The PORTOLAN

Issue 101 SPRING 2018 JOURNAL OF THE WASHINGTON MAP SOCIETY

Page 7

2017 Ristow Prize for Academic Achievement in the History of Cartography

Mapping Public Health In Nineteenth-Century Oxford

by Lauren Bouchard Killingsworth

(Detail) Dr. Acland's "Map of Oxford to illustrate Dr. Acland's report on cholera in Oxford in 1854, showing the localities in which cholera and choleraic diarrhoea occurred in 1854, and cholera in 1832 and 1849" in "Memoir on the cholera at Oxford, in the year 1854: with considerations suggested by the epidemic." London: J. Churchill; Oxford: J.H. and J. Parker, 1856. Courtesy Stanford Libraries.

In This Issue

www.WashMapSociety.org

The Washington Map Society

OFFICERS, 2017–2018

Edward Redmond
President

Eliane Dotson
Vice President

Peter Porrazzo
Treasurer

Harold Meinheit
Secretary

Jeffrey Katz
Membership

Leigh Lockwood
Webmaster
washmapsociety@outlook.com

BOARD OF DIRECTORS 2017–2018

Robert Hansen, Bert Johnson, Jeffrey Katz, Chas Langelan, Hal Meinheit, Tony Mullan, Peter Porrazzo, Iris Taylor

Thomas F. Sander
Editor, *The Portolan*
9501 Burke Rd., # 10793
Burke VA 22009-8036 USA
sanderva@erols.com

SEND ALL NON-*PORTOLAN* CORRESPONDENCE TO:

John W. Docktor
3158 Gracefield Rd, Apt. 103
Silver Spring MD 20904-0187 USA
washmap@gmail.com

Cyrus Ala'i
Imre Josef Demhardt
Ralph E. Ehrenberg
John R. Hébert
Peter van der Krogt
Richard Pflederer
Editorial Advisory Board

The Word Express, Inc
Portolan Design and Layout

The Portolan (ISSN 1096–1925) is published three times per year by the Washington Map Society. Annual subscription rates: US: $45 (1st yr student rate $25); Canada $50; All other countries: $65; Single Copy to U.S: $14.00; Canada $17; Other countries: $21. All payments are to be made in U.S. currency. Internet Address: *http://www.WashMapSociety.org*

Address all editorial correspondence to the Editor. Viewpoints of the authors do not necessarily reflect those of the Society.

Contents

From the Editor

The busy Winter season of meetings, Fairs, and exhibits is well underway, and Spring is near. In early February the Miami International Map Fair was held for the 25th time. Many WMS members from around the country are happy each year to take a several-day break from often cold hometown weather to enjoy the warmth of the weather and mixing with many map friends as they feast on a multitude of maps. Congratulations to the organizers of the Fair for many years well-done!

This ***Portolan*** opens with the paper which won the Society's 2017 Ristow Prize. Inclusion of the Prize article that has become a standard part of the Spring issue. From that article's look at 19th century Oxford, the issue continues to articles about China, Transylvania, the country of Georgia, and the US's Cumberland Gap. A summary appears inside about a new conference series beginning in California, and tribute is paid to past member Barbara McCorkle, a stalwart in the history of cartography.

While this issue is coming to you a few weeks early, the next issue will be back on schedule to arrive in late August 2018.

Tom

2017 Ristow Prize for Academic Achievement in the History of Cartography

Mapping Public Health in Nineteenth-Century Oxford

By Lauren Bouchard Killingsworth

In 1855, the physician John Snow, considered the "father of modern epidemiology," issued "On the Mode of Communication of Cholera," a monograph containing a map of the cholera outbreak in the Soho District of London. Snow took a novel approach to mapping disease: he marked each fatal cholera incident with a black bar at the site of the house in which it occurred, and pinpointed each public water pump with a dot. In residences with multiple cases of cholera, the bars were stacked upon each other inward from the street, creating a clear infographic of the incidence and distribution of disease (**Figure 1**). Snow's map was unprecedented in its effective presentation of epidemiological data and its departure from the miasmatic theory of disease. The miasmatic theory was perhaps best summarized by English social reformer Edwin Chadwick: "All smell is, if it be intense, immediate acute disease; and eventually we may say that, by depressing the system and rendering it susceptible to the action of other causes, all smell is disease."[1] During the cholera epidemics of mid-nineteenth-century England, doctors and laypeople alike felt threatened by "deleterious," "tainted," and "unwholesome" air.[2] They imagined disease "wafting through the globe" and insisted that the air was "oppressive from the smell of cholera."[3] The surgeon Dr. Fred Symonds recalled

Figure 1. (Detail) John Snow's map of the 1854 Broad Street outbreak, showing pump locations and cholera cases in "On the mode of communication of cholera." London: John Churchill, 1855. Image courtesy Wellcome Collection. (*https://wellcomecollection.org/works/qz7dkp3r?query=john+snow+broad+street+cholera+map*).

being struck by cholera during "one particular moment when the atmosphere was peculiarly oppressive and a sort of sirocos wind passed over."[4] John Snow, uniquely, did not subscribe to the miasmic theory of disease, stating, "what is so dismal as the idea of some invisible agent pervading the atmosphere, and spreading over the world?"[5] Snow believed in contagionism, and argued in his "On the Mode of Communication of Cholera" that cholera was a "morbid poison" contracted through the ingestion of contaminated water.[6] Snow's map reflected his belief that cholera was a waterborne illness: a quick glance at the map reveals that the Broad Street water pump is the epicenter of the cholera outbreak. Snow advised the local government to remove the pump handle and his advice slowed the spread of disease and reduced the number of deaths.

Snow's map of the Broad Street outbreak is often regarded as the most influential work of medical mapping and is a common reference point for historians of medical cartography. The map has been praised for its effective presentation of data supporting a scientifically accurate theory of disease transmission. Yet, there are other, less well-known disease maps (many predating Snow's) that present public health statistics in novel ways and warrant attention for their role in the evolution of medical cartography. While these maps reached scientifically inaccurate conclusions about disease transmission, they were carried out with great scientific rigor for their time, aided the portrayal of disease as a public health issue, and prompted debate over miasmatism and contagionism theories. It is important to compare the influence of Snow's medically accurate map with that of scientifically inaccurate, though rigorous, portrayals of disease. This can help us to better understand why Snow's map was so revolutionary and to trace the evolution of medical cartography during a period when the scientific basis of infectious disease was highly contentious.

