

Editor's Note: This article is a condensed version of Chapter 1 from the book *The Chlorine Revolution: Water Disinfection and the Fight to Save Lives*.

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The Journey that Launched a Revolution

“revolution . . . a: sudden, radical, or complete change . . . e: a changeover in use or preference especially in technology”
Merriam-Webster, “Revolution”

On a fair Jersey City day in mid-June 1908, Dr. John L. Leal, a physician turned water expert, sat in the law offices of Collins & Corbin to discuss a matter of great importance with William H. Corbin. Leal worked for the Jersey City Water Supply Company (JCWSC), which had hired Corbin to protect its contract interests. Corbin had recently completed a months-long trial defending his client's actions under a contract signed in 1899. The judge's decision on May 1, 1908, had largely supported the company's contractual right to be paid \$7.6 million (more than \$175 million in current dollars) for building one of the largest new water supplies on the East Coast. The judge agreed that the JCWSC should be compensated for constructing a large dam, creating Boonton Reservoir, and for laying a 23-mile pipeline to supply Jersey City.

But there was a problem. The judge found that the company was not at all times providing the city with water that was “pure and wholesome.” Because of sewage contamination, water from the Rockaway River that contained high concentrations of bacteria would short-circuit the natural purifying processes of the reservoir during rainstorms two or three times a year. In his May 1 opinion, the judge made it clear that sewers should capture sanitary wastes and divert the contaminated materials away from Jersey City's water supply. The cost of the sewers, which was significant, would be deducted from the \$7.6 million contract price. However, Dr. Leal was convinced that because of contaminated runoff from agricultural and urban lands, the sewers would not solve the problem identified by the judge. He also saw an opportunity to end waterborne disease in Jersey City, but he knew that would require a revolution in drinking water treatment.

Corbin and Leal realized they had only one chance to overturn the negative part of the judge's decision. Vice Chancellor Frederic William Stevens issued his final decree on June 4, 1908. Between May 1 and June 4, Corbin and Leal had somehow convinced Stevens that they should be given a chance to install “other plans or devices” that would reduce bacterial concentrations in the delivered water, which was the intent of the judge's requirement to build sewers. In his final decree, Stevens referred the assessment of sewer costs and the suitability of the “other plans or devices” to one of the special masters of the New Jersey Chancery Court. Leal was given only three months from June 4 to develop his alternative plan, and the urgent meeting in Corbin's law offices on June 19 was to chart the next steps.

Dr. Leal was uniquely qualified to develop and implement his radical idea. He was a physician educated at Princeton and trained at Columbia College of Physicians and Surgeons. Fascinated by the new science of bacteriology, he had taken courses and performed experiments that had furthered his knowledge in this emerging field. He was also an expert in public health. For 10 years, he had been the health officer for Paterson, New Jersey, and he had dealt with all of the public health issues of the day—smallpox outbreaks, diphtheria, typhoid fever epidemics, high rates of infant mortality, collection and disposal of sewage, and protection of public water supplies.

Leal's revolutionary idea was nothing less than introducing a "poison" into the Jersey City water supply to kill the bacteria that were present in high concentrations two or three times per year. However, he had specialized knowledge that this poison could be used safely and, in small concentrations, would be highly effective in controlling bacteria. Leal was aware of the historical uses of the poison—chloride of lime (a convenient form of chlorine)—as a disinfectant to purify contaminated households after an infectious disease had struck a family. He also knew about some limited uses of chlorine in European water supplies over the previous 10 years.

Leal's biggest challenge was that no city in the United States was using chlorine as a disinfectant as of June 19, 1908. Leal was convinced that the only course open to JCWSC was to install a chlorine feed system, treat the entire Jersey City water supply, and present the improved bacteriological evidence to the special master. But his course of action involved a major problem: no one had designed and constructed a reliable chlorine feed system capable of treating 40 million gallons per day—a huge flow of water. He knew from his years as a municipal health officer that dependable sources of chloride of lime existed. He also knew that only one man could design a reliable feed system for chloride of lime in the insanely short time period available.

Leal presented Corbin with a two-pronged plan. First, he had to recruit world-class experts in the field of chemistry and bacteriology to test the efficacy of chloride of lime in their laboratories. Second, he had to build a full-scale operating plant and show how effective chloride of lime could be. The first part of his plan would have to wait until a conference in Winnipeg, Manitoba, but the second part of his plan needed to be started right away; the only thing in his way was the Hudson River.

Leal left the Collins & Corbin law offices and walked three blocks to the ferry terminal on the Jersey City waterfront. At the terminal, he boarded a ferry to take him across the Hudson to a rendezvous with his co-conspirator in this revolutionary plan.

The thoughts that went through Leal's mind during that short ferry ride to the Manhattan ferry terminal must have been dramatic. After today, there was no turning back. He was about to set in motion a series of events that would brand him as a visionary or a criminal. He knew that jumping ahead of the entire sanitary engineering discipline and the water treatment practices of decades was fraught with risks. In the field of public health, in which human lives were at stake, there was no room for error on this scale.

From the ferry terminal on the New York City side, it was only a half-mile walk to Leal's destination—170 Broadway, the office of the consulting engineering firm of Hering and Fuller. There he sat down with George Warren Fuller and a junior member of the firm to discuss the assignment and to map out the execution of his radical idea. At the time of the meeting, Fuller was only 39 years old, but he was at the height of his intellectual powers and the foremost sanitary engineer in the early twentieth century. He was also an expert chemist and bacteriologist. He certainly understood what Leal wanted to accomplish and was aware of investigations of the use of chlorine to disinfect water supplies.

Everyone at the meeting knew they had only one chance to get this right. The good news was that George Warren Fuller had designed and installed a successful feed system for aluminum sulfate six years earlier at the Little Falls, New Jersey, water treatment plant. Leal asked Fuller to repeat his successful design and adapt it to feed chloride of lime in very small doses (fractions of a part per million) to a flow of 40 million gallons per day.

There is no record that a contract was signed on that day; it is more likely that the work was agreed to on the basis of a handshake. We know, however, that successful chlorination of water from Boonton Reservoir began on September 26, 1908—an astonishing 99 days after that fateful meeting at 170 Broadway in Manhattan. Purification of water supplies has never been the same since. Though Leal's journey from Jersey City to New York City was short in distance, it was long in its impact on public health. Millions of lives have been saved since Dr. John L. Leal made that journey to launch a revolution. The partnership between a physician and an engineer brought about a permanent change in drinking water treatment, and a court case brought the revolution to the attention of the world.

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