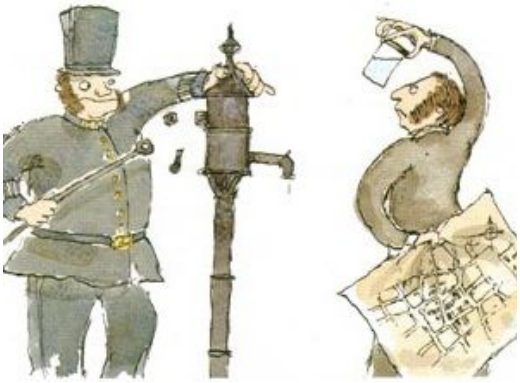
John Snow and the Origin of Epidemiology; "You Know Nothing, John Snow."

Part I—Beginnings

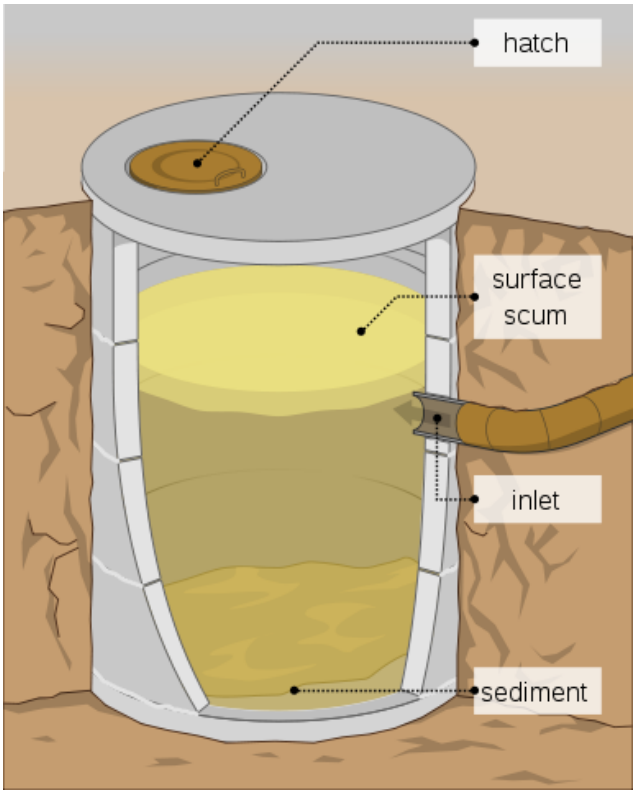


John Snow was born in York, England, in 1813, the first of 9 children of a working-class family. Snow's wealthy and well-connected uncle, arranged an apprenticeship for his nephew with a surgeon-apothecary, one of the two types of health care providers in 19th century London. Physicians were graduates of the medical programs at Oxford or Cambridge while surgeon-apothecaries went through a longer apprenticeship, attending classes part-time at smaller medical schools. John Snow moved to Newcastle at the age of 14 to apprentice with William Hardcastle. It was in Newcastle, near the end of Snow's apprenticeship, that he first encountered cholera as it arrived in England in 1831.

In his medical studies, Snow learned the current theory for how diseases occurred in the body. During that time, doctors thought diseases resulted from too much or not enough of certain body fluids that they called "humors". These humors were blood, phlegm, black bile, and yellow bile. To correct the problem, physicians would use leeches to bleed patients or substances to cause diarrhea or vomiting. This model of disease was eventually replaced with the miasma model of disease, which suggested that diseases were caused by pollution or "bad air." At the time, the Germ Theory of Disease had not been established, and physicians didn't fully understand the nature of disease and its transmission.

After being released from his apprenticeship, John Snow was one of the first physicians to study and figure out how much ether and chloroform to give patients undergoing surgery. It was his work with anesthesia and gases that made him doubt that diseases were caused by "bad air".

Part II: Sanitation in the 19th Century



London in the middle of the 19th century contained 2.5 million people, housed in 30 square miles. This is more people per square mile than are found in present-day Manhattan. The Soho district of London had a serious problem with filth due to so many people and a lack of proper sanitary services: the London sewer system had not reached Soho. Instead of a city sewer system, many houses had cesspools underneath their floorboards in their basements.

A cesspit (cesspool) was an underground holding tank used for the storage of feces. Some pits were emptied when they became full; cleaned out by workers using shovels and horse-drawn wagons. Some cesspits were designed to allow liquid to drain into the soil under the house. Because there were so many people in London,

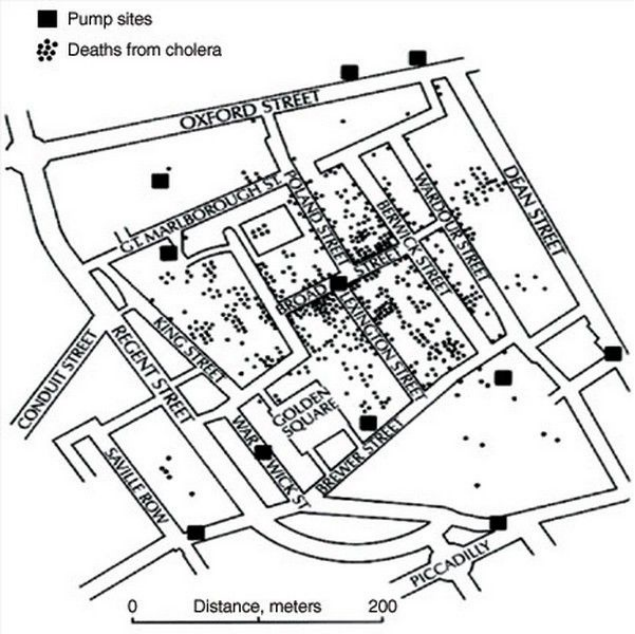
many of these cesspits were overflowing. Waste accumulated in basements, courtyards, and even the streets. Since the cesspools were overrunning, the London government decided to dump the waste into the River Thames.

