Hospitals Harbor a Built-in Disease Source

Air conditioning cooling towers may spread the deadly bacteria of Legionnaires' disease, a Vermont case shows

Burlington, Vermont. Had the killer been human rather than bacterial, the clamor would have been tremendous. But not many noticed when 19 people from the small city of Burlington, Vermont, were done in last summer by *Legionella pneumophila*, the bacteria that causes Legionnaires' disease. Part of the reason may be that what is familiar is no longer frightening, and legionellosis has been around for a few years. But, as Burlington reminds us, the bug can be hard to control, and murderous.

Burlington's record is interesting for another reason. It gives weight to a controversial theory proposed during the first Legionnaires' disease scare: that the bacteria may be spread by large ventilation systems. It also reveals how little enthusiasm there is for doing research on the ventilation problem.

In terms of deadliness, the Burlington outbreak ranks among the worst in the nation. There were 88 cases of legionellosis in the town this year. The cumulative count rivals that of the Philadelphia outbreak of 1976, the epidemic that gave the disease its name. In that one, 34 people were killed by the disease after being in or near a convention of American Legionnaires. Since 1977, when Burlington began counting, the town has had two or three outbreaks and more than 34 deaths from legionellosis.

Burlington's problem is not unique. According to a paper published in May by epidemiologists Lester Cordes and David Fraser of the federal Center for Disease Control (CDC), there are at least five other communities with legionellosis outbreaks listed as "ongoing." They are Columbus, Ohio; Kingsport, Tennessee; Los Angeles, California; Bloomington, Indiana; and Norwalk, Connecticut. Some of these outbreaks may have ended since the research was done.

In all but one case—the one in Burlington—the outbreaks were centered in hospitals. Hospitals may dominate the list because they house the most vulnerable people, those suffering from terminal diseases or taking drugs like steroids which suppress immunological responses. In addition, hospitals are at risk because they are big institutions, often having special air or water handling systems that may circulate the bacteria.

Because smokers, cancer victims, and other weakened patients are unusually vulnerable, there is a tendency to write off legionellosis as the chance instrument of death among people about to die. Yet the bug does not prey only on the weak. The age of the victims in Burlington this year ranged from 19 to 96. One patient, a healthy, 30-year-old man and a nonsmoker, died even after being treated with erythromycin, the antibiotic shown to be most effective in stopping the disease.

Although public health agencies have succeeded in their clinical attack, identifying human symptoms quickly and developing an effective medicine, they have been less successful in cornering the bacteria in its natural habitat. Relatively little is known about how *Legionella* travel through human environments, or how they infect people. The Burlington outbreak seems to offer clear documentation of one important way the bacteria get around: on mist from cooling towers.

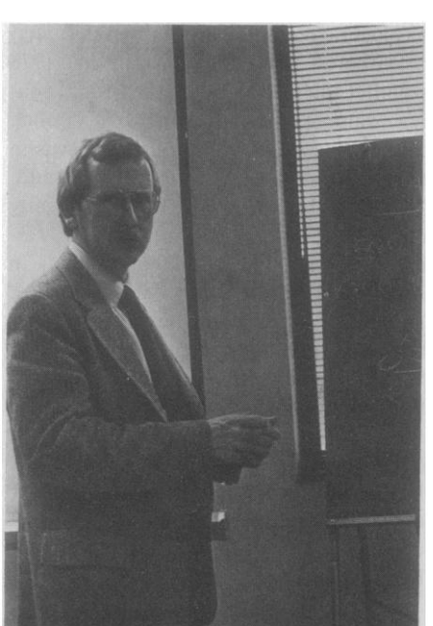
Air conditioning systems and cooling towers have been suspected of harboring *Legionella* since the first cases were reported in 1976. In nearly every subsequent outbreak, the bacteria have been found in cooling towers, but investigators from the CDC have had difficulty in tracing links between the towers and the infected people. There are two exceptions. Burlington is one, and the other was provided by the Baptist Memorial Hospital of Memphis.

After investigating the Memphis outbreak in 1978, the CDC concluded that bacteria had traveled from the hospital's cooling tower to an intake vent for the central air system. From there it may have been piped into the rooms. Thirty-nine people became sick and seven died.

