

**Disease in the British Army in India: Colonial Investigations and Interventions**

Undergraduate Research Thesis

Presented in partial fulfillment of the requirements for graduation  
with honors research distinction in History in the  
Undergraduate colleges of The Ohio State University

by

Aidan Morris

The Ohio State University

April 2022

Project Advisors: Professors Alice Conklin and Chris Otter, Department of History

## **Introduction**

The institution of public health in America has served quietly and effectively behind the scenes since the era of the AIDS epidemic. In the age of COVID-19, the institution of public health has grown massively in the public conscious. From mask-wearing, social distancing and quarantining, our way of life was fundamentally changed, at least for the duration of the pandemic. The seismic shift in human behavior during the pandemic, in accordance to public health guidelines, was unprecedented in my lifetime. The historic public health crisis of COVID-19, as well as the government's response to it, sparked my curiosity. How had the institution of public health come about? What was the scope of public health now, and how had it changed since the institution began? What cultural values shaped the evolution of public health and our understanding of disease? The specific topic of my research, disease in the British army in India, may seem disconnected from my initial inquiries. In fact, the evolution of public health in colonial India proved to be a fascinating context for my line of questioning. In addition to addressing the origins, scope and cultural values that shaped public health, the colonial context posed additional questions of cultural competency and medical autonomy.

The historiography of public health's origins in Britain provided indispensable context for the evolution of public health in colonial India. In my literature review, I turned to the work of Christopher Hamlin, historian of medicine, associate professor at Notre Dame and Honorary Professor at the London School of Hygiene and Tropical Medicine. Hamlin authored one of the first comprehensive works of the public health system of early 19<sup>th</sup> century Britain. In his book entitled "Public Health and Social Justice in the Age of Chadwick" Hamlin argues that the sanitary emphasis of modern public health was not an obvious remedy to an urban issue, but represented a compromise between the anti-social welfare political sentiment of the era and the

labor demands of the industrialized economy.<sup>1</sup> Not only does Hamlin argue that economic and political factors determined the scope of public health, but also its orientation. Hamlin posits the orientation of public health in industrial Britain was not universal, but was concerned with “*some* aspects of health of *some* people: working-class men of working age”.<sup>2</sup> Hamlin’s close analysis of the political and cultural phenomenon of Industrial Britain inspired me to examine these same phenomenon in colonial India. Through the inspection of primary source documents, including health reports of the colonial Indian government, I found that public health policy in India was consistently determined by political factors and empirical priorities, shifting to adapt to the political context.

Tracking the evolution of public health in colonial India required not only an understanding of the external influences and motivations of the colonial government, but also comprehension of contemporary ideas of disease and disease prevention. I benefitted enormously from the comprehensive scholarship of Mark Harrison, associate professor of history at Oxford and author of multiple books on the history of medicine in the colonial era. A foundational secondary source in my research, Harrison’s “*Climates and Constitutions*” discusses British attitudes towards the Indian environment, describing how the British came to see themselves as especially vulnerable to disease in India. According to Harrison, the British came to see the climate of India as the culprit for their high rate of disease mortality in comparison to local peoples. Harrison built upon this work in his publication of “*Public Health in British India: Anglo-Indian Preventative Medicine 1859-1914*”, tracing the evolving understanding of disease of British health officials during this time period. Crucially, Harrison notes the prominent role

---

<sup>1</sup> Christopher Hamlin, *Public Health and Social Justice in the Age of Chadwick: Britain, 1800-1854* (Cambridge: Cambridge University Press, 1998).

<sup>2</sup> Hamlin, *Public Health and Social Justice*, 12

the environmental paradigm of disease maintains from the 18<sup>th</sup> through the 19<sup>th</sup> century despite the advancement of scientific knowledge.

In the midst of the cholera epidemics of 19<sup>th</sup>-century Britain, a sanitary framework of disease prevention arises. Florence Nightingale, following the principles set forth by Edwin Chadwick in industrial Britain, plays a key role in the institution of sanitarianism in India.<sup>3</sup> Although Nightingale was not appointed to an official role in colonial India's health commission, historian Gérard Vallée demonstrates how Nightingale was able to form Indian public health in the sanitarian mold. Vallée discusses in detail Nightingale's direction of India's public health policy in his comprehensive introduction of "Florence Nightingale on Health in India", an edited volume of Nightingale's collected works. While Vallée simply chronicles Nightingale's role in the development of public health in India, I argue that Nightingale represents a quintessentially Victorian vision of public health, bringing to India all the cultural, moral and political baggage that constituted sanitarianism in Britain.

The principle primary sources of my research are the health reports published by the Royal Commission, a body of physicians, statisticians and administrators originally tasked with safeguarding the health of the British Army in India.<sup>4</sup> The first Royal Commission, chartered in the first years of direct British rule in India, found that preventing disease in the British army necessitated a system of public health for all urban centers of the colony.<sup>5</sup> The first report of the Royal Commission, published in 1864, conducted a wide-ranging survey of the colony to

---

<sup>3</sup> Gérard Vallée, *Florence Nightingale on Health in India*, *Florence Nightingale on Health in India: Collected Works of Florence Nightingale*, Volume 9. Waterloo, Ont: Wilfrid Laurier University Press, 2006. <https://muse-jhu-edu.proxy.lib.ohio-state.edu/chapter/369635>

<sup>4</sup> Sanitary Commissioner. *Report of the Sanitary Commissioner with the Government of India*. (1867-1900) London: Her Majesty's Stationary Office. [https://searcharchives.bl.uk/primo\\_library/libweb/action/search.do](https://searcharchives.bl.uk/primo_library/libweb/action/search.do)

<sup>5</sup> Sanitary Commission. 1864. *Report of the Commission Appointed to Inquire into the Sanitary State of the Army of India*. London: Her Majesty's Stationary Office. <https://wellcomecollection.org/works/jpnkzuau/items?canvas=11126>

ascertain the cause of the especially high mortality rate of British soldiers in India. From her home in London, Nightingale personally coordinated the efforts of the first Royal Commission, utilizing a network of influential friends including statistician William Farr and renowned sanitarian John Sutherland to carry out her designs under their own names.<sup>6</sup> The majority of these reports are available online through the British Library digital archives, while the first report can be found in the online on the Wellcome Collection's digital archive.

While these annual health reports were easily accessible, I also identified key sources offering insight into the Royal Commission's struggle against malaria, the black plague and the adoption of sanitary ideas that are only available in the British Library Archives. I owe a debt of gratitude to the Undergraduate Research Office for selecting my project for funding, which enabled me to travel to London, England to visit these documents in person. Upon arrival at the archives, I was able to request these documents from the India Office catalogue and photograph them page by page to incorporate them in my research.

My honors thesis argues that the sanitary paradigm of public health in colonial India, while initially successful, uniquely hindered the progress of the colonial health regime. The moral, cultural and national values invested in sanitarianism, coupled with the initial success of the sanitary policies ideologically calcified the system of public health, resisting the incorporation of germ theory and bacteriology into the public health framework for decades after these ideas had been promulgated.

---

<sup>6</sup> Vallée, *Florence*, 15

## **Chapter 1: Cleanliness is Next to Godliness: Industrial Origins of Public Health**

The framework of public health as practiced globally today was shaped in Industrial-era Great Britain.<sup>7</sup> Several factors explain why the first public health measures were adopted mid-century in Britain and why they took the form they did: pauperization and urbanization, changing sensibilities, and new understandings of disease. In the context of India, some of these measures were distorted due to the political landscape, constraints of resources, cultural conflicts, and the racially prejudiced colonial system in India. A close examination of the political, economic and imperial factors at play during the birth of public health in Great Britain provide valuable insight into their later implementation and evolution in India.

During the industrial revolution in Great Britain, the urban proletariat suffered mightily. Working hours were long, usually between 12 and 16 hours a day in the factory or the mines.<sup>8</sup> Injuries were very common for the urban poor, as there were essentially no protections granted to workers by employers or the government. Moreover, many of the trades at the time such as mining and metal grinding guaranteed a shortened life expectancy due to the exposure to toxic dust and other substances.<sup>9</sup> Poverty also led to inadequate nutrition which was another cause of poor health. Oftentimes parents were forced to feed infants crusts of bread or carrots because mothers were too malnourished to breast feed. Even shelter was less than adequate, homes were overcrowded and smoke-filled from the fires used to heat the home and to cook with. These conditions resulted in a high infant mortality rate and a population of workers predisposed to

---

<sup>7</sup> The use of the term “public health” is an anachronism that is used in this essay in order to provide clarity for the reader. Victorians termed the overall practice of preventive medicine as “Sanitation” because it described all of the factors believed to cause disease. Though inaccurate, the use of the term Sanitation belies how interconnectedly the Victorians viewed hygiene with health.

<sup>8</sup> Hamlin, *Public Health and Social Justice*, 47

<sup>9</sup> Hamlin, 41

disease. These deplorable conditions for the working-class contributed to a considerably higher death rate from disease than was true for the upper class.<sup>10</sup>

Another critical factor in the investigation into high mortality rates among the urban poor was the issue of public sanitation. Surveys conducted to investigate the sanitary conditions of the urban slums often found the homes of the urban poor and the streets that they inhabited filled with piles of refuse, cesspools and horribly maintained public toilets. The results were horrifying to the inspectors, who described such a state of misery and filth that they must be remedied. Despite this belief that health was connected to sanitary conditions, urban slums were allowed to accumulate human waste in every quarter.

Officials were aware of the great mortality among the urban poor but had difficulty addressing it for several interrelated reasons. The first was the lack of knowledge of disease transmission and prevention. During the mid-19<sup>th</sup> century, poverty was seen as inextricably linked with ill health, as the upper classes suffered at far lesser rates from disease than did the poor.<sup>11</sup> The reason for this disparity seemed self-evident at the time. The poor worked longer hours at more arduous jobs, were exposed to more toxic chemicals and had only enough nutrition to survive.<sup>12</sup> In contrast, the upper classes tended to work in white-collar positions that demanded limited physical labor and time at work, paid enough so that they could eat well, and had the financial means for maintaining sanitary conditions in their homes. The medical experts of the era believed that each of these factors predisposed a person to disease. The conclusion that was

---

<sup>10</sup> Hamlin, *Public Health and Social Justice*, 26

<sup>11</sup> Hamlin, 68

<sup>12</sup> Hamlin, 68

drawn was that in order to alleviate disease among the poorer classes, poverty itself must be addressed.<sup>13</sup>

This concept of poverty as a determinant of disease created an enormous political challenge for health officials in the British government. It was difficult to institute any policy that resulted in direct assistance to the poor in the form of food, shelter, housing or money as a result of the anti-entitlement political climate.<sup>14</sup> A major thinker contributing this climate was the Utilitarian philosopher Jeremy Bentham. According to Bentham, everyone was capable of work, and should work, for the benefit of society.<sup>15</sup> Following this perspective, subsistence and labor must not be separated so that the laboring class would be incentivized to work.

To bridge the gap between the need for labor and the entitlements needed to sustain the laboring class, Bentham himself proposed a compromise. The Poor Law Amendment Act of 1834 was passed by Parliament on the basis of Bentham's proposal put forward in "Pauper Management Improved," in which he advocated that workhouses be established to house and feed the poor so long as they worked. Designed as a last resort for the poor, the workhouses were meant to be as unappealing to workers as the coal mines, in order to not lose workers in the most difficult occupations.<sup>16</sup> As a result of this design, there was an uproar in many cities across Great Britain, where urban workers saw death from starvation and exposure as preferable to the workhouse.<sup>17</sup> This was the political climate that public health was born into, one in which government was very reticent to take responsibility for the health of the laboring class in any meaningful way. This situation did, however, begin to change somewhat during the cholera

---

<sup>13</sup> Hamlin, *Public Health and Social Justice*, 57

<sup>14</sup> Hamlin, 90

<sup>15</sup> Hamlin, 29

<sup>16</sup> Hamlin, 29

<sup>17</sup> Hamlin, 33

epidemics of the early 19th century. Cholera had a particularly marked effect in the crowded and unsanitary slums that surrounded manufacturing centers.<sup>18</sup> These slums had multiplied during the Industrial Revolution, offering fertile ground for infectious diseases. As the laboring class suffered the worst effects of the cholera epidemic, the government became increasingly concerned.<sup>19</sup> Cholera was a particularly virulent disease, and a hotbed of cholera in the slums could easily spread to the rest of the city. Moreover, the laborers who died from cholera represented a loss in human capital and economic productivity. Thanks to Bentham's influence, the British government saw the health of the population as a national economic issue, and they realized that the prevention and treatment of disease would cost the government less than if they did nothing and let the disease take its toll. The idea that public health had national implications for the economy, together with the impetus of the cholera epidemic of the mid 19<sup>th</sup> century acted as the catalyst for the government to take responsibility for health in the country. In 1848, the first Board of Health was established by the Public Health Act, the first centralized public health agency in Great Britain. To protect the human capital needed for industrial production, the newly formed Board of Health had to intervene, but how?