Physicians in the town of Oxford produced a number of maps in response to the cholera outbreaks of the mid-nineteenth century and the growing interest in mapping social statistics, championed by Oxford's academic societies. One of these maps can be found folded into a pocket at the back of an unassuming pamphlet "On the Sanatory Condition of Oxford" by W. P. Ormerod, surgeon to the Radcliffe Infirmary (**Figure 2**). The map, titled "Plan of Oxford Shewing the Parts Visited by Cholera and Fever," was published in 1848, predating John Snow's map by seven years. The map, though somewhat crudely rendered and not drawn to scale, used dots and crosses to mark disease. This approach to mapping statistics with discrete symbols was rare at the time.[7]

In this paper, I examine the evolution of public health cartography in Oxford during the nineteenth century. Using pamphlets, newspaper articles, and proceedings from the Ashmolean Society (Oxford's prestigious natural history society) and Oxford's Public Health Board, I investigate the intended purposes and audiences of Oxford's public health maps, and the responses to these maps. I begin with Ormerod's above-mentioned 1848 map, then turn to Oxford physician Henry Acland's 1856 "Map of Oxford to Illustrate the Localities in which Cholera & Choleraic Diarrhœa Occurred in 1854, and Cholera in 1832 & 1849." I argue that W. P. Ormerod's map and John Snow's map had a strong influence on Henry Acland's map of Oxford. I compare the Oxford cholera maps to Snow's Broad Street map, to ask why Snow's map was so novel and why Snow's map, not the Oxford maps, became one of the most influential works of early medical cartography. I show that, despite the scientific approach that Ormerod and Acland took to portraying Oxford's cholera epidemics, their analysis of the disease and proposals for reform were grounded in a belief in the miasma theory. I then examine maps published after Oxford's cholera epidemics that were concerned with the sewage system and waterworks. I provide evidence that these maps were commissioned to glorify the city by proposing advanced infrastructure systems that were rarely implemented. These sewage maps argue for the role of medical mapping in influencing public opinion about the state of public health, a departure from earlier maps that were used as tools to understand, and advocate for, certain "scientific" modes of disease transmission. While Oxford's nineteenth-century public health maps varied in their intended purposes and effects, they promoted conversation on health issues and reflected the contemporary misunderstandings of disease.

Oxford faced cholera epidemics in 1832, 1849, and 1854. The first epidemic lasted 19 weeks, infecting 184 and killing 95, in a population of 22,000.[8] The explosive, sudden outbreaks and high mortality of the disease led to widespread panic. In a sermon titled "To a Christian Congregation on the approach of the Cholera Morbus," Rev. W. Sewell warned, "It will come on us like a thief in the night, striking us down in a moment, not allowing time for preparation, or one milder state of suffering to nerve us for another more severe… It will come on us, blow upon blow, and death upon death."[9] In response to the first epidemic, an independent Board of Health was created, including city, university, and parish members.[10] The Board of Health worked with the Commissioners of Sewers and the Market Committee to manage the proper cleaning of the city, requiring that "all the Ditches, Drains, and Reservoirs, be thoroughly cleansed, and all Stagnant Water be cleared away, and the Sewers rendered free from all obstructions… to keep the Windows, especially of Bedrooms, in good repair, in order that no Person may be exposed during sleep to currents of Night Air."[11]

Figure 2. Ormerod's "Plan of Oxford shewing the parts visited by cholera and fever" in "On the sanatory condition of Oxford."

Oxford: Printed by T. Combe, printer to the University, for the Ashmolean Society, 1848. Image courtesy Stanford Libraries.

(*https://exhibits.stanford.edu/blrcc/catalog/zv553zz9093*).

After the first epidemic, conflict arose between the local Board of Health and Board of Guardians over funding and responsibilities. The Board of Guardians managed Oxford's Poor Law Union, and oversaw sanitation and relief to the poor. The Board of Guardians included ex-officio and elected members.[12] Conflict between the Board of Health and Board of Guardians eventually led to the demise of the local Board. Concern regarding public health grew across England in the 1830s and 1840s, largely due to social reformer Edwin Chadwick's establishment of the new Poor Law and publication of the *Report on the Sanitary Condition of the Labouring Population of Great Britain*.[13] Despite this rising concern, development of public health initiatives in Oxford was hindered by conflict between the university, town, and various sanitary commissions over individual responsibilities. Pressured by the threat of government-run health inspections and Parliament's approval of the Public Health Act of 1848, the Oxford City Council began discussing the possibility of implementing the 1848 act.[14] W. P. Ormerod, a physician at the Radcliffe Infirmary and a Fellow of the Royal College of Surgeons of England, decided to collect information to "save time in case such information should be required by an inquiry being made into the ordinary condition of health, or the unusual prevalence of disease any particular period in Oxford."[15] Ormerod was likely referring to the possibility of Oxford adopting the 1848 Public Health Act, or a new local measure. Ormerod may also have been driven to investigate Oxford's state of health after observing the increase in fever and diarrhea in Oxford during the summer of 1846. In 1848, Ormerod published "On the Sanatory Condition of Oxford," in which he emphasized the need to be prepared for another potential epidemic, describing how he had arranged the information such that "the parts on which disease presses most heavily may at any time be ascertained at once, and receive the chief attention."[16] The "Plan of Oxford shewing the parts visited by Cholera and Fever" included in the pamphlet reflects Ormerod's intention to portray the distribution of disease and provide practical information.

The plan served as a visual tool for Ormerod's detailed account of public health in Oxford. A closer look at Ormerod's map provides insight into its intended purpose and method of organizing public health data (**Figure 3**). The key, situated below the title of the map, highlights the main locations deemed unsanitary, chiefly yards. Vivid descriptions from Ormerod's pamphlet complement the map. The key includes Faulkner's Yard ("unpaved, with rubbish heaps, and also with the privy uncleared, suffers much from illness"), Brazier's Yard ("a small open drain, with heaps of ashes and filth, and one corner of the yard rendered still more unclean by a donkey kept in it"), and St. Helen's ("a deep pit partly filled with solid matters and covered by a wooden trap door is situated close to the house, the inhabitant of which complained much of the smell arising from it").[17,18,19] Interestingly, Ormerod omits a number of the locations he discusses in his pamphlet from the key. The justification for the inclusion or exclusion of particular locations is never made clear. Each parish is represented in the key, suggesting that perhaps Ormerod wanted to highlight the sites he felt were most egregious in each parish. Yet Ormerod includes Windmill Yard, which is barely mentioned in the text. It is also unclear why some of the locations are listed as letters of the alphabet while others are listed as numbers. There is no obvious distinction between the alphabetical locations and the numerical locations. Finding the locations indicated by the key is quite challenging due to the small size of the numbers and lack of emphasis. Close examination reveals a small number 4 written outside St. Helen's passageway (**Figure 4**). Other numbers and letters highlighting unsanitary locations can be spotted throughout the map. However, due to the selective nature of the key and the lack of clarity, the map does not provide an immediate visualization of the sanitary condition of Oxford. Though Ormerod was thorough in identifying different areas affected by unsanitary conditions, the lack of a systematic approach to plotting these locations makes his work appear less objective and less scientifically sound by today's standards.

