of guinea pigs intraperitoneally. After a 1-2 day incubation period the guinea pigs developed a febrile illness that was characterized in most animals by watery eyes and prostration. Spleen suspensions of febrile guinea pigs were inoculated into yolk sacs of embryonated eggs from antibiotic-free chicken flocks. The embryos died after 4-6 days and the Gimenez stained smears of the yolk sacs were found by microscopic examination to contain many bacilli. The bacilli were gram negative and moderately pleomorphic. Serum specimens have been tested from 117 of the 180 cases in the Philadelphia outbreak using organisms in yolk sac smears in an indirect fluorescent antibody technique. Eighty had serologic evidence of recent infection with the agent; 49 had seroconversion (increase in titer of at least 4-fold to 1:64 or higher), and 31 had high titers (1:128 or higher). Seven cases with apparently well-timed serum specimens had no evidence of recent infection. Results of testing with the remaining 30 did not permit determination of whether or not there had been recent infection because of the timing of specimens tested. Eleven patients with single days of exposure on July 21, 22, and 23 showed serologic evidence of recent infection as did 2 attendees of the Eucharistic Congress, suggesting that exposure occurred over a period of 2 weeks. Two persons who had had Broad Street pneumonia and 2 Hotel A employees also showed evidence of recent infection but had not been included in the 180 cases.

Serum specimens from 2 previously unsolved outbreaks of febrile respiratory disease were tested by indirect fluorescence for antibodies to this bacterium. In 1966 an outbreak of acute pneumonia occurred at a large psychiatric hospital in the District of Columbia; there were 94 cases and 16 deaths. Acute and convalescent sera were available from 14 patients. Thirteen had distinct rises in titer of 8-fold or more and 12 had titers of 128 or more to the organism. In the summer of 1968 there were 144 cases and no deaths of a disease characterized by fever, chills, and myalgia in personnel of and visitors to a county health department in Pontiac, Michigan. Sera preserved in CDC's serum bank were tested from 37 patients with typical disease. At least 2 serum specimens per patient were included. Of the 37 patients, 31 had seroconversions and 1 had a high titer to the same organism.

Serum specimens from 21 patients with psittacosis and 74 other patients with pneumonia were tested by the indirect fluorescent antibody technique. All were negative except 1 from a Michigan patient who had seroconversion from < 1:16 to > 1:512. His onset was August 19, 1976, and his pneumonia was severe. He had apparently not

been out of the state during the possible incubation period. Serum was also received from a patient who died from pneumonia in Indiana October 19, 1976, whose onset was October 5, 1976. On the 10th day of illness the titer was 1:16, and in the post-mortem specimen it was 1:256.

Characterization of the bacterium and further investigations of its role in the Legionnaires' disease outbreak, other outbreaks of febrile respiratory disease, and sporadic cases of pneumonia are being conducted by the Bureau of Laboratories and Bureau of Epidemiology. It appears that this bacterium was the cause of the Legionnaires' disease outbreak and that it or a related organism has caused both outbreaks and sporadic cases of pneumonia in several states.

1. Center for Disease Control: Follow-up on respiratory illness--Philadelphia. Morbidity Mortality Weekly Rep 26:9-11, 1977
2. Center for Disease Control: Follow-up on respiratory illness--Philadelphia. Morbidity Mortality Weekly Rep 26:43-44, 1977

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Mailing keys 53-1, 2, 3

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APPENDIX A

TELEPHONE CHECKLIST FOR POSSIBLE CASES

I. INITIAL QUESTIONS

1. MAXIMUM FEVER_____

2. RESULTS OF CHEST X RAY _____

3. COUGH YES_____ NO_____

II. PROCEED WITH CHECKLIST IF:

1. THERE IS FEVER EQUAL TO OR GREATER THAN 102 DEGREES WITH COUGH

2. OR, IF THERE IS X-RAY EVIDENCE OF PNEUMONIA AND ANY FEVER

III. IDENTIFYING INFORMATION:

PATIENT: NAME_____

ADDRESS_____

TELEPHONE NUMBER _____

AGE_____

LEGIONNAIRE: YES_____ NO_____

CALLER: NAME:_____

POSITION _____ ADDRESS_____

PHONE NUMBER _____

DATE OF ONSET OF ILLNESS_____ ALIVE_____ DEAD_____

DATE OF ADMISSION TO HOSPITAL_____

NAME OF HOSPITAL_____

HOSPITAL ADDRESS_____

TELEPHONE NUMBER _____

NAME OF PHYSICIAN _____

PHONE NUMBER OF PHYSICIAN _____

IV. WERE YOU AT THE AMERICAN LEGION CONVENTION IN PHILADELPHIA? Y___ N___

V. HAVE YOU HAD CONTACT WITH A PERSON WHO ATTENDED THE AMERICAN LEGION CONVENTION? YES_____ NO____

VI. HAVE YOU BEEN AT HOTEL A SINCE JULY 1, 1976? YES____ NO____

APPENDIX B

Under the Privacy Act of 1974* we are required to give you the following information before asking you any questions.

CDC is authorized to ask for the information requested in this interview by the Public Health Service Act. The information requested is considered necessary and relevant in the investigation of Legionnaires' disease. As you know, no cause has been found. Although we may have contacted you several times in the previous months, we would like to ask you a few more questions which might still be helpful in the solution of the epidemic. Your cooperation is voluntary, but without it, we will be hindered in our efforts to find the cause. The investigation is being conducted by the State and Philadelphia Health Departments with CDC who will share the information.

Many of the questions relate to your usual habits in eating and drinking, especially alcoholic beverages. We know this may be a sensitive topic to some people, but we hope that you will be willing to answer the questions. Some of the questions relate to your activities at the Convention and it may be difficult to remember them; please answer as well as you are able.