The question of how to intervene in the health of the laboring classes began to clarify in the years leading up to the establishment of the Board of Health in 1848. The Poor Law of 1834, and the workhouse system implemented by it was an implicit acknowledgement by the British government that the poverty of the laboring class was a critical determinant in their high rates of mortality.<sup>20</sup> Despite this acknowledgement, the workhouses did little in practice to alleviate

---

<sup>18</sup> *Rise And Fall Of Cholera In London* The British Medical Journal  
Vol. 2, No. 299 (Sep. 22, 1866) 338

<sup>19</sup> Hamlin, *Public Health and Social Justice*, 86

<sup>20</sup> Hamlin, *Public Health and Social Justice*, 29

poverty or to stem the mortality suffered by the lower classes. The failure of the workhouse system led reform-minded government administrators to investigate other avenues to guard the health of the lower classes without resorting to social welfare. Edwin Chadwick, secretary of the Poor Law Commission, was one such reform-minded administrator. Chadwick suspected that the accumulation of human waste in the streets and cesspools of the slums was a contributing cause of disease. This idea was informed by the Victorian medical theory that disease was spread by poisonous gas called miasma, which was propagated by sewage and other rotting organic matter. To investigate the link between sewage and disease, Chadwick dispatched three physicians to the slums of London; Southwood Smith, Neil Arnott, and James Phillips Kay in 1837.<sup>21</sup> Their report was concluded in 1838 and confirmed Chadwick's belief that sanitary conditions were linked to the spread of disease.

The reports caught the attention of the British government, which then directed the Poor Law Commission to determine if the sanitary conditions identified in London were also the causes of disease in other parts of the country.<sup>22</sup> This investigation culminated in the publishing of the Sanitary Report in 1842, a survey of the sanitary condition of industrial cities in Great Britain authored by Chadwick. The Sanitary Report found that that were three critical environmental factors that contributed to the high mortality of the lower classes: human waste management, the provision of clean and continuously available water, and the ventilation of homes.<sup>23</sup> Chadwick proposed that these three factors constitute the practice of public sanitation, which was to be in effect the practice of public health. Chadwick's report had successfully

---

<sup>21</sup> Bayliss, Robert A., and C. William Ellis. "Neil Arnott, F.R.S., Reformer, Innovator and Popularizer of Science, 1788-1874." *Notes and Records of the Royal Society of London* 36, no. 1 (1981): 103–23. 113

<sup>22</sup> Hamlin, 121

<sup>23</sup> Hamlin, *Public Health and Social Justice*, 160

shown that poverty was not a direct cause of disease, and that the government could stem the high mortality rates among the lower classes without addressing poverty directly. The avoidance of addressing poverty as a determinant of health was critical for Chadwick's recommendations to be taken up by the government. When the Board of Health was established six years later in the midst of a cholera epidemic, it was able to avoid the politically charged issue of social welfare and instead employed public sanitation interventions as its primary tool to fight the epidemic.<sup>24</sup> The narrow focus of public health that Chadwick championed continued to gain steam in the mid 19<sup>th</sup> century as municipal boards of health served primarily to eliminate cesspools and establish sewer systems and public latrines. Chadwick's conception of public health thereby took shape, establishing the boundaries of public health which would in turn influence India albeit in a very different epidemiological, political, and cultural environment.

### **The Lady of the Lamp**

Just as Chadwick was critical in advancing sanitation as the primary vehicle for public health in England, Florence Nightingale was the fierce and energetic proponent of sanitation in the British army and the colonies, particularly India. Today, Nightingale is renowned for her work as the founder of modern nursing, but her legacy extends even deeper into healthcare, influencing public health theory and policy through her work for the British Army in the Crimean War and the British colonial administration in India.

Nightingale gained a sense of what was to be her life's work during an unplanned two-week stop at a religious Lutheran community in Kaiserswerth am Rhein, Germany, during a tour of Europe in 1851. Here, Nightingale became enamored with the selfless devotion of the nurses who cared for the impoverished invalids of the area, but was simultaneously disturbed by the

---

<sup>24</sup> Hamlin, 276

sanitary conditions of the ward.<sup>25</sup> Instead of being put off by the conditions of the ward, Nightingale was inspired. Here was her chance to answer what she felt was God's calling for her life. In the following years Nightingale gained expertise as the superintendent of a women's hospital in London and established herself as a resourceful and tireless leader.<sup>26</sup>

Only a few years later in 1854, the secretary of state for war Sidney Herbert requested that Nightingale recruit and superintend a group of 38 nurses in Scutari, the location of several military hospitals servicing troops in the Crimean War.<sup>27</sup> Nightingale quickly accepted Herbert's request, seeing in the task an incredible opportunity for her to institute her regimen of sanitation and public health on a large scale. When Nightingale arrived in Scutari, she immediately saw an extreme deficiency in sanitary and hygienic arrangements. Nightingale noted the general uncleanliness of the facilities, observing "as many as six dead dogs underneath one ward window" and an accumulation of dirt and organic matter coating the ground and the walls.<sup>28</sup> The issue of cleanliness was made even worse by the overcrowding. Many men were packed shoulder to shoulder lying on the floor, an area which always seemed to be either wet and clean or dry and filthy owing to defective drainage.<sup>29</sup> Nightingale also reported the poor quality of drinking water, which was stored in a tank that at one point was littered with dirty hospital dresses and was transported by an aqueduct that was polluted by a decomposing horse.<sup>30</sup>

Ventilation was another critical element of sanitation to Nightingale. Nightingale, like most

---

<sup>25</sup> Monica Baly, and H. C. G. Matthew. *Nightingale, Florence (1820–1910), Reformer of Army Medical Services and of Nursing Organization.* (Oxford Dictionary of National Biography, 2004), Oxford University Press, September 23 2004 <https://www.oxforddnb.com/view/10.1093/ref:odnb/9780198614128.001.0001/odnb-9780198614128-e-35241> (accessed April 5, 2022) 4

<sup>26</sup> Baly, and Matthew. *Nightingale*, 4

<sup>27</sup> Baly and Matthew, 4

<sup>28</sup> Lynn McDonald. *Florence Nightingale: The Crimean War: Collected Works of Florence Nightingale, Volume 14.* (Wilfrid Laurier University Press, 2010), 914 <https://muse-jhu-edu.proxy.lib.ohio-state.edu/chapter/931251>

<sup>29</sup> McDonald, 913

<sup>30</sup> Lynn McDonald. *The Crimean War*, 914

Victorians, believed that disease was transmitted via poisonous gasses, often emanating from sewage or rotting organic matter. To disperse these poisonous gasses and displace them with clean air, ventilation was critical. Here too, the hospitals at Scutari were lacking. The windows could not be opened for lack of heating and the sewage fumes from the bathrooms poured straight into the hospital wards, circumstances that Nightingale believed were causing disease.<sup>31</sup>

Nightingale worked quickly to rectify the sanitary insufficiencies she identified at Scutari. Nightingale first ordered clean linens and made arrangements to obtain laundry facilities which were both remarkably absent when she arrived.<sup>32</sup> Improvements to ventilation, clean water and drainage were not implemented until March 1855, but did produce a remarkable change in mortality once they were instituted. In a statistical analysis conducted after the war, it was found that in the months following the institution of Nightingale's prescribed sanitary measures deaths fell precipitously and consistently.<sup>33</sup> After the war, Nightingale was recognized for her role in reducing the death rate of soldiers in the British army who fared much better than the French army, whose death rate was 30.9% as opposed to the British rate of 22.7% overall.<sup>34</sup>

Nightingale returned to England when the Crimean War ended, full of consternation at what she had witnessed in the hospitals at Scutari. The British army, Nightingale felt, had completely failed their soldiers, leaving them to die in hospitals and barracks from preventable diseases.<sup>35</sup> Not only did Nightingale witness this tragedy firsthand, she took down meticulous notes and kept statistics of the various categories of death. According to the statistics found in a

---

<sup>31</sup> Lynn McDonald, 913-914

<sup>32</sup> Monica Baly, and H. C. G. Matthew. *Nightingale*, 5

<sup>33</sup> *Report of the Commissioners Appointed to Inquire into the Regulations affecting the Sanitary Condition of the Army and the Treatment of the Sick and Wounded*. Vol 1.(London: HMSO, 1858), xxxi  
<https://wellcomecollection.org/works/xa6cwpmx/items>

<sup>34</sup> Lynn McDonald. *Journal of the Royal Statistical Society: Series A* (2014) 177, Part 3, pp. 569–586  
University of Guelph, Canada <https://cwfn.uoguelph.ca/short-papers-excerpts/nightingale-statistics-and-the-crimean-war/>

<sup>35</sup> Monica Baly, and H. C. G. Matthew. *Nightingale*, 8

report after the war, the British army experienced a death rate from disease that was five times higher than that of the death rate from wounds, even with Nightingale's help. The more Nightingale considered the statistics, the more infuriated she became with the administration that had allowed these preventable deaths to occur. It was not enough for Nightingale to lead a group of nurses or to administer a hospital to change these statistics, reform must be undertaken. To this end Nightingale began agitating for a Royal Commission to investigate the sanitary conditions of the British Army during the Crimean War. To successfully lobby the crown to create the commission, however, Nightingale could not act alone. As a woman, Nightingale's ability to affect governmental change was limited in Victorian society. However, Nightingale's aristocratic birth allowed her to maintain a social circle of prominent intellectuals and ministers of Parliament, and to develop connections with men who would ultimately carry out her vision.<sup>36</sup> Among these collaborators was William Farr, a government statistician and epidemiologist who shared Nightingale's views on sanitation. Together with Farr, Nightingale was able to lobby for the creation of the commission. When the commission was finally established, it was chaired by Sidney Herbert, the same man who had requested Nightingale's help in Crimea.<sup>37</sup> As part of the commission's investigation, Herbert called on Nightingale and Farr to serve as chief witnesses, giving Nightingale an opportunity to present her 830-page report *Notes on matters affecting the health, efficiency, and hospital administration of the British army* (1858) complete with Farr's in-depth statistical analysis.<sup>38</sup> In 1858, Herbert concluded the commission's investigation and published the report. Nightingale was elated with the commission's conclusions which empowered her, through male intermediaries, to make sanitary improvements in barracks, create

---

<sup>36</sup> Baly and Matthew, 2

<sup>37</sup> Baly and Matthew, 8

<sup>38</sup> Monica Baly, and H. C. G. Matthew. *Nightingale*, 8

a medical statistics department for the army, and to institute a medical hygiene curriculum for a new army medical school.<sup>39</sup> Despite her early success, Nightingale was not satisfied with the pace or breadth of sanitary reform. However, events in India would soon open a new frontier for sanitary reform in which Nightingale would help the British empire confront disease mortality that dwarfed those she had encountered in the Crimea.

### **Sanitation in India before the Revolt of 1857**

The British first established a territorial presence in India following the Battle of Plassey in 1757, in which the East India Trading Company defeated the ruler of Bengal.<sup>40</sup> The East India Trading Company was a joint-stock venture with a monopoly on trade in the East Indies provided by the British government. The British government authorized the East India Trading Company to use military force in order to gain trading concessions and acquire new territory, and in return the East India Trading Company maintained the privilege to administer the new territories and to reap a share of the profits gained from trade and taxation. However, the East India Trading company struggled to keep the ranks of its army full. As the East India Trading Company gained more territory in India and recruited more European troops to fight on the subcontinent, they found that soldiers from Europe were extremely susceptible to diseases endemic to India including malaria and cholera. Indian soldiers, in contrast, showed surprising (to British eyes) resilience to these feared diseases.<sup>41</sup> To strengthen the army's collective

---

<sup>39</sup> Baly, and Matthew, 9

<sup>40</sup> Kundan Kumar Thakur. "British Colonial Exploitation of India and Globalization" *Proceedings of the Indian History Congress* 74 (2013): 406. <http://www.jstor.org/stable/44158840>.

<sup>41</sup> Harrison "Public Health in India" 228

resistance to disease, the EITC recruited heavily from the Indian population who eventually comprised two-thirds of their army.<sup>42</sup>

In retrospect, we now know that the reason local Indians were less vulnerable to disease than the British is a function of immunity. While mid 19<sup>th</sup> century Western medicine and pathology were on the brink of a breakthrough, ancient and medieval ideas were still influential in this era. Among these medieval influences was humoral pathology, the theory that the body is composed of four vital fluids (blood, phlegm, black bile and yellow bile) that must be in balance to maintain health.<sup>43</sup> As Europeans began to colonize tropical climates, they had difficulty adapting to the intense heat. At the same time, they contracted virulent diseases that afflicted Europeans at higher rates than natives. To contextualize this phenomenon, the humoral paradigm was incorporated into colonial medicine. Leading physicians of the late 18<sup>th</sup> and early 19<sup>th</sup> centuries proposed that extreme heat had an irritating and inflaming effect on the body's organs, disrupting the normal functions of the liver and causing fevers by heating the blood. These misguided diagnoses were often followed by even worse prescriptions. Common humoral cures included the practice of venesection (bleeding) and the ingestion of mercurials.<sup>44</sup>

Despite the persistence of medieval ideas about the four humors, the Victorians also developed more modern ideas. For example, they believed that that some individuals and groups of people carried a greater amount of resistance to disease than others. A perceived relative invulnerability to disease was tied into the Victorian concept of a person's "constitution", which also carried connotations of health and vitality. According to the Victorians, the strength of a

---

<sup>42</sup> Harrison, 61

<sup>43</sup> Arnold, David. *Colonizing the Body: State Medicine and Epidemic Disease in Nineteenth-Century India*. (Berkeley: University of California Press 1993) 37

<sup>44</sup> Arnold, *Colonizing*, 38

person's constitution was determined by multiple factors ranging from ethnic heritage to daily habits. Among the daily habits the Victorians thought important to the "constitution" were habits of diet, alcohol consumption, sexual activity, religious practice and hygiene, and they applied these same ideas to Indians.<sup>45</sup>

Related to the idea of constitution was the theory of climatic determinism. This theory, postulated at the beginning of the East India Trading Company's establishment in India, was to prove influential in colonial public health until the 20<sup>th</sup> century. This theory held that humans were akin to plants in that they required a suitable climate based on their type, or in the case of humans, their ethnic constitution. This theory was an attempt to make sense of the seeming fragility of the British conqueror compared to the apparent strength of the indigenous subject. British medical authorities in India consistently searched for answers in the field of epidemiology by examining patterns in the weather and searching for cooler locales for army bases, a practice informed by the concept of climatic determinism.<sup>46</sup>

A foundational principle of pathology since the ancient Greeks, the miasma theory, as noted above, was the most influential theory of disease transmission in 19<sup>th</sup> century colonial India; it claimed that disease was spread through airborne emissions of rotting organic matter and feces. The sanitary framework of disease prevention, developed by Chadwick in Britain and Nightingale in India, centered the removal of all sources of miasma in its disease prevention philosophy. Contained within the miasma theory was the idea that aromas indicated the presence of disease. A pragmatic theory borne from experience with fecal matter and corpses, this

---

<sup>45</sup> Arnold, *Colonizing* 40

<sup>46</sup> Mark Harrison. *Climates and Constitutions: Health, Race, Environment and British Imperialism in India*. Oxford University Press, 2002.

misguided idea proved useful in British sanitation efforts in the Crimea and would play an important role leading up to the adoption of germ theory.

