Dr. John Snow and the Cholera Epidemic of London

Owen Martin
Senior Division
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We presently regard the transmission of disease by microorganisms as obvious, being familiarized with the luxury of modern sanitation. Humanity has not only become intent on the eradication of disease but has worked to remove from the world dangers both visible and invisible. This globalized struggle to advance the human condition is an endeavor many do not consider profound but should; indeed, the effort put forth today is unprecedented in all history. Who, then, can be identified as the origin of the world's public health movement? To answer this question, it becomes necessary to consider an epidemic made special not only by its severity but by its subsequent analysis by one man: Dr. John Snow. There have been many devastating outbreaks of disease following humanity's replacement of the nomadic lifestyle with that of permanent residences,[1] but none so extensive and so frequent as those following the urbanization brought upon by the Industrial Revolution.[2] As population density of developing countries surged, it became increasingly clear that a solution was needed for the explosive death toll of disease. Governments around the world, however, were either unable to offer solutions or unwilling to try.[3] It is in this context that the importance of Dr. Snow's research emerges. Despite the relentless criticism of his peers, Dr. Snow's analysis of the 1854 cholera epidemic of London changed forever the way governments and citizens around the world responded to disease and its transmission.

Public health initiatives in England – or any government improvements on sanitation – were proposed only decades before the onslaught of the third cholera pandemic,[4] circa 1852. The English government implemented very few effective preventative measures before the disease

[1] Hartford University. *History of Epidemics and Plagues*. October 2001. Web. 16 January 2017.
[2] Boston University. *A Brief History of Public Health*. 1 October 2015. Web. 24 January 2017.
[3] Terris, Milton. "Epidemiology and the Public Health Movement." *Journal of Public Health Policy* (1987): 315-329. Print.
[4] Hutchins, B. L. *The Public Health Agitation*. London: A. C. Fifield, 1909. Print.

struck London, leaving its inhabitants extremely vulnerable to the pathogen's transmission. Developments during the earlier Industrial Revolution gave rise to drastic increases in population density,[5] and with them squalid living conditions for the lower class.[6] A conventional method of disposing human waste into underground cesspits became obsolete with the increase of waste production.[7] Solutions in London were few and far between: some pits were filled to the point of overflowing, whereas the surplus of others was simply dumped into the nearby river Thames.[8] Both methods proceeded to contaminate the surrounding environment with fetid liquids, especially the Thames.[9] In 1855, the distinguished British scientist Michael Faraday reported to *The Times* that:

> Near the bridges the feculence rolled up in clouds so dense that they were visible at the surface even in water of this kind. The smell was very bad, and common to the whole of the water. It was the same as that which now comes up from the gully holes in the streets. The whole river was for the time a real sewer.[10]

The river Thames was a vital asset to London, its uses extending from personal hygiene to manufacturing to water supply, among others.[11] Such pollution (which came to be known as the "Great Stink" for its smell) boded poorly for Londoners, who were dependent on the river for many of their daily activities. Those who lived farther away from the river did not fare much better. The cesspools that were distant from the Thames were filled faster than the natural decomposition process could empty them, resulting in sewage overflow. This fecal matter would

[5] Chadwick, Edwin. *Report on the Sanitary Condition of the Labouring Population of Great Britain*. Commission. London: W. Clowes and Sons, 1843. Print.
[6] Engels, Friedrich. *The Condition of the Working Class in England.* Publication. London: Swan Sonnenschein & Co., 1891. Print.
[7] Powell, Christine A. *Dry Land Disposal*. 1 December 1996. Web. 15 January 2017.
[8] Dobraszczyk, Paul. *London's Sewers*. Oxford: Shire Books, 2014. Print.
[9] Halliday, Stephen. *The Great Stink of London*. Stroud: History Press, 2001. Print.
[10] Faraday, Michael. "The State of the Thames." *The Times* (1855): 8. Print.
[11] Snow, John, M.D. "On the Communication of Cholera by Impure Thames Water." *Medical Times and Gazette* (1854): 365-366. Print.