*Public Law 93-579.

TO THE INTERVIEWER: Any questions which are left unanswered (particularly "yes" and "no") will have to be treated as unknown. Be sure to check the "no" box if the answer is "no."

APPENDIX B

Form Approved
OMB No. 68-R1009

LEGIONNAIRES' DISEASE
CASE CONTROL RESURVEY

Date ____/____/____ (1-6)
month day year

Interviewer _____

Case # _____ (7-11)

Control # _____ (12-16)

Name _____ Age _____ (17,18)

Address _____ Phone _____

(1) How often do you drink any alcoholic beverage (beer, wine, hard liquor): (19)

IF NEVER, COMPLETE ONLY ITEMS 6, 8-11, 13-21. (starred questions *)

Never _____

Occasionally _____
(e.g., social functions only)

Often _____
(at social functions and other times)

(2) At a social gathering if only one of each of the following beverages were provided for you, would you normally drink it?

		Usually	Sometimes	Never
Beer alone	(20)	_____	_____	_____
Wine alone	(21)	_____	_____	_____
Hard liquor alone	(22)	_____	_____	_____

(3) If all were provided at one time which drink or drinks would you have?

		Usually	Sometimes	Never
Beer	(23)	_____	_____	_____
Wine	(24)	_____	_____	_____
Hard liquor	(25)	_____	_____	_____

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(4) If only one of the following types of hard liquor were provided for you, indicate whether you would normally drink it.

	Usually (U)	Sometimes (S)	Never (N)	Can you rank your preference of those you might drink 1-7 (1 most preferred, 7 least)?	If all were provided at the same time, indicate those you would be likely to drink (Y/N).
Scotch (26)				(33)	(40)
Whiskey (27)				(34)	(41)
Rye (28)				(35)	(42)
Bourbon (29)				(36)	(43)
Gin (30)				(37)	(44)
Vodka (31)				(38)	(45)
Rum (32)				(39)	(46)

(5) For each of the seven kinds of liquor mentioned, indicate how you prefer to drink them? (Usually = U; Sometimes = S; Never = N)

	Scotch			Whiskey			Rye			Bourbon		
	U	S	N	U	S	N	U	S	N	U	S	N
Straight	(47)			(58)			(69)			(80)		
On the rocks	(48)			(59)			(70)			(81)		
With water	(49)			(60)			(71)			(82)		
With water & ice	(50)			(61)			(72)			(83)		
With beer	(51)			(62)			(73)			(84)		
With mixer	(52)			(63)			(74)			(85)		
With mixer & ice	(53)			(64)			(75)			(86)		
Specify mixer	(54,55)			(65,66)			(76,77)			(87,88)		
	(56,57)			(67,68)			(78,79)			(89,90)		

Examples of mixers: coke, 7-up, ginger-ale, club soda, i.e., carbonated water, tonic (qu'nine) water, orange juice, tomato juice, grapefruit juice, lime ade, milk, coffee, bitter lemon, Tom Collins mixer, vermouth.

(Gin, Vodka, and Rum - continued on following page)

(5) Continued...

	Gin			Vodka			Rum		
	U	S	N	U	S	N	U	S	N
Straight	(91)___	___	___	(102) ___	___		(113) ___	___	___
On the rocks	(92)___	___	___	(103) ___	___		(114) ___	___	___
With water	(93)___	___	___	(104) ___	___		(115) ___	___	___
With water & ice	(94)___	___	___	(105) ___	___		(116) ___	___	___
With beer	(95)___	___	___	(106) ___	___		(117) ___	___	___
With mixer	(96)___	___	___	(107) ___	___		(118) ___	___	___
With mixer & ice	(97)___	___	___	(108) ___	___		(119) ___	___	___
Specify mixer	(98,99) _____			(109,110) _____			(120,121) _____		
	(100-101) _____			(111,112) _____			(122,123) _____		

★ (6) At social gatherings, if only one of the following kinds of snacks were available, would you be likely to eat it?

If all were provided at the same time, which one(s) would you be likely to eat? (Y, N, Sometimes)

	U	S	N	
peanuts (124)	___	___	___	(133) ____
potato chips (125)	___	___	___	(134) ____
pretzels (126)	___	___	___	(135) ____
crackers (127)	___	___	___	(136) ____
cheese (128)	___	___	___	(137) ____
sausage (129)	___	___	___	(138) ____
bologna (130)	___	___	___	(139) ____
sardines (131)	___	___	___	(140) ____
dip (132)	___	___	___	(141) ____

			Yes	No
(7)	Do you ever drink homemade wine?	(142)	____	____
	Do you ever drink homemade liquor?	(143)	____	____

			Yes	No
★ (8)★	At past State American Legion Conventions did you hear of or see homemade liquor?	(144)	____	____
★	Did you hear of or see such liquor at the most recent State Convention? (Philadelphia)	(145)	____	____
	Did you drink any homemade liquor at the most recent State Convention? If yes, answer Supplementary Questionnaire.	(146)	____	____

★ (9) How often do you eat homemade sausage or Lebanon bologna? (147)

Often..... ____

Sometimes... ____

Never ..... ____

★ (10) Did you eat any Lebanon bologna or sausage at the Legion Convention in Philadelphia? (148) Yes..... ____

No..... ____

Don't remember... ____

			Yes	No	Don't Know
★ (11)	During the Convention did you consume any ice from the machines in the corridors of the Bellevue Stratford in drinks such as mixed drinks, soft drinks, or ice water?	(149)	____	____	____