Climate played a critical role in pathology at the time, such that every medical survey in India published in the 19<sup>th</sup> century included multiple charts and summaries of the meteorological data and trends of the preceding years. The British believed India to have a particularly dangerous climate because the heat and humidity present in much of the country were supposed to strengthen miasmatic emissions.<sup>47</sup> Patterns of precipitation were also thought to contribute to disease transmission, as different regions of India suffered disease outbreaks in accordance with the rainy season. Closely linked to climate as a consideration of disease transmission was topography. Topography was seen to be critical in the realm of health because of the effects of humidity, vegetation and standing water. The topography of low lying, marshy areas was considered dangerous because of the abundance of those three factors.<sup>48</sup> In contrast, higher elevation locales were seen as healthful sanctuaries from these conditions. The arid conditions at higher elevations were seen as so beneficial to health that the Charter of the Royal Commission specifically requested that the Commission determine the best locations to establish a settlement at high elevation.<sup>49</sup> Soil conditions were also in the domain of topography, again for the same reasons. Soil was examined for composition of decaying organic matter and for levels of saturation.

Cultural habits of daily life were seen as another key area of pathology. Intrigued by the lower rates of disease and mortality in the Indian population, physicians and surveyors sought to

---

<sup>47</sup> Arnold, *Colonizing*, 33

<sup>48</sup> Harrison, *Climates* 154, 155

<sup>49</sup> Sanitary Commission. *Report of the Commission (1864)*, xxiii-xxiv

uncover cultural habits of the Indian population that shielded them from disease. One area of cultural difference between the British and the Indian population was the mode of dress. The British did not adapt their mode of dress suited for the dreary and cool climate of England to the intense heat and humidity of the subcontinent. This left the British sweating heavily and feeling drained from the heat. In contrast, the Indian population wore light, flowing garments that provided airflow and alleviated the effects of the heat. Some physicians even recommended adopting Indian dress as heat was seen as having a deleterious effect on the health of an individual.<sup>50</sup>

Another distinction between the British and the Indians in this arena was the pace of work and life. Indians were perceived to work at a languid pace, and to take breaks frequently. British physicians believed this mode of living necessary to guard against the effect of the heat, and so encouraged this practice for the British. Diet also was strikingly different between the two cultures. The Indians tended to imbibe light fare which included a lot of rice and vegetables, while the British consumed a much heavier diet comprised primarily of meat. The heat of India was thought to stifle the normal processes of digestion, and so many doctors advised the lighter diet of Indians. Lastly, there was a profound difference in the levels of alcohol consumption between the British and the Indians. The British, especially the soldiery, consumed alcohol in copious amounts on a regular basis, often leading to chronic liver problems. In contrast, the Indian population drank very moderately, and afflictions of the liver were much less common among them.<sup>51</sup> The problem of alcoholism in the army was thought to be related to the amount of free time allotted to them. This freedom from military duties also allowed the soldiers to engage

---

<sup>50</sup> Arnold, *Colonizing*, 40

<sup>51</sup> Arnold, *Colonizing* 41

in other behaviors that posed a danger to their health, chiefly prostitution. Sexually transmitted infections, or venereal disease as it was called then, were endemic in the military of India. An incredible 25% of British troops in the hospital for treatment were admitted for venereal disease, a rate that continued throughout the 19<sup>th</sup> century.<sup>52</sup>

By the early 19<sup>th</sup> century, Indians comprised the vast majority of the East India Trading Company's army because of the cheaper cost of conscription and their perceived resistance to endemic diseases compared to Europeans. This policy of relying on local populations for military support proved to be a drastic mistake for the East India Trading Company. In 1857, the Indian troops serving under the British East India Trading Company rebelled and besieged the British garrison in the city of Lucknow. Over the course of the rebellion, over 2,000 British soldiers of the East India Trading Company were killed. After the rebellion, the British government forced the East India Trading Company to withdraw, and itself took over control of India. Despite the magnitude of the violence, the morticians were kept busy not by the casualties of war, but rather those by disease. In fact, mortality attributed to disease so far outpaced those from warfare that a royal commission was appointed in 1859 to determine the cause of the excess deaths. When *The Royal Commission Appointed to Inquire into the Sanitary Conditions of the Army In India* published their eponymous report in 1864, they concluded that instituting sanitary measures in the army would not be sufficient to curb disease in the army; all the surrounding local communities must also be included in the sanitary project to curb the spread of malaria and other infectious diseases.<sup>53</sup>

---

<sup>52</sup> Erica Wald, *Punishing the prostitute and protecting the soldier: the lal bazaar, lock hospital and the treatment of venereal disease in colonial India*. University of London, Lecture via Zoom. [https://lshtm.zoom.us/rec/play/7V6DCHfWcESim3dHMhPuYq1rCcMbERaQBXQpFQZbOudk3PKzPDMhg\\_xfQs-2rShb3UcM\\_dBkoeGlh-sB.RFYFBihaEROFJM2q?startTime=1602072091000](https://lshtm.zoom.us/rec/play/7V6DCHfWcESim3dHMhPuYq1rCcMbERaQBXQpFQZbOudk3PKzPDMhg_xfQs-2rShb3UcM_dBkoeGlh-sB.RFYFBihaEROFJM2q?startTime=1602072091000)

<sup>53</sup> Sanitary Commission. *Report of the Commission (1864)*, 128

## **Chapter 2: British Public Health Initiatives in India: Recommendations and Results**

The Lucknow Revolt of 1857 proved to be the immediate impetus for an evaluation of public health in India due to multiple factors. At the time of the revolt, Indians soldiers or “sepoys” comprised two-thirds of the army, many of whom had joined the revolt.<sup>54</sup> To prevent future army mutinies, The British government decided that British soldiers must greatly outnumber sepoys. However, replacing sepoys with British soldiers would not be so easy: British soldiers were four-and-a-half times more likely to die from disease than sepoys.<sup>55</sup> In changing the composition of the army, it was clear that drastic measures were needed to safeguard the health of the relatively vulnerable British soldiers that were to replace the sepoys. The second factor was the evaluation of mortality statistics after the revolt. By the time the revolt was concluded, approximately 2,000 soldiers had been killed.<sup>56</sup> While the fighting was intense and the losses were severe, this number paled in comparison to disease deaths. A sober analysis of this data invited further evaluation of how to prevent the army’s greatest enemy in India: disease. The third factor was the transition from indirect rule under the East India Trading Company to the direct rule of the British Raj. The British government had a greater interest in maintaining a healthy army in India and had greater resources to devote to this goal than the East India Trading Company. Finally, the Lucknow Revolt of 1857 occurred at an auspicious time for public health intervention. In 1857 Florence Nightingale was in the midst of authoring an 800-page report on sanitation in the Crimean War which recommended reforms for the British army based on her observations and government statistics. In 1858, Nightingale’s report was used as the basis for the “Royal Commission appointed to Inquire into Regulations affecting the Sanitary Condition of

---

<sup>54</sup> Harrison. *Public Health in India*, 61

<sup>55</sup> Arnold, *Colonizing*, 68

<sup>56</sup> Douglas Peers *India Under Colonial Rule: 1700-1885* (London: Routledge Publishing, 2006) 64

the Army, the Organization of Military Hospitals, and the Treatment of the Sick and Wounded”, the first ever royal inquiry on the sanitary conditions of the British army.<sup>57</sup> The results of the commission proved unequivocally that sanitary measures were effective at preventing deaths from disease and provided a springboard for Nightingale and her cabinet of fellow sanitarians to advocate for further reforms.

The creation of a Royal Commission for India was initially suggested in 1858 by Edwin Chadwick in a letter to Lord Stanley, then the secretary of state for India; however it was Nightingale who pursued the idea, writing to Lord Stanley on several occasions describing how the commission might be structured and suggesting who best to serve on it.<sup>58</sup> Nightingale’s influence was such that she was able to elevate key intimates to important positions in the commission despite her inability to officially serve on it herself. Sidney Herbert, a dear friend of Nightingale’s who faithfully acted on her behalf, planned to chair the commission. Noted government statistician and frequent collaborator William Farr and fellow sanitarian John Sutherland were also to occupy seats on the commission, and these two combined with Nightingale were to serve as the nucleus of the commission.<sup>59</sup> In 1859, “The Royal Commission Appointed to Inquire into the Sanitary Conditions of the Army In India” was officially chartered.<sup>60</sup> Specifically, the commission was charged with identifying the diseases that afflicted the army and their causes in order to make recommendations to address them. Their challenge was monumental. In the years between 1830 and 1845, British soldiers in India died at a rate almost eight times greater than those stationed in Great Britain in a similar timeframe.<sup>61</sup> Lethal

---

<sup>57</sup> Vallée, *Florence*, 12

<sup>58</sup> Vallée, *Florence*, 46

<sup>59</sup> Vallée, *Florence*, 16

<sup>60</sup> Sanitary Commission. *Report of the Commission (1864)*, xxiii

<sup>61</sup> Sanitary Commission. *Report of the Commission (1864)*, xxvii

diseases rarely encountered in Great Britain such as malaria and yellow fever were a massive drain on the manpower and resources of the British army in India. The geographical scope of the inquiry was every bit as daunting in itself, India is 13 times the size of the modern United Kingdom. Nightingale and her collaborators were prepared nonetheless and set out to establish a framework for the massive inquiry.

“The Royal Commission Appointed to Inquire into the Sanitary Conditions of the Army In India” was made in the image of the first Royal Commission, in that Nightingale’s sanitary regime was the foundation for the inquiry. However, the commission’s inquiry incorporated other ideas about health and medicine, many of which stemmed from Victorian standards of morality and medieval ideas of health. The fields of inquiry considered by the commission were varied and seemingly disparate, including the fields of meteorology, nutrition, topography, ethnography, and pathology. In the text of the Royal Commission’s charter, the areas of investigation are delineated as follows: “We do order and direct you to inquire into the causes of such Sickness and Mortality; whether as relates to Climate, Locality, state of Barracks, Drainage, Water Supply, Diet, Drink, Dress, Duties, or Habits of Troops”.<sup>62</sup> The breadth of the inquiry displayed how interconnectedly Victorians saw their health and their environment, an idea that is once again coming into vogue in the modern era. But for the Victorians, this broad inquiry also signaled how little was practically known about the cause of disease and the unwillingness to exclude any possible avenue from investigation.