Memphis solved its problem 2 years ago by turning off the cooling system, disinfecting the tower, and following a program of decontamination devised by the CDC. What seems remarkable today is that so little has been done to expand upon that experience. No one has undertaken a research program of significance to learn what chemicals are effective in killing *Legionella* in the environment, or to develop a fail-safe system of decontamination for mass application. Very little has been done to learn why cooling towers harbor *Legionella*, how widespread the infestation is, or how pernicious.

Although contaminated cooling towers are usually present where outbreaks occur, they are not necessarily the source of the disease. This is one reason there has been no rush to study them. It is expensive to do the kind of research that may be needed, and expensive to carry out the preventive maintenance that may be required of tower owners. In the absence of hard proof—and the proof is hard to obtain—owners of the cooling equipment are not inclined to do anything that might attract attention.

Burlington's trouble began in the summer of 1977 with an epidemic in which 69 people became sick. Most of them had had some contact with the Medical Center Hospital, which is used as a teaching center by the University of Vermont. The CDC was called in to investigate but



Eliot Marshall Photo

Linden Witherell

U.S. public health officer wants more environmental research on Legionnaires' bacteria.

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could find no common source of exposure. University and hospital officials resisted the conclusion that the victims had been exposed at the hospital, and so the CDC declined to call this a nosocomial epidemic.

There were no outbreaks in 1978 or 1979, but some local officials felt uncomfortable leaving the 1977 puzzle unsolved. Linden Witherell, a U.S. public health officer working as a local agent of the Environmental Protection Agency (EPA), was one of those who thought the trouble was centered in the hospital. He sampled the water around Burlington in 1977, hoping to locate a source of bacteria. These were never analyzed, he says, probably because the laboratory at the CDC had a huge backlog of requests from other areas where outbreaks were still in progress.

In 1978, Witherell read about the Memphis outbreak in which *Legionella* had been traced to the hospital's cooling tower. In that investigation, CDC official George Mallison went to considerable lengths to test his theory that the tower was spreading the bacteria. For example, with the hospital's permission, he put a smoke bomb in the cooling tower at 5 o'clock one morning—so as not to attract attention—and found that the vapor "drift" from the tower actually did move toward the hospital's air intake vents. Other CDC investigators pinned down the source using epidemiological techniques. The tower was sealed off, thoroughly chlorinated according to Mallison's recommendations, then put on a schedule of biocidal treatment. Memphis has had no legionellosis outbreaks since.

Witherell asked Mallison in 1978 whether the CDC laboratories could analyze samples from Burlington's cooling towers, even though no outbreak was in progress. Mallison said they would. Witherell then proposed the idea locally but found no enthusiasm for it in Vermont. He wanted to collect samples in August, when the tower was in peak use. He met no opposition, he says, but certainly no active support either. Local officials brought up technical problems that would have to be solved to make this a "perfect" study. Because of the delay in getting local permission to collect samples, Witherell was not able to collect his samples until the summer was over and some of the cooling towers had been turned off.

The results came back early the next year: of the five towers sampled, only two were found contaminated with *Legionella*. One was on top of a medical building known as the De Goesbriand Unit, and the other was above the medical research laboratory in the Given Building, about 600 feet from the main hospital center. (The Given tower later proved to be the villain.) The state health department put out a press release announcing that both towers would be cleaned according to the CDC method used in Memphis. Fresh samples were taken from both towers in the spring of 1979, before start-up, and the towers were found free of bacteria.

Witherell asked to have the 1977 investigation reopened when he learned that the towers had been contaminated. But the state and CDC decided not to do so on grounds that there was not enough new information to warrant further investigation.

There were sporadic cases of legionellosis in 1978 and 1979, but no serious trouble until May 1980. The sampling and cleaning procedure used in 1979 was not followed in the spring of 1980. An early warning appeared, however. In mid-May, two maintenance men who were working on the cooling tower atop the Given Building were sprayed accidentally with mist from the tower. Both got sick, and one came down with a bad case of Legionnaires' disease. He pulled through only after spending 3 months in the hospital. Other cases of atypical pneumonia appeared in the second half of May, and it was plain that a new legionellosis outbreak had hatched.

New water samples were taken from the towers and, beginning on 6 June, both towers were treated with chlorine. When the laboratory analysis came back, the De Goesbriand system was found to have been clean, and the Given tower, contaminated. Chlorination of the Given tower continued through 26 June. Then, following the CDC method used in Memphis, the tower was put on routine biocidal maintenance. Quaternary ammonia and other chemicals were used to keep the water free of algae. Too much chlorine, it is thought, causes corrosion.