often find itself in the city wells by means of dispersion through the ground.[12] Many visitors not familiar with the quality of the poor districts' water complained of its awful characteristics; journalist Henry Mayhew described it as "covered with a scum almost like a cobweb, and prismatic with grease."[13] Despite these conditions, those who drank the water daily argued against the government's cleansing of it on the basis that such extensive work would be an infringement on citizens' private lives.[14]

It was evident to scientists that these squalid conditions were dangerous to anyone living in them[15] – that is to say, the entire population of London. Even the public itself feared a crisis,[16] though that fear was centered around the odors emitted by their foul surroundings. It was commonplace to believe that these odors caused disease; in fact, the scientific community had backed the miasmatic theory of disease transmission ever since its medieval conception.[17] One very notable exception was scientist Dr. John Snow. Snow had always been hesitant to accept the theory of communication of disease by vapor,[18] and in 1854 saw the cholera pandemic as the perfect opportunity to discover an alternative. Snow, choosing a recently stricken district of London, tabulated the number of choleric deaths by household and depicted them on a single map (see appendices A and B). Soon thereafter he hypothesized:

> …being led to the conclusion that the disease is communicated by something that acts directly on the alimentary canal, the excretions of the sick at once suggest themselves as containing some material which, being accidentally swallowed,

[12] Snow, John, M.D. *On the Mode of Communication of Cholera, Second Edition*. Research Paper. London: John Churchill, 1855. Print.
[13] Mayhew, Henry. "A Visit to the Cholera Districts." *The Morning Chronicle* (1849): 4. Print.
[14] "A Greater Plague than Cholera." *The Times* (1849): 1190. Print.
[15] Chadwick, Edwin. *Report on the Sanitary Condition of the Labouring Population of Great Britain*. Commission. London: W. Clowes and Sons, 1843. Print.
[16] Dunhill, Thomas. "On Sanitary Reform." Essay. 1848. Print.
[17] General Board of Health. *Report of the Committee for Scientific Inquiries in Relation to the Cholera-Epidemic of 1854*. Reflection Paper. London: George E. Eyre and William Spottiswoode, 1855. Print.
[18] Snow, John, M.D. *On Continuous Molecular Changes, More Particularly in their Relation to Epidemic Diseases*. Oration. London: John Churchill, 1853. Print.

> might attach itself to the mucus membranes of the small intestines, and there multiply itself by the appropriation of surrounding matter….[19]

Snow took a stand against his colleagues' opinions and those of the government by correctly theorizing the existence of the bacterium that causes cholera, *Vibrio cholera*,[20] although he refers to it as a "choleric poison" rather than an organism. Dr. Snow concluded that the infectious material was transmitted by the dispersion of fecal matter into local water sources, which subsequently contaminated the stomachs of London's residents.[21] After analyzing his data, Snow identified the cause of the local outbreak as the primary water source used by the residents, in this case, the water pump on Broad Street.[22]

Dr. Snow's conclusion was met with extreme opposition by his peers. While Snow was famed for his previous work on anesthesiology – a relatively new profession – he was not known for studying infectious diseases, and was therefore subject to skepticism. Physician Dr. Edwin Lankester recounts what happened the day Dr. Snow met with the local board of management, the Board of Guardians, to report his findings. He states, "not a member of his own profession, not an individual in the parish believed that Snow was right."[23] Indeed, despite the positive outcome of Snow's actions (see appendix C), the scientific community received Snow's analysis rather negatively, commenting in a reflection of his work:

> …we were unable to do more than conclude that he had rendered the transmission of cholera by water a hypothesis worthy of inquiry…. If his discovery should be established, the prevention of cholera would be easy, and for this reason we think