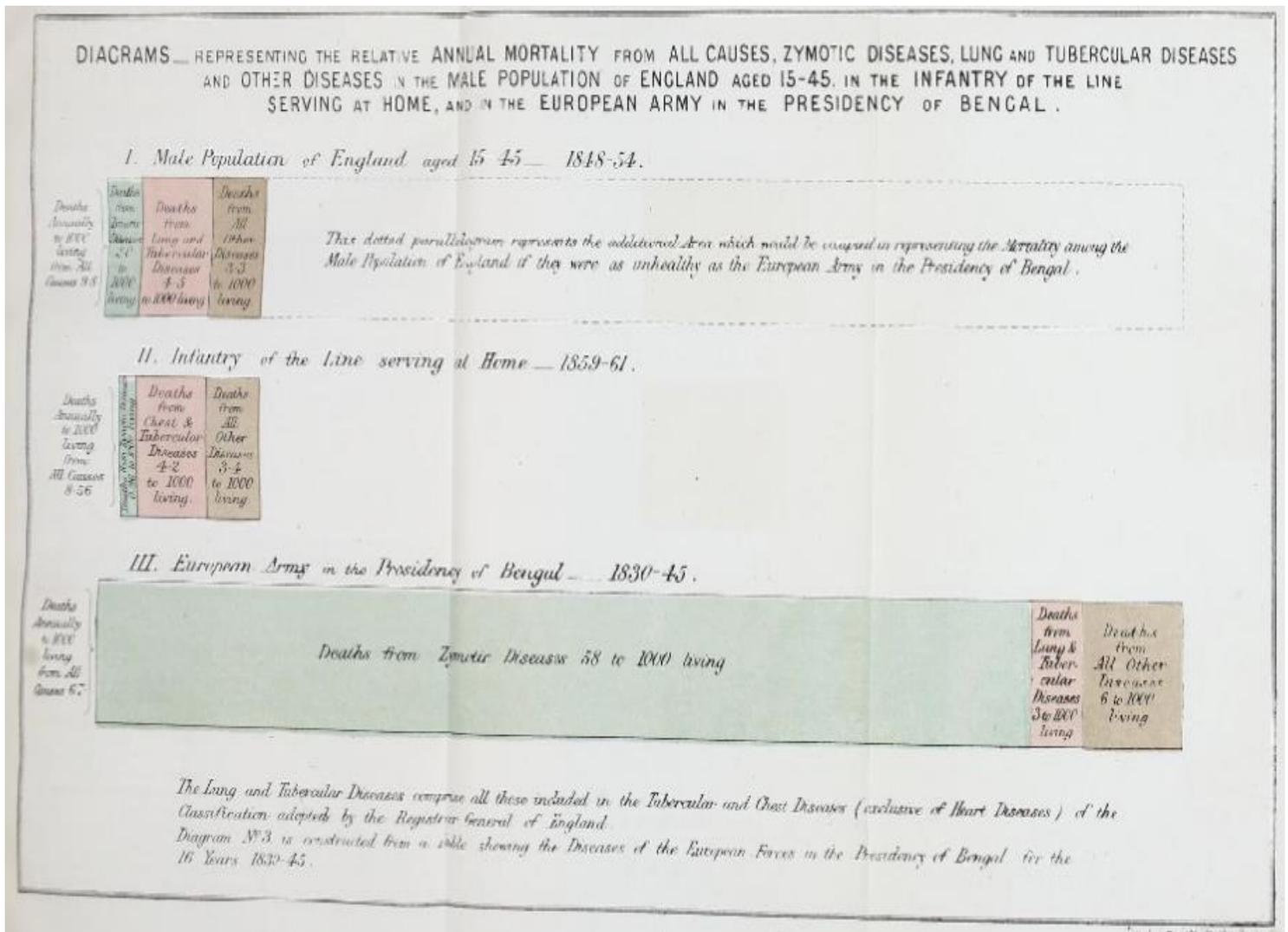
While Nightingale and the other members of the Royal Commission were based in London, the groundwork was performed by health officials assigned to each of the three

---

<sup>62</sup> Sanitary Commission. *Report of the Commission (1864)*, xxiii

Presidencies of India: Bengal, Madras and Bombay. Each of the Presidencies conducted their own investigations on the bases outlined in the Royal commission and sent their data back to London to be analyzed and compiled into an annual report. The methodology of the Royal Commission was two-fold: observational and quantitative reporting of potential health hazards. The observations of health officials provided the commissioners in London with rare insight into the possible causes of and predispositions to disease thanks to their thorough and descriptive nature. The reports were as varied as the scope of inquiry and included such disparate topics as the habits of soldiers and the climate. In fact, a description of the meteorological conditions became a fixture of the Commission's annual report, in which it gave special emphasis to the volume of precipitation and the season in which it occurred. The habits of soldiers were no less important to the commissioners, as they suspected alcoholism and the patronage of prostitutes to be contributing factors to hepatitis and venereal disease respectively. Observations of soil conditions and topography are also commonly found in the reports, based on the notion that damp soil and humid air are contributors to disease. Similarly, symptoms of diseases were described as well as the conditions they were contracted in in an effort to establish a link between them. Finally, the authors of the commission included a summary of their findings in which they made recommendations for the improvement of sanitary conditions in the army encampments and the surrounding areas. These annual reports exist for every year between 1864

and 1900. Whereas the older tradition of basing reports on observation had provided a worm's-eye-view of conditions on the ground, the new practice of using statistics provided solid data from which areas of concern could be identified positively, and correlations between diseases and their causes could be noted for the first time. The statistics collected by the Royal Commission and listed early in the pages of its first report highlighted the fundamental challenge facing the commission. Pictured below is a bar graph that illustrates the magnitude of the problem of disease in India from 1830 through 1869.<sup>63</sup> Here each section of the graph represents deaths from a particular class of disease based on its size.



<sup>63</sup> Sanitary Commission. *Report of the Commission (1864)*, xxvii

The first two charts represent the English population, with the first being the male population and the second being the army stationed in England. The third chart represents the European Army in the Presidency of Bengal, one of three British administrative units in the colony. The most shocking feature of this chart is the green section of the last chart, representing the exponentially greater rate of deaths from zymotic diseases<sup>64</sup> in India as opposed to England. Despite the obstacles facing the commission, new techniques in public health practice would help pave for the way for their work. Nightingale's fruitful utilization of William Farr's pioneering work in health statistics in the first Royal Commission in Crimea effected a shift in which health was to be increasingly seen as a "quantifiable commodity, amenable to comparative analysis as well as clinical investigation".<sup>65</sup> Having passed the acid test of war, statistical analysis of health was to become a cornerstone of the methodology used by the commission in India.

In its first report published in 1864, the commission seeks to categorize all diseases afflicting the army into categories. Lacking an understanding of the cause, the commission groups diseases by symptoms. By this method, the commission concludes that there exist four classes of disease in India that by their frequency and lethality made all others negligible: epidemic cholera, fevers (including malaria), dysentery and diseases of the liver.<sup>66</sup> In describing each of these diseases in the introduction to the report, the commissioners seek to establish a link between the environs in which diseases occur most frequently and their causes. For all four categories of disease, the commissioners conclude that they are caused, or at least are encouraged by, the hot and humid climate. Fevers are described to occur primarily in geographical locations

---

<sup>64</sup> The term "zymotic" refers to a class of diseases that were believed to proliferate in the body in a process akin to fermentation and were contagious. Such diseases include cholera, typhoid fever and diphtheria.

<sup>65</sup> Arnold. *Colonizing*, 66

<sup>66</sup> Sanitary Commission. *Report of the Commission (1864)*, 14

close to bodies of water, especially where an abundance of stagnant water can be found. Malaria is mentioned as the most dangerous and most costly disease for the army in India. Though it can be lethal, just as often malaria will incapacitate a soldier in the course of the illness so that he can no longer serve in the army. According to the commission the lethality of malaria coupled with its propensity to cause injurious long-term effects made malaria one of most dangerous diseases for European colonizers in India. Dysentery, which includes cholera, is a close second to malaria in terms of its deleterious impact on the army.<sup>67</sup> While not responsible for as many hospital admissions, dysentery was more lethal and the disease process more rapid. Adding to the difficulty posed by dysentery was the lack of a potent cure. The only recourse for those with dysentery was to relocate to an arid climate at a higher elevation, a difficult prospect for those on death's door. The commission's investigation of dysentery focused particularly on the disparity in which dysentery was contracted between European and Indian soldiers, a rate of 11:1.<sup>68</sup>

Following the observations of diseases endemic to India, the report goes on to discuss the economic damages inflicted by illness and death in the army. Of great interest to the commission and the British government was the money to be saved by the reduction of illness and mortality in the Indian army. The relatively high cost of maintaining a European army in India was accentuated by the cost of healthcare for soldiers and the wages lost on invalided or ill soldiers. Moreover, the high mortality of the soldiers in India necessitated the continual training of troops and their transport to the subcontinent from England, which strained the twin pillars on which the British Empire rested: economic and martial power.<sup>69</sup> Indeed, the Report of the Sanitary commission was chartered primarily to determine the state of health of the army, and

---

<sup>67</sup> Sanitary Commission. *Report of the Commission (1864)*, 14

<sup>68</sup> Sanitary Commission. *Report of the Commission (1864)*, 16

<sup>69</sup> Sanitary Commission. *Report of the Commission (1864)*, 14

not of the population of India. The singularly focused charter intentionally omitted the population of India, an omission that signaled British indifference to Indian health, excepting that of Indian soldiers. When the commission's report was finally published in 1864, however, it contained more than a little irony. The Commissioners concluded that the health of the army could not be preserved without extending a system of public health to Indians as well: "Apart therefore from the question of humanity, the introduction of an efficient system of hygiene in India is of essential importance to the interests of the empire".<sup>70</sup> There was a caveat to this recommendation though, which was that it only applied to population centers with which the British Army routinely interacted. This meant that rural India, which was the vast majority of the country, did not gain much by the institution of public health.

When the Sanitary Commission of 1864 concluded their report, they provided a list of recommendations following their analysis. As a matter of priority, the list of recommended sanitary projects made by the commission included only hospitals and military encampments, but they were eager to take undertake municipal projects as soon as it was practicable. A sense of optimism pervaded the commission's early years, as it seemed the lessons learned in Great Britain could be applied with great effect in India. Edmund Drummond, the Lieutenant Governor of the North-Western Provinces published a memorandum extolling the work of the Sanitary Commission in England and the potential of their precepts to improve the public health of India cities as well as military encampments. Drummond writes "By a strict attention to drainage, ventilation, and cleanliness...most of [the] active causes of disease were removed. The health of the people of England has consequently greatly improved. In London, 200 years ago, the average annual mortality rate was 7 per cent; it has now, with a greatly increased population, diminished

---

<sup>70</sup> Sanitary Commission. *Report of the Commission (1864)*, 125-126

to 3 per cent”.<sup>71</sup> This memorandum, of which this quote is only a small part, was included in the Report of Bengal from 1864 in its entirety to give a picture of the optimism felt at the time. The Sanitary Commission felt strongly that given time, the Victorian conception of public health would produce the same positive results experienced in Great Britain and Crimea, despite the differing climate and populations.

In keeping with Nightingale’s Victorian obsession with cleanliness, many of the Commission’s recommendations targeted the challenge of human waste. To the Sanitary Commission of 1864, the challenge that human waste posed in India was two-fold; its propensity to cause miasmas, and its ability to taint the water supply. To address these two avenues for disease transmission, the commission first conducted a survey of the drainage and waste management techniques in military cantonments and the towns they were stationed near. The Commission found that the military cantonments had established a superficial surface drainage system which conveyed run-off from rainfall a short distance from the encampment. The encampments also had a number of latrines and urinals, though they were not drained and waste was allowed to accumulate. In contrast, the population centers of India utilized ponds and large holes dug near their houses in order to accommodate their waste and had no system to manage surface drainage.<sup>72</sup> To the Sanitary Commission of 1864, the Indian system of waste management posed a dangerous health hazard. The Commission believed that the open sewage produced by Indian population centers was stimulated by the heat and humidity, creating a dangerous miasma in the area. In the course of its survey, the Commission also found that human waste posed a health problem when it infected the water supply. In the population centers of

---

<sup>71</sup> Sanitary Commissioner. 1864-1865. *Annual Report of the Sanitary Commissioner with the Government of Bengal* Superintendent of Government Printing. <https://www.bl.uk/collection-guides/india-office-records>

<sup>72</sup> Sanitary Commission. *Report of the Commission (1864)*, 60

India, human waste was often deposited near water sources or was positioned such that run-off from the rains would contaminate water sources including wells and rivers. The Commission concluded that an investment in proper drainage was critical for military stations and the cities they neighbored to avoid water contamination and the creation of miasma. In their official recommendations the Commission nevertheless stopped short of issuing any recommendations for the creation of municipal infrastructure in the immediate future as a matter of priority.<sup>73</sup>

Another core aspect of Nightingale's sanitation regime was ventilation. Constant airflow in dwellings and municipalities was seen as a critical aspect of health by the Sanitary Commission because of its ability to fight the effects of miasmas. As noted above, the miasma theory of disease transmission, though only one of many such theories, was the most popular one in mid-19<sup>th</sup> century India and had been in Great Britain for at least a century prior. This theory postulated that infections were caused by poisonous emanations of gas that remained suspended in the air unless dispersed. Following this perspective, it was imperative to prevent the miasmas from stagnating over a city or indoors. Ventilation also has the added quality of drying out damp areas which were another cause of concern for the Sanitary Commission, who viewed them as potential sources of miasma. To promote ventilation in military encampments and hospitals, the report recommended that all future buildings must be built on raised basements and positioned to encourage the prevailing wind in order to promote airflow.<sup>74</sup>

British theories of disease transmission, although inaccurate, often led public health officials in the right direction. For instance, the development and use of disinfectants in India was encouraged by the miasma theory. The Victorian belief that disease-causing miasmas

---

<sup>73</sup> Sanitary Commission. *Report of the Commission (1864)*, 128

<sup>74</sup> Sanitary Commission. *Report of the Commission (1864)*, 126

emitted foul odors led to the adoption of disinfectants precisely because of their deodorizing qualities. The 1866 Bengal report quotes a study by Dr. William Budd in the *British Medical Journal* describing the efficacious use of various disinfectants during an epidemic of cholera in Bristol. These disinfectants included such varied substances as sulphate of iron, carbolic acid, and McDougall's and Calvert's powders.<sup>75</sup> Although these substances proved useful, the miasmatic theory led the British to apply them in unproductive ways. Indeed, one of the most common ways of using a disinfectant was to pour it down a drain.<sup>76</sup> The example of the British adoption of disinfectants in India serves as a microcosm for their progress in public health in India in the last decades of the 19th century. British theories of disease transmission, though essentially wrong, had narrowed the causes of disease to the vectors of their transmission. By the 1880's the success of public health measures was evident in the statistics on mortality rates in the army. According to the Sanitary Report of 1890, deaths in the British army had decreased by approximately 26 percent in the 1870's compared to the 1880's.<sup>77</sup> A decline in death rate in the British army in India was seen in almost every category related to the implementation of sanitary measures. Deaths from cholera had decreased by 50 percent, hepatitis by 40 percent and malaria by 70 percent. The only category of disease that had not experienced a significant decline was one in which sanitary measures were not applied. Rates of sexually transmitted infections were occurring at approximately the same rate in 1890 as they were in 1864.<sup>78</sup>

