The Perfect Food and the Filth Disease: Milk, Typhoid Fever, and the Science of State Medicine in Victorian Britain, 1850-1900

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Like many scholars of Victorian Britain, I have been drawn to that indefatigable Victorian novelist, Charles Dickens. In Dickens' fifth novel, *Barnaby Rudge,* he quipped that, "the men who learn endurance, are they who call the whole world, brother." Two things ring true to me about this quote after writing a doctoral dissertation; finishing the project required a good deal of endurance, and I can now cheerfully call "brother" to a great number of advisors, colleagues, friends, and family, without whom this dissertation would not have been possible. I owe a great deal to Peter Vinten-Johansen, my first mentor while I was an undergraduate at Michigan State University. Peter saw promise in a young and unmolded undergraduate fascinated with history, and was the first to help me to think and write like a historian. I will never forget our meetings in Morrill Hall, and Peter's guidance.

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Contents

Introduction

In an address to the International Medical Congress held in London in 1881, John Simon, Victorian Britain's principal orchestrator of and spokesperson for a state-sponsored system of public health, defined state medicine as "the supposition that, in certain cases, the Body-Politic will concern itself with the health-interests of the people-will act, or command, or deliberate, or inquire, with a view to the cure or the prevention of disease."[1] Although in nascent form from the 1850s with calls for a centralized system by Edwin Chadwick and Henry Rumsey, state medicine was still a fledgling concept in the 1880s.[2] Simon qualified in his 1881 speech that,

> Before any such supposition can be effectively realized, the Science of Medicine-that is to say, the exact knowledge of means by which disease may be prevented or cured, must have reached a certain stage of development; and unless the science be supposed common to all persons in the State, the existence of State Medicine supposes a special class of persons whom the unskilled general public can identify as presumably possessing the required knowledge. Thus, given the class of experts to supply the required exact knowledge, the Body-Politic

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[1] John Simon, "An Address Delivered at the Opening of the Section of Public Medicine," *BMJ,* 6 vol. 2, issue 1075 (August 1881) 219-223, 219.

[2] Henry Rumsey, *Essays on State Medicine* (London: John Churchill, 1856), Christopher Hamlin, *Public Health and Social Justice in the Age of Chadwick: Britain, 1800-1854* (Cambridge: Cambridge University Press, 1998. The most prominent work on the history of state medicine in Britain has been Roy MacLeod's "The Anatomy of State Medicine: Concept and Application," in *Medicine and Science in the 1860s: Proceedings of the Sixth British Congress on the History of Medicine*, 1968), 199-227, and "The Frustration of State Medicine, 1880-1899," *Medical History* (1967), 11: 15-40.

> undertakes that, within the limits of its own constitutional analogies, it will make the knowledge useful to the community.[3]

Essential to the realization of state medicine, Simon believed, was the maturity of the science of medicine, itself a somewhat vague definition for a rough patchwork of scientific practitioners in burgeoning professions who claimed particular expertise in public health. Among the foremost in the late Victorian period were physicians, chemists, bacteriologists, engineers, epidemiologists, and statisticians.[4] And, while nineteenth century public health developed in the context of organizational and institutional developments and disciplinary formations, it was also forged out of new types of mutually shaped relationships between science, British society, and the state.[5] As David Cahan has recently argued, "the very character of 'science' changed during the course of the nineteenth century."[6] "In many minds," Cahan has noted, "'the nineteenth century' and 'science' became synonymous with 'progress.'"[7] Nowhere was this more apparent than in Britain in the second half of the nineteenth century, particularly with regard to public health and the vaulted goal of a complete system of state and preventive medicine,

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[3] John Simon, "An Address Delivered at the Opening of the Section of Public Medicine," *BMJ,* vol. 2, issue 1075 (6 August 1881) 219.

[4] This general framework has been laid out by Roy MacLeod in his introduction to *Government and Expertise: Specialists, Administrators, and Professionals, 1860-1919* (Cambridge: Cambridge University Press, 1988), 1-24.

[5] Aileen Fyfe and Bernard Lightman, for example, have recently argued that the sites of scientific practice and the justification of science fundamentally changed in the nineteenth century. See, Aileen Fyfe and Bernard Lightman (eds.) *Science in the Marketplace: Nineteenth-Century Sites and Experiences* (Chicago: University of Chicago Press, 2007),

[6] David Cahan (ed.), *From Natural Philosophy to the Sciences: Writing the History of Nineteenth-Century Science* (Chicago: University of Chicago Press, 2003), 8.

[7] Ibid, 4. John Harley Warner has been more forceful with this claim, arguing that "the notion of *scientific medicine* stands as among the sturdiest bastions of presentism in the field," John Harley Warner, "The History of Science and the Sciences of Medicine," *Osiris* (1985), 10:164-193, 188.

one which sought to integrate private medical practice, central oversight by Whitehall civil servants, and effective implementation by local authorities. Science was a crucial element to public health.

Late Victorian promoters of state medicine, such as Simon's comments above indicate, relied on an extensive, and to be sure eclectic mix of scientific experts, only some of whom actually practiced clinical medicine. The relationship between science and medicine then, has important implications for how historians have understood the development of public health in the nineteenth century. It also has historiographical ramifications for how historians delineate the boundaries between the history of science, technology, and medicine (generally referred to as 'STM').[8] Understanding nineteenth century public health necessitates that one use a broadly based STM methodology, what John Harley Warner has called "historiographic pluralism." "What we stand to gain from historiographic pluralism," Warner maintains, "is not an integration of history of medicine with the history of science, but a more integrated understanding of the multifaceted meanings of science in medicine."[9]

Many historians of medicine working on late nineteenth century Victorian medicine have focused on the emergence of scientific medicine, typically medical practitioners in physiology, pathology, and bacteriology who increasingly gained

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[8] This is a longstanding historiographical issue. See, George Sarton, "The History of Science versus the History of Medicine," *Isis* (1935), 23: 315-320, Henry E. Sigerist, "The History of Medicine *and* the History of Science*," Bulletin of the Institute of the History of Medicine*, (1936), 4: 1-13, John Harley Warner, "Science in Medicine," *Osiris* (1985), 1: 37-58, Leonard Wilson, "Medical History without Medicine," *Journal of the History of Medicine and Allied Sciences* (1980), 35: 5-7.

[9] John Harley Warner, The History of Science and the Sciences of Medicine, *Osiris* (1985), 10:164-193, 177.

scientific status in the nineteenth century.[10] There is good reason to look at the emergence of scientific medicine, particularly as it related to actual clinical medical practice, as many of the most pertinent public health problems were ultimately shaped by clinical, laboratory, and hospital practice.[11] However, such a lens obscures a wide range of scientific practitioners whose expertise lay outside of actual clinical practice, even those initially trained as physicians such as epidemiologists and bacteriologists.[12]

A more nuanced historical portrait of the uneven and contested development of public health in Victorian Britain emerged from the 1990s by the work of historians such as Michael Worboys, Anne Hardy, John Eyler, and Christopher Hamlin. The historiographical focus on these scholars has been of three types, studies of individual public health reformers, studies of specific epidemic diseases, or studies of particular scientific practices and emergent disciplines. Christopher Hamlin's 1998 examination of the controversial Victorian sanitarian Edwin Chadwick in *Public Health in the Age of Chadwick* is representative of the first approach, as is John Eyler's 1997 study of the

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[10] William Bynum, *Science and the Practice of Medicine in the Nineteenth Century* (Cambridge: Cambridge University Press, 1994. Gerald Geison, "Divided We Stand: Physiologists and Clinicians in the American Context," in Judith Walzer Leavitt and Ronald L. Numbers (eds.) *Sickness & Health in America: Readings in the History of Medicine and Public Health* (Madison: University of Wisconsin Press, 1978), 115-130. Christopher Lawrence has a more skeptical view, see Christopher Lawrence, "Incommunicable Knowledge: Science, Technology, and the Clinical Art in Britain, 1850-1914," *Journal of Contemporary History* (1985), 20:503-520, and L.S. Jacyna, "The Laboratory and the Clinic: the Impact of Pathology on Surgical Diagnosis in the Glasgow Western Infirmary, 1875-1910," *Bulletin of the History of Medicine* (1988), 62: 384-406.

[11]Steve Sturdy, "The Political Economy of Scientific Medicine: Science, Education and The Transformation of Medical Practice in Sheffield, 1890-1922," *Medical History* (1992) 36: 125-159.

[12] Russell Maulitz, "Physician versus Bacteriologist: The Ideology of Science in Clinical Medicine," in M.J. Vogel and C.E. Rosenberg (eds.) *The Therapeutic Revolution: essays in the Social History of American Medicine* (Philadelphia: University of Pennsylvania Press, 1979), 99-108.

influential late Victorian and early Edwardian public health reformer Arthur Newsholme in *Sir Arthur Newsholme and State Medicine*.[13] Anne Hardy's 1993 examination of the active role of medical officers of health and other sanitary officials in curbing the major infectious diseases in *Epidemic Streets* is characteristic of the specific disease approach.[14] So too is Michael Worboys's 2000 *Spreading Germs*, although rather than one particular disease, Worboys examines the complex nature of shifting debates over germ theories of infectious disease.[15] Hamlin's 1990 *A Science of Impurity*, which demonstrates the crucial role of chemistry in public health debates about water purity, and John Eyler's 1979 *Victorian Social Medicine*, which details the emergence of vital statistics, are both illustrative of those historians who have focused on particular medical and scientific practices that constituted public health.[16]

These historians were all in some way responding to two historiographical threads in the history of public health, Thomas McKeown's assessment in the 1950s and 1960s that the modern demographic transition which began in the late nineteenth century was

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[13] Christopher Hamlin, *Public Health in the Age of Chadwick: Britain, 1800-1850* (Cambridge: Cambridge University Press, 1998), John Eyler, *Sir Arthur Newsholme and State Medicine, 1885-1935* (Cambridge: Cambridge University Press, 1998).

[14] Anne Hardy, *The Epidemic Streets: Infectious Disease and the Rise of Preventive Medicine, 1856-1900* (Oxford: Clarendon Press, 1993). See also Robert Woods and John Woodward (eds.) *Urban Disease and Mortality in Nineteenth Century England* (London: Batsford Academic and Educational Press, 1984), and especially Margaret Pelling, *Cholera, Fever and English Medicine, 1825-1865* (Oxford: Oxford University Press, 1978), and F.B. Smith, *The Retreat of Tuberculosis, 1850-1950* (London: Croom Helm, 1988). Oxford University Press and the Johns Hopkins University Press have recently both begun series' in the history of disease, highlighting the continued presence of this analytical approach.

[15] Michael Worboys, *Spreading Germs: Disease Theories and Medical Practice in Britain, 1865-1900* (Cambridge: Cambridge University Press, 2000).

[16] Christopher Hamlin, *A Science of Impurity: Water Analysis in Nineteenth-Century Britain* (Berkeley: University of California Press, 1990), John Eyler, *Victorian Social Medicine: The Ideas and Methods of William Farr* (Baltimore: The Johns Hopkins University Press, 1979).

primarily a result of economic growth, and the longstanding tendency of historians of public health to solely focus on economic and administrative developments.[17] A generation of scholarship has now shown that activism by British medical practitioners and public health authorities, both at the local level by practitioners such as medical officers of health, and at the central level by civil servants at the Medical Department of the Local Government Board, was instrumental in the decline of the incidence of infectious disease in the second half of the nineteenth century.[18] Essential to recent historical claims has been the argument that public health reform was contingent and uneven in the late Victorian period.[19]

Building on this scholarship, this study takes a somewhat different analytical tack. It is not an examination of one particular influential public health leader, or one particular

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[17] On what has been called the "McKeown thesis" see: Thomas McKeown and R.G. Record, "Medical Evidence Related to English Population Changes in the Eighteenth Century," *Population Studies* (1955), 9: 119-41, Thomas McKeown and R.G. Record, "Reasons for the Decline of Mortality in England and Wales During the Nineteenth Century," *Population Studies* (1962), 16: 94-122, Thomas McKeown, *The Modern Rise of Populations* (London: Edward Arnold, 1976). Hardy's 1993 *Epidemic Streets* is a direct reappraisal of McKeown's argument, as is Simon Szreter's influential article, "The Importance of Social Intervention in Britain's Mortality Decline c. 1850-1914: A Re-interpretation of the Role of Public Health," *Social History of Medicine* (1988), 1:1-38, and Graham Mooney's "Second Opinions: Infectious Diseases and the Epidemiologic Transition in Victorian Britain? Definitely," *Social History of Medicine* (2007), 20:3, 595-606. Representative of the older genre of administrative histories of Victorian public health are Royston Lambert's *Sir John Simon and English Social Administration, 1816-1904* (Macgibbon & Kee, 1963), Oliver MacDonagh's "The Nineteenth Century Revolution in Government: A Reappraisal," *Historical Journal* (1958), 1:52-67, and Henry Paris, *Constitutional Bureaucracy: The Development of British Central Administration since the Eighteenth Century* (London: George Allen, 1969).

[18] An earlier interpretation is Jeanne Brand's *Doctors and the State: the British Medical Profession and Government Action in Public Health, 1870-1912* (Baltimore: Johns Hopkins University Press, 1965), and Frazier Brockington's *Public Health in the Nineteenth Century* (Edinburgh and London: E. & S. Livingstone, 1965).

[19] Roy Acheson has also clarified the uneven modes of education in public health in the Victorian period. See, Roy Acheson, "The British Diploma in Public Health: Birth and Adolescence," in E. Fee, and Roy Acheson (eds.) *A History of Education in Public Health: Health That Mocks the Doctor's Rules* (Oxford: Oxford University Press, 1991), 44-82.

scientific practice that contributed to Victorian public health, or even solely one epidemic disease, although all of these analytic frames will be used here. Instead, this project focuses on one specific public health problem, the threat of cow's milk in spreading infectious disease, particularly typhoid fever. This problem-specific approach follows from what historians Oliver MacDonagh and Anthony Wohl have long suggested, namely that Victorian public health emerged as a response to a specific set of social and environmental problems new to the nineteenth century, such as housing, air and water pollution, epidemic disease, and food adulteration.[20]

My examination of the social, political, and scientific discourses surrounding the threat of milk-borne typhoid fever contributes to one of the most elusive problems in the history of nineteenth century public health, how social problems became public health problems. In this case, I explore how various scientific groups, politicians, industry leaders, and the British public framed, debated, and dealt with the supposed threat and often reality of outbreaks of milk-borne infectious disease in the second half of the nineteenth century

Such an approach to nineteenth century medical science has several important features. It illuminates the complex ways by which different groups used the milk problem for various social, political, and scientific ends. Public health reformers such as John Simon, for example, used the threat of milk-borne disease to justify the expansion of state medicine, while various scientific groups- epidemiologists, chemists, veterinarians,

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[20] Oliver MacDonagh's "The Nineteenth Century Revolution in Government: A Reappraisal," *Historical Journal* (1958), 1:52-67, Anthony Wohl, *Endangered Lives: Public Health in Victorian Britain* (Cambridge: Harvard University Press, 1983).

and bacteriologists- used it to bolster their aims of professionalization and scientific expertise. Such a diverse lot of scientific practitioners, I show, had various theories, methodologies, and socio-political vested interests. By the last two decades of the nineteenth century, a substantial portion of the dairy industry too, used the milk problem as a way to consolidate the economic marketplace on milk and maximize profit through claiming that only large, scientifically managed dairy farms could produce pure milk free of infectious disease.

The problem-centered approach I take here also allows me to ask penetrating historical questions that delve into the core of scientific practice in the nineteenth century.[21] Who claimed particular scientific expertise in answering the milk problem in the nineteenth century? How were conflicting claims of expertise sorted out by British society and politicians? In what areas did milk-related experts compete or collaborate for scientific expertise and social prestige, and in obtaining public health positions? In turn, how was scientific knowledge about milk and infectious disease locally produced, constructed, circulated, and made available to scientists, physicians, the British public, and administrators?

The milk problem was first articulated in the 1850s as a problem of milk adulteration, which had serious consequences for the marketplace and human nutrition. By the last two decades of the century, though the milk problem was more specific to dairy practices on the farm and the health of dairy cattle and farm laborers. In this sense

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[21] Michael Worboys has recently articulated why a practice-centered approach is at the forefront of current historiography. See, Michael Worboys, "Practice and the Science of Medicine in the Nineteenth Century," *Isis* (2011), 102: 1, 109-115.

the milk problem was not a stable entity in the Victorian period; it was at times a public health problem, a nutritional problem, an agricultural problem, and an economic problem. Crucial to the process by which milk became a public health problem was scientific research by epidemiologists first conducted in the 1870s who argued that milk could spread dangerous infectious diseases. Typhoid fever was the first recognized, and, I demonstrate, created the most important model for tackling public health issues in the second half of the nineteenth century. From the 1870s many Victorians recognized that chemists, medical officers of health, and veterinarians held the scientific keys to preventing milk-borne outbreaks through a greater knowledge and recognition of milk adulteration and unsanitary dairy practices. But as I show in the following pages, scientific practices and methods that aimed to prevent the milk problem were unevenly standardized in the second half of the nineteenth century. So too were the processes by which epidemiologists, chemists, veterinarians, and other medical scientists professionalized.

Why Typhoid Fever?

Historians of medicine have long been drawn to descriptions of how British public health officials in the nineteenth century combated cholera, the feared menace of Victorian society.[22] The historical narrative of how the proto-epidemiologist, John Snow,

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[22] Asa Briggs, "Cholera and Society," *Past and Present*, (1961), 119:76-96; Charles Rosenberg, "Cholera in Nineteenth Century Europe: A Tool for Social and Economic Analysis," *Comparative Studies in Society and History* (1966), 8:452-63; Norman Longmate, *King Cholera* (London: Hamish Hamilton, 1966); Michael Durey, *The Return of the Plague*: *British Society and the Cholera 1831-32*, (Dublin: Gill and MacMillan, 1979); Margaret Pelling, *Cholera, Fever, and English Medicine, 1825-1865* (Oxford: Oxford University Press, 1978), Richard Evans, "Epidemics and Revolutions: Cholera in Nineteenth Century Europe," *Past and Present* (1988), 120:123-46. More recent cultural histories include Pamela Gilbert, *Cholera and Nation:*

used statistical, geographical, and observational methods to argue that cholera was a water-borne disease, have been taken to be representative of both the *avant garde* of British epidemiology, in particular, and of scientific empiricism in Victorian public health, in general.[23] Several notable historical studies, epitomized by Charles Rosenberg's 1962 *The Cholera Years*, have demonstrated how the fear of cholera played a powerful role in catalyzing public health reform and in challenging etiological views on the causation of infectious disease.[24] Social historians used the nineteenth century experience of cholera as a lens, or tool, from which to see culture, society, politics, and the economy.

Highlighted by Erwin Ackerknecht's classic article "Anticontagionism between 1821 and 1867," historians have also used cholera was a wedge to examine fierce etiological debates that raged in the nineteenth century about the origin and communication of infectious diseases. An earlier generation of historians, exemplified by Ackerknecht, were wedded to the dichotomous notion that cholera was "the site of the

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Doctoring the Social Body in Victorian England (Albany, NY: State University of New York Press, 2008); Christopher Hamlin, *Cholera: The Biography* (Oxford: Oxford University Press, 2009).

[23] Studies on Snow proliferate the historical marketplace. The best accounts are Peter Vinten-Johansen, et al., *Cholera, Chloroform, and the Science of Medicine* (Oxford: Oxford University Press, 2003); Sidney Chave, "John Snow, the Broad Street Pump, and After," *The Medical Officer* (1958), 99:347-49; George Davey Smith, "Behind the Broad Street Pump: Aetiology, Epidemiology, and Prevention of Cholera in mid-19th century Britain," *International Journal of Epidemiology* (2002), 31:920-32; David Lilienfeld, "John Snow: The First Hired Gun?" *American Journal of Epidemiology* (2000), 152:4-9; Jan P. Vandenbroucke, "Changing Images of John Snow in the History of Epidemiology," *Sozial und Praventivmedizin* (2001), 46:288-93.

[24] Charles Rosenberg, *The Cholera Years: The United States in 1832, 1849, and 1866* (Chicago: Chicago University Press, 1962).

grand battle between old and new, error and truth, anticontagionism and contagionsim."[25] Recently historians such as Margaret Pelling, Christopher Hamlin, and Michael Worboys have provided a more nuanced account which makes clear that most Victorians occupied a more centrist, or contingent-contagionist stance with regard to complex debates over germ theories.[26] Such a historiographical revelation has important implications for how historians understand the development and spread of the germ theory of disease, generally recognized as one of the most pivotal and transformative concepts in the history of western medicine. Although in gestation from the 1970s with the work of Richard Shryock, the idea that there were a multiplicity of germ theories, rather than one single, unified concept is now beyond doubt following Michael Worboys' 2000 revisionist account *Spreading Germs*.[27] By refocusing historical attention on how a multiplicity of germ theories were constructed, debated, and put into practice, Worboys has shifted historical attention away from grand theorizing about the universal acceptance

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[25] Christopher Hamlin, *Cholera: The Biography* (Oxford: Oxford University Press, 2009), 328. Roger Cooter has provided a revisionist account of this dichotomy, see Roger Cooter, "Anticontagionism and History's Medical Record," *The Problem of Medical Knowledge: Examining the Social Construction of Medicine*, ed. Peter Wright and Andrew Treacher (Edinburgh: Edinburgh University Press, 1982), 87-108.