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[19] Snow, John, M.D. *On the Mode of Communication of Cholera, Second Edition*. Research Paper. London: John Churchill, 1855. Print.
[20] Centers for Disease Control and Prevention. *Cholera - Vibrio Cholerae Infection*. 27 October 2014. Web. 18 January 2017.
[21] Snow, John, M.D. *On the Mode of Communication of Cholera, Second Edition*. Research Paper. London: John Churchill, 1855. Print.
[22] Snow, John, M.D. "Further Remarks on the Mode of Communication of Cholera; Including Some Comments on the Recent Reports on Cholera by the General Board of Health." *Medical Times and Gazette* (1855): 31-35, 84-88. Print.
[23] Lankester, Edwin, M.D. *Cholera: What Is It? And How to Prevent It.* London: George Routledge and Sons, 1866. Print.

> that the most careful inquiry should be made at once by the government into the subject.[24]

Some of the scientists opposed to Dr. Snow's work seized this as an opportunity to subvert his hypothesis, constructing and publishing papers in support of the old theory of disease transmission. Although many of his peers still clung to the miasmatic theory, the public, disgusted by its plight, independently petitioned the government for a solution.[25] Dr. Snow's work was not ignored; the English government found that the removal of the fetid water source stemmed the spread of cholera and prevented any further outbreak in the area. Following this success, Parliament requested the river Thames be cleansed,[26] with all fecal matter passed into an improved city-wide sewer system.[27] In 1866 Joseph Bazalgette was commissioned as chief engineer of London's Metropolitan Board of Works,[28] and began the process that would mark the government's first time focusing on large-scale domestic health reform.[29]

Dr. Snow's identification of the source of cholera created a viewpoint about disease that persists to this day, despite the efforts of his peers to discredit his work. The logical methods he employed to discover the truth about the infection are still used in what is now called collectively the epidemiological method. Snow's broader importance, however, is not limited to the impact he made on the medical community. Dr. Snow's assertion that the national government has an obligation to maintain public health was revolutionary for its time, and under different circumstances may not have come to fruition; it was only through his tireless efforts that the

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[24] Parkes, Edmund, M.D. *Review XIII, Mode of Communication of Cholera*. Reflection Paper. London: Oxford University Press, 1855. Print.
[25] Lilienfeld, David. *John Snow: The First Hired Gun?* 1 July 2000. Web. 21 January 2017.
[26] Thornbury, Walter. *Old and New London: a Narrative of its History, its People, and its Places*. London: Cassell, Petter, & Galpin, 1873. Print.
[27] Halliday, Stephen. *The Great Stink of London*. Stroud: History Press, 2001. Print.
[28] Owen, David Edward. *The Government of Victorian London, 1855–1889: The Metropolitan Board of Works, the Vestries, and the City Corporation*. Cambridge, MA: Harvard University Press, 1982. Print.
[29] Roberts, Brian. *Sir Joseph Bazalgette and London's Intercepting Sewer System*. n.d. Web.

people were given the evidence they needed to effectively stand up against their government's sanitary negligence. To him much credit must be given for the prevention of diseases that once devastated urban society.