			None	1-4	≥ 5
(12)	During the Convention period on the average how many of each of these drinks did you have each day?				
	Beer	(150)	____	____	____
	Wine	(151)	____	____	____
	Hard liquor	(152)	____	____	____

			Yes	No
* (13)	At the present time, do you smoke cigarettes?	(153)	____	____
	cigars?	(154)	____	____
	a pipe?	(155)	____	____

* (14) If you are a cigarette smoker, how many cigarettes/day do you usually smoke? (156-158) _____

		Yes	No	Don't Know
* (15)	Did you smoke any of the free Merit cigarettes available at the Convention? (159)	____	____	____

* (16) It is sometimes difficult to recall events that took place several months ago. How certain were you in answering questions relating to the Convention period? (160)

Certain..... ____
Fairly certain.. ____
Uncertain..... ____

★ (17) Interviewer:

How do you assess the reliability of answers to questions relating to the Convention period? (161)

Certain..... ____
Fairly certain.. ____
Uncertain..... ____

CENSUS ID # _____
(170-174)

APPENDIX B
6

CLINICAL QUESTIONNAIRE

CASES

		Y	N
★ (18)	Have you recovered from your illness with Legionnaires' disease?	___	___
★ (19)	Since being discharged from the hospital for Legionnaires disease, have you been rehospitalized?	___	___

If so, what hospital: _____

Dates of hospitalization: _____ to _____.

★ (20) Since being discharged from the original hospitalization for Legionnaires' disease how many times have you visited a physician? _____

Give following information for each visit:

Date of visit	Complaint	Diagnosis	Ch X ray done (Y/N?)	Name of M.D., city, and phone

★ (21) How is your health now compared to last year?

	Less	The same	More
Do you now cough:			
Do you produce sputum:			
Are you short of breath:			

Possible intervening causes other than Legionnaires' disease. _____

CONTROLS

	Y	N
Since the last week of July have you been hospitalized?	___	___

Complaint _____

Diagnosis _____

Since August 1 how many times have you visited a physician? _____

CASES ONLY

(22) Did you spend any time at the Convention with other people who got Legionnaires' disease? With whom? What activities and when?

APPENDIX B
8

SUPPLEMENTARY QUESTIONNAIRE FOR LEGIONNAIRES' DISEASE
CASE CONTROL RESURVEY

(1) In what kind of container did the homemade liquor come? Describe shape, color, size of container. Describe label on bottle. What type of liquor was it, beer, whiskey, rye, scotch, etc.?

_____

_____

_____

_____

(2) What was the color of the liquid:

	Yes	No
clear	_____	_____
whiskey colored	_____	_____
other	_____	

(3) Where was it served? At a hospitality room? _____ _____

Which one(s) (Name of host and Post #)? _____

_____

By a friend? _____ _____

Specify _____

Sold to you? _____ _____

Where did you buy it? From whom? Who else bought it? _____

_____

_____

Who else drank it? _____

_____

_____

APPENDIX C

LEGIONNAIRE CENSUS

1. Name _____ 2. Age _____ 3. Sex: ___ Male ___ Female

4. Address _____ 5. Phone _____ 6. Post # _____

7. Convention Status: (check only one)

Delegate ____
Auxiliary ____
Family member (not auxiliary) ____
Non-delegate ____
Other ____

8. Check the hotel where you stayed:

Hotel A ____ Room # ____
E ____
D ____
F ____
G ____
Home ____
Other ____ Specify _____

9. Check which days you were in Phila. for the convention:

	yes	no
Mon. 19th	____	____
Tue. 20th	____	____
Wed. 21st	____	____
Thur. 22nd	____	____
Fri. 23rd	____	____
Sat. 24th	____	____
Sun. 25th	____	____

Did not go to Phila. ____

10. How many hours did you spend in Hotel A each day?

Wednesday, 21st ____ hours
Thursday, 22nd ____ hours
Friday, 23rd ____ hours
Saturday, 24th ____ hours

11. How many hours did you spend in Hotel D each day?

Wednesday, 21st ____ hours
Thursday, 22nd ____ hours
Friday, 23rd ____ hours
Saturday, 24th ____ hours

12. Indicate below how much time you spent in Hotel A or on the sidewalk around Hotel A on Friday, July 23. Check all boxes corresponding to the time(s) you were there:

Morning:	Midnight to 2 AM	2 AM to 4 AM	4 AM to 6 AM	6 AM to 8 AM	8 AM to 10 AM	10 AM to Noon
	____	____	____	____	____	____
Afternoon and Evening:	Noon to 2 PM	2 PM to 4 PM	4 PM to 6 PM	6 PM to 8 PM	8 PM to 10 PM	10 PM to Midnight
	____	____	____	____	____	____

13. Indicate below how much time you spent in Hotel D or on the sidewalk around Hotel D on Friday, July 23. Check all boxes corresponding to the times you were there:

Morning:	Midnight to 2 AM	2 AM to 4 AM	4 AM to 6 AM	6 AM to 8 AM	8 AM to 10 AM	10 AM to Noon
	____	____	____	____	____	____
Afternoon and Evening:	Noon to 2 PM	2 PM to 4 PM	4 PM to 6 PM	6 PM to 8 PM	8 PM to 10 PM	10 PM to Midnight
	____	____	____	____	____	____

14. Check below the activities which you attended:

	Yes	No	Don't Know
Wednesday, July 21, 8 PM Joint Auxiliary and Legion meeting, Grand Ballroom in Hotel A	____	____	____
Thursday, July 22, 10 AM, Grand Ballroom of Hotel A	____	____	____
Thursday, July 22, 7 PM, Testimonial Dinner, Ballroom of Hotel D	____	____	____
Friday, July 23, 7:30 AM, Keystone "Go-Getter's Breakfast" 18th floor, Roof Garden of Hotel A	____	____	____
Friday, July 23, 10 AM, 58th Dept. Convention Session Ballroom of Hotel A	____	____	____