Ormerod depicted the distribution of disease more systematically than the sanitary conditions. Ormerod plotted sites where disease occurred in 1832, 1844, 1845, and 1846, though no distinction was made between each year on the map. The key states that "The localities of fever are marked with +" and "The localities of cholera are marked with a •". The symbols can be found throughout the city. The decision to include data on both cholera and typhoid incidence allows for a visualization of the relationship between these two diseases, and Ormerod notes that the districts affected by cholera in 1832 are the same as those affected by typhoid in the 1840s.[20] While extensive, the map lacks the clarity and quantification methods that Snow would later contribute to the public health map. A major difference between the Ormerod map and the Snow map is the base map upon which the data is illustrated. Ormerod's map is pictorial in nature; individual trees are illustrated and buildings and landmarks of interest are shaded in. In contrast, Snow's base map is a bare outline of the streets of Soho. Snow provides the minimal information needed to convey the source of disease, while Ormerod provides a detailed map of the city that distracts from the main intention of demonstrating disease distribution. Additionally, Ormerod plots only the location of disease incidents, not the exact number of fatalities—which Snow would later display with the use of the bar stacking method. The maps also differ in the data selected for display; while the Snow map plots water pumps and cholera cases, the Ormerod

Figure 3. (Detail) Ormerod's Plan of Oxford. Centered on the St. Ebbes (middle) and St. Thomas (left) parishes. "Plan of Oxford shewing the parts visited by cholera and fever" in "On the sanatory condition of Oxford." Oxford: Printed by T. Combe, printer to the University, for the Ashmolean Society, 1848. Image courtesy Stanford Libraries.

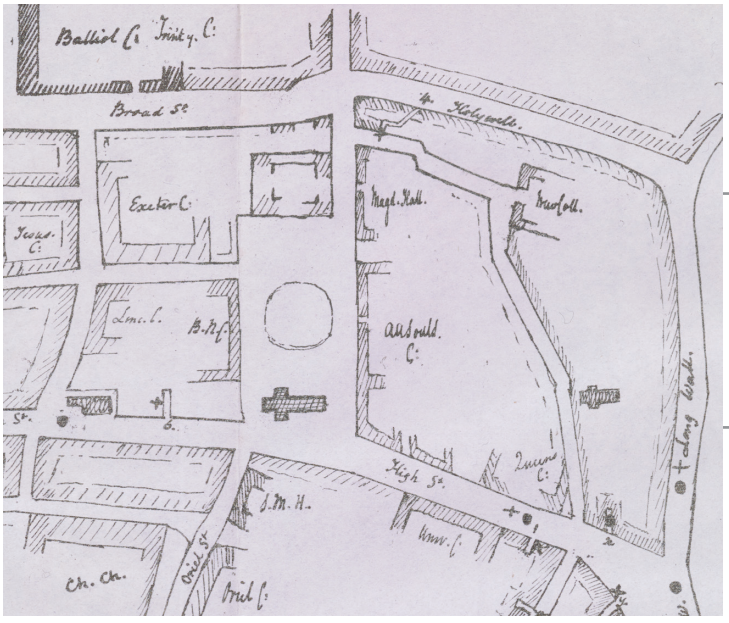

Figure 4. (Detail) Ormerod's Plan of Oxford, showing St. Helen's Passage (top middle) labelled with a small number "4." "Plan of Oxford shewing the parts visited by cholera and fever" in "On the sanatory condition of Oxford." Oxford: Printed by T. Combe, printer to the University, for the Ashmolean Society, 1848. Image courtesy Stanford Libraries.

map plots unsanitary sites, cholera, and typhoid cases. It is important to note that, while they held different views on the origins of cholera, both Ormerod and Snow used cartography to provide evidence of a causal correlation between specific factors and disease. The Ormerod map shows that Snow was not the first to implement this technique.

While Ormerod's map may be considered unclear and rather ineffective by modern standards, it is important to remember that the thematic map was not yet widespread in 1848. The thematic map displays the occurrence of a small number of phenomena over a simple base map, as seen in Snow's Broad Street Pump map.[21] Ormerod's map is more of a hybrid map than a thematic map; hybrid maps, which predate thematic maps, portray a small number of phenomena but do not use a simple base map. It is valuable for a modern viewer to remember, however, that a viewer of Ormerod's map would likely not have had previous exposure to statistical thematic maps. A more "clear," quantitative map such as Snow's Broad Street Pump map might not have been more effective in illustrating the distribution of disease in Oxford; Ormerod may have intentionally incorporated landmarks into his map to help orient the viewer. The inclusion of key buildings, such as churches, whose locations would be familiar to locals, suggests that Omerod's map was intended to be a useful document for raising awareness of public health issues among residents.

Perhaps the most compelling aspect of Ormerod's map is his method of emphasizing the areas with highest incidence of disease. As the key explains, "The parts chiefly visited by disease generally, are slightly shaded." Interestingly, the idea of shading poor or "worse off" areas in maps with dark colors was a common practice in nineteenth-century mapmaking, championed by mathematician and mapmaker Charles Dupin.[22] The map clearly shows that disease is most prevalent in the St. Ebbes, Jericho, St. Aldates, St. Thomas, and St. Clement's neighborhoods, which were often flooded. These were the poorest neighborhoods in Oxford, and were home to two-thirds of Oxford's population.[23] Referring to Jericho, Ormerod described a "bloc of new streets chiefly inhabited by the poorer class… here scarlatina and diarrhœa were very general and fatal. The locality is low, and borders on parts which are occasionally flooded… a drain of the filthiest kind runs down Jericho, quite open."[24] In describing St. Thomas, Ormerod stated, "the river, with its levels varying at different periods of the year, runs through the parish."[25] Thus the map, when presented alongside the paper, suggests that poor drainage is correlated with disease.

Newspaper articles, public health memoirs, and Ashmolean Society proceedings suggest that Ormerod's plan was very well received. Dr. Henry Acland, Lees Reader of Anatomy and Fellow of the Royal Geographical Society, remarked in his "Memoir on the cholera at Oxford, in the year 1854: with considerations suggested by the epidemic" that "Mr. Ormerod's Sanitary Map of Oxford points out in an admirable manner the way in which the Epidemic and Contagious Diseases are collected round special centres: and, as may be seen by the Map in the Memoir, these are also the undrained parts."[26] From a public health perspective, Ormerod's use of shading was effective in suggesting a remediable correlation between disease incidence and drainage. There is also evidence that Ormerod's map was used to increase awareness of public health issues, advocate for change, and help others better understand the transmission of disease. An article by G. A. Rowell in the *Oxford Chronicle*, published in 1850, praised Ormerod's map and used it to support the claim that the city needed a source of clean water. Rowell explained,

> With regard to what localities may be considered healthy or otherwise, there cannot be a better test than the valuable pamphlet and map "on the sanitary condition of Oxford," by Mr. Ormerod...In Mr. Ormerod's pamphlet the locality of every death from epidemic, or contagious disease during 1844, 5, and 6, is given, and the locality of every case of cholera in 1832 (except in the parish of St. Giles); and those parts of Oxford where these diseases prevailed in a more than ordinary degree, are distinctly shaded in the map.[27]

Rowell also used the map to argue that disease is associated with bad water.

