

The Ghost Map: The Story of London's Most Terrifying Epidemic – And How It Changed Science, Cities, and the Modern World

By Steven Johnson, 299 pp., illustrated. New York, Riverhead Books, 2006. \$26.95.
ISBN 978-1-59448-925-4

The Strange Case of the Broad Street Pump: John Snow and the Mystery of Cholera

By Sandra Hempel. 321 pp., illustrated. Berkeley, University of California Press, 2007.
\$XX.XX. ISBN 978-0-520-25049-9

London, in 1854, was a virtual sea of human and animal waste, and it stank! Two and a half million people were crammed, in layers, into a thirty-mile circumference, with no means of safe sewage disposal. People's excrement was part of their diet; the conditions were ripe for a cholera outbreak and it happened.

Historically, cholera, which had been endemic in India for millennia, was spread by people in caravans, military operations, pilgrimages and sailing ships to cause what are regarded as seven great pandemics. It reached England for the first time during the second pandemic in June 1831 [and America in 1832 (see Pollitzer, R. *Cholera*. World Health Organization, Geneva. 1959)] and then, again, during the third pandemic in 1853-'54. The causative agent, *Vibrio cholerae*, was unknown until it was isolated in pure culture by Robert Koch in Egypt in 1883 although it had been described, in 1854, by Italian microscopist Filippo Paccini whose observations were ignored by the scientific community. Until John Snow, the subject of the two books to be reviewed, the miasma (bad air) theory of the etiology of cholera prevailed over the contagionists who believed that the disease was somehow transmitted from person to person (but not by water).

John Snow (1813-1858) became the founding father of boots-on-the-ground epidemiology, but it didn't start out to be that way. At the age of 25, Snow, a vegetarian and teetotaler, received both his apothecary and surgeon's licenses from the Hunterian School of Medicine and established a general practice in London. By 1844, he had received his bachelor of medicine degree and passed his M.D. exams to become, officially, Dr. John Snow. By then, he was already widely published on a wide range of subjects largely criticizing the sloppy science of others. Snow was a witness to the first use of ether, for a dental extraction in London in 1846, and this started his highly successful career as a researcher and practitioner in anesthesiology. He administered chloroform to Queen Victoria for the birth of her eighth child in 1853.

Snow's interest in cholera, which began when he saw patients as a physician's apprentice during the 1831-'32 epidemic in England (32,000 dead), was rekindled during the outbreak of 1848-'49 (52,000 dead), which started with the index case -- a merchant

seaman arriving from Hamburg, Germany, where cholera was raging. A sequential series of cases and other observations led Snow to hypothesize that the disease was spread from person to person, by the oral route, and most likely through water, in contrast to the prevailing view that it was caused by the stench arising from open sewers, kitchen sinks and rubbish piles. His 1849 publication describing his conclusions was ignored by the medical establishment. He needed an "*experimentum crucis*," "Snow's Grand Experiment," to show that water conveyed to a distant locality, where cholera had been hitherto unknown, produced the disease in those who used it, while those who did not use it escaped. This was to come in 1854.

By 1853, cholera had waned in England but was appearing again in the Baltic States and England was about to be next. Cases appeared in north-east England but London was spared until summer 1854 when the soiled linen from a sick seaman was brought ashore for washing. Cases began appearing mainly among people along the Thames River and Snow perceived his perfect experiment. In 1849, both water suppliers, the Lambeth Water Company and the Southwark and Vauxhall, drew their water from the most polluted part of the river, but in 1852 the Lambeth Company had moved their supplies north beyond the city's outpouring of sewage into the Thames. Snow would compare the incidence of cholera in three hundred thousand people, otherwise similar, divided into two groups, one group supplied with water containing the sewage of London and the other not. For this, Snow had to determine which houses used the Lambeth and which the Southwark waters, the cholera victims' addresses having been supplied by the Government's chief statistician, William Farr. This involved Snow's "shoe leather epidemiology;" going from house to house to determine which company supplied the household's water. In the first seven weeks, in 40,046 Southwark houses there were 1,263 cholera deaths, a rate of 315 per 10,000 houses. In 26,107 Lambeth houses, there were 98 deaths, or 37 per 10,000. These figures would be hard for the medical community to ignore. But, at the moment, the signal event was about to occur right in his neighborhood near the Golden Square in Soho, where cholera was out of control: 197 deaths occurred within three days.