14. (Continued) APPENDIX C 2

Friday, July 23,1 PM, Dance, Ballroom of Hotel A ____ ____ ____
Saturday, July 24, 9:30 A.M., Closing Session, Grand-ballroom of Hotel A ____ ____ ____

15. Check below which hospitality room you visited:

	Yes	No	Don't Know
A	___	___	___
B	___	___	___
C	___	___	___
D	___	___	___
E	___	___	___
F	___	___	___
G	___	___	___
H	___	___	___
I	___	___	___
J	___	___	___
K	___	___	___
L	___	___	___
M	___	___	___

Your Post Hospitality Room _____
Your District Hospitality Room _____

Specify any other:

_____ Date _____
_____ Date _____
_____ Date _____
_____ Date _____

16. a. Were you in the parade on Friday evening? Yes ___ No ___

b. Did you watch the parade on Friday evening? Yes ___ No ___

If yes, did you watch from:

Inside Hotel A _____
From which floor? _____
From an open window? _____
From steps of Hotel A? _____
From sidewalk in front of Hotel A? _____
On sidewalk across from Hotel A? _____

c. Did you buy anything from street vendors during the parade? Yes ___ No ___

17. a. Did you drink coffee at the Friday morning "Go-Getter's" Breakfast? Yes ___ No ___

b. Did you eat pastry at this breakfast? Yes ___ No ___

	Yes	No	Don't Know
18. Did you use ice in soft drinks?	____	____	____
Did you use ice in mixed drinks?	____	____	____
Did you buy ice from outside the hotel?	____	____	____
Did you buy block ice?	____	____	____
Did you buy ice cubes?	____	____	____

From which store did you buy ice? _____

	Yes	No
19. Did you get a free beer mug at the Friday morning meeting?	____	____
Did you drink anything from the free beer mug?	____	____
Did you buy a delegate souvenir pack?	____	____
Did you drink any water at Hotel A?	____	____
Did you use any water from Hotel A in a mixed drink?	____	____

20. What is the average number of alcoholic drinks or beers which you drank each day during the convention? None _____ 1-4 _____ 5 or more _____

21. On Friday the 23rd how often did you ride the main elevators (front door) in Hotel A?

Did not ride _____
1-5 times _____
More than 5 times _____
Don't remember _____

On Friday the 23rd how often did you ride the side (Walnut St.) elevators?

Did not ride _____
1-5 times _____
More than 5 times _____
Don't remember _____

APPENDIX C
3

22. Have you been sick since the beginning of the convention? Yes___ No___
    Did you have a fever in the past 2 weeks? ___ ___
    Was it over 102 F? ___ ___
    Have you had a cough in the past 2 weeks? ___ ___
    Have you had a chest X ray in the past 2 weeks? ___ ___

23. Describe anything unusual which you think may be related to the illness.

_____

_____

_____

APPENDIX D

EMPLOYEE QUESTIONNAIRE - OUTBREAK SURVEILLANCE - CITY OF PHILA.

Name _____ Age _____ Sex _____

Home Phone _____ Hotel Job _____ Shift _____

Days absent for July _____ Were you in Hotel July 23, 1976? Yes___ No___

Symptoms: Date of Onset _____ Fever _____°F

Cough _____ Chest X ray _____

A case consists of A+ chest film (pneumonia) and any fever, or fever > 102°F, and cough. If these are present, continue.

What door do you use to enter or leave? _____

Legionnaire contact: ____Frequent (e.i., room service, front desk, maid, waitress)

____Occasional (kitchen, clerical)

Average visits per day to Legionnaires' rooms? _____

Do you regularly eat hotel food? Yes ____ No ____

Did you have food or beverage in Legionnaire's room? Yes _____ No _____

Date if known _____ Type of food _____ Room No. _____

Did you smoke free cigarettes given out at convention? Yes____ No ___

Physician _____ Address _____ Phone # _____

Interviewed by _____ Date _____

APPENDIX E

Hospitality Room Survey
Hotel A

Informant: _____

I. Hospitality Room - Name: _____ Room No. ____ Post: ____

Street: _____ Home Phone: _____

Town: _____ County: _____ State: _____

Age: ____ Sex: _____

Occupation: _____ Legion District: _____

II. Stay in Hotel A: From _____ To _____

Day Reception Held in Room: _____ No. People Attended Reception _____

Time: From: _____ To _____ Do You Have a Guest List? _____

Other Days Receptions Held: _____

Dates:	No. People Attended (Approximate No.)	Time:
1. _____	_____	From _____ To _____
2. _____	_____	From _____ To _____
3. _____	_____	From _____ To _____
4. _____	_____	From _____ To _____

III. Food

Date:		Food	Source: (Person and Where Obtained)
1. _____	a.	_____	_____
	b.	_____	_____
	c.	_____	_____
	d.	_____	_____
	e.	_____	_____
	f.	_____	_____
2. _____	a.	_____	_____
	b.	_____	_____
	c.	_____	_____
	d.	_____	_____
	e.	_____	_____
	f.	_____	_____

Date:	Food	Source: (Person and where obtained)
3. _____	a. _____	_____
	b. _____	_____
	c. _____	_____
	d. _____	_____
	e. _____	_____
	f. _____	_____

IV. Beverages Served at Hospitality Rooms

Date:	Beverages	(Person and Where Obtained)
1. _____	Ice	
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
Favors (Including cigarettes)	_____	_____
2. _____	Ice	
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
Favors (Including cigarettes)	_____	_____
3. _____	Ice	
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
Favors (Including cigarettes)	_____	_____
4. _____	Ice	
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
Favors (Including cigarettes)	_____	_____

V. Activities or Unusual Happenings:

	Date:	Activities	Unusual Happenings
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____

VI. Where Was Ice Kept In Room? _____

VII. Did You or Anyone Notice any Fumes, Irritants or Strange Odors?

Date	No:	Yes:	Specify:
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

VIII. Did Any Persons Feel Unexpectedly Sick During Receptions?

Date	No:	Yes:	Specify Number
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

IX.