[26] Margaret Pelling, *Cholera, Fever, and English Medicine,* John Eyler, *Victorian Social Medicine,* Christopher Hamlin, "Politics and Germ Theories in Victorian Britain: The Metropolitan Water Commissions of 1867-9 and 1892-3," in R. MacLeod, (ed.), *Expertise and Government: Specialists, Administrators, and Professionals, 1860-1919* (Cambridge: Cambridge University Press, 1988), 111-123, and Michael Worboys, *Spreading Germs.* See also Timothy Alborn, "Insurance against Germ Theory: Commerce and Conservatism in Late-Victorian Medicine," *Bulletin of the History of Medicine* (2001), 75: 406-445.

[27] Michael Worboys, *Spreading Germs*, 1-3. See also, John Harley Warner and Nancy Tomes, "Rethinking the Reception of the Germ Theory of Disease: Comparative Perspectives," introduction to special issue of *J. Hist. Med. And Allied Sci.* (1997), 52:7-16. Shryock's work is indicative of an earlier recognition of the plurality of germ theories, but, as Worboys notes, Shryock nonetheless conformed to the mainstream historiographical view that after 1870 the "true" germ theory emerged. See, Richard Shryock, "Germ Theories in Medicine Prior to 1870: Further Comments on Continuity in Science," *Clio Medica* (1972), 7: 81-109.

of the germ theory and its consequent bacteriological, scientific, and laboratory "revolutions," to the ways in which "the development and uses of germ theories varied across medicine, with groups constituting germs differently, depending on their interests, resources and work."[28] Worboys maintains that "the spread of germ theories, practices and ideologies showed uneven and combined development, which militates against any talk of revolutions, if we take that term to refer to rapid and radical change."[29]

This study is not of cholera, or solely of Victorian debates over the multiplicity of germ theories, although both the particular issue of cholera and the general debate over germ theories loom large here. Essential to the development of the milk problem was the more historiographically overlooked, but equally pervasive persistence of typhoid fever in the second half of the nineteenth century.[30] At the beginning of the period currently under study, around 1850, typhoid was masked in etiological obscurity. Most physicians, following well-established Hippocratic-Galenic medical doctrine, believed that typhoid was one of several forms of 'fever', a general nosological category. By the early twentieth century, where this project ends, typhoid was recognized as a specific infectious disease caused by a single bacterium, *b. Typhosus.* The process by which typhoid gained etiological specificity, however, was fraught with complexity, contingency, and confusion. Typhoid was, I show in this study, in many ways more culturally malleable than other deadly infectious diseases of the nineteenth century.

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[28] Worboys, *Spreading Germs*, 278.

[29] Ibid.

[30] Luckin has argued that in the case of London, typhoid was responsible for the largest number of deaths between 1840 and 1910. See William Luckin, *Pollution and Control: A Social History of the Thames in the Nineteenth Century* (Bristol: Adam Hilger, 1986), 118.

Throughout the nineteenth century British physicians and public health officials aligned typhoid with variety of infectious diseases in order test etiological hypotheses, push cultural rhetoric, or demand an increased role for state or local public health engagement. Early in the nineteenth century, for example, physicians grouped typhoid with typhus, while later epidemiological and statistical studies seemed to show that typhoid was more akin to cholera, particularly in its water-borne communication. By the 1870s pathologists, epidemiologists, and chemists had made the etiological picture of typhoid even more complex; some argued that typhoid could be spread zoonotically, like tuberculosis, while others focused on its spread through food, most importantly milk, and aligned the disease with other milk-borne infections such as scarlet fever and diphtheria.[31]

Typhoid fever was the first disease linked to milk, and outbreaks of milk-borne typhoid received considerable attention by the British public, politicians, and scientists. Typhoid was the preeminent "filth disease" of the Victorian period, connected to such material conditions as inadequate sewerage, water supply, and decomposing refuse, as well as social conditions such as behavior and class. "Its universal prevalence in hot and cold climates, in town and country, in the houses of the rich and the hovels of the poor," noted W. Stewart, Honorary Surgeon to the Beckett Hospital, Barnsley, in 1877, typified the contemporary concern over complex

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[31] This study then provides a comparative British precursor to Judith Walzer Leavitt's history of typhoid in the United States in *Typhoid Mary: Captive to the Public's Health* (Boston: Beacon, 1996).

etiological questions about disease causation and preventive public health.[32] Such a sentiment made clear to contemporaries that typhoid did not discriminate.

This project confirms what historians Margaret Pelling and Lloyd Stevenson have long suggested, namely that typhoid fever was one of the most important infectious diseases of the nineteenth century.[33] I provide new insight into why typhoid mattered to Victorian scientists, the government, and to the public. Typhoid remained at the center of public health discourses because of its continued endemic presence and high mortality and morbidity, but also because its ability to be spread through water and especially milk enabled the disease to cut across class lines and thus challenge cultural perceptions about purity and pollution. Typhoid's complex etiology and epidemiology were hotly disputed particularly in the period from 1860 to 1900. It was during this period that local epidemiological, chemical, and bacteriological studies made significant headway in answering difficult etiological questions, many of which were not fully sorted out in the Victorian period. Typhoid fever remained at the center of public health discourses throughout the nineteenth century because it could be used as a wedge between rural and urban, local and state, industry and regulation, and scientific expertise and laity.

This study is not purely a socially-driven history of disease, although a clearer historical picture of the social impact of typhoid emerges by the end of my narrative. More importantly though, this study delves into deep-seated historical questions about the growth of Victorian government, the construction of scientific practices, and the

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[32] W. Stewart, "A New Theory of the Origin of Typhoid Fever," *BMJ* 1 (10 March 1877), 289-290, 289.

[33] Margaret Pelling, *Cholera, Fever, and English Medicine*, Lloyd Stevenson, "Exemplary Disease: the Typhoid Pattern," *J. Hist. Med. Allied Sci.* (1982) 37:159-181.

foundation of complex and ever-changing cultural notions of purity, filth, and adulteration.[34] My analytical framework combines, as the title suggests, a study of typhoid fever as it was related to cow's milk in the second half of the nineteenth century.[35]

My central argument is that the cultural construction of milk as a wholesome, healthful food were intimately tied to and in some ways challenged by the rapidly developing sciences of epidemiology and analytical chemistry, creating a framework for public health policies.[36] In the second half of the nineteenth century British nutritionists began to show the nutritive advantages of milk consumption. At the same time, scientific groups such as epidemiologists, chemists, and pathologists were characterizing milk as easily polluted and a substrate for deadly epidemic diseases. For the rest of the nineteenth century different interest groups fought for the right to orchestrate a public health response to this dilemma.

Why Milk?

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[34] Alison Bashford has explored the Victorian concepts of purity and pollution in light of a gendered argument against an overtly masculine medicine. I am doing something quite different here. See A. Bashford, *Purity and Pollution: Gender, Embodiment and Victorian Medicine* (London: Macmillan, 1998).

[35] The vast majority of historical studies on milk and disease have focused on tuberculosis and scarlet fever and diphtheria. See, Kier Waddington, *The Bovine Scourge: Meat, Tuberculosis and Public Health, 1850-1914* (Woodbridge: Boydell, 2006), Susan Jones, "Mapping a Zoonotic Disease: Anglo-American Efforts to Control Bovine Tuberculosis Before World War I *Osiris* (2004), 19:133-148, Leonard G. Wilson, "The Historical Riddle of Milk-borne Scarlet Fever," *Bull. Hist. Med*., (1986) 60: 321–42; and John Eyler, "The Epidemiology of Milk-borne Scarlet Fever: The Case of Edwardian Brighton," *Am. J. Public Health* (1986) 76:573–84.

[36] I employ the use of construction largely in lieu of the more historiographically prevalent 'framing', here following Worboy's contention that "knowledge and practice [are] produced from social and material interactions." See Worboys, *Spreading Germs*, 10-14. The constructivist argument in the history of science is well laid out by Jan Golinski in *Making Natural Knowledge: Constructivism and the History of Science* (Cambridge: Cambridge University Press, 1998). For the historiography on framing disease, see Charles Rosenberg, introduction to *Framing Disease: Studies in Cultural History* (New Jersey: Rutgers University Press, 1997).

Milk played a variety of roles in Victorian society: a nutritive staple especially for children and invalids, an economic product to milk producers, and a symbol of purity, agriculture, and pastoralism in an increasingly urbanized and industrial world. However, dairy producers routinely adulterated the milk they sold to maximize profits (additives included water, chalk, and annatto, a coloring agent). Lack of governmental regulation in the first half of the nineteenth century allowed for such practices. It was not until mid-century that efforts by reformers such as the microscopist Arthur Hill Hassall and medical journalist Thomas Wakley identified and called this widespread practice into question. To these reformers, selling adulterated milk as "genuine" or "pure" was morally dishonest because it robbed the collective purse of the public and decreased the nutritional value of milk. Intensifying these reformist claims, in the 1870s a growing body of scientific evidence argued that such milk posed a serious public health threat; milk from diseased cows, or milk adulterated with disease-charged water, could spread deadly epidemics. Milk had been constructed as nature's perfect food, one that embodied universal nutrition and natural purity, but now it was also tied to filth, poverty, and disease.

Historians have typically viewed the rise of milk drinking as an unproblematic unfolding of advances in the scientific knowledge about the nutritive properties of milk and a release of the economic constraints imposed by the last vestiges of pre-industrial agricultural modes of production and transportation.[37] Controlling the milk problem, in turn, has been seen

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[37] John Burnett, *Plenty & Want: A Social History of Diet in England from 1815 to the Present Day* (London: Thomas Nelson, 1966). Peter Atkins has provided a plethora of studies on milk in the nineteenth and twentieth centuries, but his studies remain committed to an economic and legislative analysis. See, Peter Atkins, "Sophistication Detected: or, the Adulteration of the Milk Supply, 1850-1914," *Social History* (Oct. 1991), 16;3:317-339, and Peter Atkins, "The Growth of

as the result of a successful public health campaign that emerged in the early twentieth century, one waged predominately by bacteriologists and one that focused on structural developments such as infant milk depots.[38]

Examination of the milk problem as it emerged in the second half of the nineteenth century provides a window into broader British debates about the role of scientific experts and the state in public health, a heated issue into the early twentieth century. Although deadly infectious diseases such as typhoid fever, cholera, and smallpox annually plagued Britons and decimated colonial populations, preventive measures were seen as costly and cumbersome. As a result, public health problems were often sites for contests of scientific knowledge and professional expertise. Public health leaders such as Edwin Chadwick initially relied on sanitary engineering but by the 1860s epidemiology and chemistry became the most important tools for public health officials keen to understand communicated diseases. In the 1880s and early 1890s however, bacteriology and microbiology became central scientific frameworks, although traditional sciences such as epidemiology and chemistry were not uniformly

London's Railway Milk Trade, c. 1845-1914," *Journal of Transport History*, new series (1978), 4:208-26.

[38] Most the secondary historical literature on public health and milk has focused on the early twentieth century, and particularly on infant health and maternal mortality. See, Deborah Dwork, *Is War Good for Babies and Other Young Children: A History of the Infant and Child Welfare Movement in England, 1808-1918* (London: Tavistock, 1987), Deborah Dwork, "The Milk Option: An Aspect of the History of the Infant Welfare Movement in England, 1898-1908," *Medical History* (1987) 31:51-69, Rima Apple, "Constructing Mothers: Scientific Motherhood in the Nineteenth and Twentieth Centuries," *Social History of Medicine* (1995), 8:161-78, Angus H. Ferguson, Lawrence T. Weaver, and Malcolm Nicolson, "The Glasgow Corporation Milk Depot, 1904-1910 and its Role in Infant Welfare: An End or a Means?," *Social History of Medicine* (2006) 19:443-460, and Lawrence T. Weaver, "'Growing Babies': Defining the Milk Requirements of Infants, 1890-1910," *Social History of Medicine* (2010) 23:320-337.

displaced.[39] These changes took place against a backdrop of late Victorian life that was intent on morality and purification in England and its empire, although the latter topic is significantly out of the scope of this project. Nonetheless, it becomes clear from this study that public health played a vital role in accomplishing British imperial aims even at home.

In five chapters I trace the social, cultural, political, and scientific origins of the milk problem and the co-constituted public health response. Chapter one situates the scientific and cultural origins of the anti-adulteration reform movement that emerged in the 1850s, providing the historical context for how milk-borne disease became a social problem. Central to the anti-adulteration movement, I ague, was the microscopical and chemical research into food adulteration by Arthur Hill Hassall and Henry Letheby as part of the *Lancet's* Analytical Sanitary Commission, instituted by the *Lancet*'s editor Thomas Wakley. The widespread publicity of the commission, which lasted from 1851 to 1854 in *The Lancet*, opened a significant debate about the extent and danger of food adulteration. This led to a Parliamentary Select Parliamentary Committee on Food Adulteration, and culminated in the first Parliamentary Act to prevent food adulteration in 1860. Chapter one carefully traces the scientific practices of the *Lancet's* Analytical Sanitary Commission, revealing that early scientific debates over adulteration centered on the relative importance of microscopy and

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[39] Anne Hardy and Michael Worboys have recently made the claim that British public health officials were cautious in adopting the methodologies and theoretical explanations of laboratory-based bacteriology. My study significantly advances this claim by addressing the roles that epidemiology and chemistry played in public health. Moving beyond the work of Hardy and Worboys, I contend that public health problems, such as the milk problem, were sites for contests of professional authority, as Christopher Hamlin and William Luckin have demonstrated in the case of Victorian water analysis. See, Christopher Hamlin, *A Science of Impurity,* William Luckin, *Pollution and Control.* On the relationship between microbiology and bacteriology, see K. Vernon, "Pus, Sewage, Beer and Milk: Microbiology in Britain, 1870-1940," *History of Science* (1990), 28: 289-325.

analytical chemistry, with Hassall defending the former and Letheby the latter. Chapter one then turns to a close reading of the problematic regulatory philosophies from 1855 to 1875 by following various Select Parliamentary Committees on Food Adulteration, and the resultant Parliamentary Legislation on food adulteration in 1860, 1872, and 1875. Such legislation was fraught with legal and technical difficulty, leaving one anonymous writer in the satirical journal *Punch* to question "who will deliver us from the adulterators? I looked in vain to Parliament, now I appeal in hope to *Punch*."[40] Throughout this chapter I rely on the methodological work of historian Oliver MacDonagh, who in the 1950s and 1960s established a powerful model of nineteenth century administrative change in Britain. While I return to the relative importance of MacDonagh's model for a nineteenth century revolution in government in chapter five, chapter one illustrates the longevity of the model in framing the complex ways in which social problems were constructed in the nineteenth century. Working beyond MacDonagh's model, which implies a process of inevitability, as outlined in chapter one, I demonstrate the contingencies, or plurality of meaning of adulteration to traders and manufacturers, scientists, social groups, and government officials. In particular, I argue that despite the consistent exposure by prominent medical scientists such as Arthur Hill Hassall that adulteration posed a series risk to the public's health, adulteration was primarily framed as an economic problem until the 1870s. From the 1870s adulteration was also understood as a public health problem, the reasons for which are explored in chapter three.

Chapter two transitions from the cultural, scientific, and political debates over adulteration to the etiological questions and epidemiological practices of typhoid fever. I begin

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[40] Cavendo Tutus, "A French Check Upon Trade Cheats" *Punch* (1 October 1870), 59:145.

by demonstrating the frustration of British physicians and medical scientists in categorizing, diagnosing, and treating typhoid fever from the 1840s to the 1860s, particularly focusing on the pathological studies of William Jenner and A.P. Stewart, who argued that typhoid fever was distinct from typhus fever. Following the rise of the statistical and epidemiological methods of William Farr, John Snow, and William Budd, I argue that by the 1860s British medical scientists gradually understood typhoid fever vis-à-vis epidemiologically based claims rather than pathologically based ones.[41] Cholera thus became an important epidemiological and statistical model, and practitioners soon considered typhoid and cholera the preeminent water-borne diseases. Chapter two fills a much needed historical gap about the professional and institutional rise of the science of epidemiology in the decades from mid-century. I trace epidemiological research on water-borne and later milk-borne typhoid fever to argue that epidemiology was forged in three connected Victorian institutional and practical settings; at the Epidemiological Society of London, at the Association of Medical Officers of Health, and at the Medical Department of the Local Government Board (housed before 1871 in the Privy Council).

Chapter three bridges the roughly separate narratives built in chapter one about the cultural awakening and early scientific interest in food adulteration, and in chapter two about epidemiological practices and the endemic threat of typhoid fever. These discourses were bound beginning in 1870s when a number of forward thinking epidemiologists used previously established methods in tracing water-borne outbreaks to suggest that milk could also spread

[41] Statistical thinking in epidemiology was crucial to this transition, but, as I show in chapter two, epidemiologists were not statistically deterministic, and often relied on qualitative tools as much as quantitative ones. On the development of statistical thinking in the late nineteenth century, see Theodore M. Porter, *The Rise of Statistical Thinking, 1820-1900* (Princeton: Princeton University Press, 1986).

typhoid. In this chapter I use two of the earliest and most influential milk-borne epidemiological investigations; one conducted by the medical officer of health for Islington, Edward Ballard, in 1871, and another primarily conducted by medical inspector for the Medical Department of the Local Government Board, John Netten Radcliffe, in 1873. Connecting milk to typhoid fever was an important etiological finding that strengthened evolving ideas about the causation and communication of infectious disease, but it also led British epidemiologists to ask new questions and devise new methods of field practice, in turn necessitating calls for new types of public health supervision of dairy farms, dairy consumption, and milk transportation. Epidemiological studies of milk-borne typhoid that began in the 1870s heated up already contentious debates about food adulteration, the governmental supervision of public health, agricultural productivity, and the distinct role of medical experts such as medical officers of health, the Medical Department of the Local Government Board, chemists, and especially veterinarians.

The newly minted milk-borne hypothesis gained significant explanatory power by the mid 1870s, as it was further tested and gradually adopted by local medical officers of health, public health leaders, and medial scientists. Yet, epidemiological proof of milk-borne outbreaks was largely effective post-facto, and public health officials increasingly turned to the prevention of milk adulteration and the supervision of dairy farms, the subject of chapters four and five.

Chapter four explores the uneven application of food adulteration legislation, particularly the 1875 Sale of Food and Drugs Act. The latter act had two important features; all local authorities were mandated to hire public analysts, and local traders could appeal the certificates of local public analysts by sending the suspected sample to the Government Laboratory of the Inland Revenue Department at Somerset House. Milk adulteration loomed large in the fierce debates that ensued between local public analysts (largely through their professional society The Society of Public Analysts and journal *the Analyst*) and the Somerset House Laboratory over methods in conducting analytical tests, interpreting results, and defining what constituted normal and adulterated milk. This was, I argue, an intra-professional contest of scientific authority within the nascent profession of analytical chemistry, and this chapter significantly advances our historical understanding not only of the intricacies of how practical chemistry developed in the second half of the nineteenth century, but also how the prevention of food adulteration was mired by contests between scientists.

Chapter five examines the decisive role that the dairy industry had in shaping the milk problem in the last two decades of the nineteenth century. Epidemiological and chemical studies continued to be conducted throughout Britain which reinforced the dictum that unsanitary dairy practices were the leading cause of milk-borne outbreaks. Yet, Parliamentary legislation continued to be weak, ineffectual, and most importantly, permissive. In chapter five I demonstrate the important ways in which a significant portion of the dairy industry, using the rhetoric of scientific progress and technological innovation, consolidated the dairy industry to favor large-scale, aggregate companies who relied on veterinary, chemical, and sanitary authorities. The earliest and most innovative of these companies was the Aylesbury Dairy Company, whose new brand of scientific entrepreneurship embraced new dairy technologies such as cream separators, individual milk bottling devices, and refrigeration tanks, and employed full-time health officers, veterinarians, public analysts, and sanitary engineers. Dairy related science was without uniformity, however, leading to conflict between sanitary and veterinary experts about who was better suited to supervise dairies and protect the health of people, dairy cows, and milk. Dairy activism was successful in spite of defunct and permissive Parliamentary legislation, which often pitted veterinary authorities against sanitary authorities.

The focus of this project on milk-borne typhoid necessitates teasing out several apparently disparate narratives, such as debates about food adulteration, the role of government, dairy farming practices, and the uneven growth and professionalization of sciences such as epidemiology, chemistry, veterinary medicine, and bacteriology. Ultimately this is a story about how, in the backdrop of a social crusade for state medicine, milk became defined as a public health threat in the second half of the nineteenth century, and how different scientific groups used the milk problem to suit their own disciplinary or political goals. This project informs how historians have understood the growth and professionalism of medical science in the nineteenth century, particularly the less researched fields of epidemiology and analytical chemistry, and the changing relationship between science and government. Milk-borne typhoid was only one of a concomitant number of social problems that late Victorian public health reformers faced. Examining the milk-problem highlights the ways in which social problems became public health problems in the nineteenth century, a process that historians have long neglected. That said, this project prioritizes the importance of scientific practices in the nineteenth century.