Because this battle with the bacteria was studied in a less than systematic fashion, local officials are not entirely certain what happened. It seems that the outbreak may have tapered off even before the tower was chlorinated. It's not known why. This much is known: there were no cases of Legionnaires' disease in June while the Given tower was being treated with chlorine. When the chlorination stopped, the disease reappeared, as if on cue. In July Burlington had an outbreak far worse than the one in May. Chlorination was resumed on 17 July. The cases dropped off again, sharply. The University of Vermont prudently

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For Future Grants, Ski Trips Are Out

Is it a slap on the wrist or a slug in the nose?

Under provisions of a new regulation, the government could ban future research grants to individuals or their institutions for misuse of funds awarded by the Department of Health and Human Services (HHS.).

Institutions balk at the broad scope of the new rule known as the debarment regulation. "It's overkill to punish the entire institution and the majority of trustworthy researchers for an isolated case," says Estelle Fishbein, general counsel for Johns Hopkins University.

William Metterer, a senior attorney at the National Institutes of Health and principal author of the rule, says "We're not going to debar an institution just because of one bad apple." The rule "is just enough of a stick to have the institutions keep their houses in order."

The regulation arose because of several cases of misappropriation of funds during the past decade. In one of the most recent incidents, a university researcher used grant money for a Colorado ski trip.

Conditions for debarring an individual include conviction for any criminal offense related to the grant, serious unsatisfactory performance, and any other cause that is deemed "of sufficiently serious nature" by the HHS secretary. The institution may be debarred if it knew about the offense or should have known about it. If the institution takes "remedial action," it is less likely to be debarred.

University attorneys maintain that the rule's language is vague and puts too much power in the hands of the HHS secretary. Fishbein says, "It's an invitation for corrupt use of discretionary power by the secretary. It permits the secretary to respond to political influence that seeks to pressure institutions."

The lawyers argue that existing grant application procedures can be used to screen out candidates that have abused research funds.

Metterer says that by keeping these people out of the process, the grant committees can devote more effort to reviewing qualified applicants. Yet he

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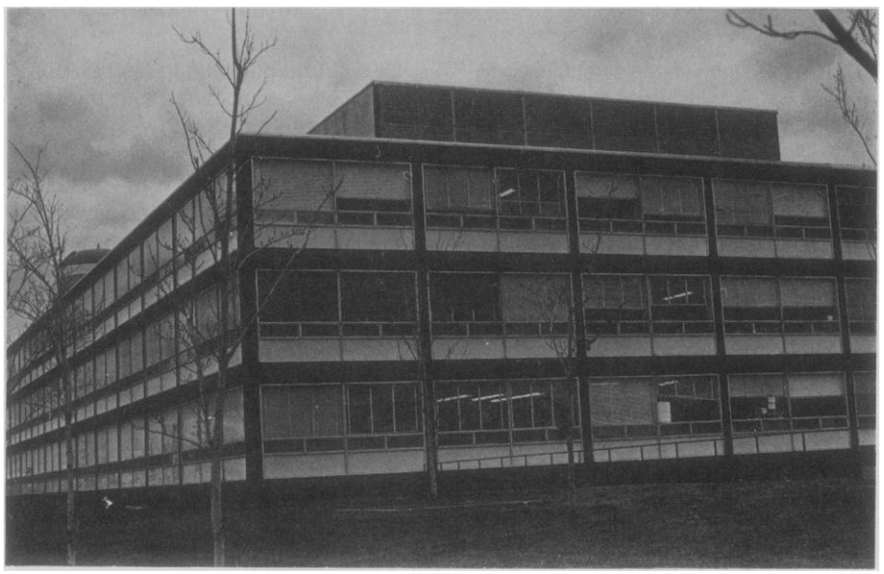

Eliot Marshall Photo

A place in the sun

The cooling tower (box on roof) atop the Given Medical Building served as a home and launching pad for the Legionnaires' bacteria. Blown aloft by powerful fans, the bacteria apparently drifted 600 feet downwind from here into open hospital windows.