> The most probable cause has been bad water; and I have ascertained, that in almost every part of Oxford which is shaded by Mr. Ormerod as a fever district, the water is decidedly bad. The whole of the district lying below the Trill Stream is marked by Mr. Ormerod as very subject to fevers…The houses on the north side of the New-road, between Pacey's Bridge and the Hollybush, are marked as a fever district; and there the water is so bad that the inhabitants now get it from a pump on the opposite side of the road, which side is not shaded on Mr. Ormerod's map (**Figure 5**).[28]

Ormerod's map raised awareness about the unequal distribution of disease and sanitary conditions in Oxford. Rowell's comment that inhabitants got their water from the side of the road which was not shaded on Mr. Ormerod's map suggests that Rowell was using the map to better understand the health inequality he observed between neighborhoods. Additionally, the publication of Rowell's article in Oxford's local newspaper suggests that Ormerod's map was introduced to laypeople as well as

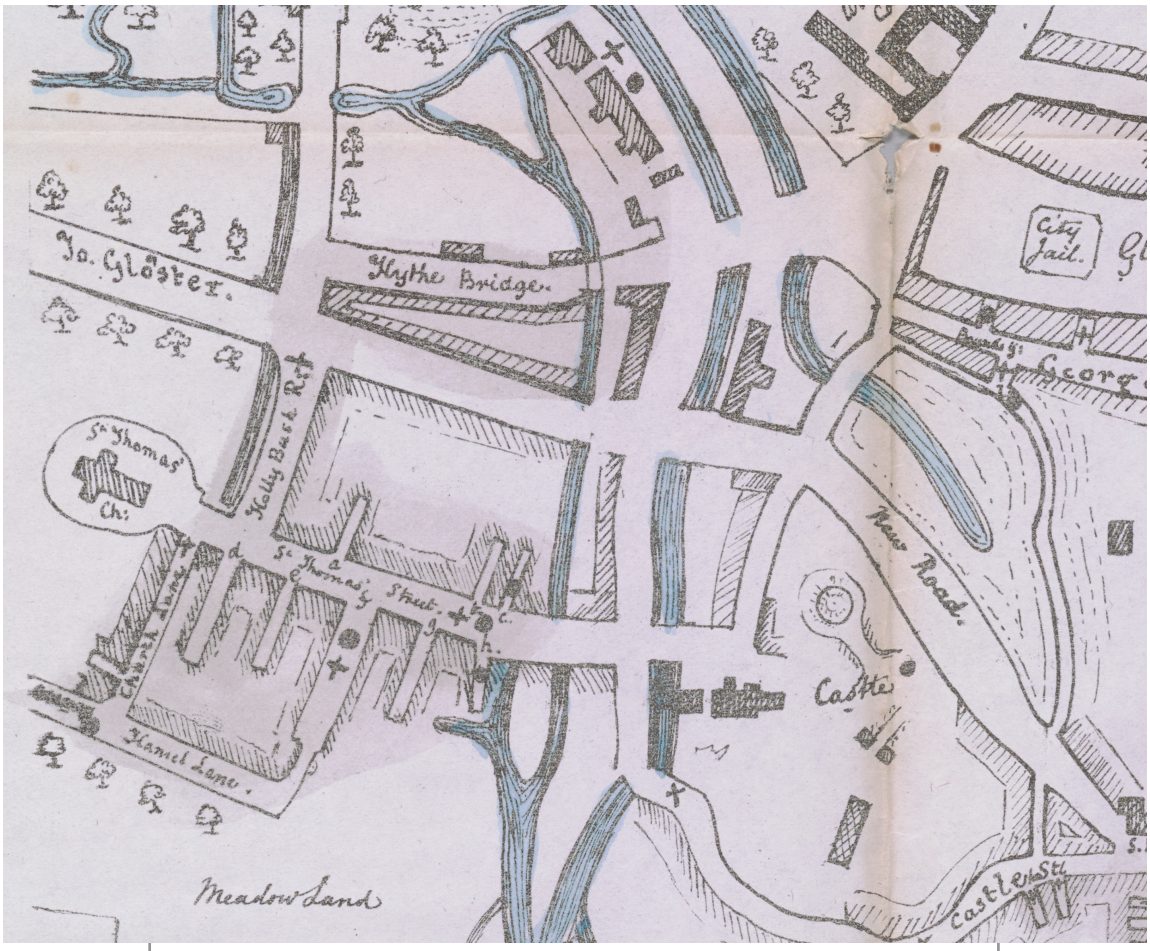

Figure 5. (Detail) Ormerod's Plan of Oxford. Shaded area described by G. A. Rowell. "Plan of Oxford shewing the parts visited by cholera and fever" in "On the sanatory condition of Oxford." Oxford: Printed by T. Combe, printer to the University, for the Ashmolean Society, 1848. Courtesy Stanford Libraries.

those invested in public health issues. Ormerod's decision to include landmarks familiar to locals and a key that explains how to read the map shows that he intended for his map to be circulated among the public.

Ormerod's map was also influential in the academic setting. Ormerod's pamphlet and map were published by Oxford's Ashmolean Society. The proceedings of the Ashmolean Society reported that Mr. Ormerod's map displayed a correlation between prevalence of disease and undrained regions[29]. The society suggested a possible remedy for the situation involving lowering the level at which the river was kept by locks and improving the valley drainage system. Ormerod's work demonstrably contributed to public health efforts by stimulating discussion regarding the flooding situation of Oxford and possible use of a dam to remedy the issue.

While Ormerod brought light to the issue of drainage, medical professor and public health advocate Dr. Henry Acland emphasized the relationship between altitude, "bad air," and disease. Acland published his "Memoir on the cholera at Oxford, in the year 1854: with considerations suggested by the epidemic" in 1856, one year after John Snow published his map of the Broad Street outbreak. Acland's memoir included a main map of Oxford showing "the localities in which Cholera and Choleraic diseases occurred," a smaller map of the locations and order of the first thirty cases, a map of the affected districts surrounding Oxford, and a number of graphical representations and charts on epidemiological data. Acland aimed to discover and present "information which will bring practical good to the people," with the aim of developing a better understanding of the cause of cholera.[30] Here, I focus on Acland's "Map of Oxford to illustrate Dr. Acland's Report on Cholera in Oxford in 1854 showing the localities in which Cholera and Choleraic Diarrhœa occurred in 1854 and cholera in 1832 and 1849" (**Figure 6**).

Figure. 6. Dr. Acland's "Map of Oxford to illustrate Dr. Acland's report on cholera in Oxford in 1854, showing the localities in which cholera and choleraic diarrhoea occurred in 1854, and cholera in 1832 and 1849" in "Memoir on the cholera at Oxford, in the year 1854: with considerations suggested by the epidemic." London: J. Churchill; Oxford: J.H. and J. Parker, 1856. Courtesy Stanford Libraries.

(https://exhibits.stanford.edu/blrcc/catalog/rt260gd2393).