Milk became a public health problem as a result of a complex circulation of scientific knowledge that cut across several emerging disciplines.[42] But milk-related science was being practiced in very different locations and institutional settings, from urban laboratories to rural field-sites such as dairy farms. This was particularly the case for epidemiology, veterinary science, and analytical chemistry, highlighting David Livingstone's recent claim that "science is a cultural *practice*, then, is exemplified with particular clarity in the field. For here hands-on experience, routine improvisation, and performative rationality are highly valued."[43] Epidemiological inquiry was local in character, this was especially true of investigations of endemic diseases such as typhoid fever which were rampant in rural and urban locations. Examining the local production of scientific knowledge is fundamental to the process by which scientific theories were generated in the late Victorian period. Moreover, the circulation of scientific knowledge between (and sometimes within) different scientific fields necessitated adaption and often translation. This process was exacerbated when epidemiologists, veterinarians, or chemists tried to make their scientific claims important to politicians and the British public. Nowhere was this more important in the late nineteenth century than in the case of milk, as British culture and British science increasingly put that lacteal substance on a pedestal of purity and nutritional necessity. Yet the persistence of milk-borne typhoid fever raised issues about the relations between town and country, urban dairies, commercial economic interests, and the boundaries of local and central governance,

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[42] This is largely a constructivist argument that follows some of the ideas laid out by, Bruno Latour in *The Pasteurization of France* (Cambridge, MA: Harvard University Press, 1988), and more recently by James Secord in "Knowledge in Transit," *Isis* (2004), 95: 654-672.

[43] David Livingstone, *Putting Science in its Place: Geographies of Scientific Knowledge* (Chicago: University of Chicago Press, 2003), 45.

cementing the milk issue at the center of public health debates in the late nineteenth and early twentieth century.

While the Victorian pioneers of state medicine such as Simon and his contemporaries William Farr, Edwin Chadwick, and Henry Wyldbore Rumsey were instrumental in framing and debating the need for a coherent and organized system of the governmental protection of the health of the British population, it was ultimately up to Edwardian public health leaders such as Arthur Newsholme and George Newman to bring such a complex and integrated system to fruition. In time state medicine transitioned to preventive medicine, and then to social medicine by the mid Edwardian period, and this project confirms that the process was fraught with contingency.[44] The milk problem was certainly not solved by the end of the nineteenth century, although to most late Victorian scientists there was a fairly clear-cut solution. Manchester bacteriologist and milk specialist Sheridan Delepine recommended in 1897 that pathogenic materials could be kept out of milk through proper inspection, cleanliness at the farm and of milk vessels, rapid transit, and of keeping of milk at as the lowest temperatures as possible. He concluded that, “I do not offer these as new suggestions, but as well recognised desiderata, put forth by many authorities, and which the present investigations show in a remarkably clear manner to be of great importance.”[45] Twentieth century public health reformers brought new tools to bear on the milk problem, but the

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[44] This general pattern was long ago recognized by George Rosen in “Approaches to a Concept of Social Medicine: A Historical Survey,” *The Millbank Memorial Fund Quarterly* (Jan., 1948), 1;26: 7-21.

[45] Sheridan Delepine, “The Examination of Cow’s Milk for the Detection of Pathogenic Properties,” *The Journal of Comparative Pathology and Therapeutics*, vol. 10, no.3 (30 September 1897), 189-206, 206.

framework was essentially a product of Victorian negotiations between science, the British public, and the state. This project situates the construction of scientific knowledge in nineteenth century Britain as deeply embedded within local (which could mean rural or urban) investigative scientific practices.[46] I eschew a common misunderstanding that Victorian science was produced in urban metorpoles and simply extended to rural locations. The recognition of rural and urban environments was crucial to the process by which epidemiologists and analytical chemists framed the importance of sanitary practices at rural dairy farms. Late Victorian politicians often misconstrued scientific evidence, and produced legislation that either favored industry or political incumbents, this in spite of the rhetoric of the public good. Often in the nineteenth century this was because scientists themselves disagreed not only about methodology, but interpreting results and making recommendations.

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[46] Historians, philosophers, and sociologists are only beginning to recognize the myriad number of ways that milk is, and has been, entrenched in social, economic, scientific, environmental, and political discourses. Two recent books published while this project was nearing completion highlight this scholarly trend, and help put this dissertation into sharper focus and illustrate its felicitous publication; Peter Atkins 2010 *Liquid Materialities* and Richie Nimmo's 2010 *Milk, Modernity, and the Making of the Human: Purifying the Social*.

Chapter One: Cheated *and* Poisoned: Defining Adulteration in Victorian Britain

It has been a tacit assumption in the United States and the United Kingdom for most of the twentieth century that food safety is an integral part of a modernized, developed political economy. The presumption is predicated upon two ideals: that a rigorous system of governmental regulation will protect the public's health as well as the public's wealth, and the unfaltering view that the scientific evidence of what constitutes food safety is theoretically unproblematic and methodologically straightforward. The former, what we might call social assumption, has recently been criticized by historians such as Simon Szreter as representative of a neoliberal concession made by western governments to global corporations.[1] The latter, what we might call scientific assumption has also recent been criticized by historians such as Peter Atkins, by examining repeated food-scares that have occurred throughout the twentieth century.[2] The inherent tension that historians such as Szreter and Atkins have identified highlights the ways in which scientific experts, but not scientific expertise, has been challenged to suit social rhetoric or political ends. Yet the question of expertise in protecting the public food supply was not a product of the twentieth century, but part of a longstanding, post-Enlightenment debate between health and wealth, where contests of scientific authority, public agitation, and governmental indecisiveness have been the norm, rather than the recent exception. In this context debates about food safety were most intense in Britain from the 1850s, when

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[1] Simon Szreter, *Health and Wealth: Studies in History and Policy* (Rochester: University of Rochester Press, 2005), particularly chapters eleven and twelve.

[2] Peter Atkins and I.R. Bowler, *Food in Society, Economy, Culture, Geography* (London: Hodder, 2000).

varying scientific groups such as physicians and chemists sought to use the public concern over food safety as a way to bolster their respective social authority and thus professionalize. It was also in the period between 1850 and 1900 that the British government underwent a massive administrative restructuring, replacing weak and permissive laws administered by local authorities with forceful and compulsory ones administered by civil servants centrally located in Whitehall.

In 1958 historian Oliver MacDonagh published an influential article in which he proposed a model for the nineteenth century "revolution in government."[3] In that essay, and the subsequent work he published in the 1960s and 1970s, MacDonagh explained both how and why the *laissez-faire* individualism of early Victorian Britain was replaced by a collectivist model of state intervention.[4] MacDonagh articulated a five-stage model. In the first half of the nineteenth century Parliament passed a number of remedial, and often permissive legislative acts to curb the exposure of perceived social evils, such as outbreaks of infectious disease or industrial health crises. Early legislative acts were permissive in nature and nearly always ineffectual, necessitating the employment of inspectors to gather evidence and enforce Parliamentary acts. The precarious situation of the underpaid and overworked inspectors, coupled with defects in the legislative acts, produced a gradual process of the closing of loopholes and the tightening of administrative screws. In the third stage central administrative boards were created, but

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[3] Oliver MacDonagh, "The Nineteenth-century Revolution in Government: A Reappraisal", *Historical Journal* (1958), 1:52-67.

[4] Oliver MacDonagh, *A Pattern of Governmental Growth: the Passenger Acts and their Enforcement* (London: MacGibbon & Kee, 1961), Oliver MacDonagh, *Early Victorian Government* (London: Weidenfeld and Nicolson, 1977).

enforcement remained ineffective, necessitating more flexible and continuous legislation; power was put into the hands of local governments, but supervised by central administrators. In the fourth stage the failure of local government was gradually replaced by the creeping arms of centralized administration. The fifth stage saw the culmination of the process. From there, as social problems arose, they were remedied at the central level.

Some historians have subsequently found it unproblematic that a so-called revolution in administrative government occurred. A modern collectivized state did emerge near the end of the nineteenth century, one that was increasingly defined by reliance on scientific, administrative, and technological expertise. Historians have oft criticized, however, the mechanism that MacDonagh attributed to the process, that the nineteenth century revolution was propelled by a self-reinforcing momentum, what MacDonagh likened to a process of internal dynamism. Under the banner of the new social history, some historians such as Steven Novak and Peter Dunkley claimed that MacDonagh's post-war Anglo-centric model reeked of Whiggish teleology. The revolution was never inevitable, they argued, and certainly not linear.[5] The debate was renewed in the late 1980s when a number of historians applied MacDonagh's model, or at least its foundational ideas, to different fields, such as engineering, law, public health, and colonial administration. Such revisionism culminated in a volume edited by Roy

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[5] Steven Novak, "Professionalism and Bureaucracy: English Doctors and the Victorian Public Health Administration," *Journal of Society History*, vol. 6, no. 4 (Summer, 1973), 440-462, Peter Dunkley, "Emigration and the State, 1803-1842: The Nineteenth-century Revolution in Government Reconsidered," *The Historical Journal*, vol. 23, no. 2 (Jun., 1980), 353-380. After MacDonagh' original 1958 article was published, other administrative historians such as Henry Paris attacked MacDonagh for not neglecting the influence of Benthamite ideology. See, Henry Paris, "The Nineteenth-Century Revolution in Government: A Reappraisal Reappraised," *The Historical Journal*, vol. 3, no. 1 (1960), 17-37.

MacLeod in 1987 titled *Government and Expertise*.[6] The central theme of MacLeod's volume was an examination of the role of experts in Victorian government, a fundamental category according to MacDonagh, as experts provided the fuel to the self-propagating juggernaught of the revolution. Who were considered 'experts', and how they obtained 'expertise' were central questions in the volume, whose authors problematized the role of Victorian engineers, Metropolitan Water Commissioners, and medical officers of health. *Government and Expertise* was the first to attempt to remedy the imprecise nature of MacDonagh's historical mechanism, and to explore why, to borrow a phrase from MacDonagh, "the correlation between social problem and administrative remedy is seldom exact."[7] Yet, as a generation of science studies scholars have since identified, the historiographically driven question of scientific expertise has vital implications beyond the scope of administrative governmental reform. Moreover, it penetrates deep-seated questions about the modern construction of scientific practices and the contestation of scientific theories.

Graeme Gooday, for example, has recently put such a constructivist critique to use by examining the concept of expert authority in late Victorian British science. Exploring the traditional sociologically driven dichotomies between expertise and laity, and expertise and authority, in the context of debates about electricity, Gooday has forced historians to consider how

> The acquisition and maintenance of scientific authority in Victorian Britain was thus something of a contingent matter, not so readily demarcated after all from the

[6] Roy MacLeod (ed.) *Government and Expertise.*
[7] Oliver MacDonagh, "The Nineteenth Century Revolution in Government," 55.

> partisan world of either expert or entrepreneurial cultures. Further research on the public careers of such leading scientific figures might thus usefully shed more light on the ways in which their attainment and maintenance of 'authority' was not necessarily just a function of professional-institutional status but had to be managed to avoid the controversies that bedeviled the role of the 'expert.'[8]

The crux of Gooday's argument is that historians of science, technology, and medicine should reevaluate the construction, maintenance, and contestation of scientific expertise in the post Enlightenment period. Nowhere is this more important than in studies of nineteenth century science, as it was in the nineteenth century, after all, that most sciences began to draw institutional boundaries and professionalize, although no uniformly.

Questions of scientific expertise were at the center of contemporary discourses about public health in the nineteenth century. From the 1850s a new class of experts emerged in Britain who made specific expert claims in making governmental decisions about public health based on their perceived scientific authority. These experts were a diverse lot; engineers, vital statisticians, epidemiologists, analytical chemists, microscopists, bacteriologists, physicians, and veterinarians. Claiming specialized expertise about nature, disease, the body, or the environment was a rhetorical way for many of these groups to professionalize, and it should come as no surprise that there was both intra-professional and inter-professional conflict. Scientific claims for expertise, even rhetorical ones, in turn had critical implications for how social problems were

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[8] Graeme Gooday, "Liars, Experts, and Authorities" *History of Science* (2008), 46: 431-456, 449.

constructed in the Victorian period. Scientific expertise, moreover, was at the center nineteenth century revolution in government.

Food adulteration was one of the most important social problems of the nineteenth century. It was also an issue rife with various claims of scientific expertise. At the annual meeting of the National Association for the Promotion of Social Science (NAPSS) in 1868, John Postgate read a paper titled, "Legislation on Adulteration of Food, Drinks, and Drugs." Postgate, from Birmingham, was one of the leading British anti-adulteration reformers. At the age of eleven he began working as a grocer's boy, earning his way to study at the Leeds School of Medicine, obtaining L.S.A in 1843, M.R.C.S. in 1844, and F.R.C.S. in 1854.[9] In 1854 Postgate wrote an influential letter to Birmingham Members of Parliament, William Scholefield and George Frederick Muntz, calling for the appointment of pubic analyzers, and the formation of a Select Committee on Food Adulteration in the House of Commons. This began Parliamentary involvement and a series of protracted debates into the governmental protection of food, and later drugs. Specifically, debates in two Select Parliamentary Committees, one in 1854 and another in 1874, led to the adulteration Acts of 1860, 1872, and 1875. Postgate's role was that of an anti-adulteration proselytizer; he traveled throughout Britain between 1850 to 1870 giving public lectures theatrically analyzing local food and drug samples.[10] His 1868 speech to the NAPSS exemplified his goal of more public recognition of the failings of the permissive 1860 Adulteration Act, in particular, and a more widespread discourse

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[9] Anon., "Obituary of John Postgate," *BMJ*, vol. 2, no.1085 (15 October 1881), 651.

[10] Review of Postgate's 1868 speech in "Miscellaneous," Transactions of the National Association for the Promotion of Social Science (London: Longmans, Green, Reader, and Dyer, 1869), 506-508.

against adulteration. By 1870, at the annual meeting of the NAPSS in Newcastle, Phillips Bevan, anti-adulteration reformer and editor of the *Food Journal,* was rhetorically optimistic in noting that,

> I am happy to perceive signs of an awakening to more common sense and greater earnestness of thinking in these and kindred matters, and this awakening would be still more rapid if people would but take the trouble to reflect what adulteration of our food means. It does not end with an unpleasant taste or an unappetizing meal: it is far beyond that: it means the gradual poisoning of a people, the lowering of the physique of a whole nation, the stunting of our growth, the rapid deterioration of our constitution, while morally it means a daily and constant fraud practiced by the seller on the buyer…it is one of those insidious sappings of a nation's honesty, of which we have, unfortunately, learnt of late years to make so light.[11]

Co-opting the adulteration problem to ignite social fears of national degeneration was a common tactic from the mid nineteenth century, and one that gained significant prominence in Britain by the end of the century with conscription for the South African War.[12]

Concerns about food adulteration were at the heart the national British consciousness, what Mary Poovey and Pamela Gilbert have recently called the Victorian

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[11] Phillips Bevan, "What Legislative Matters ought to be taken to Prevent the Adulteration of Food, Drink, and Drugs?" in Transactions of the National Association for the Promotion of Social Science (London: Longmans, Green, Reader, and Dyer, 1871), 391.

[12] National degeneration also became an important biological topic by the end of the nineteenth century. See, for example, Edwin Ray Lankester, *Degeneration: A Chapter in Dawrinism* (London, 1880), and James Cantile, *Degeneration amongst Londoners* (London, 1885).

'social body.'[13] By the 1860s the prevention of adulteration was firmly rooted in Victorian middle class values, integral to what historians have called the Victorian 'spirit of reform.' As Patrick Brantlinger has shown, by the middle decades of the nineteenth century middle class Britons were more politically active in participating in social reform. As middle class Britons became more interested in social problems such as food adulteration, culturally entrenched categories such as purity and pollution became tools to cut across class-based political divisions.[14] Adulterated food was likened to filth, disease, and moral depravity, conditions rampant amongst poor urban Britons. Pure food meanwhile, was likened to cleanliness, health, moral fortitude, and (it was clear above for Bevan), the enlightened British upper class citizen and the superiority of the British Empire.[15]

The heated debate that followed the reading of Bevan's 1868 paper at the NAPSS centered on the theoretically reflexive, but practically daunting question of what constituted purity, health, and morality. Of particular importance was the role of local public analysts, who, as Postgate had suggested, would serve as on-the-ground inspectors employed by local authorities. Adulteration could be prevented from the top down through Parliamentary Legislation, he thought, but also from the bottom up through local inspection. The 1860 Sale of Food and Drugs Act, as we will see, did provide that local

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[13] Mary Poovey, *Making a Social Body: British Cultural Formation, 1830-1864*. (Chicago: University of Chicago Press, 1995), Pamela Gilbert, *The Citizen's Body: Desire, Health, and the Social in Victorian England* (Columbus: The Ohio State University Press, 2007), and Pamela Gilbert, *Cholera and Nation: Doctoring the Social Body in Victorian England* (New York: State University of New York Press, 2008).

[14] Patrick Brantlinger, *The Spirit of Reform: British Literature and Politics, 1832-1867* (Cambridge: Harvard University Press, 1977).

[15] On earlier debates about civilization, cleanliness and what has been recently been called "the social body" see Pamela Gilbert, *Cholera and Nation*, and Mary Poovey *Making a Social Body.*

authorities could appoint public analysts, but Parliament left undefined what constituted professional or scientific credentials, leaving many local authorities to either not appoint an analyst, or appoint one conducive to local trade interests. More importantly, though, was the fact that public analyst posts were not made compulsory until 1875. Additional legislation, in the form of the revised 1872 Adulteration Act, attempted to define the role of the public analyst, but it too was vague. The 1872 Act lived a relatively short legislative life, however, as agitation from traders and manufacturers increased, and forced re-evaluation in 1874 that led to the formation of a Second Select Parliamentary Committee. The crowning achievement of the 1874 Committee, according to Michael French and Jim Phillips in *Cheated not Poisoned*, was the 1875 Sale of Food and Drugs Act (SFDA), which, the above authors argue, "was to form the basis of food law in the United Kingdom until 1955."[16] Although it is clear that adulteration continued well into the twentieth century, one need not be reminded here of Upton Sinclair's 1906 novel *The Jungle,* French and Phillips argue that the 1875 SFDA was a success and a historical watershed.[17] In some ways, as we will see, it was; the 1875 SFDA was the first compulsory legislation on food adulteration in Britain, and the first to mandate that local authorities appoint public analysts. In practice, however, the control of food adulteration was beset by a number of contingent factors, such as scientific conflicts over theory, methodology, and expertise, and a highly fractured and largely permissive

[16] Michael French and Jim Phillips, *Cheated not Poisoned: Food Regulation in the United Kingdom, 1875-1938* (Manchester and New York: Manchester University Press, 2000), 1.

[17] Derek Oddy *From Plain Fare to Fusion Food* (Suffolk: Boydell Press, 2003). Oddy clearly articulates the depth of late nineteenth and early twentieth century adulteration reform movements. For a more sociological analysis, see, Ingeborg Paulus *The Search for Pure Food: A Sociology of Legislation in Britain* (London: Martin Robertson, 1974).

set of supplementary Parliamentary acts which exemplified central local administrative frustrations.

The legislative history of food regulation, as presented by French and Phillips, largely fails to underscore the complex ways in which the category of adulteration changed throughout the Victorian period. In particular, it masks the ways in which food adulteration was seen not only as a moral and economic threat, but also a public health one. Such a legislative focused narrative highlights several vital late Victorian and early Edwardian tensions, such as private versus public interest and successive Parliamentary reform. It does not however, inform how historians have come to understand the multiple meanings of adulteration, and how the concept of adulteration evolved throughout the nineteenth century. To this end, the failures of the Adulteration Act of 1860 and 1872 are equally as important as their culmination in 1875.

This chapter explores the complex and changing meaning of food adulteration in Victorian Britain, chiefly from 1850 to 1875. In particular, I focus on ongoing debates about the importance of connecting adulteration to public health and state medicine, a contested process which was not inevitable; adulteration, as we will see, was defined by different groups for a variety of socio-political and scientific reasons, often representing opposing interests. Medical scientists did not alone construct the meaning of adulteration however, and the problem was tied to religious, class, economic, and environmental issues. The anti-adulteration movement (by the 1860s it was clearly a social movement) could be substantiated in order to protect the defenseless poor, ensure the strength of the British Empire, or safeguard the finances of both the individual and the state. Above all was a unifying concern with the nation, and with Britishness itself, perhaps best summarized by a writer in the *British and Foreign Medico-Chirurgical Review* in 1876, who argued,

> That the health and physical well-being of a community are matters bound up with the food of the people is an incontrovertible proposition, and its truth is nowhere more apparent than in the English-speaking race. The differences between the squalid, typical wild Irishman, and the Irishman well fed and prosperous in England and America, are matters of notoriety, and in no small degree due to differences of food. The Dorsetshire labourer with his scanty fare is incapable of executing the same amount of work as the better fed, and consequently more stalwart, Norfolk or Yorkshire laboruer.[18]

Despite the rhetoric that a healthy nation needed pure and proper food, compulsory anti-adulteration legislation remained controversial throughout the second half of the nineteenth century. Considering that the rapid pace of industrialization and urbanization in the first half of the nineteenth century resulted in mid-Victorian Briton's being the first British society to be substantially distanced from the production side of food consumption, perhaps resistance to adulteration is more understandable. However, anti-adulteration reformers used the social and material distancing of the food supply to bolster their argument for governmental protection. The goal of these reformers was to change the very motto of the English spirit, and lest we forget, the very foundation of English Common Law, from *caveat emptor* (let the purchaser beware) to *caveat venditor* (let the seller beware). Many physicians, scientists, and reformers took the lead, such as

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[18] Anon., "Food: Its Adulterations and Analysis," *The British and Foreign Medico-Chirurgical Review*, 1876 (London: J & A Churchill), 120.

the famed microscopist Arthur Hill Hassall, and the zealous sanitary reformer Thomas Wakley. Scientific contempt over adulteration was not unanimous, however. William Farr, in a discussion about adulteration at the meeting of the NAPSS in Newcastle in 1870, thought that the cries of adulteration were widely exaggerated. "He [Farr] believed the majority of tradesmen were honest, and therefore the greatest sufferers from the practice of their adulterating brethren, because the latter undersold them," noted the discussion notes from the meeting.[19]

Debates about food adulteration from the 1850s reveal several important aspects of how public health problems were constructed and contested in the Victorian period. Food adulteration was only gradually understood as a public health problem, and even then, throughout the nineteenth century, it was rarely, to borrow a phrase from historian Christopher Hamlin, "built of sound science and shared moral reflection."[20] As Hamlin reminds, we must be wary of unreflexive analysis which ascribes science as 'sound' and cultural morals as 'shared'. In the case of Victorian debates over food adulteration, these categories were, perforce, intimately shaped by politics, cultural presumptions of health and disease, purity and pollution, and discussions of the individual and the nation.