Snow then again marked the houses where the deaths had occurred and drew a map, "The Ghost Map," of their distribution. The result: sixty-one of the eighty-three deaths he located got their water from the pump on Broad Street; the others could have consumed water from the pump unknowingly. A lady, who lived at a distance from the pump but who received deliveries of water from it because she preferred it, drank the water on Thursday and Friday and died of cholera on Saturday. Her niece, who had visited her, returned to her residence in a distant healthy part of London where she died the day after. Curiously, none of the 70 employees of the Lion Brewery a few yards from the pump got cholera. Why? Having free access to the malt liquor, they rarely, if ever, drank water. At the same time as Snow was doing his shoe-leather epidemiology, the reverend Henry Whitehead, who knew all the families in the area, but who was determined to prove Snow wrong, was conducting his own investigation. He found that the source of the infection of the Broad Street pump was Sarah Lewis who had washed the index case's, her sick baby's, nappies in a cesspit just a yard from, and draining into, the well of the pump. He became convinced that Snow was right; the two became bonded; and the evidence

convinced the skeptical members of the Board of Governors of St. James Parish to close down the pump – to remove its handle on September 8, a week after the outbreak had begun. It is generally acknowledged that removal of the pump handle had little, if any, effect on the outbreak which had already peaked and was in decline – many of the "susceptibles" having fled the area – but it did perhaps prevent a second outbreak because Sarah Lewis's husband became sick that very day and she soaked his soiled linen in the same cesspit.

Now we have two books to review, 620 pages, describing the events leading to, surrounding, and following "The Broad Street Pump Episode," not to mention a third, Vinten-Johansen, P. et al., "*Cholera, Chloroform, and the Science of Medicine: A Life of John Snow*" Oxford University Press, New York, 2003, which was cited by both authors. Was John Snow worth all this attention? Unfortunately, he died of apoplexy at the age of 45 before the impact of his work was fully appreciated. His brief obituary in *Lancet* cited his research on anesthetics but didn't mention his epic cholera studies. But his story and his contributions that were to change the world were championed by the reverend Henry Whitehead and others and led to his legacy -- the recognition of the importance of clean water. Countless millions of lives have been spared as a consequence. His impact was certainly equivalent to that of Koch, Pasteur, Fleming, Sabin and Salk. Both books, well-documented, read like novels; they develop Snow, the persona. They describe, in detail, the events and the environs which enabled (and still do) cholera epidemics; and they describe and discuss the players -- be they the disease, the microbes, the patients, colleagues, officials and other contemporaries of Snow and their interactions. Florence Nightingale, a miasmatist, is there as are Dickens, Engels, Karl Marx and others. Neither of the authors is a scientist, but they have done creditable jobs in reporting the science. Steven Johnson, Distinguished Writer in Residence at New York University's Department of Journalism, has previously published bestsellers on scientific subjects. Sandra Hempel, a resident of London, describes herself as a health journalist who, while looking for a bigger story, stumbled onto an encyclopedia's abbreviated description of the pump handle incident and believed there was more to be told. If forced to choose between the two, I would lean toward Johnson because he seemed to be more focused; I found myself somewhat bewildered by the details of Hempel. (I would be remiss if I failed to mention that, on Page 275, she refers to the new epidemic strain of *V. cholerae* O139 as 0139, substituting the numeral 0 for the capital O, a common mistake for those not too familiar with the nomenclature or its history.) Both certainly presented more than I needed to know about John Snow. The Vinten-Johansen volume, 437 pp., authored by an interdisciplinary team of five Michigan State University professors, "The Snowflakes," over a period of six years, is more of a college text, a well-structured, focused and thorough, but dry, analysis of the "complete" John Snow – physician, scientist, experimentalist, respiratory physiologist, anesthesiologist, and epidemiologist. Interested readers wanting to learn more without buying or borrowing a book may wish to examine the UCLA website at www.ph.ucla.edu/epi/snow.html.

What is "the take-home message?" If you're stuck in the middle of a cholera epidemic, it's best to stick to beer.

The author of this review, Richard A. Finkelstein, Ph.D., Curators' Professor and Millsap Distinguished Professor *Emeritus*, Department of Molecular Microbiology and Immunology, School of Medicine, University of Missouri-Columbia, has been involved in research on cholera since the beginning of his dissertation research in 1952.