Appendix A

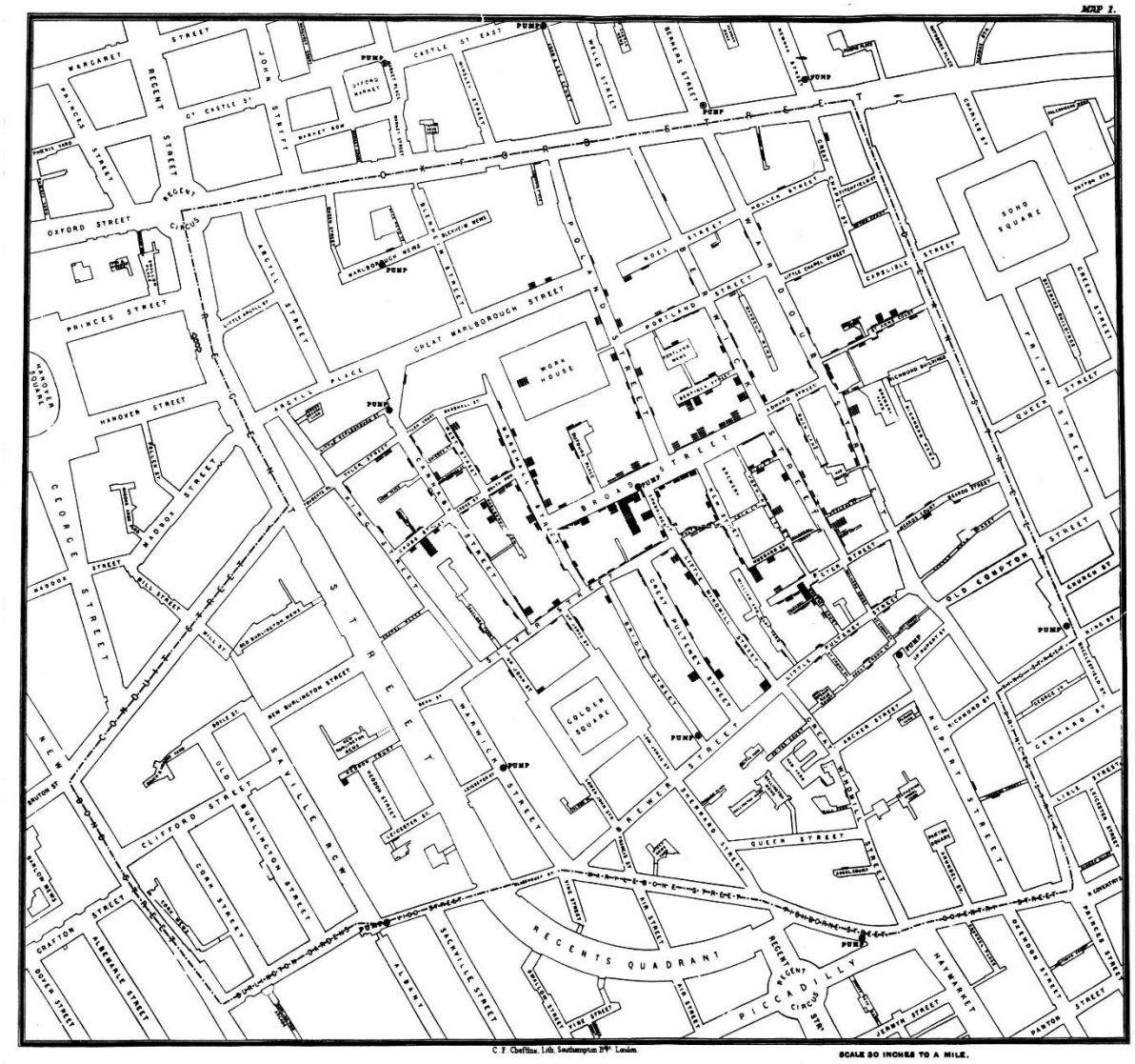
TABLE I.

Date.		No. of Fatal Attacks.	Deaths.
August	19	1	1
„	20	1	0
„	21	1	2
„	22	0	0
„	23	1	0
„	24	1	2
„	25	0	0
„	26	1	0
„	27	1	1
„	28	1	0
„	29	1	1
„	30	8	2
„	31	56	3
September	1	143	70
„	2	116	127
„	3	54	76
„	4	46	71
„	5	36	45
„	6	20	37
„	7	28	32
„	8	12	30
„	9	11	24
„	10	5	18
„	11	5	15
„	12	1	6
„	13	3	13
„	14	0	6
„	15	1	8
„	16	4	6
„	17	2	5
„	18	3	2
„	19	0	3
„	20	0	0
„	21	2	0
„	22	1	2
„	23	1	3
„	24	1	0
„	25	1	0
„	26	1	2
„	27	1	0
„	28	0	2
„	29	0	1
„	30	0	0
Date unknown		45	0
	Total	616	616

Snow, John, M.D. *On the Mode of Communication of Cholera*. Research Paper. London: John Churchill, 1855. Print.