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decided to chlorinate the tower continuously from July to October, when the system was turned off for the winter. The university also decided in October, after some indecision, to allocate the funds (about $850,000) needed to redesign the cooling system in the Given Building. (Earlier in the summer it dug deep in its pockets for the $2.2 million needed for a gymnasium addition.)

One Burlington official was quoted in the local paper complaining that the CDC had not given good advice on cleaning the tower. Asked about this, Mallison says, "I literally do not know what went on in Vermont; they didn't invite us up there." The CDC must be asked in by the state before it may conduct an investigation. In this case it wasn't asked.

Lloyd Novick, Vermont's health commissioner in Burlington, said the town chose not to invite the CDC because he thought there was enough expertise available locally. Furthermore, the town gained a lot of experience during its 1977 outbreak, according to Novick.

As late as 4 July, the university's physical plant division manager, Burton Preston, was cited in the Burlington *Free Press* as being "put out" by the "bad press" the tower was getting. Health officials now agree that the Given tower was the source of trouble. It was contaminated with the same bacteria found in the victims of legionellosis, at the same time that the outbreaks of the disease occurred. And the outbreaks ended when it was decontaminated. It has been associated by location as well, for most of the disease victims had been within 1000 feet of the tower.

Here is a guess as to what may have happened, based on conversations with Novick, Witherell, and state epidemiologist Richard Vogt. *Legionella*, which thrive in tepid water and like the company of algae, found a comfortable home in the cooling tower on the roof of the Given Building. It's not known how the bug got there, but it may have come in the tap water.

The tower is part of a water circulation system used to cool pipes filled with air conditioning refrigerant. Water, hot from contact with these pipes, drips down a maze of wooden slats while air is blown up through it from beneath. This lowers the water's temperature, but not much below 80° Fahrenheit. The water collects in a basin at the bottom of the tower before being recirculated. As it drips into this basin, some of the water is blown aloft in a plume. In this case, Vogt estimates that the thermal plume may rise three stories high.

Some of the bacteria and algae, after basking in the tower on a warm afternoon, may have been carried on water particles blown upward by the fans. The wind may have lifted these particles and carried them quite a distance—perhaps into the open windows of nearby buildings. In Burlington, the hospital did keep some windows open last summer, and they were downwind of the Given tower, Witherell says. People may have inhaled the aerosol from the tower and become infected with *Legionella*.

Novick says that biological warfare studies have shown that aerosols of this kind can travel well over 600 feet and still be potent. Carl Fliermans, who has studied *Legionella* at E. I. duPont's Savannah River Laboratory, says it is possible for bacteria in an aerosol to travel half a mile and produce an infection. Fliermans notes that *Legionella* are found quite commonly in aquatic environments, and he has shown that they can obtain all the nutrients they need from blue-green algae, which are commonly found in cooling towers. Furthermore, the bacteria seem to derive special protection against desiccation when airborne if they travel with algae. Fliermans is looking into the types of chemicals and levels of treatment that may be needed to retard the growth of *Legionella* in cooling towers and other water systems.

Why did the chemical treatment of the Given tower fail? A number of theories are being considered. The dose of chlorine in June may have been too weak to disinfect the tower. It may have been administered improperly. Someone may have forgotten that the tower goes through periodic "blowdown" or flushing procedures, which introduce fresh water and dilute chemicals in the system. Some of the bacteria and algae may have survived the summer's first bout of chlorination by living in crevices in the tower's wooden slats.

The CDC has identified many contaminated towers. Fliermans alone has examined 50 cooling towers or evaporative condensers and found them all contaminated with *Legionella*. He has treated three. But this evidence has not inspired a major clean-up campaign.

Disease outbreaks have occurred where towers were not the source, and contaminated towers have been found where there were no outbreaks. For example, the Wadsworth Veterans Hospital in Los Angeles has been trying to eradicate an in-hospital plague of legionellosis since early in 1977. (It has had 199 cases.) Wadsworth began continuous chlorination of its cooling tower more than 2 years ago, but this did not lower the incidence of the disease. The hospital has reduced the problem to a normal level since July only by maintaining a very high level of chlorine in the entire potable water system.

The Cooling Tower Institute of Houston, representing operators and designers of the equipment, sees in the Wadsworth case the evidence that no special research needs to be done on cooling towers. Technical spokesman for the institute, Sidney Sussman, says that in "every one of those cases" in which a

tower was associated with a disease outbreak, "it's been established that the tower was not receiving recommended biocidal treatment." The problem in Vermont, he guessed, was caused by an "asinine" approach to maintenance. "The public health hazard is minimal," he concludes.