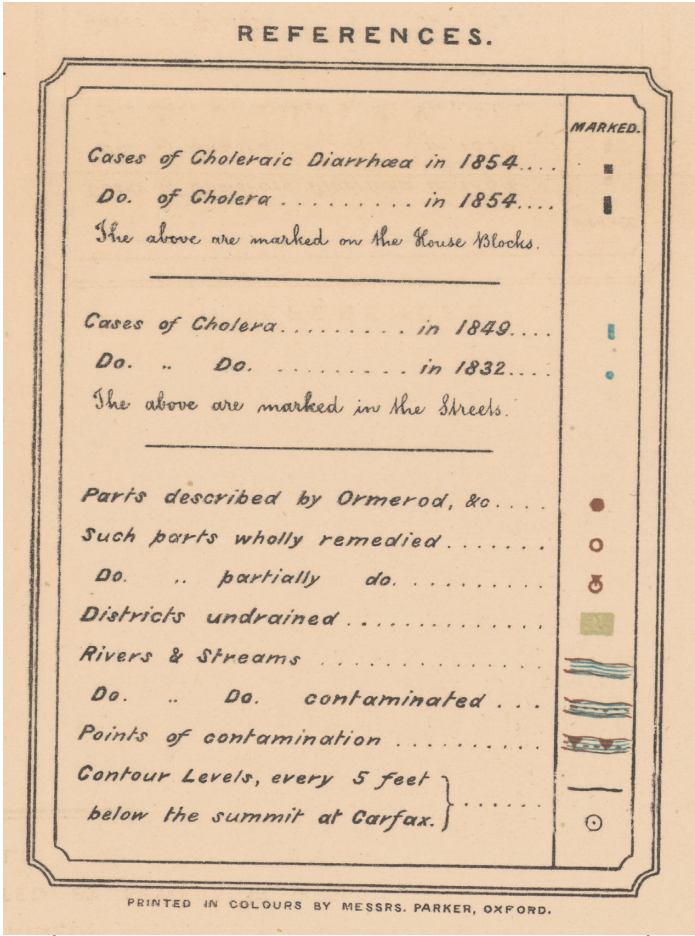

Figure 7. The key on Dr. Acland's Map. "Map of Oxford to illustrate Dr. Acland's report on cholera in Oxford in 1854, showing the localities in which cholera and choleraic diarrhoea occurred in 1854, and cholera in 1832 and 1849" in "Memoir on the cholera at Oxford, in the year 1854: with considerations suggested by the epidemic." London: J. Churchill; Oxford: J.H. and J. Parker, 1856. Courtesy Stanford Libraries.

Acland expertly illustrated data on disease incidence and location over three different epidemics (1854, 1849, and 1832), expanding far beyond the range of statistics conveyed in Snow's map. The "References" box highlights the main features of the map: cases of cholera are marked in 1854, 1849, and 1832, each with a distinguishable symbol (**Figure 7**). Unlike Ormerod, Acland used a symbol for each person who contracted cholera, providing a more accurate visualization of the incidence of disease. Acland used the same method of stacking bars at the site of the patient's residence that Snow used, indicating his familiarity with Snow's work.[31] Acland was also influenced by Ormerod, evidenced by the inclusion of "parts described by Ormerod" in the map's key and by the shading of districts. Acland plotted a red dot for each unremedied location previously described by Ormerod, and used an empty red circle to symbolize "parts wholly remedied." This contributed to a temporal element that is absent in the maps of Ormerod and Snow. By examining the changes in unsanitary regions identified by Ormerod and illustrating data from all three years of epidemics, Acland effectively portrayed the issues of cholera and sanitation over time—creating a more comprehensive map. Additionally, by demonstrating that a number of the locations identified by Ormerod eight years prior were still in dire condition, Acland demonstrated that important public health issues had been neglected.

Color plays an important role in Acland's map, particularly in highlighting contaminated rivers, points of contamination, and undrained districts. The red backdrop signals danger, and the murky green "undrained regions" warn the viewer of a frightening, swamp-like atmosphere. The red-dotted river, signaling pollution, can be clearly spotted winding through the St. Thomas and St. Ebbes regions, both dense with cholera cases (Figure 8). Acland details every building in Oxford, providing an even more intricate background than seen in Ormerod's map. Yet, unlike Ormerod's map, the backdrop is faded, allowing for emphasis on the cholera symbols and the contour lines. Contour lines connect points of equal height, providing a visualization of the 3D landscape. Acland included contour lines to illustrate his theory that cholera was related to altitude. Starting at the Carfax, the highest point in Oxford, Acland made contour lines marking five-foot gradients (**Figure 8**).[32]

The map clearly illustrated that cases were clustered in the lower elevation areas. Observing that "The mortality on our lower level was proportionally three times as great as that of our upper level," Acland concluded that altitude was the main explanation behind cholera. He asserted that cholera was a disease of "poisoned air" that festered in the lowlands and didn't rise to higher altitudes.[33] While Acland took a scientific approach to mapping cholera incidence, he reached an inaccurate conclusion grounded in his belief in the miasmatic theory. The map itself expertly conveyed a quantification of disease incidence over time and a relationship between altitude and incidence. This correlation was in fact accurate: higher locations received cleaner water sources, while lower locations received contaminated water from the Thames and were heavily affected by flooding. It was Acland's miasmatic explanation of the role of altitude in disease transmission that was faulty. It was not "foul smells" but contaminated water that spread disease. In fact, Acland's map could be interpreted as strong support for the theory of waterborne illness, had it not been accompanied by a pamphlet advocating for the miasmatic theory. Acland drew flood lines on the

Figure 8. (Detail) Dr. Acland's map of Oxford, showing the contour lines and color scheme. "Map of Oxford to illustrate Dr. Acland's Report on cholera in Oxford in 1854, showing the localities in which cholera and choleraic diarrhoea occurred in 1854, and cholera in 1832 and 1849" in "Memoir on the cholera at Oxford, in the year 1854: with considerations suggested by the epidemic." London: J. Churchill; Oxford: J.H. and J. Parker, 1856. Courtesy Stanford Libraries.

map, marking incidences of high water. To Acland, these flood areas were places that bred toxic smells, not places where waterborne illnesses could more easily spread.

It is thought that Acland's map received wider attention than most pamphlets on cholera, largely due to his status as a well-known member of Oxford's medical community and the Ashmolean Society.[34] Acland's study was praised in medical and lay periodicals, evidence that he was successful in raising public awareness about his theory on the cause of cholera and proper prevention strategies.[35] One of Acland's chief goals was to spark discussion on the topic and encourage the public to address public health issues. In one passage of his pamphlet, Acland referred directly to the reader, stating, "Another question may however be put to the influential readers in the County and City, into whose hands these pages may fall. Is there a significant acreage of land lying in the Valley of the Isis and Cherwell, which could be made far more valuable by Sewage raised to such a height by steam power?"[36] This direct engagement with the reader emphasizes Acland's desire to have a wide public audience engage with his work. Although Acland's work did not cause the immediate implementation of a sewage system, it played a significant role in fostering the public demand for better drainage, sewage, and water supply that was eventually addressed in the 1870s.