Date	Bartender	Ice How Served?

X. Did you Hire any other People for your Receptions?

Date	Name	Purpose

XI. Where did you obtain your Utensils?

Eating: _____ _____

Drinking: _____ _____

XII. Oh, by the way, do you remember those people who attended party and who developed penumonia?

Party Date			
1. _____	a. _____	Post:	_____
	b. _____	Post:	_____
	c. _____	Post:	_____
	d. _____	Post:	_____
	e. _____	Post:	_____
2. _____	a. _____	Post:	_____
	b. _____	Post:	_____
	c. _____	Post:	_____
	d. _____	Post:	_____
	e. _____	Post:	_____
3. _____	a. _____	Post:	_____
	b. _____	Post:	_____
	c. _____	Post:	_____
	d. _____	Post:	_____
	e. _____	Post:	_____
4. _____	a. _____	Post:	_____
	b. _____	Post:	_____
	c. _____	Post:	_____
	d. _____	Post:	_____
	e. _____	Post:	_____

APPENDIX F

Case # _____

I.D. # _____

Name _____ Age _____ Sex: ___Male ___Female

Address _____ County_____ State _____

Patient's Phone # ( ) _____ Legion Post # _____

Date and Time interviewed _____ Interviewer _____
(print)

INTRODUCTION

Hello _____, please. My name is _____ from _____. We are investigating the illness that occurred among Legionnaires at their convention in Philadelphia. (pause) We are conducting a telephone survey of legionnaires and others, both sick and well, to uncover any differences between them. (pause) We realize that you have been contacted before and have answered many questions already. Depending on what information we already have about you, this may be a very short interview. Hopefully, at the completion of this interview we will have all the information we need. Please bear with us in answering these questions. (pause)

I.1) How many people live in your household, besides yourself? Please list these people below in Column A and complete.

A. HOUSEHOLD MEMBERS

	Name	Age	Sex M	Sex F	Attended Convention Yes - No
1					
2					
3					
4					
5					
6					
7					

2) Have any of these household members been ill since the Legion Convention July 21st-24th? Yes____ No____ If YES complete Column B below for each ill person.

B. ILLNESS. (Please check column if positive or insert a code letter)

	Name	Date Onset	Fever °F	Cough	Sputum (S) Dry Cough (D)	CXR Done	CXR Normal (N) Abnormal (A) Unknown (U)	Diarrhea	Vomiting	Muscle Aches	Headache
1											
2											
3											
4											
5											
6											
7											

DIRECTIONS TO INTERVIEWER

Continue below with Part II A or B
YES
NO - Conclude Interview

READ TO ALL PATIENTS

This next part of the interview involves a very detailed questionnaire regarding your activities during the convention. Take your time and try to recall to the best of your ability the detailed answers to these questions. We are trying to determine differences between those legionnaires who became sick and those who remained well. (pause)

BEGIN WITH SECTION IIA ____YES ____NO (If YES, go to APPENDIX C)
(If NO, skip to III B.)

SECTION III B

If box checked ☐ begin at the top of this page with Question 23A. If box not checked, skip to Question 24.

23A. Were you at the "Go-Getter's Breakfast" on Friday morning in the Roof Garden?
Yes ____ No ____ Unknown _____

23B. How many hours did you spend in Hotel A each day? (Estimate)

Wednesday, 21st _____ hours
Thursday, 22nd _____ hours
Friday, 23rd _____ hours
Saturday, 24th _____ hours

24. Now we would like to ask you some questions about activities in the hotel lobby of Hotel A and in the street in front of Hotel A.

First question: Can you estimate in minutes or hours the total time you spent in the lobby of Hotel A during each day of the convention?

Wednesday, 21st (Opening Day) _____Mins./Hrs.
Thursday, 22nd _____Mins./Hrs.
Friday, 23rd (Parade Day) _____Mins./Hrs.
Saturday, 24th (Closing Day) _____Mins./Hrs.

TO INTERVIEWER: If person is having difficulty in giving an estimate by each day, then ask the next question (24A.)

24A. Can you estimate an average time per day you spent in the lobby? ____Hrs. ____Ukn

25. Did you use the restroom in the lobby during the convention? (It is located in the rear of the lobby in the registered guests reading lounge next to the florist shop.) Yes____ No_____ Unknown _____

26. Can you estimate in hours or fractions of hours how much time you spent on the sidewalk in front of Hotel A each day? (For example, waiting for friends, taxis, etc.) (The sidewalk includes the entire block on the hotel side of the street.)
Wednesday, 21st (Opening Day) _____hours
Thursday, 22nd _____hours
Friday, 23rd (Parade Day) _____hours
Saturday, 24th (Closing Day) _____hours

TO INTERVIEWER: If person is having difficulty in giving an estimate of each day, then ask the next question (26A.)