Dr. Snow’s table of fatal attacks and deaths near Golden Square, or the Broad Street pump.

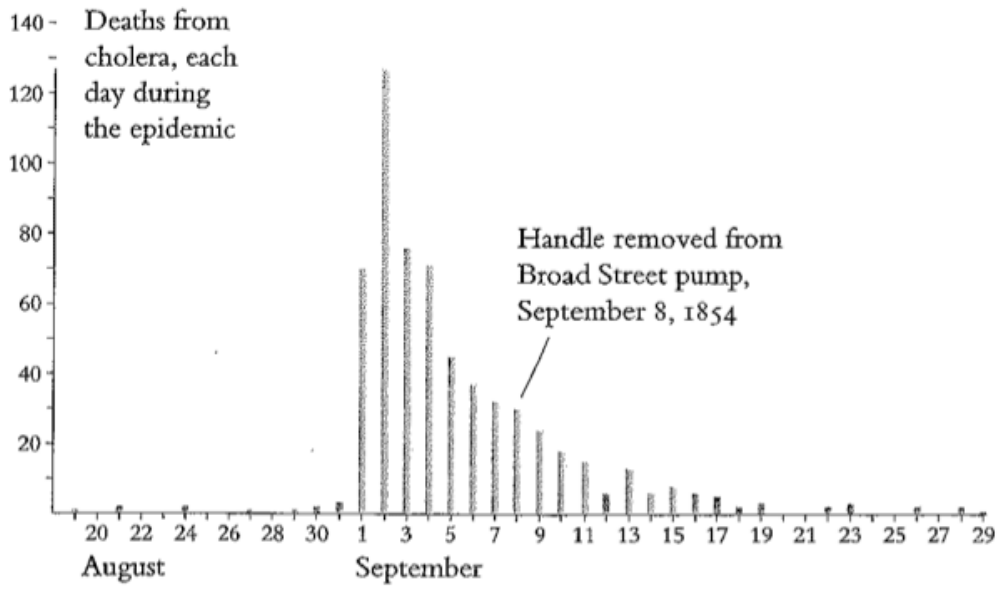
Appendix B



Snow, John, M.D. *On the Mode of Communication of Cholera*. Research Paper. London: John Churchill, 1855. Print.

Dr. Snow's map of choleric deaths near Golden Square, or the Broad Street pump.

Appendix C



Tufte, Edward. "John Snow's Cholera Map." 21 October 2013. *Visualizations - Beyond Mapping.* Web. 23 January 2017.

Time-series chart of Dr. Snow's data found in appendix A.

Annotated Bibliography

Primary Sources:

"A Greater Plague than Cholera." *The Times* (1849): 1190. Print.

This excerpt from *The Times*, a popular newspaper among Londoners, provided an example of the resistance to public sanitation put forth by the laity. It demonstrates the fear that an enforcement of more extensive cleanliness would embolden the government, and begin a process of decaying the people's civil rights.

Chadwick, Edwin. *Report on the Sanitary Condition of the Labouring Population of Great Britain*. Commission. London: W. Clowes and Sons, 1843. Print.

Edwin Chadwick did extensive research on the condition of London's lower class, which I used to put Snow's research in perspective. His book was instrumental in understanding what the motivations of the public were, for both those who advocated change and those who opposed it.

Dunhill, Thomas. "On Sanitary Reform." Essay. 1848. Print.

Dunhill's essay was particularly interesting because it came from a non-scientific point of view. Though Thomas himself was a member of the growing middle class (and as such was not one to mingle with the lower class), he recognized the need for public health and advocated for its creation, for which reason I used his essay.