Early Anti-Adulteration Reform

Arthur Hill Hassall, pioneering Victorian microscopist, botanist, and sanitary reformer, was vital to drawing widespread attention to the adulteration of food and drugs in the 1850s. While John Postgate was well known throughout Britain as a persistent

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[19] Discussion notes in Transactions of the National Association for the Promotion of Social Science (London: Longmans, Green, Reader, and Dyer, 1871), 403.

[20] Christopher Hamlin, *Public Health in the Age of Chadwick: Britain*, 1.

social publicist of anti-adulteration, Hassall gave the movement's new scientific backing. Under the banner of Thomas Wakley's Analytical Sanitary Commission of the *Lancet*, from 1851 to 1854 Hassall conducted (sometimes in conjunction with chemist Henry Letheby) a series of analyses on what he considered the most widely adulterated articles of food in Victorian London. The results were published in the *Lancet* between 1851 and 1854, causing a great deal of public outcry. Together with John Postgate's public lectures, Hassall and Wakley were instrumental in shaping the Parliamentary appointment in 1855 of the first Select Committee on Food Adulteration.

There was interest in food adulteration before Hassall's analytical work with the *Lancet*'s Sanitary Commission. Most historians have pointed to the agitation produced by the early nineteenth century chemist Frederick Accum.[21] Late in the eighteenth century Accum (1769-1838) moved from Westphalia to London, where he gained experience in pharmaceuticals and surgery, the latter at the Hunterian School of Medicine at Great Windmill Street. Accum became a rather well-known chemist, befriending Humphrey Davy and William Nicholson, and joining the ranks of professional societies such as Royal Irish Academy, the Linnaean Society, and the Royal Academy of Sciences. By the early 1810s Accum began giving public lectures on chemistry and laboratory instrumentation. A lifelong interest in poisons and adulterations led Accum in 1820 to publish his most well known text, *A Treatise on the Adulterations of Food and Culinary Poisons.* The aim of the latter was to educate the public on the best ways to distinguish

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[21] On Accum, see C. A. Browne, "The Life and Chemical Services of Frederick Accum," *Journal of Chemical Education*, 2 (1925), 1–27, R. J. Cole, "Friedrich Accum (1769–1838): A Biographical Study," *Annals of Science*, 7 (1951), 128–43. B. Gee, 'Amusement chests and portable laboratories: practical alternatives to the regular laboratory', *The Development of the Laboratory*, F. A. J. L. James (ed.) (London, Macmillan, 1989).

and detect the commonest adulterations. Accum considered adulteration widespread in Britain; he noted that "spurious articles are every where to be found in the market, made up so skillfully, as to elude the discrimination of the most experienced judges."[22] Essential to Accum's reformist claim was an element of fear mongering; exclaiming that there was "death in the pot" was as much scare tactic in stopping nefarious trade practice as it was representing the reality of adulteration. Not only was there no public machinery for curbing adulteration, Accum argued, but adulterations in many foods could scarcely be detected by scientific methods in analytical chemistry. Opinions differed with respect to particular foodstuffs.

One contemporary, writing in *The London Medical Gazette* in 1830 on the adulteration of milk, noted that while milk is frequently adulterated- with water, flour, and almond emulsions- these additions are easily detectable. The analytical methods were so simple, the author boasted, "that anyone may practise them."[23] It is quite clear from contemporary literature that tea, milk, beer, bread, coffee, wine, oil, pepper, vinegar, cream, and mustard, were all regularly adulterated foods. Without reliable statistics, however, and few court cases on adulteration before the 1860s, it is difficult to discern the actual extent of adulteration. Accum's 1820 treatise did have some degree of social impact, as over one thousand copies were sold in the first month of its publication. Two foreign editions appeared shortly thereafter, one in Philadelphia in 1820, and another in Berlin in 1822. However, little attention, either scientific or social, appears to have been

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[22] Frederick Accum, "A Treatise on Adulterations of Food, and Culinary Poisons," (London, J. Mallett, 1820), iv.

[23] Anon., "Adulteration of Milk," *London Medical Gazette,* vol. 5 (30 January, 1830) 571-572.

given to the adulteration issue in the decades that followed. Most historians, including Accum's *Oxford Dictionary of National Biography* biographer, argue that this was because of a personal scandal, namely, that Accum was caught stealing manuscripts from the Royal Institution Library, and fled back to his native Germany. Thus Britain lost its anti-adulteration advocate.

One group was particularly active in preventing a specific kind of adulteration in the early Victorian period. This was the Board of Excise, who employed a Government Chemist, and was equipped with a modest laboratory and a small staff. Throughout the 1820s and 1830s reports appeared in the *Times,* for example, about court prosecutions by the Board of Excise on cases of adulterations in pepper, tea, flour, wine, and other excisable foodstuffs.[24] Excise officials did have legal recourse to stop adulteration, albeit only in cases of excisable goods, and from the 1820s the Excise Office was fairly aggressive in attempting to curb the adulteration of imported and taxable goods. This was different from the public marketplace; the Excise Office could prosecute traders selling coffee laced with chicory, a popular adulteration, but not those adulterating milk with water or bread with alum. One contemporary complained in *The Times* about the addition of chicory to coffee, exclaiming, "what can Government be about, to allow the same? It must be a serious injury to the revenue, and the only way to protect the public from being imposed on by such rubbish would be to put a heavy duty on it."[25] Preventing adulteration could be in the public interest, but it was mostly done in the early Victorian

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[24] See, for example, Anon., "Hatton-Garden- Adulteration of Bread," *The Times*, 11963 (29 August 1823), 3; Anon., "Adulteration of Pepper," *The Times*, 12387 (10 July 1824) 3; Anon., "Adulteration of Wine and Spirits," *The Times* 13431 (8 November 1827), 2.

[25] Anon. signed 'P', "Adulteration of Coffee," *The Times* 14753 (20 January 1832), 4.

period in response to a perceived threat to governmental revenue. Adulteration was first constructed as a problem not of health, then, but of wealth. There were some critics of this position, however. Aruthur Hill Hassall, perhaps the most outspoken opponent of the purely economic argument that adulteration hurt the purse of the consumer (and by extension the government), summed up this position in 1855 during his testimony to the First Select Committee on the Adulteration of Food. He lamented that "at the present time, the adulteration of all articles upon which an Excise duty is levied is punished, when discovered, by heavy pecuniary penalties; but the Excise does not take notice of adulteration in non-exciseable commodities, and which adulteration, therefore, at present for the most part escapes punishment altogether."[26] One solution that was widely proposed in the decades before the 1850s was to increase the legislative scope of the Excise Office. However, this solution proved socially unpopular, economically disadvantageous, and too cumbersome to enforce. Defining adulteration as either a health or economic problem each had important ramifications for framing Parliamentary legislation.

Although there was economic interest in the prevention of adulteration at the Excise Office, little reformist attention was given to the health related effects of adulteration until the early 1850s. Wakley's Analytical Sanitary Commission of the *Lancet* provided the main impetus. There were others who joined the anti-adulteration campaign. One important contributor was H. Hodson Rugg, M.R.C.S., who in 1850

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[26] Arthur Hill Hassall, testimony before the Select Committee on the Adulteration of Food, & c., HC, 27 July 1855, 29.

published a lengthy pamphlet on milk adulteration in London.[27] That Rugg's treatise was solely on milk adulteration is illustrative of how anti-adulteration campaigners often focused on particularly offensive example. Milk was central to adulteration debates because it was widely adulteration, and because it had a vaulted cultural status as nature's perfect food. Rugg went as far as to call milk "a most perfect diet."[28] The prevention of milk adulteration, according to many contemporaries such as Rugg, could only be achieved by reforming the deplorable state of the London cowsheds. Metropolitan milk was so poor, he maintained, because it was, "drawn from cows confined in ill-constructed, ill-ventilated, and improperly drained places- their milk at the same time being formed by such unnatural and improper foods as distillers' wash, and distillers and brewers' grains."[29] Explicit in Rugg's argument was a national concern similar to one later be echoed by Bevan (as we saw above) for the well-being of the individual and of the nation. To Rugg, "there cannot be, one would imagine, a more national object of its kind than to place a free and unadulterated supply of milk."[30] Yet Rugg's argument was essentially urban focused. He recommended a complete overhaul of the dairy system: government officers should be employed to test and, if necessary, confiscate adulterated milk; police should regularly inspect cowsheds for ventilation and space requirements; and a government run cow infirmary should be established and staffed with competent

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[27] H. Hodson Rugg, *Observations on London Milk, showing its unhealthy character, and poisonous adulterations; with remarks on the food of the cows, their pestilential places of confinement; with suggestions for remedying the evil,* (London: Bailey and Moon, 1850)

[28] Ibid, 1.

[29] Ibid, 2.

[30] Ibid, 4. Rugg estimated that of the 2,000,000 inhabitants of London, each individual consumed, on average, half a pint of milk per day. It would require 50,000 cows producing ten quarts per day each to maintain the supply of 500,000 quarts per day, or 182,500000 quarts per year.

veterinarians, with every cow in the metropolis officially registered. [31] Some endorsed Rugg's proposed system, such as the editor of *The Medical Times*.[32] Others, however, critiqued his plan as akin to a Prussian system of medical police. The example of Rugg highlights how anti-adulteration reformers used specific articles of diet to wage their attack on the adulteration problem. This was echoed in specific tracts on coffee, bread, tea, etc.

One important critic of Rugg's proposal was waged by the well-known and influential Victorian social theorist Herbert Spencer. In his 1851 *Social Statics: or, The Conditions essential to Happiness specified, and the First of them Developed,* Spencer argued that Rugg's proposals were a slippery slope which would lead to a "condition somewhat like that of the slave states."[33] According to Spencer, governmental interference in food adulteration was unnecessary, as it disrupted the free market economy. The choice of commodity, according to many Victorian social scientists and economists, should be left to the consumer. We should understand such social rhetoric as the dually entrenched product of a deep-seated fear of centralized government, and a faith in the laissez faire economic theories espoused by Adam Smith and Thomas Malthus. The middle decades of the nineteenth century were full of such dichotomous arguments, and Spencer's neo-Benthamism, with its contradictory belief in laissez-faire individualism and social organicism, were indicative of the ways in which the anti-

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[31] Ibid, 36-37.

[32] Editor, Review of Rugg's "Observations on London Milk," *The Medical Times*, old series, vol. 22 (27 January, 1850). 95.

[33] Herbert Spencer, *Social Statics: or, The Conditions essential to Happiness specified, and the First of them Developed*, (London: John Chapman, 1851), 367.

adulteration cause could be politically muddled or economically suppressed.[34] Educating the public about the dangers of adulteration might help, but ultimately, buyer beware was essential to the laissez faire principle of the marketplace. Some scientists agreed, and put the onus of the preventing adulteration on the consumer. In a lecture before the Royal Polytechnic Institution on 8 October 1855, the eminent London pharmacist and physician Jacob Bell argued that recent claims of the widespread nature of adulteration were exaggerated, and that the only prevention needed was to educate the public so as to not purchase adulterated articles. Such a system, however, proved extremely difficult to enact.[35] What is important, though, is that one could criticize adulteration and not necessarily demand governmental interference, whether centralized or local. Framed as an economic problem, adulteration needed an economic, not a public health solution.

Many mid-century social critics saw the anti-adulteration cause as a way to bolster the spirit of social reform in the context of a materialist explanation of class struggle. More than anything else, many reformers saw adulteration as a particular problem for the working class and indignant poor rhetorically stylized in Edwin Chadwick's 1842 *Report on the Sanitary Condition of the Labouring Population*, Henry Mayhew's 1861 *London Labour and the London Poor,* or Charles Booth's 1890s *Life and Labour of the People in London*. [36] Of particular importance too was the work of Karl Marx and Frederich Engels. In 1844 Engles wrote that "they [the working class] are

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[34] Patrick Brantlinger, *The Spirit of Reform*, 4-6.

[35] Anon., "Royal Polytechnic Institution," *Lancet* 1855, *2*, 355.

[36] This general argument is made by Christopher Hamlin, *Public Health and Social Justice in the Age of Chadwick*, especially chapter five.

victimised in yet another way by the money-greed of the middle-class. Dealers and manufacturers adulterate all kinds of provisions in an atrocious manner, and without the slightest regard to the health of the consumers."[37] It was typical in the mid-Victorian period to blame traders and manufacturers, and too often historians have framed adulteration as an obvious social problem unable to be remedied because of a weak centralized state and powerful trade interests. This masks the frequent, but far from universal calls for reform on the part of traders and manufacturers, which we will see in chapter five, were crucial to reforming the British dairy industry.

In his *The Rural Cyclopedia, or a General Dictionary of Agriculture*, Reverend John M. Wilson, for instance, aimed to communicate knowledge of farming and natural sciences largely to rural traders and manufacturers. Wilson was keen to condemn adulteration. Wilson defined adulteration as "the mixing of cheap foreign substances with articles of food and medicine, in order that purchasers may be deceived, and large profits obtained."[38] Manufacturers knew unscrupulous trade practices existed, and Wilson noted that farmers, bakers, dairymen, grocers, confectioners, and druggists all widely practiced adulteration. Wilson's was a moralizing mission, and one exclusively in line with William Paley's Enlightenment natural theology.[39] Wilson condemned adulterators of food as "incomparably guiltier in sight of God… at best a robber of the poor, and a cheat in general society; and, in most instances, he is also in some degree- occasionally in very

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[37] Frederich Engels, *The Condition of the Working-Class in England in 1844* (London: Swan Sonnenschein & Co., 1892), 69.

[38] John M. Wilson, *The Rural Cyclopedia, or a General Dictionary of Agriculture*, volume I (Edinburgh: A. Fullerton and Co., 1852), 45.

[39] Neal Gillespie, "Divine Design and the Industrial Revolution: William Paley's Abortive Reform of Natural Theology," *Isis* (June, 1990), 81:214-229.

dreadful degree- a secret stabber at the life of his fellow creatures,- an unsuspected, a well-disguised, and therefore an eminently guilty poisoner of his fellow-men."[40]

By the early 1850s there was a growing awareness of the widespread extent of adulteration. There were different interests at stake, however in constructing adulteration as a social problem. Anti-adulteration reformers could use scientific rationale, such as Hassall and Wakley's *Lancet* Analytical Sanitary Commission to frame adulteration as a health specific problem, such as hunger or public order.[41] However, as we have seen, food adulteration was not necessarily only framed as a health or even sanitary problem. The topic had considerable social, religious, and economic significance, receiving attention from literary, and as we have already seen, religious figures. On the former, Charles Dickens' literary magazine *Household Words*, which cost a mere tuppence, published a string of anti-adulteration articles in 1850 and 1851 ensuring that the topic reached a wide readership. Of particular importance were Richard H. Horne's 1850, "The Cow with the Iron Tail," a critique on milk adulteration, followed by articles written by W.H. Wills and Charles Strange titled "Death in the Teapot," "Death in the Bread-Basket," and "Death in the Sugar Plum."[42] Dickens's readers were largely working and middle class Britons, and the coverage of the anti-adulteration cause in popular

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[40] John M. Wilson, *The Rural Cyclopedia, or a General Dictionary of Agriculture*, volume I (Edinburgh: A. Fullerton and Co., 1852), 45. For an overview of the concept of poison in Victorian culture and science, see Ian Burney, *Poison, Detection, and the Victorian Imagination* (Manchester: Manchester University Press, 2006).

[41] Christopher Hamlin, *Social Justice in the Age of Chadwick*, 52.

[42] Richard H. Horne, "The Cow with the Iron Tail," *Household Words,* 9 November 1850, *2*: 145-51; Charles Strange and W.H. Wills, "Death in the Teapot," *Household Words*, 14 December 1850, *2*: 277, Death in the Bread-Basket," *Household Words* 28 December 1850, *2*, 323, and "Death in the Sugar Plum," *Household Words*, 25 January 1851, *2*, 426-427. More generally, see: William Long, "Dickens and the Adulteration of Food," *Dickensian* (1988), 84:160-170.

periodicals demonstrates the extent to which various groups had an important stake in framing what adulteration was and how it was to be prevented. Public recognition, specifically middle-class revulsion towards adulteration was cultural dishonest and physically corrupt, in turn catalyzed the reformist ethos of sanitary administrators and scientists keen to frame adulteration as a central issue in either politics or science.

Arthur Hill Hassall- the 'Apostle of Anti-Adulteration'

Explaining his objective for issuing the Analytical Sanitary Commission (ASC) in 1851, Thomas Wakley bemoaned, "public authorities take no cognizance whatever of the deterioration and poisoning of our bodies by the slower, but equally sure modes of adulterations of food and drink."[43] The ASC was meant to serve the public and punish the fraudulent, the latter to be done by publishing the names and addresses of adulterators.[44] Most importantly, the Analytical Sanitary Commission was meant to inform the public of the widespread practice of adulteration. It was to be, as Wakley compared in the *Lancet*, a body similar to the Board of Health and the Commissions of Sewers. Adulteration, according to Wakley, might rob the customer of money, "but the question is not merely one of honesty and dishonesty, of profit and loss, it is also sanitary, one of health, and even, in some cases, of life itself."[45] Ensuring purity of food and drink, Wakley thought, was a necessity akin to uncontaminated air and pure water.[46] In conjunction with Hassall,

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[43] Thomas Wakley, Leading Ariticle *Lancet*, vol. 57, issue 1427 (4 January 1851) 18.
[44] Ibid, 20.
[45] Ibid, 21.
[46] Ibid, 20. Henry Acland called pure air, water, and food, "necessary to health." See, Henry Acland, "Health" *Transactions of the National Association for the Promotion of Social Science* (1873) 64-87, 80.

Wakley was one of the first to extensively argue that adulteration was most importantly a public health threat.

Hassall has been remembered for his pioneering microscopical analyses in the mid-1850s of water samples suspected to be laden with cholera germs, as Hamlin and others have shown.[47] Some historians have pointed to Hassall's role in the anti-adulteration campaign, and specifically to his insistence that the microscope should serve as the primary tool in water and food analysis.[48] Burnett's classic study in 1966 claimed that "Hassall represented the dispassionate scientist pre-eminently acceptable to the Victorian intelligentsia."[49] F.B. Smith has likewise heroicized Hassall, arguing that the he provided the first scientific evidence of food adulteration through the use of microscopy.[50] In a recent and more nuanced account, Simon Smith has warned that we should be skeptical with such Whiggish interpretations of the contributions of Hassall and the ASC.[51] In part, Smith's reinterpretation is predicated upon Hamlin's discussion of Hassall's microscopical work on water analysis and cholera. Taking a critical eye to Hassall's scientific research and social publicizing, Hamlin argues that Hassall relied extensively on shock tactics aimed to guilt the public into water purity reform through

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47 Christopher Hamlin, *A Science of Impurity.*

48 Peter Vinten Johansen, et.al., *Cholera, Chloroform, and the Science of Medicine*, (Oxford: Oxford University Press, 2003), and Christopher Hamlin, *A Science of Impurity*, especially 104-116.

49 John Burnett, *Plenty and Want; A Social History of Diet in England from 1815 to the Present Day* (London; Routledge, 1989, 3rd ed.), 222.

50 F.B. Smith, *The People's Health* (London, 1979), 208.

51 S.D. Smith, "Coffee, Microscopy, and the *Lancet's* Analytical Sanitary Commission," *The Social History of Medicine* (2001), 14:171-197,172.

instinctive cultural revulsion against filth and pollution.[52] A dispassionate scientist, Hamlin argues, Hassall was not. While Hassall's use of microscopy was novel, and in many ways scientifically crucial, public health methodologies were highly contested in the mid-Victorian period, particularly between microscopy and analytical chemistry. In this light Smith argues that in the 1850s, particularly through the work of Hassall and the ASC, the most important adulterated commodities were coffee and chicory, not milk, bread, beer, or flour, the latter articles only became central to later anti-adulteration campaigns.

Between 1851 and 1854, the time of Hassall's involvement, the ASC tested forty-four different kinds of food and drink. Looking back on his days with the ASC in his autobiography, Hassall explained his usual routine;

> Mr. Miller and I used to sally out from time to time, usually in the evening, often on Saturday nights, in all weathers and at all seasons of the year; we were provided with a bag to receive the samples, paper and ink. Sometimes we entered the shop together, but more often I told Mr. Miller what to buy and he made the actual purchase… on leaving the shop, the name of the vendor, the date and cost of the purchase, together with our initials were at once inscribed in ink on the wrappers of the package. [53]

Hassall continued,

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[52] Hamlin, *A Science of Impurity*, especially chapters two and four.

[53] Hassall, *Narrative of a Busy Life*, (London: Longmans, Green, & Co., 1893), 45-46.