The success of the colonial public health regime was not accomplished without difficulty. A unique set of challenges accompanied the development of a public health system in India

---

<sup>75</sup> Sanitary Commissioner, *Report of the Sanitary Commissioner of Bengal (1866)*, 20

<sup>76</sup> Sanitary Commissioner, *Report of the Sanitary Commissioner of Bengal (1866)*, 20

<sup>77</sup> Sanitary Commissioner. *Annual Report of the Sanitary Commissioner with the Government of India (1892)*, 12

<sup>78</sup> Sanitary Commissioner. *Annual Report of the Sanitary Commissioner with the Government of India (1892)*, 12

ranging from the Indian rejection of Western medicine in favor of indigenous medicine to the ever-present threat of revolt against the colonial government. These factors and others demanded change and compromise from the Chadwickian version of public health if it were to be effective in Indian society. The power and latitude of the British to address these challenges was of course considerable in the colonial context because the people of India did not have a representative government under British rule. As a result, the British were able to implement public health policy without political or legislative obstacles. Despite this wide latitude to implement public health policy, the British were careful not to provoke unrest; this fear of unrest in turn forced the British to exercise a degree cultural competence in their implementation of health policy. An example of the limitation of force in the public health regime in India was the small-pox vaccination campaign. In 1864, The British launched a campaign to vaccinate Indians population centers near military encampments, but it was stymied by popular resistance to vaccination. India's long history of traditional medicine made both the practitioners and the patients of Ayurveda and Unani medicine wary of foreign ideas of disease prevention and treatment. Traditional medicine in India favored the practice of inoculation, a relatively dangerous and less effective method of preventing small-pox. The British realized that forced vaccination was not an option and that collaboration with traditional medicine practitioners was essential to build trust with the Indian population. To this end, British health officials convinced a handful of Hakims and Vaidis to administer the vaccines on their behalf. This strategy proved beneficial as rates of vaccinations increased and small-pox outbreaks stemming from inoculations decreased.<sup>79</sup> The fear of a revolt again influenced British health policy in its efforts to combat cholera. The British believed that Hindu pilgrimages were potential causes of cholera outbreaks due to the volume of

---

<sup>79</sup> Sanitary Commissioner, *Report of the Sanitary Commissioner of Bengal (1866)*, 100

people involved and the seeding of cholera across the colony when the pilgrims returned home. Despite the available evidence that linked cholera to pilgrimages, the British health regime decided not to directly interfere with the holy voyages. The administration believed that interfering with the religious practices of Hindus, particularly the pilgrimages, would lead to another popular uprising. Faced with this potential consequence, public health officials decided to make sanitary accommodations for the pilgrims instead.<sup>80</sup>

The culturally competent public health interventions of the British helped to make allopathic medicine more palatable to Indians, but allopathy still struggled to establish itself as the dominant form of medicine in India. Most Indians preferred the treatment of traditional medicine practitioners to the treatment provided in British hospitals, frustrating the medical establishment. It is interesting to note here that in the years of the East India Trading Company, the British themselves had visited Vaid and Hakims (Hindu and Muslim doctors respectively) as they believed native practitioners to have treatments and cures specific to the climatic and environmental causes of disease in India. The environmentalist paradigm of the time also encouraged practitioners of Western medicine to adapt their practices to the environment of India, which frequently involved borrowing medicinal remedies from traditional Indian medicine.<sup>81</sup> The legitimacy granted to Indian medicine during the 18<sup>th</sup> and early 19<sup>th</sup> centuries was enhanced by the shared belief of humoral pathology, the belief that the imbalance of the bodies four essential fluids was the immediate cause of illness.<sup>82</sup> As the British shed the doctrine of humoral pathology in favor of putrefactive and germ theory later on in the 19<sup>th</sup> century,

---

<sup>80</sup> David Arnold *Cholera and Colonialism in British India. Past & Present*, no. 113 (1986): 141. <http://www.jstor.org/stable/650982>.

<sup>81</sup> Arnold, *Colonizing* 42

<sup>82</sup> Arnold, 42

however, indigenous medicine was relegated to an inferior position. Despite the early dialectical exchange between allopathic and indigenous medicine, Western medicine developed and maintained an increasingly dismissive attitude toward indigenous medical practice beginning around the Mutiny, complaining about the strong ties of native medical practice to religion and superstition.<sup>83</sup> As Western medicine and indigenous medicine drifted further apart, Indians were less likely to seek treatment from Western medicine.

The dismissive attitude of the British towards indigenous medicine was reciprocated by the Indian population. Certain British medical practices were considered anathema to Hindu and Muslim religious sensibilities, which hindered their progress in Public Health. The practice of dissection frequently performed in British hospitals and medical schools in India was viewed with religious aversion by the Hindus and Muslims of India. The practice was considered so polluting to the body that the British were only able to recruit Indians from the “Dom” caste, a class that was despised even by the Untouchables. The stigma of the practice of dissection and the association of the Doms with it made for a further cultural barrier between Indians and allopathic medicine.<sup>84</sup>

Further discouraging the Indian population from subscribing to British medical practice was the racial prejudice of the British. The British view of Indians is typified by this account from a physician identified as “Dr. Bose” who was dispatched to conduct a survey of the sanitary conditions of Bengal on behalf of the Sanitary Commission of Bengal in 1866, regarding the people of Bengal and their habits, Dr. Bose describes the “proverbial apathy, indolence, a sort of childish helplessness, and also the innate selfishness of the Native character...[and] their

---

<sup>83</sup> Arnold, 58

<sup>84</sup> Arnold. *Colonizing*, 5

peculiarly unclean habits”.<sup>85</sup> The British prejudice towards Indians and their customs undoubtedly was felt by the Indians and discouraged them from forming a positive view of Western medicine. If racist rhetoric had a negative effect on the adoption of Western medicine by the Indian population, so too did racist policy. Residential segregation was enforced such that British and European denizens occupied an exclusive enclave in Indian cities that was higher in elevation and better equipped with drainage and sanitary infrastructure than the rest of the city.<sup>86</sup> Policies and rhetoric such as these engendered distrust and antipathy by Indian population toward the colonial medical establishment, driving them away from western medicine.

Just as harmful to the public image of Western medicine in India was the moral prejudice harbored against Indian society by the Colonial medical authorities who purported to have their best interests at heart. In addition to the negative stereotypes mentioned in Dr. Bose’s report, the colonial public health officials were often critical of Indian society, claiming that the moral defects of Indian society were the cause of physical illness. J.R. Martin, writing in 1839, cites the caste system, religious practices and child marriage as some of the causes of disease in India.<sup>87</sup>

The inception of public health in India was driven by the same imperial self-interest that brought about its naissance in Great Britain. In both cases, the British government was reluctant to expend resources to limit the high mortality of disease. In the case of Great Britain, it was the threat to the industrial capacity and the economy that incentivized the creation of a system of public health that circumvented the issue of poverty and defined health instead in sanitary terms. In India, it was the threat to military power that spurred the need for to implement that same

---

<sup>85</sup> Sanitary Commissioner, *Report of the Sanitary Commissioner of Bengal (1866)*, 62

<sup>86</sup> Sanitary Commission. 1864. *Report of the Commission Appointed to Inquire into the Sanitary State of the Army of India*. London: Her Majesty’s Stationary Office. <https://wellcomecollection.org/works/jpnkzuau/items?canvas=11>

<sup>87</sup> Arnold, *Colonizing*, 42

system in a colonial context. The Indian system of public health that emerged in the late 19<sup>th</sup> century nevertheless distinguished itself from the Chadwickian version developed in Britain through its negotiation with the cultural, religious, pathological and imperial factors specific to the subcontinent.

India provided a public health challenge to Nightingale's Royal Commission that surpassed any she and her sanitarian colleagues had yet undertaken. The geographical and demographic scope of the colony was enormous, and Nightingale's sanitary prescriptions were often at odds with local customs. Even when sanitary measures could be instituted, some diseases were not responsive to these interventions. Malaria in particular was impacted comparatively little by Nightingale's emphasis on cleanliness that had such a tremendous effect in lowering disease mortality in Crimea. Not only was malaria more resistant to Nightingale's hygienic measures, it was prolific and debilitating. Soldiers ill with malaria often never recovered fully from the disease if they survived, suffering chronic fatigue and recurrences of illness that prevented them from returning to the ranks.<sup>88</sup>

Despite malaria's priority status, much about malaria remained a mystery for the remainder of the 19<sup>th</sup> century. In the Royal Commission's first report on India in 1864, malaria was studied in the context of miasmatic pathology, the purported mechanism for infection for almost all diseases in this era. Targeting sources of miasma had been the lodestar of British health officials in the army since Nightingale's institution of a sanitary program in Crimea in 1854, and the commission relied on the same principles of hygiene, cleanliness, drainage and ventilation to combat malarial miasma in India as they had in Crimea for a host of other diseases.<sup>89</sup> While the principles of sanitation were applied to address malaria, malaria was still considered to be unique in its causes and especially difficult to eradicate. Instead of being linked primarily to unhygienic conditions in urban areas like cholera or typhoid fever, malaria was increasingly thought of as a disease of nature rather than of urban areas. Nonetheless, the

---

<sup>88</sup> Sanitary Commission. *Report of the Commission (1864)*, 15

<sup>89</sup> Sanitary Commission. *Report of the Commission (1864)*, 52

historical weight of hygiene in sanitarianism and Nightingale's personal experience in Crimea were too great to exclude malaria from the typical sanitary framework, at least initially.

During the 1870s and 80s, the focus of malarial research and prevention moved steadily in the direction of the environment. In these decades, the environmental trajectory of malaria research remained unchanged even as hygienic diseases came to be thought of as having specific, pathogenic causes. Diseases caused by failures of public hygiene began to be treated as distinct from their vectors of transmission, while malaria was thought of as both a vector and a disease until the last decade of the century. The tendency of the Royal Commission to view diseases of a hygienic nature in a pathogen-centered framework was a result of the limited scope of inquiry. Sewage and water had been consistently linked with disease for centuries, all that was needed to scientifically make the causal connection was to identify the germ under a microscope – a breakthrough usually attributed to Pasteur during his experiments in the 1860's. In the case of malaria, the inquiry was far too broad. Malaria was studied in such an expansive context that it was much more difficult to identify the origin of the disease. This chapter aims to trace the British understanding of disease through the second half of the 19<sup>th</sup> century with special attention paid to the interplay between the sanitarian paradigm and the germ theory of disease in the fight against malaria.

Among the first priorities of the Royal Commission was to address the unhealthy habits of the soldiers that left them vulnerable to malaria. Soldiers stationed in India were notorious for intemperance, consuming more liquor than their counterparts stationed at home or the French stationed in Algeria.<sup>90</sup> Unsurprisingly, the British army had exceedingly high rates of liver disease, a condition that was believed to make one particularly vulnerable to malaria. Closely

---

<sup>90</sup> Sanitary Commissioner, *Report of the Sanitary Commissioner of Bengal (1866)*, 97

related to intemperance was the patronage of sex workers, the practice of which led to the rampant spread of STI's. Sexually transmitted diseases had a huge effect on the British army, hospitalizing a quarter of the army in any given time. Moreover, these diseases were also thought to weaken the constitution, making soldiers more liable to suffer serious illness from malaria. While combatting intemperance was a difficult task, addressing sexually transmitted diseases was bound to be nigh impossible. In an attempt to stop the problem at the perceived source, so called "Lock Hospitals" were constructed to quarantine sex workers with STI's from the soldiers. While the Lock Hospitals ultimately proved unsuccessful, Nightingale had her own ideas about vice in the army.<sup>91</sup> Having spent time with soldiers in Crimea, Nightingale believed she knew the root of the soldiers vices: boredom. As part of her official recommendations in the Royal Commission, Nightingale made the case for increased amenities and activities for the soldiers. In particular, Nightingale believed intellectual stimulation to be critical, as increased education was associated with higher moral conduct.<sup>92</sup> To keep the soldiers occupied and to give them a chance to better themselves through education, libraries and reading rooms were constructed. Within these reading rooms, coffee and tea were offered instead of gin. In the spirit of forming new, healthier habits, Nightingale also proposed the installation of wash basins and water sources for every barracks. Washing regularly was encouraged and mandatory personal hygiene classes were taught to incoming soldiers on Nightingale's advice. While Nightingale's attempts to reform the behavior in the army had some success, they were just as important in illustrating the holistic view of health the sanitarians subscribed to.