Engels, Friedrich. *The Condition of the Working Class in England*. Publication. London: Swan Sonnenschein & Co., 1891. Print.

Engels, like Chadwick, was one who published illuminating accounts of the situation of the lower class. This book enabled me to cross-reference Chadwick's data and further explore the depravity that accompanied the London's cramped living conditions.

Faraday, Michael. "The State of the Thames." *The Times* (1855): 8. Print.

Well-respected in England for his work on electromagnetism, Michael Faraday put an official seal on the necessity of sanitary change when he wrote his letter to *The Times*. I found his description of the Thames to be the most effective when illustrating the disgusting environment upon which the people of London depended.

General Board of Health. *Report of the Committee for Scientific Inquiries in Relation to the Cholera-Epidemic of 1854*. Reflection Paper. London: George E. Eyre and William Spottiswoode, 1855. Print.

This report by London's Board of Health demonstrated the insistence of the scientific community to maintain its belief in the miasmatic theory of disease transmission, despite

the evidence produced by Dr. Snow to the contrary. I used it to ascertain the formal reason of the scientific community's ignorance in this field.

Lankester, Edwin, M.D. *Cholera: What Is It? And How to Prevent It.* London: George Routledge and Sons, 1866. Print.

Edwin Lankester's book was helpful for me because it describes in detail the exchange between Dr. Snow and the Board of Guardians when he came to discuss his conclusions about the transmissions of cholera. It also demonstrated the success Snow met when the pump handle was removed.

Mayhew, Henry. "A Visit to the Cholera Districts." *The Morning Chronicle* (1849): 4. Print.

Mayhew's account of the lower-class environment in the newspaper *The Morning Chronicle* was useful because it agreed with Dr. Snow's claims that the people were discontent with the purity of the cholera-infested water. I used it to demonstrate an outsider's opinion on the subject; Mayhew was not native to London's poorer districts.

Parkes, Edmund, M.D. *Review XIII, Mode of Communication of Cholera*. Reflection Paper. London: Oxford University Press, 1855. Print.

This review paper by Edmund Parkes was the best example of the scientific community's view on Snow's work available to me. It demonstrates the overall apathy towards his conclusion and the (somewhat forced) cordiality associated with peer-reviewed scientific papers at the time.

Snow, John, M.D. "Further Remarks on the Mode of Communication of Cholera; Including Some Comments on the Recent Reports on Cholera by the General Board of Health." *Medical Times and Gazette* (1855): 31-35, 84-88. Print.

In this journal article, Snow elaborates on some of his earlier discoveries. He states more explicitly that the cause of the local cholera outbreak was the communal water pump, which was infected with fecal material. I use this to demonstrate that his target audience is not only the medical community, but also the public.

—. *On Continuous Molecular Changes, More Particularly in their Relation to Epidemic Diseases*. Oration. London: John Churchill, 1853. Print.

Written before Snow's discoveries in the Soho district of London, this oration explained his views on disease transmission to the scientific community, before any evidence was put forth. It was helpful to me in identifying his skepticism of the miasmatic theory.

—. "On the Communication of Cholera by Impure Thames Water." *Medical Times and Gazette* (1854): 365-366. Print.

This journal article by Dr. Snow articulated the importance of the river Thames in the daily lives of people all over London, and the consequences of its pollution. He correctly predicts the negative influence of the waste, while dissociating it from miasma.

—. *On the Mode of Communication of Cholera, Second Edition*. Research Paper. London: John Churchill, 1855. Print.

The most thorough report of Snow's experience with the local cholera outbreak, this paper was the primary work of John Snow during the third cholera pandemic. I used this paper extensively when discussing his discoveries, but was sure to cross-reference it with other sources when necessary.

Secondary Sources:

Boston University. *A Brief History of Public Health*. 1 October 2015. Web. 24 January 2017.

This website provided me a succinct introduction to the timeline of public health. It illustrated the demand for sanitation over time and the process through which scientific discovery evolved into the medical revolution we experience today.