> These nocturnal excursions brought us into many curious parts of London and gave us a wonderful insight into the habits and ways of life of the people in the poorer districts: in summer they were pleasant and interesting enough, but in winter most trying and wearisome, waiting and hanging about we became chilled to the bone, sometimes not arriving home till near midnight.[54]

The investigations, particularly obtaining samples, were often difficult, and demonstrate the lengths Hassall was willing to go to undertake what he considered a crucial scientific and social endeavor. So much so, that Hassall later lamented, "my health suffered greatly," as a result.[55]

Hassall's reports were similarly structured; he listed reasons for undertaking the investigation, a summary of the nature of the article in its pure form, and how the article could be adulterated. Typically around twenty to forty samples of each type of article were analyzed, purposely purchased from a wide range of vendors from different social classes throughout London. Finally, ASC reports listed suggestions for the public in discerning adulteration. Included in most reports were woodcut illustrations drawn by Mr. Miller that showed the microscopical appearances and structure of the article, both in its genuine and adulteration forms. In 1851 alone, the year of the ASC's inception, Hassall analyzed: coffee (1851, vol. 1, 21-26, 465-471, 501-506), sugar (1851, vol. 1, 74-79, and 100-104), arrowroot (1851, vol. 1, 139-144; 1851, vol. II, 352-354), pepper (1851, vol. I, 163-168), water (1851, vol. I, 187-193, 216-225, 253-261, 279-284),

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[54] Ibid.

[55] Ibid, 51.

chicory (1851, vol. I, 302-307, 526-529; 1851, vol. II, 420-422), mustard (1851, vol. I, 340-345), bread (1851, vol. I, 366-371, 386-391, 419-425, 444-445, 1851, vol. II, 398-400, 445-446), cocoa (1851, vol. I, 552-556, 608-612, 631-637; 1851, vol. II, 15-20), ervalenta, revalenta (lentil meal). (1851, vol. I, 654-660), farinaceous foods (1851, vol. I, 675-679), oatmeal (1851, vol. II, 42-43), tea (1851, vol. II, 90-95, 112-116, 136-141, 161-163, 210-213), milk (1851, vol. II, 257-262, 279-282), 322-325), isinglass (1851, vol. II, 472-474, 510-511). In 1852 they added vinegar, pickles, spices, preserved provisions, India pale ale, cayenne pepper, curry-powder, bottled fruits and vegetables, anchovies, potted meats and fish, sauces. In 1853, they added drugs and pharmaceutical preparations, scammony, preserves and jellies, lard, jalap, butter, ipecacuanha, tobacco. In 1854 they added opium, confectionery, porter, gin. To put it another way, 25 reports appeared in 1851- these consisting 1,054 analyses; 20 reports appeared in 1852, consisting 512 analyses; 7 reports appeared in 1853, consisting 340 analyses; 3 reports appeared in 1854, consisting 291 analyses. The reports were extensive, and demonstrate the breadth of Hassall's analytical framework. The widespread publishing of Hassall's research also indicates the growing public awareness of the extent and frequency of adulteration, although early scientific research on food adulteration was rife with internal squabbles over methodology and priority disputes.

Palmam Qui Meruit Ferat: 'Let Whomever Earns the Palm Bear It'

The ASC did get the attention of the public and the government. Traders and manufacturers also responded. The *Commercial Daily List*, a trade journal, noted in 1851 in response to the first ASC investigation of coffee,

> We cannot, of course, answer for the correctness either of the facts or the theory contained in it. At the same time, it has commanded so much attention from all parties concerned in the trade, and appears to us to have been so cleverly, as well as industriously, based upon actual inquiries, that it is our duty to give the pith and the marrow of it.[56]

According to the *Illustrated London News*, a nationalist concern was at stake, "there is, to our shame, no country in the world where this system of adulteration is carried on to the same extent as in England."[57] ASC reports were reprinted throughout the country, and in a wide range of journals such as *Morning Advertiser, Commercial Daily List, Manchester Guardian*, *The Times, The London News, The Lady's Newspaper, The Family Herald*.

Some trade manufacturers responded favorably to the ASC reports, although most focused on the economic rather than health related effects of adulteration. Thomas Dewar, a Newcastle mustard manufacturer, wrote to the *Lancet* confirming the poor state of mustard sold in London. Dewar noted that he had attempted to sell his mustard for twenty years in London, but could not succeed because of the lower price of inferior and adulterated mustards from competitors.[58] It is clear that most traders and manufacturers however, were furious with Wakley and the *Lancet*. In his official testimony to the Select Parliamentary Committee on Food Adulteration in 1856, Wakley noted, "I think I made

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[56] Clipping from *Commercial Daily List*, 10 January 1851 in Anon.,"The Analytical Sanitary Commission, Notes of the Press," *Lancet*, vol. 57, issue 1428 (11 January 1851), 84.

[57] Clipping from *Illustrated London News,* 29 March 1851 in Anon., "The Analytical Sanitary Commission, Notes of the Press," *Lancet*, vol. 57, issue 1440 (5 April 1851), 393.

[58] Letter from Thomas Dewar to *The Lancet*, vol. 57, issue 1442 (19 April 1851), 450. At the Great Exhibition of 1851 Dewar advertised his product as "pure mustards," a strategy widely used in the late nineteenth century. See Dewar's advertisment in *Official Mustard Catalogue Advertiser of the Great Exhibition* (London: Spicer Brothers, 1851) 42.

more enemies by the publication of that Commission in six months than I had made in my whole life before, and certainly it was the most perilous thing that a man connected with the press ever did; and so perilous that it is one which I shall not willingly undertake again."[59] These were hard lessons for even Wakley to learn, a political radical and Chartist supporter.[60]

Aside from the complex and controversial implications of the ASC research, Hassall's analytical and microscopical work was praised by many contemporaries who argued that he was the most important contributor to the anti-adulteration movement. When the first Select Committee met in 1855, Hassall was the first scientific witness to give testimony. However, the public praise given to Hassall was fraught with considerable controversy. One anonymous letter sent to the *Times* on 26 July 1855, signed, "Palmam Qui Meruit Ferat," (Latin for 'let whomever earns the palm bear it') deserves to be quoted in full. It read,

> Although Dr. Hassall is undoubtedly entitled to much praise for the manner in which he has performed his part in exposing the frauds practised in food and drink yet others have been employed with him in the same work who are entitled to an equal share of public esteem; for example, it was Mr. Wakley who originised the idea of a Sanitary Commission, and it was he who planned the arrangements necessary to put it into operation. He it was who paid all the expenses of the inquiry, and who was at the cost of publishing the results in the *Lancet*, and who

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[59] Select Committee on the Adulteration of Food, Drinks, and Drugs, 2 April, 1856, 144.

[60] For a particularly new account of Wakley's radical views, see Michael Brown, "Like a Devoted Army: Medicine, Heroic Masculinity, and the Military Paradigm in Victorian Britain," *Journal of British Studies* (July 2010), 49:592-622.

> also bore the risk which was attendant thereon. A poor artist of the name of Miller made the microscopic examinations and drawings, without which the work of the commission would have been very incomplete. Dr. Letheby of the London Hospital, conducted all the important chymical analyses; and Mr. Postgate, of Birmingham, was really the agent of public agitation, whereby this inquiry of Mr. Scholefield's has been instituted.[61]

Four days later Hassall wrote the *Times* in order to clarify his contributions and indebtedness to the aforementioned individuals. He acknowledged the primary role of Wakley, but stressed that he alone undertook the research and wrote the reports. The main issue was with regards to the contribution of Henry Letheby. Hassall noted that when necessary, he employed Dr. Letheby for "chymical assistance," of which it was infrequent and not exclusive.[62] Letheby, infuriated, penned his own letter to the *Times,* arguing that he not only analyzed a great deal of articles (all of the samples of bread, flour, and salt), but directed Hassall in analyzing nearly every article, at least in the chemical nature of each substance. Letheby noted, "in truth, he [Hassall] invariably wrote to me when he began a new inquiry… in many cases, indeed, I may say in most, he got just far enough with the inquiry to become embarrassed, and then his products were sent to me for completion, or his results for correction."[63] Letheby was clearly upset, and felt that his chemical assistance was being disregarded. He wrote to the *Times* again on 2 August, "ashamed of the circumstance which calls for another letter from me on the

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[61] Anon. signed "Palmam Qui Meruit Ferat," "Adulteration of Food," *The Times* (26 July 1855), *22116*:12.

[62] Henry Letheby, "Adulteration of Food," *The Times* (30 July 1855), *22119*: 7.

[63] Ibid.

subject of Dr. Hassall's inconsistencies."[64] There he noted that from 1851 to 1855 he conducted 291 analyses for Dr. Hassall, and concluded the letter saying that he and Hassall were no longer friends. Others joined the anti-Hassallian fray as well.

T.H. Henry wrote that the ASC was presaged by analytical work in 1831 by W.B. O'Shanghnessy on the analyses of colored sugar confectionary, and Henry himself, from 1836 to 1837. George Bent, who wrote another letter on 30 July, agreed with Henry, saying that analytical work on food adulteration had been conducted intermittently between 1830 and 1850 in connection with the *Lancet*. Caught in the middle of the controversy, Wakley penned his own letter in the same issue of the *Times*, and claimed the exclusive rights of originating the ASC and taking the financial and legal risk, making it probable that Letheby was the author of 'Palmam Qui Meruit Ferat.' Hassall replied the next day, again giving credit to Henry and O'Shanghnessy for conducting earlier investigations, and to Wakley for providing the means to execute the ASC. Hassall was adamant, however in claiming that he alone provided the spark for the anti-adulteration movement and the bulk of the scientific research. Hassall argued that after the publication and favorable press of his 1850 paper on coffee adulteration read before the Botanical Society of London, Wakley asked him to head the ASC. It was his microscopical research on coffee in 1850, Hassall noted many years later in his autobiography, that led him to suspect that the microscope could be invaluable in detecting adulterations in the animal and vegetable kingdoms.[65] In a letter to Hassall asking him to lead the ASC, Wakley noted, "I have observed what you have been doing, but you will never effect any lasting

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[64] Henry Letheby, "Adulteration of Food," *the Times* (2 August 1855), 22122:12.

[65] Arthur Hill Hassall, *Narrative of a Busy Life*, (London: Longmans, Green, &c, 1893), 43.

good until you area able to publish the names and addresses of the parties of whom the articles were purchased."[66] Hassall would provide the scientific skill, in other words, and Wakley the platform.

At the center of the controversy was Hassall's claim to have conducted all of the microscopical investigations, a large portion of the chemical analyses (Letheby's rebuttal), and written all of the reports. Hassall did rescind part of his claim; he was not the originator of the ASC, and Wakley deserved much of the credit. At stake was a larger scientific claim about the use of the microscope in framing the adulteration problem. Hassall argued, "what I do claim is, that I was the first to apply on a large scale the microscope to the detection of adulteration." Hassall did give credit to Letheby for his chemical assistance, both in letters written during the 1855 scandal being currently described, and previously in the pages of the *Lancet* and Hassall's own 1855 publication.[67] It is probable, however, that while Letheby did occasionally assist, his contributions were relatively small. Wakley continued with a leading article in the *Lancet* on 28 July 1855, again laying claim to converting the press into "an instrument of police for preventing the adulteration of food."[68] By 4 August 1855, Wakley wrote another leading article in the *Lancet* which lamented that, "reclamations as to priority or originality in the conception and conduct of successful undertakings… are not unfrequently the occasions of pain to many who are dragged unwillingly into the

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[66] Ibid, 44.

[67] The correspondence was also reprinted in the *Lancet*. See various authors, "Analytical Sanitary Commission," *Lancet* (4 August 1855), 1666, 66:109-114.

[68] Thomas Wakley, leading article, *Lancet*, vol. 66, issue 1665 (28 July 1855), 83.

contest."[69] Wakley proceeded to dismiss Hassall's claim that he was the first to use the microscope in detecting adulteration, citing O'Shaughnessy, Chevallier in France, and Normandy and Mitchell in England. He ended the leading article by saying, "the benefits which have already resulted from that undertaking [the ASC], and are still further sure to arise from it, are of too much public importance to allow of their being frittered down to mere questions of individual claims and disputes."[70] Finally leaving the issue aside, in a leading article on 10 November 1855 Wakley turned his attention away from Hassall and Letheby back to a moral crusade against adulteration. Adulterators, he said, "positively revile those plain-spoken persons who call 'a spade a spade and a knave a knave.'"[71] The debate over the priority claim, Wakley believed, had proved a barricade against anti-adulteration reform.

By the mid 1850s support for the anti-adulteration movement was building in Ireland as well. In early 1855 the Dublin Chemical Society met to discuss food adulteration. That society's president, Sir James Murray, was one of Hassall's mentors, and the first resolution of the Dublin Society was to give credit to Hassall and the *Lancet* for bringing the subject into the British public and scientific consciousness. It was from around this period that Charles Cameron, perhaps the most vocal public health official in Dublin in the second half of the nineteenth century, also began to turn his attention to the adulteration problem.

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[69] Thomas Wakley, leading article, *Lancet*, vol. 66, issue 1666 (4 August 1855), 111-112.
[70] Ibid, 111.
[71] Thomas Wakley, leading article, *Lancet*, vol. 66, issue 1680 (10 November 1855), 444.

Despite the controversy and the agitation against Hassall, public acclamation for him continued. On Thursday, 15 May 1856, a testimonial dinner was held at the London Freemasons' Tavern to honor Hassall. The group, which consisted of members of both Houses of Parliament, and dignitaries in science, literature, and commerce, toasted Hassall for his scientific zeal, originality, and public service. In return, Hassall gave a brief lecture on the current state of food adulteration and the use of the microscope. He also made sure to cite the role of Wakley in the anti-adulteration movement, himself toasting "to the health of Mr. Wakley."[72] Wakley, who attended the testimonial, recommitted his friendship with Hassall, calling their struggle "a mere lovers' quarrel."[73] Letheby did not attend. He called the testimonial "not only premature, but also, as I think, unmerited."[74] The controversy between Hassall, Wakley, and Letheby was clearly about a priority claim, but it was also a debate about what type of scientific evidence was more important to the anti-adulteration cause.[75] This was not a debate about what constituted adulteration, a question that would be central to adulteration debates for the rest of the century, but one about how best to detect adulterated goods. Hassall, of course, was adamant about microscopy, and continually reinforced his status as the first to use the microscope to detect adulteration. Letheby, however, was equally persuasive in defending analytical chemistry. In an 1855 letter to the *MTG* Letheby argued,

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[72] Anon., "The Hassall Testimonial Dinner," *Lancet*, vol. 67, issue 1708 (24 May 1856), 562.

[73] Ibid.

[74] Letter from Henry Letheby to *MTG*, "The Hassall Testimonial," *MTG 1* (4 August 1855), 120-121.

[75] Berris Charnley has recently begun to unravel the internal tensions between Hassall, Wakley, Postgate, and Letheby. The topic, and the importance of the ASC warrants further study. See Berris Charnley, "Arguing over Adulteration: the success of the Analytical Sanitary Commission, *Endeavour* (December 2008), 32:129-133.

> Chemistry has done more to expose the character of the frauds practised on the people than the microscope possibly could have done. The former has exhibited the kinds of adulterations which are mischievous to the health of the people; the latter merely those which are frauds on the pocket.[76]

Methodological disputes between analytical chemists and microscopists continued throughout the second half of the nineteenth century, but, as chapter four indicates, the discourse on the prevention of food adulteration gradually shifted by the 1870s to one almost entirely framed and disputed within the ranks of analytical chemistry itself.

Microscopy, Chemistry, and the Domestication of Nature

What was the rift between microscopy and analytical chemistry? The *Manchester Guardian*, in an article on adulteration, thought that the two should work together, and that, "these diabolical practices may most likely be detected by accurate chemical analyses, the use of the microscope, and those evidences which are afforded by 'structural botany and anatomy.'"[77] Mid-Victorian Britons had witnessed a dramatic shift in the use and meaning of the microscope.[78] Although specialist organizations such as the Microscopical Society of London were founded as early as 1840, it was in the middle decades of the nineteenth century, as Graeme Gooday has effectively argued, that the microscope became "domesticated," meaning that it became a "trustworthy indoor

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[76] Ibid.

[77] Clipping from *Manchester Guardian* in Anon. "The Analytical Sanitary Commission, Notes of the Press," in *Lancet*, vol. 57, issue 1428 (11 January 1851), 84.

[78] Jutta Shickore, *The Microscope and the Eye: A History of Reflections, 1740-1870* (Chicago: University of Chicago Press, 2007).

mediator of ‘Nature.’[79] No longer was the microscope a mere contrivance for amateur gentlemen, as exemplified in books such as E.G. Ballard’s *Microscopic Amusements* (coincidentally, Ballard was the father of famed Victorian epidemiologist Edward Ballard). Instead, the microscope gained new scientific authority as a tool which enabled one to intimately peer into nature. One contemporary in 1869 thought, “through the microscope we may be said to become acquainted with the trademarks of Dame Nature herself; and the forging of them is a feat which defies the cunning of the most crafty adulterator.”[80] Using the microscope was about detecting adulteration, but necessary to this process was also knowledge about what was genuine. This was clearly evident in Hassall’s early work with the ASC. Each report included the description of pure and natural substances, and their various adulterations. Both the natural, and the adulterated needed to be constructed, and were contested, as methods in structural botany were rarely taken in chemistry courses. By the late 1860s and early 1870s one could purchase an adequate microscope for chemical, or pharmaceutical purposes, for around £10. Relative financial access to microscopes coupled with new practical uses such as in detecting food adulteration also necessitated new manuals, such as Lionel Beale’s *How to Work with the Microscope*, first published in 1857, placing it in the middle of the debates between chemistry and microscopy.

Some contemporaries saw the controversy between analytical chemistry and microscopy as a deep-seated problem in sanitary science. In 1856 James Durnford and

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[79] Grame Gooday, “’Nature’ in the Laboratory: Domestication and Discipline with the Microscope in Victorian Life Science,” *Journal for the History of Science* (Sep., 1991), 24:307-341, 309.

[80] Anon., “The Adulteration of Food and Drugs,” *The Westminster Review* (1869) 35:188.

John Power separately published a pamphlet, titled "The Correspondence relating to the Lancet Sanatory Commission (which appeared lately in the *Times*) Examined. The object, the authors noted, was to present to the public the full of the correspondence, at to "exculpate Dr. Hassall from the censures which have been cast upon him."[81]

Science and the Victorian Middle Class Consciousness

In 1855 Hassall published *Food and its Adulterations*, a collection of the analyses he made for the ASC as, he noted, 'Chief Analyst of the Commission.' The book was a hefty 659 pages, and included 159 engravings originally illustrated by Henry Miller, who Hassall first hired in the late 1840s to illustrate his findings from the former's post as anatomical demonstrator at St. George's Hospital, London.[82] Miller was, as Hassall noted, "a microscopical draughtsman.. a most intelligent young man… he rapidly became, aided by his natural ability and constant employment, exceedingly proficient."[83]

It was in *Food and its Adulterations* that Hassall first attempted to define and categorize adulteration. He identified three different types of adulterations. The principal form of adulteration, Hassall argued, was the addition of inferior articles for the purpose of increasing bulk and weight. For example, adding water to milk or tapioca starch to sugar. A second form was the addition of coloring materials, to enhance the appearance of the article, and disguise adulterants of the first form. For example, adding venetian red to cocoa. Lastly, Hassall identified the use of additional substances to improve the smell,

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[81] Anon., "The Correspondence Relating to the *Lancet Sanatory Commission,*" *MTG* (15 March 1856), 12:264.
[82] Hassall, *Narrative of a Busy Life*, 40.
[83] Ibid.

flavor, or pungency of the article. For example, adding alum to flour.[84] Reviewing Hassall's book in the *Lancet* in 1855, Wakley again reaffirmed his priority claim about originating the ASC, and in praiseworthy tone, recommended Hassall's book, which he noted should be "widely known to the scientific and commercial world."[85] Wakley did give credit to Hassall for his use of the microscope, noting,

> He [Hassall] demonstrated that the microscope, wielded by the skilful naturalist and chemist, was able to unravel and to analyse the component structures of substances that bid defiance to the blowpipe and the test-tube alone. It is the great and original merit of Dr. Hassall to have applied the microscope to important uses in inquiries of this nature.[86]

Hassall's analytical work, as Wakley had noted in his review of *Food and its Adulterations,* reached a widespread British public. A full essay review of *Food and its Adulterations* appeared in the March edition of *The Quarterly Review*. There the author related Hassall to Accum, and praised both as anti-adulteration heroes. The article started with an interesting colonial analogy that illustrates the ways in which the anti-adulteration cause was embedded within a larger concern about British identity and the economic success of the British Empire. The article led;

> A story is told of an European who, wishing to convince a Brahmin of the folly of his faith in interdicting, as an article of food, anything that once possessed life,

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[84] Arthur Hill Hassall, *Food and its Adulterations*, (London: Longman, Brown, and Green, 1855), iii-v.

[85] Thomas Wakley, review of Arthur Hill Hassall, *Food and its Adulterations, The Lancet*, vol. 65, issue 1639 (27 January 1855), 97-98.

[86] Ibid.

> showed him, by the aid of the microscope, that the very water which he drank was full of living things. The Indian, thus suddenly introduced to an unseen world, dashed the instrument to the ground, and reproached his teacher for having so wantonly destroyed the guiding principle of his life. We too have at home a Hindoo, in the shape of the believing British public, to whose eye Dr. Hassall nicely adjusts the focus of his microscope, and bids him behold what unseen villanies are daily perpetrated upon his purse and person.[87]

Dickens's *Household Words* also ran a story directed towards Hassall and adulteration in 1855 following the publication of *Food and its Adulterations*. Titled "Starvation of an Alderman," the premise was a satirical story of a London alderman and his family struggling with starvation because they could not find anything safe and unadulterated to eat.[88] Receiving a copy of Hassall's *Food and its Adulterations*, the alderman's daughter reads with keen interest throughout the night. The next morning, when her father sits down for his tea, she retorts with a lengthy summary of its primary adulterants. Opting for coffee instead, she expands on the nefarious practices of coffee adulterations. Hassall's book provided the opportunity, as Dickens noted, to "apply the torch of science" to the problem of adulteration. More than anything else, the Dickensian coverage of Hassall and the anti-adulteration campaign demonstrates that adulteration had reached the heart of the Victorian middle-class family.[89] No longer was adulteration

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[87] Anon., "Food and its Adulterations," *The Quarterly Review*, (March 1855), 460-492.