Although cooling towers are not the only possible source of infection, they are certainly among the most important. Witherell, Burlington's EPA official, argues that it is risky to lean so heavily on a single maintenance procedure—such as the one required last summer in Burlington—to protect the public from a deadly disease. He thinks multiple barriers should be raised between the bacteria and vulnerable people. Last summer, university employees had to check the chlorine level in the Given tower every 2 hours. Witherell checked it every day. A system that needs this much attention to be kept safe is not safe, he thinks.

Neither the CDC nor the EPA has shown much interest in sponsoring research on the cooling tower problem. The EPA essentially wishes to be assured that the biocides used in the towers will not cause air pollution. And the CDC is not intrigued by environmental questions.—ELIOT MARSHALL

Scientist with Unpopular Data Loses Job

A biologist thought cooling towers would hurt Hudson River fish, but his company didn't want the judge to hear about it

Whistle-blowing—that is, going public with claims of misconduct by one's employer—is coming under increasingly explicit protection in federal laws. But as Morris H. Baslow has discovered, it is still a perilous undertaking.

Baslow is a currently unemployed marine biologist. A little over a year ago he was fired without warning or explanation by his company, Lawler, Matusky and Skelly (LMS) Engineers. At the time, he had been pressuring the company to include data potentially unfavorable to its clients in testimony before the Environmental Protection Agency (EPA). On getting the sack, Baslow filed a suit with the Department of Labor, claiming he was unjustly dismissed. After a year of unemployment and vigorous legal hassles, his suit was finally settled out of court at the end of October.

The scientific issues, relating to the effect of power plant thermal effluents on fish in the Hudson River, have yet to be evaluated. But the case, costly, complicated, and unpleasant, has amply demonstrated that the lot of a whistle-blower is not an enviable one; rather it requires patience, persistence, and no small amount of courage.

Baslow, who has been engaged in marine research for the past 25 years, began his association with LMS Engineers in 1974 when he was hired as senior scientist. He directed biological studies of the Hudson River for clients that included five power plants, most of them owned by Consolidated Edison, located on the river. The utilities had been ordered by EPA to put up cooling towers to reduce the amount of heated water being released into the river. ConEd wanted an exemption, which necessitated showing EPA that its thermal effluents were not damaging the river's marine life. LMS Engineers developed data for the EPA hearings which backed up the utilities' contention that power plants did only negligible damage to larvae and fish eggs in the river. Their case, made on the principle of "density dependent growth" was that destruction of eggs and larvae—which have a high mortality rate anyway—was beneficial for the surviving population, enhancing their size and surviveability. Baslow does not quibble with the density-dependent growth principle, but contends that it is not the crucial one in this situation. In his research, he found that larvae and fish growth are dependent on optimal temperatures and that any temperatures above the desired range inhibit growth.

Baslow's position is that for almost 2 years he tried to persuade his employers to include this data in testimony at the EPA hearings. His last plea was a few days before his dismissal when he warned a superior that if she wouldn't intercede he would have to go to EPA directly with the information.

On 11 October 1979, on his way to work, he posted a letter to Administrative Law Judge Thomas B. Yost, who was the hearing case, explaining that he feared his company was "perjuring" itself with regard to the biological data and that "the density-dependent growth testimony . . . is not valid." When he got to work he discovered it was his last day. In the course of cleaning out his office, Baslow gathered 70 documents relating to his temperature data. The following month he mailed off copies of them to Judge Yost and later, on request, to the Federal Energy Regulatory Commission (FERC) which was holding related hearings on the proposed Storm King pump storage facility in Cornwall, New York.

Meanwhile, Baslow had filed suit with the Department of Labor claiming that he was a "protected" employee under the Federal Water Pollution Control Act and thus had a right to a hearing. The water act is one of six basic environmental statutes that contain an explicit clause prohibiting discrimination against employees who engage in whistle-blowing activities.

Morris H. Baslow

According to an EPA official, most of last winter was given over to legal maneuvers instigated by LMS's lawyer Jack S. Kannry as well as lawyers for ConEd and several other utility companies involved in the case. LMS was fighting to regain control over the documents

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