While these holistic efforts to improve the general health of the soldiers were partially successful, the rates of malaria remained stubbornly high. By 1870, a more focused approach

---

<sup>91</sup> Sanitary Commission. *Report of the Commission (1881)*, 40

<sup>92</sup> Sanitary Commission. *Report of the Commission (1864)*, 322

was beginning to take shape. John Sutherland, pioneering sanitarian and close collaborator of Florence Nightingale, described the changing policy of the Royal Commission in an 1870 edition of the *Edinburgh Medical Journal*, stating that “I am now of the opinion that too much weight was assigned to the condition of the affected localities as regards cleanliness, and that probably too little importance was attributed to the drainage and the state of dampness of the towns and villages”.<sup>93</sup> Sutherland’s assertion illustrates how the commission’s focus was now narrowing in on water and the natural environment as the two most important factors in causing malaria. Yet even before 1870, the natural environment had been seen as a potential cause of malaria. In 1864, Royal Commission member Dr. Ranald Martin reported that environmental factors were responsible for the *production* of malaria,<sup>94</sup> noting that malaria was most prolific in areas that were humid, located near water sources, and lacked wind.<sup>95</sup> Not only was the climate blamed for producing the disease but also for weakening the constitution of British soldiers, leaving them susceptible to disease. These ideas were reinforced by the high malarial mortality rate in India compared to the extremely low rate in England. To investigate the effect of climate and geography on malaria, the Royal Commission kept meticulous records of meteorological trends in every military station in the colony. These annual reports contain detailed tables of precipitation, temperature, and air pressure and were often followed by a verbal report discussing the impact of weather on outbreaks of diseases like cholera or fevers.<sup>96</sup> In the report of 1867, for example, a pilgrimage of 2.5 million Hindus to the Ganges River was watched closely by sanitary officials in India, with special attention paid to the climatic conditions at the site of the

---

<sup>93</sup> John Sutherland. “On the Causes of Endemic Fever in Lower Bengal, the Influence of Canal Irrigation in Their Production in Upper India, and the Means of Prevention to Be Employed.” *Edinburgh Medical Journal* vol. 15,12 (1870): 1086-1091.1088

<sup>94</sup> The term “malaria” is used to refer to both the disease and the vapor that was thought to cause the illness.

<sup>95</sup> Sanitary Commission. *Report of the Commission (1864)*, 52

<sup>96</sup> Sanitary Commission. *Report of the Commission (1868)*, 21

pilgrimage. Referencing meteorological and topographical data, sanitation officials were surprised by the health of the pilgrims, despite their frequent exposure to the “very deleterious effect” of fluctuations of temperature and heavy rains.<sup>97</sup> While climate does not cause disease on its own, sanitary officials here did accurately identify a correlation between weather patterns and disease. Precipitation seemed to be a major predictor of both malaria and gastrointestinal diseases, which both occurred in large numbers during the monsoon season. Royal Commission officials extrapolated from this data that monsoon rains must be causing illness, but why – they asked – was this the case? The range of diseases the monsoon rains caused defied any simple explanation of the phenomenon. The sanitarian paradigm espoused by the Royal Commission, however, was uniquely equipped to uncover the cause of this correlation.

Nightingale believed that an environment with clean air, water, and people were essential in the maintenance of a healthy population. Within a short period, it became obvious that the drinking water was not clean, and that the monsoon rains were partially responsible for the high rates of disease. Without drainage and sewage infrastructure in India, precipitation had a real effect on the transmission of disease. In India, the month of May marks the end of the hot, dry season and the beginning of the monsoon season. Throughout the months of May, June and July, monsoon rains result in floods across the sub-continent. These tropical deluges swept away months’ worth of animal and human waste, contaminating the whole city with raw sewage. Moreover, the floodwaters contaminated wells and water tanks, which the British believed caused both malaria and gastrointestinal diseases. However, sewage wasn’t the only waste that impacted the quality of drinking water. In one anecdote included in the 1864 report, Colonel G. Campbell recounts the effects of buried, decomposing elephants near the wells of his military

---

<sup>97</sup> Sanitary Commission. *Report of the Commission (1867)*, 9

encampment in Lucknow. According to Campbell, the well water was contaminated by precipitation run-off, transmitting agents and byproducts of decomposition to the well through the soil. Oddly, well water contaminated by decaying tissues often become more palatable, acquiring a sparkling quality and a slightly saline flavor.<sup>98</sup> The appealing, soft-drink like qualities of water contaminated in this way encouraged its consumption, leading to the Royal Commission to recommend only deep water wells for consumption instead of the more easily contaminated shallow water tanks.<sup>99</sup> Interestingly, the chemical processes that caused this reaction were understood at the time. According to a contemporary chemist referenced in the report, these changes were caused by the introduction of carbonic acid<sup>100</sup> and nitrates into the well, each by-products of the decomposition of the organic tissues of the elephants. The ability of chemists to isolate molecular compounds, and their concurrent inability to identify bacteria illustrated the asymmetric progression of scientific discovery in the Victorian era. Great point!

Despite such asymmetry, much progress in pathology was still made in this era. Drawing upon the seminal work of sanitarian Edwin Chadwick, the Royal Commissioners were able to identify the link between illness and precipitation via the improper drainage of water and human waste. In a report discussing the conditions of Indian cities, Dr. G. C. Wallich of the Royal Commission reported that the lack of an organized toileting system resulted in human waste scattered across urban areas, which then permeated the soil in heavy rains and percolated towards underground water tanks, used by both the British military and Indian civilians.<sup>101</sup> The contamination of the water supply was known to cause gastrointestinal illness, but tainted water

---

<sup>98</sup> Sanitary Commission. *Report of the Commission (1864)*, 66

<sup>99</sup> Sanitary Commission. *Report of the Commission (1864)*, 70

<sup>100</sup> Carbonic acid is the substance used in soft-drinks to make them effervescent.

<sup>101</sup> Sanitary Commission. *Report of the Commission (1864)*, 67

was also blamed for the incidence of malaria. To investigate which qualities of the water supply might be causing illness, a qualitative analysis was conducted of the water in Secunderabad, the location of a military station with high rates of gastrointestinal illness. The investigation revealed a significant amount of microscopic organic matter in the water supply, which was thought to be the culprit.<sup>102</sup> Although not entirely accurate, the trend toward identifying, specific, microscopic entities as the causative agents for disease represented an important divergence from the sanitary framework, where macroscopic causes were most often blamed for disease. The father of epidemiology, John Snow, was one of the first to eschew the miasma theory in favor of more specific causes of disease. During the cholera outbreak of 1854, Snow had discovered that certain contaminated sources of water were causing the epidemic. The spread of cholera confounded physicians and scientists who all considered disease transmission to be airborne according to the miasma theory. Cholera patients, who did not expectorate effluvia, provided no clues as to how they contracted the illness given the miasmatic paradigm. In Snow's epidemiological survey of London's water supply and the spread of cholera in the city, he had discovered that one of the water pumps was responsible for a large cluster of cholera cases in the city, convincing proof to proponents of the water-borne theory of cholera transmission.<sup>103</sup> Foreshadowing Louis Pasteur's work on germ theory, Snow proposed that cholera was "communicated by some material that passes from the sick to the healthy and which has the property of increasing and multiplying in the systems of the person it attacks".<sup>104</sup>

The application of Snow's discovery in India also represented another step forward for public health in India. In the mid 19<sup>th</sup>-century, the British believed India to have a unique disease

---

<sup>102</sup> Sanitary Commission. *Report of the Commission (1864)*, 65

<sup>103</sup> Sanitary Commission. *Report of the Commission (1864)*, 68

<sup>104</sup> John Snow. *On the Mode of Communication of Cholera*. (London: Churchill 1855) found in

environment that resulted in the production of malaria by virtue of its environmental qualities, including climate and even ecology.<sup>105</sup> The heat, humidity, and dense vegetation were all thought to contribute to the generation of dangerous diseases endemic to India. However, these factors were not blamed only for the generation of the diseases, but also for weakening a person's "Constitution", a primitive conception of the immune system, of British people in India. This idea had been reinforced by contending with diseases in India dissimilar to those suffered in Great Britain and the disproportionate rate of death among the British in India. However, as more was learned about the causative agents and methods of transmission of cholera in India, the more the experience with cholera in London seemed analogous. The applicability of Snow's conclusions in regard to cholera were not lost on the 1864 Royal Commission, which reported that "In applying this experience to India it is necessary to point out that the diseases which our home experience has proved to be so strikingly under the influence of the quality of the water are the same diseases which bring so much loss and inefficiency in the Indian army".<sup>106</sup> The realization that cholera was a disease with a discrete cause unaffected by local climatic or geographical conditions was a massive step toward the future disease paradigm of bacteriology. Yet, while climate was discounted from further considerations of cholera infection in both Britain and India, climatic conditions were still thought to play a key part in the disease process of other illnesses, chief among them malaria.

Arguably the biggest problem posed by the monsoon rains was the countless pools of stagnant water they created. While the British recognized that stagnant water was productive of malaria, they did not know exactly how. As a result, their only option was to remove the water, necessitating a system of drainage for every urban center in the country. As early as their first

---

<sup>105</sup>Sanitary Commission. *Report of the Commission (1864)*, 52

<sup>106</sup> Sanitary Commission. *Report of the Commission (1864)*, 68

annual report in 1864, the Royal Commission identified eliminating stagnant water as a major priority in the fight against malaria.<sup>107</sup> Although misguided, diminishing areas of stagnant water proved to be a somewhat effective public health measure, as public health officials were unknowingly removing the breeding ground for malaria-infected mosquitos. Although health officials were addressing a proper target, reducing stagnant water in a country that regularly experiences long droughts and intense monsoons was a monumental task. Aside from natural areas of standing water like marshes and wetlands, human interventions also contributed to the accumulation of standing water. Colonial infrastructure projects like railroads often interrupted the natural flow of drainage resulting in the proliferation of pools of stagnant water. Additionally, the British deemed Indian irrigation practices dangerous as whole fields were flooded for rice cultivation instead of using small irrigation ditches in the European style. The British believed the wide surface area of wet soil was far more dangerous than the narrow drainage ditches leading from rivers to the fields. Accepting the essential nature of rice cultivation, the British allowed cultivation to continue, but not within five miles of military stations.<sup>108</sup> While rice cultivation was considered a danger, the cultivation of other plants and crops was considered as a potential malarial prophylactic. In England, the drainage of the soil and cultivation of crops was considered to have eradicated the disease from the country.<sup>109</sup> Following this logic, the Secretary of the Government of Bengal suggested cultivating sunflowers in an attempt to combat the malarious emanations of marshland.<sup>110</sup>

---

<sup>107</sup> Sanitary Commission. *Report of the Commission (1864)*, 41

<sup>108</sup> Sanitary Commission. *Report of the Commission (1864)*, 63

<sup>109</sup> Sanitary Commission. *Report of the Commission (1864)*, 41

<sup>110</sup> London, British Library, MS *Cultivation of sunflower for the purpose of neutralizing the injurious effect of marshy exhalations*. (Home Department Proceedings 1869)

[http://access.bl.uk/item/viewer/ark:/81055/vdc\\_100079496930.0x000001#?c=0&m=0&s=0&cv=0&xywh=98%2C1984%2C3278%2C1928](http://access.bl.uk/item/viewer/ark:/81055/vdc_100079496930.0x000001#?c=0&m=0&s=0&cv=0&xywh=98%2C1984%2C3278%2C1928)

Another chief concern of the sanitary commission and Florence Nightingale was the issue of ventilation. The oppressive heat of India was especially unbearable indoors yet, the prescriptions for increased ventilation in hospitals and barracks were not related to temperature or the comfort of the men. According to the miasmatic paradigm, ventilation with fresh air was the only way to prevent miasma and malarious air from stagnating indoors. The barracks and hospitals already constructed in India were extremely deficient in ventilation in Nightingale's view, as many had very few windows and were generally overcrowded.<sup>111</sup> Nightingale had first-hand experience designing hospitals and barracks according to sanitary principles, as she had been recruited by the British army and foreign governments to design military buildings after her service in Crimea.<sup>112</sup> However, it was a Brigadier General named Russell who innovated a method for retrofitting the barracks that was then adopted by the Royal Commission. By raising the walls of barracks by three feet, air was allowed to flow freely in and out of the structure. To keep out insects and debris, a layer of wire gauze spanned the gap between wall and ceiling.<sup>113</sup>

Having identified the potential causes and aggravating factors of malaria, Nightingale and the Royal Commission set out to address them. The first priority was to remove soldiers from what the Royal Commission believed to be "malarious locations". Wherever possible, soldiers were stationed at higher, more arid climates. If soldiers became ill in a malarious area, they were often sent to an area of cool and dry climate to encourage vitality and restore the constitution. This approach was derivative of the popular Victorian concept of sanitoriums, or medical facilities generally located in temperate, dry climates which were thought to be healthful in comparison to the hot and humid climate of India or the cold and wet climate of England.<sup>114</sup>

---

<sup>111</sup> Sanitary Commission. *Report of the Commission (1864)*, 309

<sup>112</sup> Baly and Matthew, *Nightingale*, 11

<sup>113</sup> Sanitary Commission. *Report of the Commission (1864)*, 78

<sup>114</sup> Sanitary Commission. *Report of the Commission (1867)*, 28

Ideally, soldiers would be stationed in the famous hill stations of the Himalayas, but most soldiers were needed in areas that were deemed unhealthy as a result of dense jungles and hot, humid weather. Faced with few options, Nightingale and the Royal Commission set out to determine locations of future military encampments that avoided low-lying, marshy areas to escape the worst of the detrimental effects of what was perceived to be an unhealthy land.<sup>115</sup>

Other than seeking out healthier climates, few options for the treatment or prevention of malaria were available in this era. The treatment of malaria in India was so abysmal that it could only be described as palliative. Doctors were powerless to prevent death or the recurrence of fevers in those who survived. Nonetheless, rates of mortality from malaria fell even in the most malarious climates as a result of preventative measure. In Bengal, the rate of mortality from malaria more than halved from an average of .66 per 1,000 soldiers in the 1860's, to an average of .17 per 1000 soldiers in the 1870's.<sup>116</sup>

Only in the last decade of the century did medical interventions for malaria begin to improve, as a certain herbal medicine called quinine began to gain in popularity as a prophylactic. Prior to the 1890's, quinine was used exclusively as a remedy for malaria. Derived from the cinchona tree native to Brazil, the bark of the tree had been used since the 17<sup>th</sup> century by the British. Despite the wide use of cinchona bark as treatment for malaria, the use of quinine as a prophylactic did not begin in earnest until the final years of the 19<sup>th</sup> century. In the 1897 Sanitary Report, the commissioners observed the prophylactic administration of quinine was “on the whole, favourable”.<sup>117</sup> Once the value of quinine was established, huge efforts were made by the British to cultivate Cinchona trees in India for the manufacture of quinine.