[88] Henry Morley, "Starvation of an Alderman," *Household Words* (31 March 1855), 2:213-216. See also, Catherine Waters, *Commodity Culture In Dickens's Household Words* (Hampshire; Ashgate Press, 2008), Chapter three.

[89] Samuel Alberti has recently made the claim that science, technology, and medicine were crucial aspects of mid Victorian bourgeois middle-class values. Hassall's anti-adulteration

simply a problem of feeding the industrial and urban poor, who were, as earlier critics suggested, unable to defend themselves economically against adulterated food and drink. By the middle of the 1850s, following the aftermath of the ASC and the Wakley-Hassall-Letheby controversy, this middle class revelation can be seen in food advertising as well, with companies specifically adding words such as “good” “pure” “unadulterated,” and “genuine” in their advertisements.[90] Public agitation, coupled with the increased publicity of scientific evidence, help explain the formation of the first Select Parliamentary Inquiry into the Adulteration of Food and Drugs, formed in 1855. Hassall’s research was particularly important as it demonstrably situated adulteration as a medical and economic problem, a deliberate rhetoric which had important implications for the anti-adulteration debate in the 1870s.

The First Parliamentary Select Committee

Throughout the Victorian period, Select Committees of the House of Commons were, as Roy MacLeod has noted, the quintessential Victorian instrument of expert inquiry.[91] A leading article in the *Medical Times and Gazette* for 30 June 1855 announced, “we are at last to have a Parliamentary inquiry into the Adulteration of Food

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campaign appears to be a pertinent example of this process. See, Samuel J.M.M. Alberti, “Conversaziones and the Experience of Science in Victorian England,” *Journal of Victorian Culture* (2003), 8:208-30.

[90] For a larger discussion on this topic that stretches into the early twentieth century, see Mark Weatherall, “Bread and Newspapers: The Making of “A Revolution in the Science of Food,” in Harmke Kamminga and Andrew Cunningham *The Science and Culture of Nutrition, 1840-1940* (Cambridge: Cambridge University Press, 1995), 179-213.

[91] Roy MacLeod, *Government and Expertise* (Cambridge: Cambridge University Press; 1988), xiv.

and Drugs."[92] The editor of the *MTG* questioned not the extent of adulteration, as earlier reformers were keen to address, but its solution; in other words, how to curb nefarious trade practices. More problematic, the author of the article acutely lamented, "it is impossible to define in what adulteration really consists; that is, unless our legislators will favour us with authorized formulae for our various articles of diet, and make it criminal to depart from them."[93] At the center of the adulteration debate in the Select Committee was the question of how to define adulteration.

It was fitting, considering his role with the ASC and the press it received thereafter, that Hassall was the first witness examined by the First Select Committee on the Adulteration of Food, Drink, and Drugs on 13 July 1855. In his testimony Hassall first clarified that adulteration was "exceedingly prevalent." His experience with the ASC had demonstrated that adulteration had become an art, and, he bemused tongue in cheek, almost a science, where everything that could be cheapened by admixture was. He claimed that "it may be stated generally that it prevails in nearly all articles which it will pay to adulterate, whether of food, drink or drugs. There are but few exceptions to this rule."[94] Hassall's testimony was consistent with, and often verbatim, from his other published works, such as *Food and its Adulterations*; he provided an exhaustive list of adulterated articles, and praised the methodological value of the microscope. Only by the aid of that instrument, Hassall argued, could one see the intimate organization and

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[92] Anon., "The Week," *MTG* (1855), 1:648.
[93] Ibid.
[94] Testimony of Arthur Hill Hassall, in *First Report from the Select Committee on Adulteration of Food, &c.' with the minutes of evidence, and appendix*. (27 July 1855), 1.

structure of vegetable substances.[95] As before, Hassall was also keen to distinguish the value of microscopy vis-à-vis chemistry; his success in detecting adulteration "could never have been effected by chemistry; the most accomplished chemist would hardly have succeeded in detecting more than one of these substances."[96] In particular, Hassall claimed that the Government Chemists of the Excise Office relied too heavily on analytical chemistry, and in turn neglected the microscope. It is unclear how much Hassall actually knew of the work of the Government laboratory. In his testimony before the second meeting of the Select Parliamentary Committee in 1855, George Phillips, the Principal of the Government Laboratory, argued that he used the microscope "very largely" but his claims are also difficult to access.[97]

Part of Hassall's goal in providing such a long list- it contained over 100 articles- was shock value. Although some of the adulterations could be seen as innocuous, many were potentially dangerous, even poisonous Hassall argued. Hassall also made clear that adulteration was a problem for the British Empire; beyond the fact that many consumable goods in high demand such as tea, coffee, cocoa, and sugar were in high demand, numerous articles used as adulterants were also adulterated and imported goods.

Hassall's solution was threefold: establishment of a Central Board composed of scientific analysts (he back off earlier claims by noting that they should be microscopal *and* chemical); hiring of inspecting analysts to be employed throughout the country; and publication of a treatise on adulteration issued by the newly established Central Board,

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[95] *First Report from the Select Committee on Adulteration of Food, &c.* (27 July 1855), 27.
[96] Ibid.
[97] *Second Report from the Select Committee on Adulteration of Food, &c.,* (3 August, 1855), 63.

including the exact forms of adulterations and including extensive illustrations.[98] It was unclear, however, how these new positions would relate to the centrally located Chemical Laboratory of the Excise Office, and the local sanitary infrastructure of medical officers of health and inspectors of nuisances. Hassall argued that not only would revenue be benefited, but more importantly, the public's health protected.

Other expert witnesses included Robert Warington, a chemical operator employed by Apothecaries Hall, Alphonse Normandy, a chemist (and physician), John Simon, then the medical officer of health for the City of London, Sir John Gordon, the Mayor of Cork, John Mitchell, a chemist, Robert Dundas Thomson, Professor of Chemistry at Saint Thomas's Hospital, Thomas Blackwell, a wholesale pickle and sauce manufacturer, and Theophilus Redwood, Professor of Chemistry to the Pharmaceutical Society.

Originally trained as a physician, Normandy took a special interest in chemistry and received laboratory experience in Germany under Leopold Gmelin. In 1850 he published a widely influential text, *Commercial Hand-Book of Chemical Analysis*, which explored both methods in analytical chemistry and some means of detecting adulteration. Normandy was also a champion of the use of the microscope, although it appears that he was more willing to marry microscopal and chemical methods than Hassall. In this way Normandy was perhaps more representative of the conciliatory ethos and reductionist stance that most sanitary reformers held at the time, one which favored the ends and not the means of preventing food adulteration. Giving testimony on the adulteration of bread, Normandy noted, "there are certain substances which chemistry would altogether fail in

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[98] Ibid, 29.

detecting, which the microscope enables you to detect with certainty; but there are many substances for the detection of which the microscope is useless, but which a chemical analysis will detect with the greatest accuracy."[99] Normandy also differed with Hassall with regard to his definition of adulteration. To Normandy, adulteration meant, "the addition of a substance which does not impart to the article adulterated any quality whatever."[100] The addition of harmful substances was still a fraud to Normandy, but on a different scale compared to Hassall. Normandy's proposed solution to adulteration did mirror Hassall's, as he recommended local inspectors to be placed throughout the country who could analyze suspected articles. But Normandy dismissed the formation of a Central Board, and was less optimistic that adulteration could be completely prevented, due to the nature of competition in the British marketplace. "At present," Normandy argued, "competition, instead of being what competition ought to be, a competition of skill as to who shall produce the best article at the cheapest price, is now really a competition as to who shall adulterate with the greatest cleverness."[101]

John Simon, in his testimony, did note that adulteration was both widely practiced and, with a nod to Hassall and Wakley, often injurious to health. Unlike Hassall and Normandy, though, who were primarily asked questions with concern to the detection and extent of adulteration, Simon was asked to provide expert witnessing about legislative means of preventing adulteration. In other words, how could the current public health infrastructure incorporate the detection, prevention, and punishment of

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[99] Ibid, 56.
[100] Ibid, 69.
[101] Ibid, 75.

adulteration? This is perhaps not surprising, considering Simon's experience and expertise as medical officer of health for the City of London. Simon's solution was for Parliament to provide legislation allowing local authorities to appoint competent analysts and conduct legal proceedings against adulterators. Such analysts could be local medical officers of health, Simon thought, but they could not be inspectors of nuisances, who lacked experience and expertise. Simon's definition of adulteration sat somewhere between those provided by Hassall and Normandy, as he distinguished between two kinds of adulterations, those of commercial fraud, and those injurious to health. To this end, he did propose that the existing Central Board of Health might be the centralized governmental arm to oversee anti-adulteration measures. However, Simon disagreed with Hassall's idea of having local inspectors send samples to the central office, advising that, "I think there would be serious difficulties in the Central Board having thus constantly to supply scientific evidence in aid of the legal proceedings of local authorities…the best service the Central Board could render would be in deliberating and advising on those general principles which would fix the public schedule of hurtful adulterations."[102] Given Simon's later project to develop a centralized system of state medicine in the late 1860s and early 1870s, it is interesting to note that in the mid 1850s he was still firmly convinced of the value of local self government.

In his testimony, well-known pharmaceutical chemist Theophilus Redwood claimed that Hassall and Normandy had not considered the difference between adulteration and impurity; an article could be impure without being adulterated. Some

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[102] Ibid, 83.

substances, and here, as a pharmaceutical chemist, he meant mostly drugs (he noted carbonate of soda as an example) could be far from a state of chemical purity, but sufficient for the purposes in which they were intended. Adulteration, Redwood defined, was "the addition of some substance with a view of deteriorating the quality of the body to which it is added… with a view of cheapening it."[103] The difference for Redwood, to put it another way, was one between deceiving the public and injuring the public. Adulteration, by necessity then, was about injuring the health of an individual, a practice he considered grossly exaggerated by Hassall and others.[104] Henry Letheby agreed. He thought that there was an important difference between adulteration and impurities, the former being categorically split between deliberate adulterations and accidental innocuous adulterations. Letheby's training in chemistry helps explain this position.

When the committee met again for its second meeting, a new host of expert witnesses were questioned, including John Postgate, George Phillips, Principal of the Government Laboratory of the Board of Inland Revenue. Henry Letheby, Thomas Herring, a wholesale Chemist and Druggist. Normandy was also questioned two more times, and Redwood a second and third time. It is perhaps interesting to note that both manufacturers questioned, Herring and Blackwell, both said adulteration existed to a very great extent and wanted remedial measures taken.

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[103] *Second Report from the Select Committee on Adulteration of Food, &c*. (31 July 1855), 10.
[104] Ibid, 24.

Perhaps upset because he was left out of the Hassall-Wakley-Letheby controversy, John Postgate began his testimony by making his own priority claim, arguing,

> I originated the present movement… suggesting the appointment of a public analyser, and also that an Act of Parliament should be introduced, to check adulteration. My attention was attracted to the subject by a violent purging and vomiting produced on a patient by adulterated coffee, and also by the state of bread at that time in Birmingham.[105]

Postgate differentiated between harmless adulterations, and what he termed 'pernicious' adulterations, similar to Letheby's two-part definition. Postgate thought that harmless adulterations were a swindle, and could be remedied by fines. 'Pernicious' adulterations, however, he felt, were criminal acts, and could only be remedied through imprisonment. Traders and manufacturers who deliberately adulterated knowing the outcome would injury health, Postgate quipped, could even be punished by making the offender eat his own product, and, "and leave him to reflect on its effects."[106] It is clear that Postgate was, similar to Hassall, interested in public outcry against adulteration.

Perhaps the most controversial testimony came from George Phillips, Principal of the Chemical Laboratory of the Board of Inland Revenue (in 1849 the Excise Office merged with the Board of Taxes and Board of Stamps to form the Board of Inland Revenue). Phillip's laboratory was established to provide analytical chemical evaluations of excise articles. Phillips stated that since 30 October 1843, his laboratory had analyzed

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[105] Ibid, 44.

[106] Ibid, 48.

1,139 samples of beer, 1,116 of peppers, 12,483 of coffee, 187 of soap, 1,1616 of tobacco, 40 of hops, 105 of spirits, 49 of wines, 1 of vinegar, and 142 of tea. The system of inspection for the department was quite extensive; six chemists staffed the London laboratory, and between 60 and 70 chemical officers were stationed throughout England and Wales. Chemical Officers, in addition, needed to pass a three-year course in analytical chemistry at University College London.[107] They were further educated in-house for a period of time, and usually apprenticed to existing officers before receiving their own post. Their remuneration varied, as Phillips noted, between £100 and £600 per annum, the latter quite sizeable for a lower-level civil servant.[108] Phillips' views on adulteration were also quite divergent from those of Hassall, Normandy, and Postgate. Although the latter three slightly differed in their definition of adulteration, they all nonetheless thought it a universal practice in need of parliamentary legislation. Phillips, on the other hand, claimed that adulteration "does not exist, in my opinion, to an alarming extent."[109] Phillips stated that he had not read Hassall's *Food and its Adulterations*, but thought his statements a "great exaggeration."[110] He went on further to say that some adulterations were actually either preferable, or beneficial, such as coffee adulterated with chicory, which he preferred as a superior beverage, and gin adulterated with water, which he thought would be more beneficial to the immoral poor who drink their gin at forty to fifty proof.[111] The question of regulation, according to Phillips, was one

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[107] Ibid, 51.
[108] *Second Report from the Select Committee on Adulteration of Food, &c.* (3 August, 1855), 64.
[109] Ibid, 68.
[110] Ibid, 69.
[111] Ibid, 56.

necessitated only by price, and by the fact that manufacturers often had no standards of quality, such as gin distillers. "We are not a Board of Health," Phillips demanded to the committee, but "a Board of Revenue."[112] Consequently, and in line with his view that adulteration was merely a matter of pecuniary gain and deceit, Phillips was a proponent of the free marketplace. He disagreed with nearly all of the other expert witnesses in stating that a system of inspection throughout England would be "unbearable," adding that "the public can generally best protect themselves."[113] Phillips' testimony clearly differentiated between governmental interest and individual interest.

What did the Select Committee make of the differing, and in some instances, conflicting evidence? In their first report, ordered 22 July, 1856, they agreed with Hassall and others that adulteration prevailed to a large extent. The committee called adulteration a public health problem (although failed to define what such a problem constituted), a pecuniary problem, and a moral problem.[114] Their definition of adulteration combined Hassall's three-point definition and Letheby's distinction between innocuous additions and those injurious to the public's health. The 1856 report noted,

> It is necessary to distinguish between the pecuniary fraud practised on the public, and the injury to public health. If, as regards the adulteration of articles with substances of a cheaper and innocuous character, the public derive the full benefit of this cheapness in a lower price, it would be difficult, if not unwise, for the Legislature to interfere… but, whenever an article is so adulterated as to involve

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[112] Ibid, 65.
[113] Ibid, 69.
[114] *Report of the Select Committee on the Adulteration of Food, &c.,* (22 July, 1856), iii.

> pecuniary fraud or injury to health, it appears to your Committee to be the duty of the Legislature to provide some efficient remedy.[115]

Still unresolved was what constituted adulteration? Who decided if adulteration was a 'fraud' or an 'injury to health'? By 1856, in his third testimony to the Select Committee, Hassall triumphantly defined adulteration "to consist in the intentional addition to an article, for purposes of gain or deception, or any substance or substances, and the presence of which is not acknowledged in the name under which the article is sold."[116] Hassall's 1856 definition excluded both substitutions- selling one article in place of another- impurities, fraudulent contaminations, and accidental contaminations. Hassall did maintain that a further, and important sub-classification of adulteration consisted between those adulterations prejudicial to health, and those that were merely commercial frauds.

The Committee's report recommended that local authorities should be empowered to appoint a scientific analyst in order to analyze suspected articles, positions called local public analysts. In addition, they suggested that the General Board of Health should appoint one or two central analyzers, who could provide competent analysis in difficult cases. The latter suggestion, that of a central board attached to the General Board of Health, never took form. The matter was not sufficiently worked out from a legislative point of view until the 1874 meeting of the Select Parliamentary Committee on Adulteration. Their final resolution was to have George Phillips' (and his successor

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[115] Ibid, iv.

[116] Ibid, 2 May, 1856, 297.

James Bell) at the Government Laboratory at Somerset House, as final arbiters in disputed local cases, a measure that created a great deal of controversy, as we will see in chapter four.

Permissive Legislation and the Second Select Parliamentary Committee

As the result of agitation beginning in the 1850s by Hassall and Wakley, coupled with the expert witnessing during the Select Parliamentary Committee, the first Parliamentary legislation against adulteration in Britain was put into force in 1860 (23 & 24 Vict. c. 84). However, as several contemporaries mused, the Adulteration Act of 1860 was largely a "dead letter." Although functionally the act was permissive, it did permit Courts of Quarter Sessions (in the counties), and Vestries (in the metropolis) to appoint public analysts. Some progressive British towns followed suit by hiring well-known analytical chemists and providing them with an ample salary and laboratory space. Like the conditions in which medical officers of health (MOsH) worked in the decades of the 1850s, 1860s, and early 1870s, the location of where a public analyst worked was often the crucial factor in whether any sanitary work was accomplished.[117] Progressive local authorities might hire a competent MOH and public analysts, and properly remunerate them, but in most instances this was not the case. The two posts, MOH and public analyst, were structurally tied, either figuratively, or in many instances these posts were occupied by the same individual.

In practice a local public analyst could define adulteration in any way they saw fit, as the 1860 Act made no clear legal definition of what constituted adulteration. Henry

[117] Anne Wilkinson, "The Beginnings of Disease Control in London: The Work of the Medical Officers of Health in Three Parishes," unpublished D.Phil. thesis, University of Oxford (1981).

Letheby, for example, who succeeded John Simon as the City of London's joint MOH and public analyst, split adulterations into two kinds, those injurious to public health, and those innocuous to health but still public frauds. Letheby considered the former such examples as the use of poisonous pigments for coloring confectionary, the use of red lead in cayenne pepper, and the use of the salts of copper in pickles and preserves. Examples of the latter included chicory added to coffee, flour added to mustard, and water added to milk.[118] The case of water added to milk remained the most controversial aspect of adulteration debates throughout the nineteenth century. Some expert witnesses at the first Select Parliamentary Committee had placed the example of watered milk in the category of those adulterants injurious to the public's health; watered milk robbed the nutritional value of milk and might particularly injure infants and invalids who depended on a milk diet. Others however, such as Letheby, only considered watered milk a public fraud, in other words, solely an economic problem.

Putting the 1860 Adulteration Act into practice, in other words, was a difficult operation. The decisive limitation of the act was its permissive nature. John Postgate, in a letter in the *BMJ* aptly summarized this position, noting, "the law is permissive, and the suppression of adulteration now rests with local authorities. The efficiency or non-efficiency of the Act depends entirely on the amount of public spirit possessed by corporations."[119] Looking back in 1885, Charles Cameron, the most outspoken anti-adulteration reformer in Ireland, argued that the 1860 Act had several fundamental problems: it had not provided for the appointment of inspectors to obtain suspected

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[118] Anon., "Adulteration of Food," *The Times*, 1860, *2379*, 6.
[119] John Postgate, "The Adulteration of Food and Drink Act," *BMJ*, (1861), 2,35: 241.

samples, it left out provisions for dealing with the adulteration of drugs, and it obliged the purchaser of a sample to disclose to the vendor that the article was to be submitted to analytical tests. As noted earlier, the act was, according to Cameron and many others such as Letheby, a "dead letter."[120] Fines for adulteration were also seen as problematic. The severest penalty for adulteration, according to the 1860 Act was £5 (and the costs of the proceedings). Repeat offenders could face publication of their names in local newspapers (following Hassall and Wakley's recommendation), but such tactics were rarely used by local authorities.

Even where local authorities were progressive leaning and willing to hire a public analyst, it was often difficult find an analytical chemist competent enough to undertake the task at such a low rate of pay. As mentioned, some local authorities opted to throw the responsibility of inspecting and analyzing foods to already overburdened MOsH. At a meeting of the London-based Association of Medical Officers of Health on 15 December 1860, metropolitan MOsH first reflected on the working of the 1860 Act. Some, such as the well-respected John Liddle, MOH for Whitechapel, thought that MOsH "might by joint action carry out the act very efficiently, paying a scientific chemist to assist them."[121] Edward Ballard, MOH for Islington, said that he had already undertaken the post of public analyst, as had Henry Letheby, without remuneration. In return, however, the Islington local vestry had put forward not the small sum of £100 towards laboratory

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[120] Charles Cameron, "On the Results of the Working of the Acts Relating to the Adulteration in Dublin," Transactions of the Royal Academy of Medicine in Ireland, 1885, *3*, 375-381, 375. On Letheby's views concerning the shortcomings of the 1860 Act, see Henry Letheby, "On Food," Cantor Lectures, *Journal of the Society of Arts* (2 October 1868), 828,16:767-770.