It may seem surprising, given the scientific approach that Ormerod and Acland took to mapping disease, that both believed in modified theories of miasma. Both used a

combination of miasma and sanitary conditions to explain the cause of disease. They also were proponents of the idea that self-indulgence, particularly over-eating and consumption of alcohol, could induce cholera. While Ormerod subtly conveyed his beliefs in miasma in his pamphlet, Acland was outspoken in his defense of miasma and directly opposed Snow's theory of contagionism in his memoir.

Evidence for Ormerod's miasmatic beliefs can be seen in his frequent references to smells. In his pamphlet, he stated, "The inhabitants are exposed to the most unwholesome smells, and almost destitute of fresh air."[37] He went on to explain, "It has also been shown that the cleansing of drains with the emptying of cesspools during the occurrence of contagious disease is at times rather an evil than a good, by exposing a large mass of decomposing matter to the open air."[38] It is important to note that "contagious disease" did not necessarily mean that Ormerod believed in the passing of disease from person-to-person, though it does imply an understanding that disease could be spread. The idea of "decomposing matter" is the hallmark of the miasmatic belief that disease originates from impure particles released to the air. While Ormerod made no reference to the idea that disease was communicated between people, he did recognize that drainage issues contributed to the spread of disease. Thus his theory on disease was informed by, but not limited to, the tenets of miasma.

Acland took a stronger stance in favor of miasma. He raised the possibility of "contagion" in a few places in his memoir, only to argue against it. Acland observed that, "Small families suffer grievously when visited by Contagious Disease."[39] Snow would have viewed this as the results of communication of disease between people living in close quarters. In contrast, Acland, using a diagram of a house in which many family members contracted the disease, explained that this was not an incidence of contagion but "a condition of too many people in too small space… in plain words, *life in poisoned air.*"[40] Acland directly countered Snow's theory, asking,

> How does the man who, in a remote country parish (Oakley), with no traceable communication with any locality affected by Cholera, falls ill, while at work in a field…Then he goes home, and all his family are attacked. Any just hypothesis of Cholera must explain a single case like this just the same as it should explain the devastation of a city. Both of these cases are perfectly intelligible, if we assume that the atmosphere or its concomitant imponderable agents produce on the whole human organism an effect resulting in Diarrhœa.[41]

To Acland, this isolated case of "cholera" was sufficient to disprove person-to-person spread of the disease. Acland's miasmatic beliefs were also reflected in the inclusion of contour lines in his map that demonstrated the effect of the "bad air" at low elevations. Additionally, Acland was convinced that God and meteorology played important roles in the outbreak of epidemics. Acland explained that cholera occurred during the combination of certain meteorological events (such as "thunder unaccompanied by lightning" and "aurora borealis").[42] He also explained that those who "violated the sanitary laws which our Creator has imposed" were subject to punishment by God.[43]

The Oxford cholera maps, though novel in their display of disease data, are muddied by the authors' conflicting—and incorrect—theories on disease. Unlike Snow, Ormerod and Acland used their maps to promote miasmatic theory, which was widely accepted at the time. Though both experimented with new statistical mapping techniques, they did not use their maps to propose groundbreaking new conjectures about the transmission of disease. The lasting influence of John Snow's map can be attributed to the novelty—and accuracy—of his theory that cholera was spread through water. Today, Snow's work is highly regarded as an example of the role of medical cartography in understanding the scientific basis of disease and in providing a course of action during an epidemic. While Ormerod and Acland's Oxford maps did not lead to an immediate solution like Snow's monumental removal of the water pump handle, they did promote important conversation on Oxford's pressing public health issues and advanced the science of medical cartography. Acland, in particular, championed the idea of social statistics, the extensive collection of data, and analysis of social issues. Both Ormerod and Acland were rigorous and methodical in their approaches to public health, collecting data on diarrhea, fever, and cholera incidence in each parish, recording changes in weather patterns, observing possible sources of disease across town, and identifying areas of poor drainage. Both explained their methods of mapping in great detail in the pamphlets that accompanied their maps, a valuable resource for those interested in mapping other public health issues and for those seeking a more detailed explanation of the epidemics. In addition to advancing the field of statistical medical mapping, Acland and Ormerod advocated for policies effective in addressing contagious disease, though their underlying reasoning was flawed. The removal of cesspits and sanitation of houses, though intended to remove the "poisonous air," did effectively reduce risk of contact with the water-borne cholera bacteria. Additionally, the maps helped to increase awareness of public health issues and health inequality in Oxford, as suggested by discussion of the Oxford maps in lay periodicals. Increased discussion and debate over the state of public health in Oxford would eventually lead to reform in the 1870s, after many years of