---

<sup>115</sup> Sanitary Commission. *Report of the Commission (1864)*, 52

<sup>116</sup> Sanitary Commission. *Report of the Commission (1881)*, 34

<sup>117</sup> Sanitary Commission. *Report of the Commission (1897)*, 21

While prophylactic measures against malaria were always considered essential, discovering the origins and vectors of transmission of malaria was by far the more important task. The search for the mechanism of transmission of malaria was given renewed urgency internationally by the discovery in 1880 of the parasite that caused malaria by a French physician named Alphonse Laveran in Algeria.<sup>118</sup> Influenced by Laveran's work, the "father" of tropical medicine British colonial doctor Patrick Manson began investigating the vector for the transmission of parasites. Based on his research in China on the parasitic disease filariasis, Manson became convinced that the mosquito transmitted the malarial parasite.<sup>119</sup> Encountering Ronald Ross in London in 1894, Manson encouraged Ross to test his theory once he arrived in India in date. Convinced that Manson was correct in his hypothesis, Ronald Ross began experiments during his deployment as the Resident Surgeon in Bangalore. During his tenure in Bangalore, Ross was able to observe the metamorphosis of the malarial parasite within the mosquito, but his research was stymied when he was reassigned to Madras. Recognizing the importance of Ross's work, the chief secretary of Madras wrote to the government of India requesting that Ross be put on special duty to conclude his investigations in a location better suited to his research. One gets a sense of Ross' impatience to leave behind theories of miasma as causative to disease at a time when the field of bacteriology had become the vanguard of medical science. "The determination of this point is clearly of the greatest practical importance since we have as yet no definite knowledge as to how the parasite enters the human system being obliged to content ourselves with theories, more or less vague, of infection by means of miasma

---

<sup>118</sup>William L. Marr "Malaria." *The American Journal of Nursing* 36, no. 10 (1936): 969–75. 1 <https://doi.org/10.2307/3413564>.

<sup>119</sup> William Bynum. *Patrick Manson and Ronald Ross: malaria and the rise and fall of a scientific friendship* (York: University of York, 2013) <https://www.york.ac.uk/history/global-health-histories/events/bynum-lecture/>

and so on”<sup>120</sup> In 1899, Ross made the breakthrough discovery that built on the work of Laveran in Algeria and Manson in China: the malarial parasite was transmitted from mosquitos to humans.<sup>121</sup> Upon the moment of his discovery, Ross composed a poem reflecting the import of the discovery and capturing the victory of the moment:

This day relenting God  
Hath placed within my hand  
A wondrous thing; and God  
Be praised. At His command,  
Seeking His secret deeds  
With tears and toiling breath,  
I find thy cunning seeds,  
O million-murdering Death.  
I know this little thing  
A myriad men will save.  
O Death, where is thy sting?  
Thy victory, O Grave?<sup>122</sup>

---

<sup>120</sup> London, British Library, MS *Proposal to place Surgeon Major Ronald Ross on special duty to investigate the truth of Dr Patrick Manson's theory of the transmission of the infection of malaria by means of the mosquito*. March 1897 Home Department Proceedings  
[http://access.bl.uk/item/viewer/ark:/81055/vdc\\_100079496300.0x000001?\\_ga=2.268888561.1020011074.1648605828-1864625692.1648605827#?c=0&m=0&s=0&cv=0&xywh=-313%2C188%2C3735%2C1770](http://access.bl.uk/item/viewer/ark:/81055/vdc_100079496300.0x000001?_ga=2.268888561.1020011074.1648605828-1864625692.1648605827#?c=0&m=0&s=0&cv=0&xywh=-313%2C188%2C3735%2C1770)

<sup>121</sup> London, British Library, MS *Proposed appointment of a Scientific Commission to investigate the causes and cure of malaria and the deputation to India of Dr C W Daniels to aid in the investigation*. January 1899. Home Department Proceedings.  
[http://access.bl.uk/item/viewer/ark:/81055/vdc\\_100077840478.0x000001#?c=0&m=0&s=0&cv=0&xywh=462%2C-1804%2C2276%2C7536](http://access.bl.uk/item/viewer/ark:/81055/vdc_100077840478.0x000001#?c=0&m=0&s=0&cv=0&xywh=462%2C-1804%2C2276%2C7536)

<sup>122</sup> Illingworth, Sam. *A Sonnet to Science: Scientists and Their Poetry*. Manchester University Press, 2019.  
[http://www.jstor.org/stable/j.ctv1qr6sn8\\_89-119](http://www.jstor.org/stable/j.ctv1qr6sn8_89-119)

The results of this discovery enabled the sanitary officials in India and throughout the empire to pursue new methods of malarial prophylaxis. Instead of draining areas of stagnant water, these areas could be treated with oil.<sup>123</sup> Homes and exposed skin were covered by gauze, a primitive form of the mosquito nets now in use.<sup>124</sup> Now that it was known that mosquitos could transmit malaria from one person to another, Europeans were segregated from the local population in areas where malaria was particularly prevalent.<sup>125</sup>

When the Royal Commission was chartered in 1864, the dominant perspective on health and disease was sanitarianism, a medical philosophy that emphasized public and personal hygiene and abhorred miasma. However, sanitarianism was not completely ideologically rigid. When confronted with the unique challenges of malaria, emphasis was shifted from hygiene to such environmental interventions as drainage, water filtration and ventilation infrastructure. Ultimately though, the idea that miasma caused diseases was incompatible with the impending bacterial revolution, and sanitarians were in the end displaced by those who believed in the power of the germ.

### Epilogue: The Plague

By the late 1890's, the British have made great strides in driving down mortality in the army due to disease. The introduction of germ theory and the burgeoning field of bacteriology provided a new understanding of the etiology of diseases such as malaria and cholera, increasing

---

<sup>123</sup> London, British Library, MS *Communications received from Major Ronald Ross regarding the prevention of malaria in India by the destruction of the anopheles mosquito*. June 1905

<sup>124</sup> London, British Library, MS *Communications received from Major Ronald Ross regarding the prevention of malaria in India by the destruction of the anopheles mosquito*. June 1905

<sup>125</sup> London, British Library, MS *Communications received from Major Ronald Ross*, June 1905

British confidence in their ability to prevent and treat the subcontinent's most dangerous diseases. However, the introduction of germ theory into British public health and medicine did not completely displace previous ideas about disease based on the sanitarian framework. While the introduction of germ theory is seen as a watershed moment for medical science and public health by historians today, it was not seen as such by contemporary British public health experts. Undoubtedly, the discovery of bacteria and their pathogenic potential was viewed as critically important. However, it did not justify a paradigm shift to the British in India. British public health experts did not exchange their sanitary framework for a bacteriological one, but incorporated germ theory into their own understanding of disease. Part of this resistance to accept a new disease paradigm was rooted in the past success of the sanitary regime. Eliminating disease deaths significantly in Britain and India in the 19<sup>th</sup> century, the British were unwilling to eschew beliefs about pathology that had served them well in the past century. Significantly, the ideas that challenged miasma theory came from two rival European powers, Louis Pasteur in France and Robert Koch in Germany. The always-present spirit of competition between Britain and its rivals made adopting these new ideas wholesale even less palatable.

Despite the competition between the three rival powers, the existential threat of the plague encouraged cooperation between the powers when the plague first appeared in Hong Kong in 1894. Early in 1894, microbiologist Alexandre Yersin was sent to Hong Kong by the French government, while a commission of microbiologists led by Robert Koch represented the German government when the plague struck Bombay in 1896.<sup>126</sup> Confronted with a drastically more deadly and transmissible disease than any they had recently encountered; it became necessary for British health officials to reconcile the ascendant ideas of the bacterial revolution

---

<sup>126</sup> London, British Library, MS *The Plague in India, 1896, 1897*. Vol. 1, (Simla: Government Central Printing Office 1898) 25

with the still influential ideas of the sanitarian framework in a coherent disease containment strategy. However, reconciliation did not necessarily equate to replacement, as the two disease paradigms were not diametrically opposed. Each perspective contained a portion of the full picture of disease, and many aspects of sanitarianism complemented the tenants of bacteriology and germ theory. Even Florence Nightingale, who stubbornly held to the miasma theory for over a decade after Louis Pasteur published his work on germ theory, eventually came to accept germ theory in the mid 1880's.<sup>127</sup> However, Nightingale accepted germ theory only as secondary to her sanitary concerns and was worried that it would “excuse inaction toward the real causes of disease, the filth or bad water that later science would see as nourishing the growth and spread of germs”.<sup>128</sup> While Nightingale no longer influenced public health policy in India as she had in prior decades, her views reflected those of colonial public health officials in India. Even after the plague bacillus had been identified in 1894, the sanitary framework held sway.

In an effort to determine the method of transmission of the plague, the German Plague Commission, assisted by the father of bacteriology Robert Koch, tested the resilience of the plague bacillus to various conditions. Koch's investigations found that the plague bacillus was able to survive outside the body only in certain conditions and for a limited amount of time. Conducting experiments that reflected real world applications, the durability of the plague bacillus was tested in different medias including linen, glass, water, and the skin of dead mice.<sup>129</sup> The bacillus was also tested for its reliance on oxygen, now a defining characteristic of bacteria in the modern field of bacteriology. While these experiments provided a windfall of useful information, lingering sanitary ideas made the British skeptical of the conclusions. British health

---

<sup>127</sup> Vallée, *Florence*, 18

<sup>128</sup> Vallée, 865

<sup>129</sup> London, British Library, MS *The Plague in India, 1896, 1897*. Vol. 1, (Simla: Government Central Printing Office 1898) 25

experts argued that while these experiments did demonstrate a decrease in pathogenicity of the bacillus, a moist environment could revive the pathogen's virulence.<sup>130</sup>

Evidence of the British commitment to sanitary principles can be seen in the public health guidance for cities during the plague. In Indian cities, every household was instructed to keep their windows and doors open to promote ventilation, to clean the drains leading from their houses twice a day, and to empty their latrines twice a day.<sup>131</sup> While by this point British health officials recognized the association between germs and unsanitary conditions, they also believed unsanitary conditions had a depressing effect on health aside from the germs they sustained. This idea was reflected in a report written on the course of the plague in the years 1897 and 1898: “Something more than mere exposure to contagion being necessary to develop the disease – most probably overcrowding...deficient cubic space, ventilation, sunlight and general unsanitary condition[s]”.<sup>132</sup> The British assumption that sanitary measures played a vital role in the transmission of the plague seemed to be confirmed by the relatively low levels of transmission within plague wards in hospitals.<sup>133</sup> Moreover, the British were not content to disregard their ideas of the human constitution as they adopted a bacteria-centered framework. Similarly, personal habits and the climate were likewise thought to depress health, a continuation of the role of the constitution in individual health. Inhabitants of Indian cities were instructed not to drink in excess, stay up too late, or expose themselves to wet and cold conditions, based on the belief that inhabitants would become more vulnerable to the plague if they did so.

---

<sup>130</sup>London, British Library, MS *The Plague in India, 1896, 1897*. Vol. 1, (Simla: Government Central Printing Office, 1898) 27

<sup>131</sup> London, British Library, MS *Sanitary rules for the prevention of plague in municipalities*. (Madras, 1903. 13

<sup>132</sup> London, British Library, MS *The Plague* 45

<sup>133</sup> London, British Library, MS *The Plague*, 45

Despite the retention of sanitarian ideas of disease, the acceptance of key tenets of germ theory had an indelible effect on how efforts against the plague were conducted. Coupled with traditional sanitary ideas, new precautions based on bacteriology were utilized. Water was to be boiled before consumed and bundles of clothing, potentially containing the plague bacillus, were not to be piled up indoors or hung from the rafters. In an acknowledgement of blood-borne bacterial transmission, persons with cuts on their hands were not to be allowed to handle plague patients. Disinfection was another idea that came to fruition in the era of the plague. First introduced in colonial India in the 1870's, the applications and motivation for chemical disinfectants served to undermine its effectiveness when it was first utilized in India. The sanitary perspective viewed odor as a tangible element of miasma such that chemical agents that simply masked foul odors were thought to be effective disinfectants. However, the discovery of the bacterial origins of cholera, anthrax and tuberculosis in the intervening years led to a clearer understanding of the bactericidal action of disinfectants by the late 1890's. Informed by a more accurate pathological framework, German pathologists collaborating with the British in India tested chemical disinfectants by measuring their ability to eliminate the plague bacillus in 1896.<sup>134</sup> Heat was also found to be an effective bactericide, a method suggested by one of the early British detractors of miasma theory, John Snow, in the wake of the cholera epidemic of 1854.