26A. Can you estimate an average time per day spent on the sidewalk in front of Hotel A? _____hours _____Unknown

21-248 O - 78 - 11

27. Did you walk down Chancellor Street or down the small back alley street behind the hotel? (Chancellor Street is the first street to the right when exiting from the main entrance on Broad Street. The back alley has the Lounge (bar) on the corner.)
Yes _____ No _____ Unknown _____

If yes, approximately how many times? _____ Unknown _____

28. Were you close enough to touch any pigeons in the area of Hotel A?
Yes _____ No _____ Unknown _____

29. Did you see any sick or dead pigeons in the area of Hotel A? Yes__ No___ Ukn___
If yes, describe _____

We have just a few more questions about activities inside the hotel.

30. Did you stay overnight in Hotel A? Yes____ No____. If NO, proceed to Question 31.
If YES: What was your room number _____ Unknown _____
If YES: (a) Did you keep the window open most of the night? Yes___ No ___
(b) Did you use the airconditioner most of the night?Yes___ No ___

32. Did you drink water in Hotel A? Yes ___ No ___ Unknown ____
If YES, from: room tap ____ water fountain____ both ____

A few final questions about hospitality rooms...

33. Can you estimate total time that you spent in hospitality rooms on each day of the convention:

Wednesday, 21st	(Opening Day)	_____hours
Thursday, 22nd		_____hours
Friday, 23rd	(Parade Day)	_____hours
Saturday, 24th	(Closing Day)	_____hours

TO INTERVIEWER: If person is having difficulty in giving an estimate by each day, then ask the next question (33A.)

33A. Can you estimate an average time per day you spent in the hospitality rooms?
_____hours _____unknown

If no time spent in hospitality rooms, conclude interview.

If time spent in hospitality rooms, ask question 33B.

33B. Did you notice that the window was open in any of the hospitality rooms you visited? If YES, which ones _____, _____, _____, _____ unable to name

CONCLUDE INTERVIEW

APPENDIX G

EPIDEMIOLOGIC QUESTIONNAIRE

Informant _____
Phone # _____

I. Guest name _____ Address _____

Town _____ County _____ State _____
Sex _____ Race _____ B___ W____ Other _____
Marital Status _____ Age _____ DOB _____

II. Date of arrival in Philadelphia _____ Date of Departure _____
Hotel of Residence: Name _____ Dates _____ Room _____
Name _____ Dates _____ Room _____
Attended Convention: Yes _____ No _____
Status: Delegate___ Family Member ____ Purpose of Visit: _____
Other _____ _____

III. Clinical

Have you been ill recently? Yes___ No____. Date of onset _____
What were your first symptoms? _____
Did you see a doctor? Yes____ No____. Name _____
Address _____ Phone _____
Were you admitted to the hospital? Yes____ No____. If yes, when _____
Name of hospital _____ Location _____
Any pre-existing illness? Yes____ No____. If yes, what _____
_____
Dates of onset _____

Symptoms associated with recent illness (check):

1) fever __
2) temperature, highest___
3) chills ___
4) headache___
5) myalgia ___
6) malaise___
7) cough ___
8) sputum ___
9) chest pain ___
10) vomiting ___
11) shortness of breath___
12) abdominal pain___
13) constipation ___
14) diarrhea

IV. Conferences

Wed., 7/21, 8 pm	Joint auxiliary and Legion meeting Grand Ballroom, Hotel A	Yes____	No____
Thurs., 7/22, 10am	Grand Ballroom, Hotel A	Yes ____	No____
Thurs., 7/22, 7 pm	Testimonial dinner, Ballroom, Hotel D	Yes ____	No____
Fri., 7/23, 7:30 am	Keystone "Go-Getter's Breakfast", 18th floor, Roof Garden, Hotel A	Yes ____	No____
Fri., 7/23, 10 am	58th Dept. Convention Session, Grand Ballroom, Hotel A	Yes ____	No____
Sat., 7/24, 9:30 am	Closing Session, Grand Ballroom, Hotel A	Yes ____	No ____

V. Receptions

For State Commander	A	Yes ___	No ___
	B	___	___
	C	___	___
For Central Vice Commander	D	___	___
For Eastern Vice Commander	E	___	___
	F	___	___
For Western Vice Commander	G	___	___
	H	___	___
	I	___	___

V. Receptions (Continued)

For National Executive Committeeman	J K	Yes ____	No ____
For Alternate National Executive Committeeman	L	____	____
For Finance Committeeman	M	____	____

For other hospitality rooms (i.e., Post)--Specify (Dates, rooms, food and alcohol consumed)

VI. Did you obtain food or liquor from any of the following sources (# of times if possible)?

SOURCE	FOOD	LIQUOR
Hotel A		
Dining rooms	_____	_____
Coffee shop	_____	_____
Room service	_____	_____
Brought into hotel (state source)	_____	_____
Havey House	_____	_____
Eagle II	_____	_____
Bain's	_____	_____
Horn & Hardart	_____	_____
Red Oak	_____	_____
Bellevue Lounge	_____	_____
Nick's Roast Beef	_____	_____
L & H Sandwich Shop	_____	_____
Colonado	_____	_____
Mitchell's	_____	_____
American Flame	_____	_____
Red Onion	_____	_____
19th Hole	_____	_____
Dewey's	_____	_____
Poor Richard's Club	_____	_____
Hickory Lounge	_____	_____
Bookbinder's	_____	_____
The Office	_____	_____
H. A. Winston	_____	_____
Frank Clements Tavern	_____	_____
Top of the Tooz	_____	_____
Paper Plate	_____	_____
Other Bars on Locust Street	_____	_____
Other (specify)	_____	_____

VII. Food eaten at Keystone "Go-Getter's Breakfast," Friday, July 23rd, 7:30 to 9:00 am at Hotel A, 18th Floor, Roof Garden.