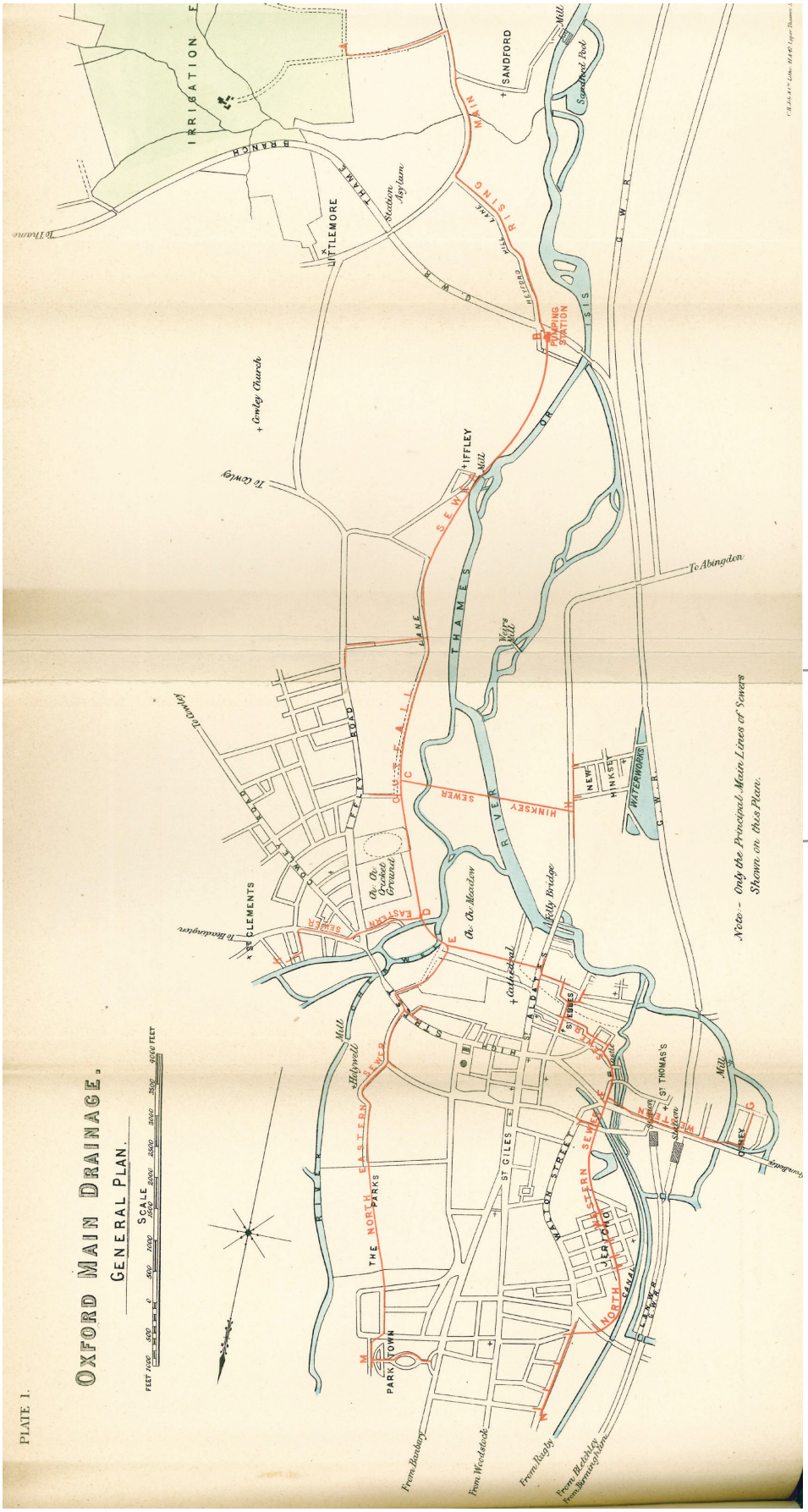

Figure 9. White, William Henry. "The main drainage of Oxford." Oxford: E. Pickard Hall and J. H. Stacy, printers to the University, 1877. Courtesy London School of Hygiene & Tropical Medicine.

conflict between Oxford's competing committees, industries, and the university.

Following the cholera epidemics, sewage became a major focus of public health cartography in Oxford. Maps diversified from the plotting of disease to detailed plans of proposed sewage and water systems. In 1850, the Paving Commissioners, who managed Oxford's sewage and other sanitary issues, appointed a surveyor to map the city's drainage.[44] Engineers Sir William Cubitt and MacDougall Smith made a detailed, exhaustive survey and identified various upstream sites as possible water sources. Cubitt provided a plan for the new waterworks and drainage system. Despite the effort and expense taken to produce the plan, little was done with Cubitt's recommendations. Instead, the Paving Commissioners built only a few new sewers in the Jericho parish.[45] In 1854, a new Sewerage Committee was established and another survey was commissioned. After another period of inaction, yet another survey was requested. In 1864 the Local Government Act of 1858 was adopted, leading the Oxford Local Board of Health to request a series of plans from various surveyors, who all suggested an identical approach. The surveyor John Galpin lamented, "If only the scheme so many times proposed could be proceeded with, Oxford could be second to no city in the kingdom."[46] It is likely that Oxford's committees sought to publish new sewage maps due to an internal conflict between the committees, and a desire to outdo the competition. The publication of maps that illustrated an Oxford with a perfectly functioning drainage and water system aimed to portray a positive image of the highly ineffective committees. These maps portrayed an ideal that was never fully implemented. In 1873, after much conflict over the proper type of sewer system and location of sewage outfall, the committees signed the first sewage contract.

The obsessive publication of later sewage maps was fueled by the Public Health Act of 1875. The Public Health Act called for plans to be drawn of proposed infrastructure before requesting government-issued loans. An instructional pamphlet was issued, titled "Suggestions as to the Preparation of District Maps, and of Plans for the Main Sewerage, Drainage, and Water Supply," written by the civil engineer Robert Rawlinson. It detailed each type of required map, instructing, "Such Plans or tracings may be used for showing lines of main-sewers, drains, water-pipes, and gas-mains. The lines of main-sewers and drains should have the cross-sectional dimensions of the sewers and their gradients distinctly marked."[47] This set a new standard for the ideal sewage system, which may explain the abundance of sewage maps produced in Oxford in the late nineteenth century. In "The Main Drainage of Oxford," published in 1877, sanitary engineer William White provided a series of maps demonstrating Oxford's water and sewage systems, complete with cross-sections of the sewer pipes, in line with the guidelines set forth by the Public Health Act (**Figure 9**). These maps were issued after the final sewage system was approved in 1873, and appear to have been a celebration of Oxford's new sewage system, providing additional evidence for the role of the public health sewage map in portraying the city in the best possible light.

The Oxford cholera maps and the Oxford sewage maps take a very different approach to public health cartography. While the cholera maps aim to address the sanitation issues that plague the city and to better understand cause of disease, the sewage maps are chiefly interested in improving Oxford's public image. This highlights the diverse functions of maps as scientific tools, vehicles for social change, and propaganda.

The English public health map could be used to expose and better understand medical issues affecting the city—but also as a tool to conceal concerns over the sanitation and health of the town, providing false assurance to the public. The Oxford maps provide important insight into the multidimensional role of cartography in shaping public health in nineteenth-century England. Analysis of the Oxford maps suggests that medical cartography was used as a tool to understand disease transmission and remedy health issues, as well as an important communication medium to argue for scientific theories and to publicize city image. In a time where miasmatic theory dominated, disease maps provided viewers with a visualization of an otherwise invisible and seemingly pervasive threat. By depicting regions affected by disease and plotting possible sources, medical cartography allowed physicians and public health advocates to identify remediable causes of disease and make plans for reform.

ABOUT THE AUTHOR

Lauren Bouchard Killingsworth is the winner of the 2017 DR. WALTER RISTOW PRIZE FOR ACADEMIC ACHIEVEMENT IN THE HISTORY OF CARTOGRAPHY. Ms. Killingsworth was born and raised in California and is currently a senior at Stanford University, where she studies History and Biology. At Stanford University she developed an academic interest in the history of cartography after taking Prof. Kären Wigen's courses on early modern cartography. She also pursued coursework in biology, conducted biochemistry research, and travelled to the Galápagos Islands and Tanzania to study conservation issues. While studying abroad at Oxford University under Prof. Geoffrey Tyack, she found an intersection of her interests in mapping and biology in the study of the history of medical cartography. Her research on cholera maps in Oxford culminated in her paper "Mapping Public Health in Nineteenth Century Oxford." She is interested

in the role of medical cartography is shaping popular perceptions of disease and public health, and in the debate between contagionists and anti-contagionists (or "localists") during the cholera outbreaks of the mid-nineteenth century. She would like to thank Professor Kären Wigen for her unwavering support and mentorship.

BIBLIOGRAPHY

Abstracts of the Proceedings of the Ashmolean Society. Oxford: The Ashmolean Society, 1848.

Acland, Henry W. "Map of Oxford, to illustrate Dr. Acland's Memoir on cholera in Oxford in 1854, showing the localities in which cholera and choleraic diarrhoea occurred in 1854, and cholera in 1832 and 1849." Oxford: J. H. and J. Parker, 1856.

Acland, Henry W. *Memoir on the cholera at Oxford, in the year 1854: with considerations suggested by the epidemic*. Oxford: J. H. and J. Parker, 1856.