[121] Society of Medical Officers of Health (Wellcome Collection) SA/SMO/G2/1/1, 15 December 1860.

equipment. George Buchanan, MOH for St. Giles, had also undertaken the responsibilities of public analyst, though in his case it was in order to prevent a stranger from taking the post and thus jeopardizing his authority in the local community.[122] Most MOsH were fearful of undertaking the joint responsibility of both MOH and public analyst, especially without pay as Letheby and Ballard had done. But, with proper remuneration, the Association noted, MOH "might reasonably become Candidates for the office."[123]

At the heart of analytical practice lay the problem of how public analysts made practical decisions of what constituted adulteration. One could look to printed manuals such as Hassall's *Foods and their Adulterations* (1855), W. Marcet's *On the Composition of Food, and how it is Adulterated* (1856), or Letheby's *Food, Its Varieties and Chemical Composition, etc.* (1870). We have already explored the scientific competition between Hassall and Letheby, and similar scientific bantering played out in the preface of scientific manuals throughout the period under study. Marcet's 1856 publication, for example, took issue with Hassall's work. Although Marcet acknowledged Hassall as the first public agitator in anti-adulteration reform, he thought many of Hassall's descriptions "rather exaggerated."[124] Marcet implied that Hassall's analytical studies were both impartial and overstated, and went as far as to call Hassall's 1855 book a "collection of voluminous reports" rather than a "guide."[125] Although there were many practical choices

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[122] Ibid.
[123] Ibid.
[124] William Marcet, *The Composition of Food and How it is Adulterated*, (London: J.E. Adlard, 1856), ix.
[125] Ibid.

that a public analyst had to make, often they were predicated on political, social, or scientific motivations. Inconsistency seemed to be the general practice amongst most public analysts practicing in the 1860s.[126]

By the late 1860s it was becoming abundantly clear that the 1860 Act needed revision. An anonymous writer in the *Westminster Review* in 1869 went as far as to say that "it would be sheer waste of time to point out the numerous evils, physical and moral, that must necessarily be attendant upon the wide-spread practice of adulterating food and drugs which undoubtedly prevails in this country."[127] The matter came to a head in 1872, when at the end of the year's session, Parliament passed a revised Adulteration Bill (35 & 36 Vict. c. 74). The 1872 Act, in addition to incorporating the 1868 Pharmacy Act for adulterated drugs, enacted more severe punishments for adulteration; those found to have added injurious or poisonous materials (still vaguely defined) faced fines of up to £50 for the first offence and up to six months' imprisonment with hard labor for the second. Adulterations not deemed injurious to health but still fraudulent faced penalties up to £20. The 1872 Act also sought to define an adulterator as "any person selling any article of food or drink knowing the same to have been mixed with any other substance with intent fraudulently to increase its weight or bulk, and who shall not declare such admixture to a purchaser."[128]

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[126] Better food inspection manuals appeared by the last decade of the century, the most widely read was Francis Vacher's *The Food Inspector's Handbook* (London: The Record Press, 1893).

[127] Anon., "The Adulteration of Food and Drugs," *the Westminster Review*, 1869, *35* (London: Trubner & Co.), 206. Although drugs were not included in the 1860 Act, the Pharmacy Act of 1868 declared that adulterated drugs should be treated similarly to adulterated food and drink.

[128] *Adulteration of Food and Drugs Act*, 1872

By the early 1870s there was a greater consensus among sanitary reformers and government officials that a complete system of food inspection, both central and local, was necessary to curb adulteration. The revised Adulteration Act of 1872 allowed inspectors of nuisances and other local officers to procure samples for local public analysts, thus attempting to remedy the difficulty of obtaining suspected samples. The 1872 Act also attempted to define the qualifications necessary for a public analyst, stating that they should possess "competent medical, chemical, and microscopical knowledge."[129] The 1872 Act did lead to a number of public analysts being hired throughout the country, but their numbers overall were small until the post was made compulsory in 1875. The Select Committee of 1874 found that of 171 boroughs and 54 counties, only 26 boroughs and 34 counties had appointed public analysts. It was also only after 1871, with the creation of the Local Government Board, that the appointment of public analysts had to be reported to and approved by the Local Government Board, as opposed to the previous arrangement, whereby the Secretary of State for the Home Department made such confirmations.

Nonetheless, dissatisfaction with the 1872 Act was evident on all sides. We might expect such discontent on the part of traders and manufacturers, who argued that honest purveyors were being harmed by the 1872 Act, in large part because of incompetent or conflicting reports from public analysts. With fines being exceedingly large, particularly for repeated offenders, more was at stake to traders and manufacturers. But, public analysts were discontented with the 1872 Act as well. William Crookes, editor of the

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[129] Ibid.

Chemical News, was particularly vocal about the failing of the 1872 Act.[130] Crookes thought the hiring of competent public analysts by local authorities had "now proved a delusion."[131] A competent analyst, Crookes defined, was one who had undergone a course in chemistry at some University or recognized School of Science, and been engaged with a full range of analytical work for around four years. Even so, Crookes argued in another editorial in 1873, the normal course of training in analytical chemistry did not adequately prepare one for the duties of a public analyst. What was needed was a special course in adulteration and analytical methods, a course unavailable until the late nineteenth century.[132] Part of the problem was that frugal local authorities out to save pounds often added £100 or £150 a year to the salary of their medical officer of health. The solution, to many chemists such as Crookes, was that all appointments should be made by a central government body, whether that be the Local Government Board, the Inland Revenue, or the Pharmaceutical Society was an unresolved and contentious matter. The revised 1872 Act did order that appointments of public analysts had to be approved by the Local Government Board, but this measure applied only to new appointments. Exacerbating the problem of hiring competent analysts was the fact that some local authorities were either unwilling to even hire analysts, or deliberate in hiring incompetent men who would not disrupt local trade interests.

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[130] William Brock, *William Crookes (1832-1919) and the Commercialization of Science* (Aldershot: Ashgate, 2008), especially chapter sixteen.

[131] William Crookes, "The Adulteration Act," *Chemical News* (7 February 1873), 27:61.

[132] William Crookes, "Public Analysts," *Chemical News* 27 (31 October 1873), 219.

Rumblings about the 1872 Act led to the appointment of a second Select Parliamentary Committee which sat throughout the summer of 1874. This committee revisited now familiar, but still unanswered questions such as what constituted adulteration? Should new legislation adopt universal standards of adulteration? Why were public analysts routinely producing conflicting certificates of adulteration? How should public analysts be hired, and what was the state of their education and experience? Although working under a similar scope and framework, the 1874 Select Committee was perhaps more extensive than its 1856 predecessor. The 1874 committee held 14 meetings and examined 57 witnesses. Again, the variety of witnesses examined was wide-ranging, from chemists and manufacturers to traders and government officials.

Central to debates in the 1874 Select Committee were two questions; what constitutes adulteration? And how are conflicts between public analysts to be resolved? Many local analysts were either incompetent or inexperienced, making education and the training of analysts of prime concern. Of the public analysts examined, most agreed that referees were needed in disputed cases. This had been Hassall's original point in 1856, that a central body of chemical analysts should oversee local analytical practices. Michael Carteighe, chemist and Examiner of the Pharmaceutical Society, thought that the Government Laboratory of the Inland Revenue Department at Somerset House, whose leadership was now under James Bell, would be the most suitable body. Others agreed, such as Henry Critchett Bartlett and Francis Sutton, Fellows of the Chemical Society.

Some were skeptical about appointing the Somerset House chemists as chemical referees. When asked if he thought the Government Laboratory would be a suitable choice, John Williams, a manufacturing chemist, nervously refused to answer the question. Charles Cameron, of Dublin, was equally ambivalent. Others such as Hassall and James Alfred Wanklyn, however, were veraciously outspoken against the Government Laboratory. Hassall had thought it a poor idea in 1856 and had severely critiqued the government chemists' ability to detect adulteration in non-excisable commodities. In his 1856 *Adulterations Detected*, the revised version and manual form of his *Food and its Adulterations*, Hassall made frequent reference to the scientific deficiency of the Government Laboratory. Hassall's ofty claim was that "they do not sufficiently employ the resources of science for the discovery of adulteration."[133] By this Hassall meant that the Government Laboratory did not always use the microscope in detecting adulteration. Alfred Allen, public analyst for Sheffield, thought the Inland Revenue Laboratory would fulfill many of the objects of a neutral central body, but he feared, like Hassall, that they lacked experience in analyzing many adulterated goods. The *Pharmaceutical Journal* echoed these fears, noting that "past experience proves that the Excise does not take charge of adulteration in the interests of public health."[134] Again, the adulteration issue was framed between a public health threat and a pecuniary fraud. This discourse would continue to define anti-adulteration discussions until the end of the late nineteenth century, facilitated by epidemiological studies that showed that some adulterations, principle among them disease-charged water added to milk, were deadly. This is further explored in chapter three.

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[133] Arthur Hill Hassall, *Adulterations Detected; or Plain Instructions for the Discovery of Frauds* (London: Spottiswoode & Co., 1857), 33.

[134] Anon., "Adulteration" *The Pharmaceutical Journal* (1872), 671.

Most expert witnesses at the 1874 Select Committee thought it unnecessary that the Government chemists should act as final arbiters in cases of adulteration. The common attack against the Government chemists was that they were incompetent, already overworked, or simply not up to the task. Charles Cameron, MOH and public analyst for Dublin, thought that a new, independent body of eminent chemists could be selected for the purpose, but others such as Stevenson Macadam, of Edinburgh, maintained that the Government chemists would "carry on investigations in a thoroughly impartial spirit."[135] Charles Meymott Tidy, Edward Ballard's successor as public analyst and MOH for Islington, opposed such a measure on the grounds that most cases of adulteration were as much a medical matter as a chemical one. Alfred Allen agreed with Cameron and Macadam, but instead argued that independent referees would best be elected annually by public analysts themselves, a matter Cameron left untouched. Writing in the *Chemical News*, William Crookes fully supported Allen's suggestion, sarcastically quipping, "when we heard the Inland Revenue Laboratory at Somerset House suggested as the ultimate court of appeal we were disposed to think that the proposal was a joke."[136] Allen's suggestion was contentious, and many believed it was a ploy by the public analysts to gain monopolistic control over the adulteration issue.

Chief among the defenders of the government chemists was Augustus Voelcker. Voelcker was perhaps the driving force in backing their role as analytical referees.[137] As Professor of Chemistry at the Royal Agricultural College, Cirenchester, Voelcker had

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[135] *Report of the Select Committee on the Adulteration of Food Act, 1874* (11 June, 1874), 259.
[136] William Crookes, "The Committee on Adulteration," *Chemical News* (10 July 1874), 30:11.
[137] William Crookes, "The Committee on Adulteration," *Chemical News* (3 July 1874), 30:1.

devoted nearly his whole career to the questions surrounding agriculture, food (particularly milk), and chemistry. His 1856 *On the Chemistry of Food* was influenced by Justus Liebig and focused on the chemical constituency and nutritive value of a wide array of agricultural foodstuffs.[138] Voelcker believed that many of the problems with the working of the 1872 Act were due to the ineptitude of public analysts; in many cases, he thought, the skills of the analytical chemist were not even needed to detect adulteration. A common market inspector, Voelcker argued, could more easily and effectively do the task. He stated to the 1874 Select Committee that "a good deal of mischief has been done by the so-called analyses, and the food analysts have been the greatest enemies of the Food Act."[139] He pleaded that, "common sense and ordinary acquaintance with the materials that are to be examined will lead a man to give a far more correct opinion than the biased and clouded views of scientific men."[140] To Voelcker, analytical chemists were inexperienced and improperly trained. Some recommended that public analysts should be trained and certified by the College of Chemistry (part of the School of Mines) at the South Kensington Laboratory headed by Edward Frankland. This was the arrangement already in place between the Somerset House Chemists of the Government Laboratory and Frankland's South Kensington Laboratory. Such a marriage never came to fruition, however, perhaps because of growing antagonism between public analysts and the

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[138] Augustus Voelcker *On The Chemistry of Food* (London: J. Ridgway, 1856). On the general importance of Liebig see Harmke Kamminga and Andrew Cunningham's introduction to *The Science and Culture of Nutrition, 1840-1940* (Amsterdam: Rodopi, 1995), particularly 1-8.

[139] *Report of the Select Committee on the Adulteration of Food Act, 1874* (15 June 1874), 284.

[140] Ibid, 285.

Government chemists, explored in chapter four. Nonetheless, the education of public analysts remained a central and controversial issue.

It is interesting that Voelcker suggested that the professional place of analytical was a low one. He went as far as to argue that in all of Britain there were not a dozen men that would make competent analysts. The appointment of public analysts, according to Voelcker, should be made by a central commission, attached he argued, to the Government chemists at the Excise. This was not, he argued, to be left to the whims of local authorities or a body of public analysts themselves. James Alfred Wanklyn, who gave testimony three days after Voelcker, opposed the latter's suggestion that the Somerset House chemists should be final referees. Wanklyn flippantly called to mind Voelcker's argument used to dismiss analytical chemists, arguing that "the Excise laboratory does not enjoy a high repute amongst chemists…I can promise you that if you were to elect any such body, and give them powers of this description, you would be giving them a license to blunder and to disregard the general views of chemists."[141] In a letter to the Local Government Board in 1874, John Postgate unsuccessfully attempted to settle the matter by imploring that three eminent chemists should be attached to either the Board of Trade or the Local Government Board, to be used in all disputed cases.[142]

Hassall, who again gave testimony between Voelcker and Wanklyn, warned the Select Committee to temper Voelcker's remarks with regard to the poor position of public analysts. Hassall admitted that public analysts "in many cases have been found to some extent wanting," but thought it was due to suddenness of the demand, the lack of

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[141] *Report of the Select Committee on the Adulteration of Food Act, 1874* (18 June 1874), 328.
[142] Letter from John Postgate to LGB, 7 April, 1874. National Archives, Kew. MH 25/25.

proper remuneration, the difficulty of the task, and the inefficiency of the legislation. Given more time, Hassall argued, public analysts would improve.[143] Reframing the problem, Hassall's testimony reverted back to the "the vexed and much disputed question, which is constantly puzzling our judges and defeating the ends of justice, namely, what is and what is not adulteration?"[144] Answer that question, Hassall thought, and the adulteration problem could more easily come under legislative control. Hassall proposed that in addition to a revised definition of adulteration, a series of sub-definitions of specific articles should be placed in the new Act, which in numerous cases would place specific and universal standards what on constituted adulteration.

Obtaining suspected samples was a problem, as was the fact that there was public demand for adulterated goods. They were cheaper, most importantly, and many argued that the poor deliberately chose diseased meat, watered milk, alum-laced flour, and chicory-borne coffee. On the question of the procuring of samples, Charles Cameron, public analyst in Dublin, told the Select Committee that once tradesmen could recognize who the local inspector was, they would simply always give them a pure sample. To remedy this problem, Cameron would often hire "women and sometimes, also, old men, and we tell them to take off their coats and pretend they are labourers, and go in for a halfpenny worth of milk, and in this way try to deceive the vendors into the impression that they are selling it to persons who want to consume it for food."[145] Cameron thought that in some articles, such as flour, milk, and butter, universal standards of adulteration

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[143] *Report of the Select Committee on the Adulteration of Food Act, 1874* (18 June 1874), 307.
[144] Ibid.
[145] *Report of the Select Committee on the Adulteration of Food Act, 1874*, (10 June 1874), 227.

should be put in place. This would, Cameron believed, remedy the imprecise definition of what constituted adulteration. The implementation of standards was a particularly contentious issue, and one that was at the center of the controversy between local public analysts and the Government Laboratory at Somerset House, the subject of chapter four and revisited in chapter five.

Conclusion

Despite the mixed scientific advice, and the continued struggle to define adulteration, Voelcker's testimony must have been particularly forceful, for in the end, the 1875 Act followed large portions of his advice. Most importantly, the 1875 Act made the Somerset House chemists the final referee on all disputed cases of adulteration. What resulted was a Parliamentary repeal of the 1860 and 1872 Acts, and the creation of a new act, consolidating and revising to two, called 'The Sale of Food and Drugs Act, 1875.' The 1875 Act made compulsory that every local authority hire a public analyst. The appeal clause of the 1875 Act meant in practice, for instance, that if a local public analyst reported a case of adulteration against a milkman for adding too much water or skimming too much cream from their milk, once summoned at court, could file a formal appeal, and the indicted milk sample would be sent to Somerset House, where the Government chemists would provide their own certificate of chemical authenticity. That report would then sent back to the local appeals court and the prosecution could continue. The Principal of the Somerset House Laboratory by the 1870s was James Bell, who had studied under the Gieseen trained Liebigian Alexander Williamson.[146] The 1875 Act also

[146] On Williamson, see J. Harris and W.H. Brock, 'From Giessen to Gower Street: Towards a Biography of Alexander William Williamson,' *Annals of Science* (1974), 31: 95-130.

tried to specify that public analysts, in addition to needing chemical, medical, and microscopcal knowledge, also needed competent knowledge, skill, and experience. The definition was still vague, and dissatisfaction by public analysts led them in 1875 to form their own association, the Society of Public Analysts (SPA), which went to great lengths in the late 1870s and 1880s to define methodologies, theories, and practices that all public analysts could agree upon.

In their final report, the 1874 the Select Committee concluded that "in the matter of adulteration," the public are "*cheated* rather than *poisoned*."[147] French and Phillips, largely following Burnett, have taken position that the above Parliamentary indictment not only favored the belief that adulteration was an economic rather than a public health problem, but also that by 1875 most adulterations did not actually threaten the public's health. Both propositions warrant careful consideration. We have already made clear that most expert witnesses-- Hassall, Letheby, Normandy, Wanklyn, Allen, and Simon being the most vocal-- were keen to distinguish between dangerous adulterations which threatened the health of an individual, and innocuous adulterations which threatened the pocket-book of the individual. Indeed, most of these witnesses thought that the threats to public health outweighed those that were simply pecuniary frauds. The 1874 Report, which culminated in the 1875 Act, largely ignored the public health aspects of the adulteration problem, perhaps to appease traders and manufacturers. This was consistent with other aspects of the 1875 Act, such as appointing the Government chemists of the Inland Revenue as scientific arbiters in disputed cases.

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[147] *Report from the Select Committee on Adulteration of Food Act, 1874*, viii.

That the public health aspect to the adulteration problem was relatively ignored is particularly curious considering that from 1871 to 1875 several British epidemiologists, working as either MOsH or medical inspectors at the Medical Department of the Local Government Board, had traced outbreaks of typhoid fever to adulterated milk supplies. These cases of milk-borne typhoid received extensive attention in not only scientific circles, where they served as crucial experiments in testing etiological hypotheses, but also popular circles, where they sharpened consumer fears of adulteration and questioned Britain's relationship between purity, filth, and disease. Most importantly for this chapter, the recognition that adulterated milk could spread disease refocused the anti-adulteration campaign firmly back to the public health aspect of the adulteration problem. The next chapter explores the importance of typhoid fever in the Victorian period, and how public health officials, particularly epidemiologists, MOsH, and the Medical Department of the Local Government Board (previously of the Privy Council) responded to and constructed the preeminent 'filth disease.' By the mid 1870s it was becoming increasingly clear that some adulterated food could spread disease. In turn, the phrase 'the public was cheated rather than poisoned' was reformulated into the public could be cheated *and* poisoned.

Chapter Two: A 'National Disgrace:' Typhoid Fever and the Practices of Epidemiology

A year before he was hired as the first medical officer of health (MOH) for the Northamptonshire Districts, well-known British surgeon and medical geographer Alfred Haviland argued in 1872 that, "typhoid fever is now a national disgrace; we ought not to rest until we reduce it to one simply local or personal; its existence will then become punishable."[1] As MOH, Haviland would spend nearly the next thirty years, until his death in 1903, devoted to the investigation of local outbreaks of infectious disease. Public health practitioners such as Haviland considered typhoid fever a "national disgrace" because of a larger cultural framing of the deadly endemic disease which related it to filth, and because Britons deemed typhoid preventable. Typhoid, along with typhus and cholera, were considered the preeminent 'filth diseases' of the nineteenth century, connected to material conditions such as inadequate sewerage, water supply, and decomposing refuse, and social conditions such as poverty, behavior, and class.[2] Typhoid fever was particularly remarkable to contemporaries because of its veracity to strike not only the poor, but also the rich; it killed those who were atrociously dirty and those who were impeccably clean. Prince Albert's death in 1861 from typhoid and the subsequent attack

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[1] Alfred Haviland, "Abstract of Two Lectures on the Geographical Distribution of Typhoid Fever in England and Wales," *BMJ,* vol. 580 (1872), 148-149, 148. For more on Haviland, including his involvement as MOH in the local typhoid crises in Uppingham, see Nigel Richardson, *Typhoid in Uppingham: Analysis of a Victorian Town and School in Crises, 1875-1877, Science and Culture in the Nineteenth Century*, 5 (London: Pickering and Chatto, 2008), and F.A. Barrett, "Alfred Haviland's Nineteenth-Century Map Analysis of the Geographical Distribution of Disease in England and Wales," *Social Science and Medicine* (1998), 46: 767-81.

[2] For a general discussion of filth in post Englightenment western culture, see William Cohen and Ryan Johnson, *Filth: Dirt, Disgust, and Modern Life* (Minneapolis: University of Minnesota Press, 2005).

on the Prince of Wales ten years later in 1871 catalyzed what Anne Hardy has called a "royal impetus," guiding a public sentiment that increasingly recognized that typhoid was not only deplorable and widely prevalent, but above all preventable.[3] Coupled with a series of epidemiological investigations in the decade from 1870 to 1880 that linked typhoid to the milk consumed by wealthy Britons, the subject of chapter three, typhoid merited the national concern with which Haviland spoke in 1872.