Because of the problems of waste disposal, few Londoners had a source of drinking water uncontaminated by human sewage. At that time, a total of nine different water companies supplied Londoners with water that came from either shallow wells or the Thames River. Some companies collected their water farther upstream than others. Water collected downstream were more likely to be contaminated with human waste.

Part III: Outbreak

On August 31, 1854, after several other outbreaks had occurred elsewhere in the city, a major outbreak of cholera struck Soho. By September, 500 people had died from cholera. By the end of the outbreak, 616 people had died. John Snow later called it "the most terrible outbreak of cholera which ever occurred in this kingdom."

The germ theory says that diseases are caused by microscopic bacteria and viruses. Germ theory was not created at this point (as Louis Pasteur would not create it until 1861), so Snow did not know how disease was transmitted. However, evidence led him to believe that it was not due to breathing foul air as the miasma model would suggest. He first published his theory in an essay *On the Mode of Communication of Cholera* in 1849 which proposed that cholera was transmitted in water. The essay received negative reviews in the Lancet and the London Medical Gazette. However, a reviewer told Snow that he should set up an experiment comparing people who got their water from different sources but otherwise lived very similar lives. The reviewer said if Snow discovered that a group of people who all got their water from the same source were more likely to get cholera, then this would provide evidence that cholera is transmitted through water.



Snow sought ways of strengthening his argument by carrying out the crucial experiment sought by the Medical Gazette's reviewer. He went door to door interviewing families of cholera victims.
Snow began marking cholera deaths on city maps, and patterns began to emerge. . He mapped out the locations of individual water pumps and generated areas which represented all the points on his map which were closest to each pump.

Part IV: Snow Makes His Case

In Snow's own words:

> *On proceeding to the spot, I found that nearly all the deaths had taken place within a short distance of the [Broad Street] pump. There were only ten deaths in houses situated decidedly nearer to another street-pump. In five of these cases the families of the deceased persons informed me that they always*

sent to the pump in Broad Street, as they preferred the water to that of the pumps which were nearer. In three other cases, the deceased were children who went to school near the pump in Broad Street...

The result of the inquiry, then, is, that there has been no particular outbreak or prevalence of cholera in this part of London except among the persons who were in the habit of drinking the water of the above-mentioned pump well.

I had an interview with the Board of Guardians of St James's parish, on the evening of the 7th inst [September 7], and represented the above circumstances to them. In consequence of what I said, the handle of the pump was removed on the following day.

—John Snow, letter to the editor of the *Medical Times and Gazette*

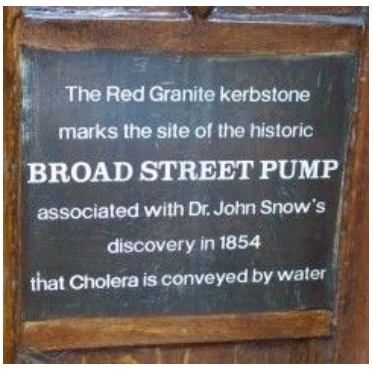
Snow looked at a sample of water from the Broad Street water pump under a microscope, but, since microscopes weren't very powerful in that time, he was unable to see what was causing cholera. Despite this, his studies of the patterns of cholera outbreaks were convincing enough to persuade the authorities to remove the handle of the well pump to stop people from using it. At this point, John Snow had partnered with Reverend Henry Whitehead who helped him interview families and track the disease. Whitehead succeeded in identifying an earlier case, an infant living in a house a few feet from the Broad Street pump who died from diarrhea two days before the cholera outbreak was officially recognized.

The Broad Street well was examined and they found out that it had been dug only three feet from an old cesspit that had begun to leak fecal bacteria. The mother of the baby who had contracted cholera washed the infected baby's diapers into this cesspit, which likely spread the cholera bacteria to the surrounding area when the cesspit leaked.

Part V: The Aftermath

Unfortunately, after the cholera epidemic had ended, government officials replaced the Broad Street Pump Handle. They had responded only to the urgent threat posed to the population, and afterward they rejected Snow's theory. The idea that feces was entering the water supply was too unpleasant for most of the public to contemplate.

Although many continued to reject Snow's explanation, some began to give it grudging acceptance, often without acknowledging his contribution. Snow's vindication came at a meeting of the Medical Society where a member stood up after such a presentation insisting that Snow be given credit. The pump is now a historic site in London and is located in front of the John Snow Pub.



London Map: https://str.llnl.gov/str/September02/Hall.html
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