While the plague provided a unique testing ground for the recently adopted germ theory, the exigencies of the plague surpassed those of any disease prior. Families were separated by quarantine, homes were invaded in military-style raids and whole cities are held *in-situ* by

---

<sup>134</sup> London, British Library, MS *The Plague in India, 1896, 1897*. Vol. 1, (Simla: Government Central Printing Office, 1898) 28

public health administrators.<sup>135</sup> All lines of privacy, religious tolerance and bodily autonomy were crossed in a risk-reward calculation forced by the lethality of the plague. In the span of a few months, the parameters of public health changed drastically from the narrowly defined sanitary interventions created in the era of Edwin Chadwick to the all-encompassing authority of the Epidemic Diseases Act of 1897. The new law gave the Sanitary Commissioners of each Presidency *carte blanche* regarding public health measures, precipitating the most invasive program of public health ever practiced by the British in India. Cities were divided into small circular zones and were assigned to a team of health officials who had broad powers of enforcement.<sup>136</sup> Inspectors patrolled each zone for cases of plague, removing the patient from their home and family and placing plague patients in a quarantine camp. The homes of plague patients were disinfected with chloride of lime, and their roofs were destroyed to allow light and air to further disinfect the domicile. Oftentimes, homes were destroyed outright while the belongings of the plague victims were burned.

The reason for the drastic response to the plague can be partially explained by a shift in the orientation of public health precipitated by the plague itself. The initial focus of public health, delineated in the first Royal Commission report, was assigned to the army and only incidentally to the urban centers near military stations. However, the plague threatened to disrupt trade to and from India as diseases in ways that malaria and cholera did not. Not for the first time, public health policy was determined by the exigencies of the British empire. To continue to engage with global trade from the ports of India, the plague had to be contained. As a

---

<sup>135</sup> London, British Library, MS Epidemic Diseases Act of 1897 (III of 1897) found in: India. Home Department, *A compilation of regulations issued by the Government of India and Local governments in connection with plague* (Calcutta, 1898)

<sup>136</sup> London, British Library, MS, The plague inspector's manual, (Madras, 1902) 4

consequence of the infectious and lethal nature of the plague, the health status of every Indian became critical to the British Empire in its efforts to stem the plague's spread.

The 1894 plague epidemic in India was unprecedented in its scale and the government's response in the colonial era, though the investigation of the plague mirrored the British experience with malaria in India in many ways. In the case of the plague, the causative bacillus was discovered in 1894, while the intermediary vector of transmission<sup>137</sup> was not discovered until 1898.<sup>138</sup> Similarly, the causative agent of malaria, the plasmodium parasite, was discovered first while the method of transmission of malaria was not discovered for many more years. In both cases, the critical breakthroughs did not come from British scientists, but their colonial and scientific rivals. Thanks to Louis Pasteur's trail-blazing experiments in microbiology, the French had decades of experience in bacteriology by the end of the 19<sup>th</sup> century. The early orientation of the French towards discrete, discoverable agents of disease provided a solid foundation for French microbiologists working in the final decades of the century. In 1880, Alphonse Laveran discovered *plasmodium malariae*, benefiting from the early adoption of Pasteur's work by French medical institutions.<sup>139</sup> Again in 1894, another disciple of Pasteur paved the way for microbiologists of the era, Alexandre Yersin. Yersin was responsible for isolating the plague bacillus in Hong Kong, just as the plague began its journey out of China and across the world.<sup>140</sup>

While the French were given a head start by Pasteur's pioneering work, germ theory diffused across the scientific institutions of Europe in the following years, influencing German microbiologist Robert Koch and founder of sanitary surgery, Joseph Lister. Although the

---

<sup>137</sup> Oriental rat fleas transmitted the plague bacillus through biting human victims.

<sup>138</sup> Jean-Paul Simond discovered that rat fleas could transmit the plague to humans through its bite.

<sup>139</sup> William L. Marr "Malaria." *The American Journal of Nursing* 36, no. 10 (1936): 969–75.  
<https://doi.org/10.2307/3413564>. 1

<sup>140</sup> Wong, T., & Fung, K. "The Plague Pandemics and the Discovery of the Plague Bacillus" *Asia Pacific Journal of Public Health*, 1988. 2(2), 144–149. <http://www.jstor.org/stable/26720472>

Germans were quick to adopt the principles of germ theory, the British were more reticent. The British were wary of theories that contradicted the sanitary framework, while a sense of competition with the French also deterred British health officials from adopting Pasteur's work. In issues of military health and medicine, the British were constantly comparing their own results to French. During the Crimean war, the British were acutely aware that more British soldiers were dying than were Frenchman. In an effort to outperform the French, Secretary of War Sidney Herbert dispatched Nightingale to the Crimean theater.<sup>141</sup> After the Crimean War, the French continued to serve as a measuring stick of British health policy. In the 1864 Royal Commission, the health returns of French soldiers in Algeria were again used to determine an acceptable standard of mortality for its troops due to disease. Unwilling to validate French scientific breakthroughs, the British relied on the sanitary paradigm for decades after germ theory was postulated and only incorporated the theory as a complement to sanitarianism when it was accepted in the 1890's.

The British experience with the plague at the end of the 19<sup>th</sup> century is wonderfully reflective of the evolution of public health in India beginning in 1859.<sup>142</sup> The sanitary paradigm introduced by Chadwick and enhanced by Nightingale continued to exert influence even during the plague epidemic of 1894, decades past the naissance of bacteriology. Sanitarianism proved itself to be powerful not only in its ability to prevent disease, but also in its ability to shape British ideas about disease for the rest of the century. The deep roots of the sanitary framework in Victorian culture and morality provided a system of health that affirmed behavior that promoted health and denigrated unhealthy behaviors as vice. During the plague epidemic in India, those who engaged in intemperance, solicited prostitution, or maintained poor hygiene

---

<sup>141</sup> Vallée, *Florence*, 11

<sup>142</sup> 1859 was the beginning of direct rule of India by the Crown.

were as guilty of immoral behavior as they were unhealthy behavior. The integration of existing cultural and moral norms into public health provided staying power for sanitarianism, while its effectiveness seemed to reinforce the moral imperatives implied in the sanitary system. The introduction of a secular cause of disease, the germ, was an affront to the simple duality of sanitarianism: clean and unclean, virtue and vice. While the germ was ultimately incorporated into the British system of public health, it would remain subservient to the morally invested sanitarian framework for the duration of the 19<sup>th</sup> century.

## **Bibliography**

### **Secondary Sources**

- Arnold, David. *Colonizing the Body: State Medicine and Epidemic Disease in Nineteenth-Century India*. Berkeley: University of California Press.
- Bayliss, Robert A., and C. William Ellis. "Neil Arnott, F.R.S., Reformer, Innovator and Popularizer of Science, 1788-1874." *Notes and Records of the Royal Society of London* 36, no. 1 (1981): 103–23. <http://www.jstor.org/stable/531660>.
- Baly, Monica E., and H. C. G. Matthew. "Nightingale, Florence (1820–1910), reformer of army medical services and of nursing organization." *Oxford Dictionary of National Biography*. 23 Sep. 2004; Accessed 11 Apr. 2022. <https://www.oxforddnb.com/view/10.1093/ref:odnb/9780198614128.001.0001/odnb-9780198614128-e-35241>.
- Christopher Hamlin. *Public Health and Social Justice in the Age of Chadwick: Britain, 1800-1954*. Cambridge University Press, 1998.
- Erica Wald, *Punishing the prostitute and protecting the soldier: the lal bazaar, lock hospital and the treatment of venereal disease in colonial India*. University of London, Lecture via Zoom. [https://lshrm.zoom.us/rec/play/7V6DCHfWcESim3dHMhPuYq1rCcMbERAqBXQpFQZbOudk3PKzPDMhg\\_xfQs-2rShb3UcM\\_dBkoeGlh-sB.RFYFBihaEROFJM2q?startTime=1602072091000](https://lshrm.zoom.us/rec/play/7V6DCHfWcESim3dHMhPuYq1rCcMbERAqBXQpFQZbOudk3PKzPDMhg_xfQs-2rShb3UcM_dBkoeGlh-sB.RFYFBihaEROFJM2q?startTime=1602072091000)
- Illingworth, Sam. *A Sonnet to Science: Scientists and Their Poetry*. Manchester University Press, 2019. <http://www.jstor.org/stable/j.ctv1qr6sn8>.
- Kundan Kumar Thakur. "British Colonial Exploitation of India and Globalization" *Proceedings of the Indian History Congress* 74 (2013): 406. <http://www.jstor.org/stable/44158840>.
- Lynn McDonald. *Journal of the Royal Statistical Society: Series A* (2014) 177, Part 3, pp. 569–586 University of Guelph, Canada <https://cwfn.uoguelph.ca/short-papers-excerpts/nightingale-statistics-and-the-crimean-war/>
- Lynn McDonald. *Florence Nightingale: The Crimean War* Collected Works of Florence Nightingale, Volume 14. (Wilfrid Laurier University Press, 2010), 914 <https://muse-jhu-edu.proxy.lib.ohio-state.edu/chapter/931251>
- Nightingale, Florence and Gérard Vallée. 2006. *Florence Nightingale on health in India*. Waterloo, Ont: Wilfrid Laurier Univ. Press.
- Peers, Douglas M. *India under colonial rule: 1700-1885*. (London: Routledge Publishing, 2006)
- William Bynum. *Patrick Manson and Ronald Ross: malaria and the rise and fall of a scientific friendship* (York: University of York, 2013) <https://www.york.ac.uk/history/global-health-histories/events/bynum-lecture/>

William L. Marr “Malaria.” *The American Journal of Nursing* 36, no. 10 (1936): 969–75.  
<https://doi.org/10.2307/3413564>.

Wong, T., & Fung, K. (1988). The Plague Pandemics and the Discovery of the Plague Bacillus. *Asia Pacific Journal of Public Health*, 2(2), 144–149.  
<http://www.jstor.org/stable/26720472>

### Primary Sources

John Snow *On the Mode of Communication of Cholera* London: Churchill, 1855.  
<http://www.ph.ucla.edu/epi/snow/snowbook.html>

John Sutherland. “On the Causes of Endemic Fever in Lower Bengal, the Influence of Canal Irrigation in Their Production in Upper India, and the Means of Prevention to Be Employed.” *Edinburgh Medical Journal* vol. 15,12 (1870): 1086-1091.

London, British Library, MS *Cultivation of sunflower for the purpose of neutralizing the injurious effect of marshy exhalations* Home Department Proceedings October, 1869  
[http://access.bl.uk/item/viewer/ark:/81055/vdc\\_100079496930.0x000001#?c=0&m=0&s=0&cv=0&xywh=98%2C1984%2C3278%2C1928](http://access.bl.uk/item/viewer/ark:/81055/vdc_100079496930.0x000001#?c=0&m=0&s=0&cv=0&xywh=98%2C1984%2C3278%2C1928)

London, British Library, MS Epidemic Diseases Act of 1897 (III of 1897) found in: India. Home Department, *A compilation of regulations issued by the Government of India and Local governments in connection with plague* (Calcutta, 1898)

London, British Library, MS *Communications received from Major Ronald Ross regarding the prevention of malaria in India by the destruction of the anopheles mosquito*. June 1905

London, British Library, MS *Proposal to place Surgeon Major Ronald Ross on special duty to investigate the truth of Dr Patrick Manson's theory of the transmission of the infection of malaria by means of the mosquito*. March 1897 Home Department Proceedings  
[http://access.bl.uk/item/viewer/ark:/81055/vdc\\_100079496300.0x000001?\\_ga=2.268888561.1020011074.1648605828-1864625692.1648605827#?c=0&m=0&s=0&cv=0&xywh=-313%2C188%2C3735%2C1770](http://access.bl.uk/item/viewer/ark:/81055/vdc_100079496300.0x000001?_ga=2.268888561.1020011074.1648605828-1864625692.1648605827#?c=0&m=0&s=0&cv=0&xywh=-313%2C188%2C3735%2C1770)

London, British Library, MS *Proposed appointment of a Scientific Commission to investigate the causes and cure of malaria and the deputation to India of Dr C W Daniels to aid in the investigation*. January 1899. Home Department Proceedings.  
[http://access.bl.uk/item/viewer/ark:/81055/vdc\\_100077840478.0x000001#?c=0&m=0&s=0&cv=0&xywh=462%2C-1804%2C2276%2C7536](http://access.bl.uk/item/viewer/ark:/81055/vdc_100077840478.0x000001#?c=0&m=0&s=0&cv=0&xywh=462%2C-1804%2C2276%2C7536)

London, British Library, MS *The Plague in India, 1896, 1897*. Vol. 1, Simla: Government Central Printing Office 1898

London, British Library, MS, *The plague inspector's manual*, (Madras, 1902).

London, British Library, MS *Sanitary rules for the prevention of plague in municipalities*.  
Madras, 1903.

Reports of the Sanitary Commissioner with the Government of India (1868-1900)

Reports of the Sanitary Commissioner with the Government of Bengal (1865-1900)

Report of the Royal Commission Appointed to Enquire into the Sanitary State of the Army in  
India (1864)

*Report of the Commissioners Appointed to Inquire into the Regulations affecting the Sanitary  
Condition of the Army and the Treatment of the Sick and Wounded*. Vol 1.(London:  
HMSO, 1858), <https://wellcomecollection.org/works/xa6cwpmx/items>

*Rise And Fall Of Cholera In London* The British Medical Journal  
Vol. 2, No. 299 (Sep. 22, 1866) 338 <https://www.jstor.org/stable/25205940?seq=1>