Coffee ( )
Tea ( )
Milk ( )
Pastry (Schnecksn)( )

VIII. Occupation _____
Residence: Rural ( ) Urban ( ) Suburban ( ) Pig Contact ( )

IX. Household Contacts:
1. Adults (18 or older) in family _____
   a. No. attending convention _____
2. Children in family _____
   a. No. children attending convention _____

Describe any illness in family contacts (name, age, sex, symptoms, attended convention, hospital).

X. Did you smoke any free cigarettes given to you at the convention? Yes___ No___
Total free cigarettes consumed _____. Did you smoke any other cigarettes? Yes____ No____ How many per day?_____ Did you notice any noxious gases or fumes? Yes ____ No____. If YES, specify: _____

XI. Did you drink any ice water from the metal containers in Hotel A? Yes___ No___
Total number of cups consumed ____.
Did you have a roommate at the hotel? Yes ____ No____
Name/Phone_____/_____

XII. FORM COMPLETED BY: Name_____

Title_____

Date _____

APPENDIX H

EPIDEMIOLOGIC SURVEY FORM

I. Name _____ Address_____
(street) (town)
Sex ____ American Legion Post No. _____ Age____ Date of birth _____
Dates attending convention_____
Date arrived in Philadelphia_____ Date left Philadelphia _____

II. Hotel(s) of residence _____ Dates_____

III. Attendance at conferences (check)
Wednesday, July 21, 8 pm, Joint Auxiliary and Legion meeting, Grand Ballroom of Hotel A _____
Thursday, July 22, 10 am, Grand Ballroom of Hotel A _____
Thursday, July 22, 7 pm, Testimonial Dinner, Hotel D _____
Friday, July 23, 7:30 am, Keystone "Go-Getter's Breakfast" 18th floor, Roof Garden of Hotel A _____
Friday, July 23, 10 am, 58th Dept. Convention Session, Ballroom of Hotel A _____
Saturday, July 24, 9:30 am, Closing Session, Grand Ballroom of Hotel A _____

IV. Attendance at "Hospitality Rooms" (check)

For State Commander:
A _____
B _____
C _____

For Central Vice Commander:
D _____

For Eastern Vice Commander:
E _____
F _____

Other Hospitality Rooms (list):
_____
_____

For Western Vice Commander:
G _____
H _____
I _____

For National Executive Committeeman:
J _____
K _____

For Alternate Nat'l Executive Committeeman
L _____

For Finance Committeeman:
M _____

V. Food eaten at Keystone "Go-Getter's Breakfast" on Friday, July 23, 7:30-9 am at Hotel A, 18th Floor, Roof Garden (check):

Coffee____ Tea____ Milk____ Pastry (Schnecksn)____

VI. Restaurants attended (number of times, if possible):

Havey House _____, Horn Hardart _____, Nick's Bar _____, Coffee Shop, Hotel A Basement) _____, Dining Room and Lounge Hotel A (Main Floor) _____, Book Binders _____.

VII. Occupation _____
Residence: Rural____ Urban____ Suburban____ Any contact with pigs? _____

VIII. Household contacts:
1. Adults in family _____. Number attending convention _____.
2. Children in family _____. Number attending convention _____
3. Describe any family illness in contacts: (Name, age, sex, symptoms)

Hospitalized _____

IX. Did you drink any ice water from the galvanized metal containers in Hotel A Grand Ballroom? Yes____ No____ Total number of cups consumed _____

X. Form completed by: _____
Title_____(EIS Officer, Public Health Representative, or Other)

EIS OFFICER: _____

Number: _____

Source: _____

APPENDIX H
3

EIS Officer _____

Number: _____

Source: _____

Name _____ County of Residence _____

Age _____ Sex _____M _____F Post # _____

Race _____B _____W _____Other Doctor's name _____

Status at convention: delegate
family member
staff
did not attend convention { 1 of 5 at hotel / not at hotel

Address _____

Phone _____

Pre-existing illness: _____
Date of onset: _____

Hosp. date of adm. _____
Name: _____
Location: _____
Phone #: _____

Illness during convention Y N

Symptoms: (circle)		Y	N
	fever	Y	N
	chills	Y	N
	myalgia	Y	N
	HA	Y	N
	Cough	Y	N
	SOB	Y	N
	Abd. pain	Y	N
	Vomiting	Y	N
	Diarrhea	Y	N
	Constipation	Y	N
	Sputum	Y	N

Signs: (check)

	Nl.	Abn.	Describe
Rash	___	___	_____
Peak temp.	___	___	_____
Chest findings	___	___	_____
CNS	___	___	_____
Abdomen	___	___	_____
Cardiac	___	___	_____

Lab Chest X ray
Cultures blood
sputum
urine
stool

RX:

Outcome: Dead (date)
Convalescing
Well (date)

Abn. renal chemistry
Abn. U. A.
ECG
LFTs
platelets
WBC
Hct
sputum gram stain
ABGs

Path:

If PM pathologist's name

Phone number:

3K4390377

Center for Disease Control
Priority Setting and Resource Allocation

A discussion of resource allocation by the Center for Disease Control (CDC) must start with a discussion of its mission and operations. The Center is not primarily a "research organization". Its primary mission is to be a leader, advisor, and assistant to the nation's public health community in the prevention of disease and disability. CDC does get involved in research, to the extent that such research is related to improved public health measures. Thus, the Center maintains ongoing activities related to monitoring of the status of the nation's health, investigation of a wide range of known and recognized public health problems, and the development of new disease control methodologies. The Center is looked upon as a problem-solving organization. State and local health departments turn to CDC for assistance in coping with epidemics, handling unusual or unique disease outbreaks, to provide diagnostic reference services to back-up State capabilities, and for training.