Centers for Disease Control and Prevention. *Cholera - Vibrio Cholerae Infection*. 27 October 2014. Web. 18 January 2017.

The CDC website gave me an understanding of our modern knowledge of Cholera (especially its symptoms and means of transmission) and helped me understand more deeply the breadth of Snow's analysis. It also described the current prevalence of cholera in developing countries.

Dobraszczyk, Paul. *London's Sewers*. Oxford: Shire Books, 2014. Print.

Dobraszczyk's book contained information pertaining to the quality and condition of London's sewers, from their beginning to the present day. I was particularly interested in his account of the state of the river Thames, and its relation to the creation of the sewers in the nineteenth century.

Halliday, Stephen. *The Great Stink of London*. Stroud: History Press, 2001. Print.

Halliday's book provided me the most extensive narrative on the plight of the residents of London in the wake of the sanitary epidemic. I used it to cross-reference many of my sources and to understand the progression of the public's mindset from maintaining their ways of life to changing them for the benefit of all.

Hartford University. *History of Epidemics and Plagues*. October 2001. Web. 16 January 2017.

This website helped me to understand how disease is formally analyzed, including common trends in its spreading. Most of the data was placed in historical context, in terms of human hygiene at the time.

Hutchins, B. L. *The Public Health Agitation*. London: A. C. Fifield, 1909. Print.

Hutchins's book is primarily an analysis of Chadwick's work. I used it to corroborate Chadwick's conclusions about the middle class. It also gave a synopsis of the third cholera pandemic's background, in terms of pathology and medical preparation.

Lilienfeld, David. *John Snow: The First Hired Gun?* 1 July 2000. Web. 21 January 2017.

This website article was helpful because it provided a transcript of Dr. Snow's exchange with the British Parliament, in which Snow is met with skepticism. Parliament eventually agrees with Snow out of desperation; they are situated right by the polluted river Thames.

Owen, David Edward. *The Government of Victorian London, 1855–1889: The Metropolitan Board of Works, the Vestries, and the City Corporation*. Cambridge, MA: Harvard University Press, 1982. Print.

Owen's book illustrates the development of the Metropolitan Board of Works after John Snow's discoveries. I used it to understand the impact of the public health movement in Britain following the success of Snow's experiment.

Powell, Christine A. *Dry Land Disposal*. 1 December 1996. Web. 15 January 2017.

Powell's website was helpful because it discussed the (rather rare) topic of waste disposal throughout English history. I used it to cross-reference the claims made by Snow about the state of the cesspits, and their inefficiency over time.

Roberts, Brian. *Sir Joseph Bazalgette and London's Intercepting Sewer System*. n.d. Web.

This website gave an overview of Bazalgette's professional background and the decisions he made as chief engineer. I specifically used the information pertaining to the sewer systems he ordered to be constructed, and how they affected the course of the cholera epidemic.

Terris, Milton. "Epidemiology and the Public Health Movement." *Journal of Public Health Policy* (1987): 315-329. Print.

Terris' article discusses the symbiotic relationship between epidemiology and the public health movement, with specific reference to its development in England during the Industrial Revolution. I use this paper to identify the cause-effect relationship between population density and public health demand.

Thornbury, Walter. *Old and New London: a Narrative of its History, its People, and its Places*. London: Cassell, Petter, & Galpin, 1873. Print.

Thornbury's book recounts many of the British Parliament's decisions in light of contemporary events, which includes its response to John Snow's evidence of choleric transmission by water. I use this source to give context to their decision to build a city-wide sewer system.

University of California, Los Angeles. *Asiatic Cholera Pandemic of 1846-63*. n.d. Web. 20 January 2017.

This website relays the history of cholera in regards to the third cholera pandemic, which spread from Asia to England over the course of a decade. Cholera is widely regarded as one of the deadliest diseases of the nineteenth century, which demonstrates even more importance in Dr. Snow's research.