Friendly, Michael and Gilles Palsky. "Visualizing Nature and Society." In *Maps: Finding Our Place in the World*, edited by James R. Akerman and Robert W. Karrow, 207–53. Chicago: University of Chicago Press, 2007.

Koch, Tom. *Cartographies of disease: maps, mapping, and medicine*. Redlands: Esri Press, 2005.

Koch, Tom. *Disease maps: epidemics on the ground*. Chicago: University of Chicago Press, 2011.

Metropolitan Sewage Committee. *Parliamentary Papers*. 1846.

Morris, Robert J. "Religion and medicine: the cholera pamphlets of Oxford, 1832, 1849 and 1854." *Medical History* 19, no. 3 (1975): 256–70.

Ormerod, William P. "On the sanatory condition of Oxford." Oxford: Ashmolean Society, 1848.

Ormerod, William P. "Plan of Oxford shewing the parts visited by cholera and fever." Oxford: Ashmolean Society, printed by T. Combe, 1848.

Parfit, Jessie. *The health of a city: Oxford, 1770–1974*. Oxford: Amate Press, 1987.

Rawlinson, Robert. *The Public Health Act, 1875. Suggestions as to the Preparation of District Maps, and of Plans for Main Sewerage, Drainage, and Water Supply*. London: H.M. Stationery Office, 1878

Rowell, G. A. "On the Effects of the Oxford Spring Water on Health." *Oxford Chronicle* (1850).

Sewell, William. "An address to a Christian congregation on the approach of the cholera morbus." Oxford: D.A. Tables, 1832.

Sheen, R. and J.C. Jones, "At a meeting holden in the audit room of the town hall, Oxford, on Tuesday, the 15th Day of November, 1831." 1831.

Snow, John, "On the Mode of Communication of Cholera" London: John Churchill, 1855.

Vaughan, Thomas. "Memorials of the malignant cholera in Oxford, MDCCCXXXIII." Oxford: W. Baxter, 1835.

White, William Henry. "The main drainage of Oxford." Oxford: Ashmolean Society and E. Pickard Hall and J. H. Stacy, printers to the University, 1877.

ENDNOTES

1 Metropolitan Sewage Committee. *Parliamentary Papers* (1846), 651.

2 William P. Ormerod, "On the sanatory condition of Oxford" (Ashmolean Society, 1848), 45. Thomas Vaughan, "Memorials of the malignant cholera in Oxford, MDCCCXXXIII" (Oxford: W. Baxter, 1835), 2.

3 Henry W. Acland, *Memoir on the cholera at Oxford, in the year 1854: with considerations suggested by the epidemic* (Oxford: J. H. and J. Parker, 1856), 79.

4 Jessie Parfit, *The health of a city: Oxford, 1770–1974* (Oxford: Amate Press, 1987), 43.

5 Tom Koch, *Cartographies of disease: maps, mapping, and medicine* (Redlands, CA: Esri Press, 2005), 145.

6 John Snow, "On the Mode of Communication of Cholera," (London: John Churchill, 1855), 15.

7 Michael Friendly and Gilles Palsky, "Visualizing Nature and Society" in *Maps: Finding Our Place in the World*, edited by James R. Akerman and Robert W. Karrow (Chicago: University of Chicago Press, 2007), 244.

8 Jessie Parfit, *The health of a city: Oxford, 1770–1974* (Oxford: Amate Press, 1987), 39.

9 William Sewell, "An address to a Christian congregation on the approach of the cholera morbus" (Oxford: D.A. Tables, 1832), 14.

10 Jessie Parfit, *The health of a city: Oxford, 1770–1974* (Oxford: Amate Press, 1987), 41.

11 R. Sheen and J.C. Jones, "At a meeting holden in the audit room of the town hall, Oxford, on Tuesday, the 15th Day of November, 1831" (1831), n.p.

12 "Poor Law Unions," Oxfordshire.gov.uk (Oxfordshire History Center), n.p.

13 Jessie Parfit, *The health of a city: Oxford, 1770–1974* (Oxford: Amate Press, 1987), 13.

14 Ibid.

15 William P. Ormerod, "On the sanatory condition of Oxford" (Ashmolean Society, 1848), 3.

16 Ibid.

17 Ibid., 16.

18 Ibid., 23.

19 Ibid., 26.

20 Ibid., 42.

21 Michael Friendly and Gilles Palsky, "Visualizing Nature and Society" in *Maps: Finding Our Place in the World*, edited by James R. Akerman and Robert W. Karrow (Chicago: University of Chicago Press, 2007), 212.

22 Ibid., 240.

23 Jessie Parfit, *The health of a city: Oxford, 1770–1974* (Oxford: Amate Press, 1987), 11.

24 William P. Ormerod, "On the sanatory condition of Oxford" (Ashmolean Society, 1848), 23.
25 Ibid., 24.
26 Henry W. Acland, *Memoir on the cholera at Oxford, in the year 1854: with considerations suggested by the epidemic* (Oxford: J. H. and J. Parker, 1856), 51.
27 G. A. Rowell, "On the Effects of the Oxford Spring Water on Health," Oxford Chronicle (1850), n.p.
28 Ibid.
29 Abstracts of the Proceedings of the Ashmolean Society, from 1843 to 1852 Inclusive, vol 2 (Oxford: The Ashmolean Society, 1854), 190.
30 Henry W. Acland, *Memoir on the cholera at Oxford, in the year 1854: with considerations suggested by the epidemic* (Oxford: J. H. and J. Parker, 1856), 12.
31 Henry W. Acland, *Memoir on the cholera at Oxford, in the year 1854: with considerations suggested by the epidemic* (Oxford: J. H. and J. Parker, 1856), 70.
32 Tom Koch, *Disease maps: epidemics on the ground* (Chicago: University of Chicago Press, 2011), 119.
33 Ibid., 120.
34 Robert J. Morris, "Religion and medicine: the cholera pamphlets of Oxford, 1832, 1849 and 1854" in *Medical History* 19, no. 3 (1975), 262.
35 Ibid.
36 Henry W. Acland, *Memoir on the cholera at Oxford, in the year 1854: with considerations suggested by the epidemic* (Oxford: J. H. and J. Parker, 1856), 140.
37 William P. Ormerod, "On the sanatory condition of Oxford" (Ashmolean Society, 1848), 45.
38 Ibid., 48.
39 Henry W. Acland, *Memoir on the cholera at Oxford, in the year 1854: with considerations suggested by the epidemic* (Oxford: J. H. and J. Parker, 1856), 136.
40 Ibid., 81.
41 Ibid., 77.
42 Ibid., 75.
43 Ibid., 105.
44 Jessie Parfit, *The health of a city: Oxford, 1770–1974* (Oxford: Amate Press, 1987), 25.
45 Ibid.
46 Ibid., 27.
47 Robert Rawlinson, *The Public Health Act, 1875. Suggestions as to the Preparation of District Maps, and of Plans for Main Sewerage, Drainage, and Water Supply* (London: H.M. Stationery Office, 1878), 2.