Other than occupational safety and health, the Center's research is funded out of the line item in the budget called Disease Investigation, Surveillance, and Control. From this part of the budget, CDC supports epidemic aid, disease monitoring, and laboratory services as well as research investigations and studies. It is from within this category that Legionnaires' Disease efforts are funded. Within this activity the Center has staff working on a continuing basis in various disease categories on the many aspects of study and investigation, surveillance, and service. There is more than enough ongoing public health work to keep this staff fully occupied. However,

it is understood that a part of the mission is to respond to special health needs that arise. In other words, the Center is prepared to get engaged in the "problem solving" aspect of its mission whether or not it is specifically budgeted. When a problem arises that cannot be adequately handled by the part of the Center with primary responsibility, special emphasis is given to the problem, and resources from various parts of the Center are applied to finding the solution. At such times, more routine activities take second place in order to deal with the crisis. It is in this manner that the Center has been able to respond to major public health problems such as Venezuelan Equine Encephalitis in 1971, an outbreak of salmonellosis spread across the nation in contaminated dried milk in 1966, major outbreaks of Dengue in Puerto Rico in 1976 and 1977, a major outbreak of disease caused by contaminated intravenous fluids in 1971, and many others. These major health crises were handled in addition to the more than 1,500 outbreaks investigated by Epidemic Intelligence Service Officers each year and the more than 170,000 specimens referred to our laboratories for reference diagnosis from State public health laboratories.

CDC program priorities are the result of a continuing process that involves many different parties and which culminates in the forward planning and appropriations process. Input into the priority setting process comes through many avenues:

A. The Center depends heavily on the public health professionals in its own employ: the physicians, the scientists, and the other public health specialists and managers who make up the staff of nearly 1,400 professionals at the Center. Their knowledge of health problems

comes from daily contact with the problems of State and local health departments and from analysis of disease and illness afflicting the American people.

B. In selected areas the Center has benefit of the advice of Public Health Advisory Committees from Universities, health departments or other government agencies such as the Advisory Committee on Immunization Practices and the Medical Laboratories Advisory Committee. In addition, the Center seeks the advice and guidance of individual experts in the various aspects of disease control such as epidemiology and disease diagnosis.

C. The Center maintains continuing contact with key public health organizations such as the Association of State and Territorial Health Officers, the Association of State and Territorial Epidemiologists, and the Association of State and Territorial Public Health Laboratory Directors. From these groups the Center gains input concerning both specific and general public health needs and problems. Recently the Center has formally requested, in writing, the advice of over 1,000 key persons and groups regarding the overall direction of the Center and it programs and priorities. A committee composed of outstanding citizens and public health individuals will review the many responses and will make specific recommendations based on them.

D. The various formal and informal inputs come together as I indicated earlier in the formal forward planning and appropriations process. At this time, of course, the management officials in the Public Health Service and in the Office of the Secretary of HEW have a strong impact on the direction of CDC programs. The ranking procedure under Zero

Based Budgeting has made their priority setting role even more explicit. On special problems such as Legionnaires' Disease, the Center Director keeps the Assistant Secretary for Health and the Secretary's office fully informed on developments often making specific weekly reports when appropriate.

E. Through legislation and attendant hearings, such as oversight hearings, and annually through the appropriations process Congress participates in the setting of priorities for CDC.

Factors Warranting High Priority for Legionnaires' Disease Problem Solving

1. Perhaps the most important factor was the unknown. In general, the outbreak of illness and death in Philadelphia did not fit known patterns and could not be explained and therefore any future course could not be predicted.

2. Given the known population--the legionnaires at the State convention--there was a very high rate of both morbidity and mortality.

3. No pathogenic organism or substance could be implicated.

4. The source of the illness--air, soil, water, food, human contact--could not be identified. The public health problem that was inherent in this problem by virtue of the above factors was heightened by the public concern over this public health mystery. The media, the public, the administration, and the Congress made known their fears and impatience. In one sense, little reprogramming was required in working with this problem because in the laboratories the scientists could work with various samples and specimens, each in their own specialty areas, for none knew precisely what to expect. It was in this way that the organism was finally discovered--the new bacterium was found by rickettsia laboratorians.

Summary

In martialing resources under this procedure to deal with the Legionnaires' Disease problem, each of the above mentioned aspects applied. While the Center was successful in dealing with the problem up to a point, two things became evident during the course of events:

1. The experience highlighted the need for strengthening the Center's capabilities in toxicology, and 2. events have progressed to the point where we must now assure that our knowledge is shared comprehensively and formally with others in the scientific and health community.

Senator JAVITS. Very good. Thank you very much, Dr. Sanford, we certainly appreciate your testimony.

This concludes the hearings as far as the witnesses are concerned. I would like simply to add that I think the Center has credited itself magnificently in this matter and we certainly deeply appreciate its hospitality, the fine arrangements which have been made, and the very instructive points which have been made. I believe they indicate there is room for major civilian or nonscientific input in these decisions; the allocation of resources in an emergency represents a major problem. In addition international collaboration can be of tremendous assistance to the United States. I believe personally that we have touched a new vein of scientific inquiry which may uncover a great many answers to a great many things which seem obscure. We should not allow this experience and all of the magnificent work which has been done to simply stand as accounting for one phenomenon.

Dr. FOEGE. Thank you, Senator, I would like only to thank you for coming down here. I realize that it is an imposition but I think it demonstrates to people at the Center for Disease Control and to others the kind of concern that you have and the interest in the Center. Thank you very much.

Senator JAVITS. The hearing is adjourned.

[Whereupon, at 11:55 a.m., the subcommittee adjourned subject to the call of the Chair.]

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