Although it was a central challenge to Victorian physicians and scientists, typhoid fever was also firmly rooted in the Victorian social consciousness. Its endemic nature throughout the second half of the nineteenth century reminded Victorians that public health reform was often slow and incremental, and that improvements in rural sanitary infrastructure often lagged behind urban developments. Unlike cholera, whose epidemiological profile in the Victorian period manifested in four large-scale, urban-centered mid-century outbreaks in 1831-32, 1848-49, 1853-54, and 1865-66, typhoid remained a serious endemic threat until the early twentieth century. There were scattered large-scale typhoid outbreaks throughout the second half of the nineteenth century, but for the most part, typhoid was a locally persisting problem, affecting both urban centers and rural parishes. Anne Hardy and William Luckin have both examined the apparent increase in the incidence of typhoid from 1860 to 1870, and have shown that there was a slow, but unsteady post-1870 decline.[4] While Hardy and Luckin's figures are perhaps fair

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[3] Anne Hardy, *The Epidemic Streets,* 165. Two other royal cases led to further concern, one in the house of the Earl of Cadogan at St. James's in 1874, and another that struck Prince Leopold in 1875.

[4] Ibid, 154. As for Luckin's similar demographic data, see William Luckin, *Polluion and Control,* especially chapter six.

estimates, the use of mortality statistics in examining typhoid fever for most of the nineteenth century should be deployed with serious caution. This is due to the fact that until 1869 the Statistical Office of the Registrar-General did not distinguish between typhoid, typhus, and simple continued fever. For most of the century, the ambiguous term 'fever', which in the English context was predominated through the lens of a post-Galenic symptom-based nosological definition informed by the refinement of the fever doctrines of seventeenth century English physician Thomas Sydenham and eighteenth century Scottish physician William Cullen.[5] As late as the mid nineteenth century, most British medical practitioners thought that fever was a broad diagnostic and nosological category; it was a general moniker that could manifest in several forms. In particular, there was much confusion between typhoid and typhus, the separation of which was first argued in Britain by William Jenner, Alexander Stewart, and Charles Murchison beginning in the 1830s. Although French pathological anatomists such as Pierre Louis (and his American students) took the lead in distinguishing between typhoid and typhus in the 1820s and 1830s, the matter seemed less clear in Britain, where diagnostic confusion persisted until at least the 1880s.

This chapter argues that typhoid was at the center of an important epistemological and methodological shift in the scope of scientific research that occurred in the middle

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[5] Andrew Wear, *Knowledge and Practice in English Medicine, 1550-1680* (Cambridge: Cambridge University Press, 2000), 448-460. On Sydenham see also; Andrew Cunningham, 'Thomas Sydenham: Epidemics, Experiment and the "Good Old Cause"' in Roger French and Andrew Wear (eds) *The Medical Revolution of the Seventeenth Century* (Cambridge: Cambridge University Press, 1989), 164-190. On Cullen, see W.F. Bynum, 'Cullen and the Study of Fevers in Britain, 1760-1820,' *Medical History*, Supplement 1 (1981), 135-147.

decades of the nineteenth century. From the 1830s and 1840s pathological anatomists such as Jenner and Stewart claimed that distinguishing typhoid from typhus would radically change both the diagnosis and treatment of infectious fever. By the mid 1860s medical scientists, informed by the new epidemiology, increasingly began to focus on the transmission of typhoid in the population. New research on typhoid centered on its epidemiological profile. It was in the middle decades of the century that some British medical scientists argued that typhoid was most similar not to typhus, but to cholera. Typhoid, like, cholera, reformers such as William Budd argued, was a dangerous water-borne disease. The shift from pathological anatomy to epidemiology had several crucial and lasting ramifications on the nature and scope of British public health; typhoid reminded public health authorities throughout the second half of the nineteenth century that water supplies, sewerage, and drainage needed radical and systematic improvement throughout the country. The epidemiological shift presaged the understanding of typhoid as a water-borne disease, placing it at the center of complex and fierce etiological debates that raged in the second half of the nineteenth century.[6]

The epidemiological shift in typhoid research also led to a more general transition in the direction of scientific practice on infectious diseases. Once they recognized that typhoid was as a water-borne disease, British epidemiologists then turned their attention on other possible mediums, the most important being milk, shellfish, flies, and later even asymptomatic human carriers. This transition was facilitated by medical scientists in three different, but intimately related and intricately networked Victorian institutions that

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[6] Michael Worboys, *Spreading Germs,* especially chapter one.

were the heart of Victorian epidemiology, the Epidemiological Society of London (ESL), the Association of Medical Officers of Health, and the Medical Department of the Privy Council (the Local Government Board from 1871).

Diagnostic Confusion and the French Impulse in Britain

As is well-known in the history of medicine, the post-revolutionary Enlightenment ethos that prevailed in early nineteenth century Paris led to a reformation of the organization of medical research. Bichatian pathological anatomy linked knowledge from the bedside with post-mortem dissection, and led to an epistemic shift between doctor and patient, what Michel Foucault has termed the "Birth of the Clinic."[7] Beginning in the late 1810s and early 1820s, several notable French pathological anatomists began systematically conducting post-mortem dissections on patients who had died of fever, attempting to distinguish a morbid pathology between the various forms of the disease. Pierre Louis' work, particularly at the La Charite Hospital and later at La Pitie Hospital, as Leonard Wilson has argued, formed, in connection with Bretonneau's pathological research, the nexus of fever research in Paris.[8] It was at La Charite and La Pitie that Louis distinguished the characteristic feature of typhoid fever, namely the distinctive appearance of lesions in the Peyer's patches of patient's small intestines.

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[7] Erwin H. Ackerknecht, *Medicine at the Paris Hospital, 1794-1848* (Baltimore: Johns Hopkins Press, 1967), Michel Foucault, *The Birth of the Clinic: An Archeology of Medical Perception*, A.A. Sheridan Smith, trans. (New York: Vintage Press, 1975), John E. Lesch, *Science and Medicine in France: The Emergence of Experimental Physiology, 1790-1855* (Cambridge: Harvard University Press, 1984), Russell C. Maulitz, *Morbid Appearances: The Anatomy of Pathology in the Early Nineteenth Century* (Cambridge: Cambridge University Press, 1987), and John Harley Warner, *Against the Spirit of the System: the French Impulse in Nineteenth Century American Medicine* (Princeton: Princeton University Press, 1998).

[8] Leonard G. Wilson, "Fevers and Science in Early Nineteenth Century Medicine," *J. Hist. Med. Allied Sci.* (1978), 33:386-407. On Bretonneau see Adam Patrick, *The Enteric Fevers, 1800-1920* (London: Royal College of Physicians, 1955), 6-8.

Louis' pathological work was replicated by several of his American students, including George Shattuck and James Jackson, Jr., from Boston, Caspar W. Pennock and especially William Gerhard, from Philadelphia.[9] By 1837, Wilson has argued, the distinction between typhus and typhoid was relatively settled in both France and America. However, the controversy over the classification of fever remained heated in Britain.

The two most vociferous and early advocates for distinguishing between typhus and typhoid in Britain were William Jenner, distinguished physician to the London Fever Hospital, and Alexander Patrick Stewart, the Glasgow-born physician to the Middlesex Hospital. Joining Jenner and Stewart in this view was also William Budd, who in 1839 submitted an unsuccessful entry to the Thackeray Prize Essay titled "On the Causes of Fevers." Budd also had extensive experience in Paris studying with Francois Broussais, and was an active practitioner in his hometown of Bristol. Jenner, Stewart, and Budd were not alone in Britain in distinguishing typhoid from typhus, but most British practitioners believed that 'continued fever', as a general nosological condition, was one disease which was capable of assuming and changing into different forms. Less common was the belief, following the French school, that the general term 'continued fever' actually represented three or four distinct diseases, with separate origins, modes of communication, and pathological manifestations. Stewart, Jenner, and Budd, all of whom had Parisian intellectual debts or educational experiences, were the most important British physicians sympathetic to the French distinction.

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[9] Dale C. Smith, "Gerhard's Distinction between Typhoid and Typhus and its Reception in America, 1833-1860," *Bull. Hist. Med.* (1980), 54: 368-85.

Stewart had studied for a brief period in Paris in the early 1840s. On 23 April 1840 he read, "Some Considerations on the Nature and Pathology of Typhus and Typhoid Fever, applied to the Solution of the question of the Identity or Non-Identity of the two diseases," before the Parisian Medical Society.[10] It was in that paper where Stewart first laid out his confirmation of the distinction between the two diseases, the first for a British physician. It should come as no surprise therefore that he spent several weeks in Paris following Louis in the wards of the Hotel Dieu. In Britain, it was also in the early 1840s that William Jenner sought to resolve the dispute, collecting notes from over one thousand cases and working with prominent London physicians and fever writers Thomas Southwood Smith and Alexander Tweedie. Jenner published his results in late 1849 in article form, and a year later in an extended monograph titled *The Identity or Non-Identity of Typhoid or Typhus Fevers*, which remained the most important British book on fever until Charles Murchison's 1862 *Treatise on the Continued Fevers*. Although the matter remained controversial, by the early 1850s most British medical practitioners, even non-contagionists such as Charles Murchison, at least agreed that typhoid was a distinct disease.[11] Nonetheless, so pervasive was the problematic categorization of typhoid that many British medical practitioners preferred to call typhoid fever "enteric fever," denoting the organs with which the lesions of the disease occurred. Here nomenclature mattered, as those physicians who preferred enteric fever almost always

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[10] A.P. Stewart papers, Royal College of Physicians, London. MS 567/1- 567/7

[11] Although in practice many British physicians found difficulty in distinguishing between typhoid and typhus, William Jenner noted that "that the nurses of the London Fever Hospital rarely fail to distinguish between the two." See William Jenner, *Lectures and Essays on Fevers and Diphtheria, 1849-1879* (London: Rivington and Percival, 1893), 173.

allied themselves with the French School of pathological and nosological specificity. Enteric remained the favored name for many British public health officials throughout the second half of the nineteenth century, although by the 1880s most sloppily used typhoid and enteric interchangeably.

Some lamented the loose terminology. Delivering what was perhaps the most famous lecture on typhoid, distinguished late Victorian public health official William Corfield, in his 1902 Milroy Lecture before the Royal College of Physicians, admonished his colleagues for still using enteric in favor of typhoid.[12] Other nosological terms for typhoid gained momentary popularity throughout the Victorian period, including dothinenteritis, entero-mesenteric fever, enteric typhus, bowel fever, pythogenic fever, and colonial fever in British India, Australia and New Zealand.[13] While the diagnosis of typhoid fever remained controversial throughout the second half of the nineteenth century, many British medical practitioners began to turn to epidemiological studies of typhoid in the 1860s and 1870s. Instead of eschewing the problematic diagnostic question regarding the fevers, this turn reinforced the need for proper diagnosis and death certification as paramount for making informed statistical arguments. John Netten Radcliffe, for instance, in 1863 speaking before the Epidemiological Society of London, lamented that typhus was still being used to designate all forms of continued fever. He argued,

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[12] William Corfield, *The Etiology of Typhoid Fever and its Prevention*, (London: Gower Street, W.C., 1902), 2.

[13] For a contemporary account, see Robert Christison, “President’s Address in the Public Health Department of the Social Science Association,” delivered at Edinburgh on 13 October, 1863, *BMJ* (1863), *2*: 437-445.

> If "typhus", "typhoid", and "relapsing" fever are to be regarded etiologically and nosologically as distinct forms of disease, as Dr. Murchison and others cogently argue, and as would seem most probable, it is manifest that the use of the term, "typhus" in the returns of the Registrars-General of England and Scotland, diminishes very greatly the scientific and practical value of the returns, and tends to no little confusion.[14]

Murchison's 1862 *Treatise on the Continued Fevers of Great Britain*, was, as Radcliffe noted in the above speech, "an epoch in the study of fever," particularly in solidifying the fever distinction in Britain.[15] It is clear, however, that many nosological questions remained unanswered into the late 1860s. Dublin physician Henry Kennedy, for example, in his 1865 article in the *Medical Press And Circular*, titled "Mixed Types of Fever," was furious about rumors that any medical student going before examination in London would be rejected if they did not share Jenner's views on the distinction between typhoid and typhus.[16] Kennedy suggested that the Jennerian view of fever was particular to 'London physicians', and that in most places medical practitioners still maintained that the "typhus poison is capable of engendering the type of fever known as typhoid or enteric, and that this particular type must be due to some other cause rather than a specific poison."[17] Kennedy's claim may have been oversimplified or exaggerated, but

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[14] John Netten Radcliffe, "The State of Epidemic, Epizootic, and Epiphytic Disease in Great Britain, in 1861-62," *Transactions of the Epidemiological Society of London*, vol. I, (1863), 393.

[15] Ibid, 394.

[16] Henry Kennedy, "Mixed Types of Fever: in relation to the question of the Identity or Non-Identity of Typhus and Typhoid Poisons," reprint of article in *Medical Press and Circular* (July 1865), 3.

[17] Ibid, 4.

his view nonetheless demonstrates two claims; there was a lack of nosological clarity well into the late 1860s, and perhaps a level of urban elitism by the London medical community regarding the classification of fever. Kennedy did believe that the two types of fever were distinct clinical entities. More conflated, however, was his belief that the poison of one could produce the other. As indicated by Kennedy, the endemic nature of typhoid outbreaks in rural communities could have potential limitations, such as the continuance of out-dated etiological models such as spontaneous generation. Cornelius Fox, Medical Officer of Health for Essex, in 1876 still lamented that country doctors and patients would often reply to the question "where did the patient catch the fever" with "nowhere; he (or she) bred it, sir."[18]

To British epidemiologists, distinguishing between typhus and typhoid was essential to the epidemiological practice of case tracing. In 1862 John Netten Radcliffe suggested that the Epidemiological Society of London write to the Office of The Registrar-General recommending that the latter officially support the nosological distinction between the continued fevers. Radcliffe feared that epidemiological studies on typhoid were doomed without proper diagnosis, keenly reflecting the belief of many epidemiologists and statisticians. While the Registrar-General did not officially distinguish between typhoid and typhus until 1869, it is clear that support from epidemiologists and institutions such as the ESL contributed to the crucially important official nosological change.

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[18] Cornelius B. Fox, "Is Enteric Fever Ever Spontaneously Generated?" *BMJ* (25 March 1876), 795:374-377, 376.

As Dale Smith has persuasively noted, "the questions concerning fever in the 1840s were of two sorts: first, the degree of difference between the different forms of continued fever and the evidence to be used in establishing the answer, and second, the source(s) and mode(s) of propagation."[19] Distinguishing typhoid from typhus clarified a longstanding nosological problem in western medicine on the nature of 'fevers'. Although it signified to many medical practitioners the coming of scientific medicine, albeit in a uniquely French form, diagnostic confusion remained, leading to statistical uncertainty and therapeutic anxiety. More importantly, perhaps, was the vexed question that followed the French School's conclusion that typhoid was a distinct disease; namely, if a specific clinical entity, what was typhoid's etiology? Jenner commented in the late 1840s that in order for new research on 'fever' to be fruitful, one had to start with the fact that each fever had "a different origin, a different course, different symptoms, and leading to or accompanied by different lesions."[20] This reflected a shift, starting in the early 1850s, from a 'pathological impulse' to an 'epidemiological impulse.'

As research on typhoid in the 1850s increasingly turned towards etiological questions, many British medical practitioners began to rely on the emerging science of epidemiology. William Budd was crucial to what we might call the 'epidemiological turn' in the study of typhoid. From his earliest epidemiological investigation of typhoid in Richmond Terrace, Clifton (outside of his hometown of Bristol) in 1847, Budd was keen

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[19] William Budd, *On the Causes of Fevers* (1839) (ed.), Dale C. Smith, The Henry E. Sigerist Supplements to the *Bull. Hist. Med.*, New Series, no. 9 (Baltimore: Johns Hopkins University Press, 1984), 123.

[20] William Jenner, *Lectures and Essays on Fevers and Diphtheria, 1849-1879* (London: Rivington and Percival, 1893), 393.

to marry the pathological (relating to the specificity of typhoid) and epidemiological (relating to its etiology, or spread) characteristics of the disease. Historian Lloyd Stevenson, in his masterful 1982 article "Exemplary Disease: the Typhoid Pattern" argued that mid nineteenth century studies- pathological, epidemiological, and later bacteriological- of typhoid fever served as one of the most important models for public health reformers. Stevenson wrote that, "not typhoid alone but almost all categories of disease were soon regarded as amenable to the same approach- pure water, pure milk, pure food, and by no means least, a stupendous system of modern sewers."[21] Typhoid was an important disease in the Victorian social consciousness because of its longstanding designation as one of the "filth diseases," meaning it was not only preventable through a rigorous system of public health, but also shameful in the context of Victorian attitudes towards social progress and purity. Scientific research on typhoid was a crucial testing ground for pathological theories, as argued above, and etiological theories, explored below. Typhoid was arguably the most important disease to British epidemiologists in the second half of the nineteenth century.

Cholera, Typhoid, and the Water-borne Theory of Disease Transmission

Most historians have argued that the modern discipline of epidemiology emerged in mid-Victorian Britain as a result of a series of important investigations on cholera by proto epidemiological giants John Snow and William Budd.[22] While the epidemiological

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[21] Lloyd Stevenson, "Exemplary Disease: the Typhoid Pattern," *JHMAS* (1982), 37:161-62.

[22] David Lilienfeld, "The Greening of Epidemiology: Sanitary Physicians and the London Epidemiological Society (1830-1870)," *Bull. Hist. Med.* (1979), 52:503-28. For a general overview, see George Rosen, *A History of Public Health*, expanded edition (Baltimore: The Johns Hopkins University Press, 1993), 261-263.

investigations of cholera by Snow and Budd were decisive in establishing the water-borne hypothesis, which in turn provided a model for other diseases such as typhoid, and other mediums such as milk, cholera provided a limited example for epidemiological research.[23] Nineteenth century outbreaks of cholera were most devastating in urban areas, where it was difficult to conduct intricate case tracing and statistical mapping, two crucial elements of epidemiological fieldwork according to Snow and Budd. A more important testing ground for epidemiological hypotheses such as the water-borne theory were outbreaks of typhoid fever. The incidence of typhoid in Britain seems to have been most intense from 1860 to 1880, although some large-scale outbreaks of typhoid continued into the twentieth century. Understanding this chronology is important for several reasons, not least because the last cholera outbreak was in 1866, meaning that after that date, British epidemiologists turned their attention away from cholera and towards typhoid. Yet, typhoid manifests in a population slightly differently than cholera; its incubation period is longer, its presentation of symptoms is more nuanced, and it is spread by not only by water, but also foodstuffs, flies, and asymptomatic human carriers. Moreover, the substantial mid-century cholera outbreaks killed thousands at specific times, mostly in urban areas and often rapidly over the course of several months or a year. Typhoid conversely, attacked both urban and rural areas, killed fewer at a time, but occurred more consistently throughout the second half of the nineteenth century.[24] Although it did not strike fear into British hearts in the same manner as cholera, typhoid

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[23] The best current biography of John Snow is Peter Vinten-Johansen, et al., *Cholera, Chloroform, and the Science of Medicine*. On the water supply of London in the nineteenth century, see Anne Hardy, "Water and the Search for Public Health in London in the eighteenth and nineteenth centuries," *Medical History* (1984), 28: 250-282.

[24] Stevenson, "Exemplary Disease," 174.

was the more common water-borne disease experience, making it more useful for epidemiological research.

Snow's epidemiological investigations of the 1848-49 and 1854-55 cholera outbreaks have been extensively covered by historians of public health, and they need not be recounted here. It is useful, however, to examine one of Snow's more peculiar, but equally informative papers. On 8 March 1853 Snow delivered a lecture to the Medical Society of London, titled, "On Continuous Molecular Changes, More Particularly in their Relation to Epidemic Diseases." The topic was a broad one, and Snow described his subject as "the chief phenomena of living beings."[25] It combined themes of eighteenth century vitalism, spontaneous generation, animal chemistry, and physiology. The basis of Snow's argument was that infectious diseases needed to be understood both chemically and biologically; diseases were products of and produced by natural chemical and physiological processes (vital processes) that could be understood at the molecular, individual (patient) and population level. Some diseases, 'communicable diseases', Snow arged, are caused by specific materials produced in the system of other individuals. Of these, Snow cited syphilis, smallpox, measles, scarlet-fever, typhus, typhoid fever, relapsing fever, erysipelas, yellow fever, plague, cholera, dysentery, influenza, whooping cough, mumps, scabies, and the entozoa. Snow was specific in using the word communicable, as Vinten-Johansen et al. have argued, because unlike 'contagious' or 'zymotic' (the latter William Farr's nosological preference) 'communicable' meant that

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[25] John Snow, *On Continuous Molecular Changes, More Particularly in Their Relation to Epidemic Diseases* (London: Churchill, 1853), in *Snow on Cholera*, ed. Wade Hampton Frost, (New York: Hafner, 1965), 147.

the spread of the disease "could be direct as well as indirect.[26] It also emphasized the process of biological change," hinting at Snow's evolutionary proclivities.[27] Snow's theory, fully developed by 1855, that cholera was a specific disease spread by the intestinal discharges of previous sufferers, was labeled by some contemporaries as a contagionist theory, and thus pitted against anti-contagionist (or miasmatic) theories.[28] However, as Margaret Pelling has conclusively argued, most nineteenth century British medical practitioners were neither purely contagionist nor purely anti-contagionist. Etiological camps were ill defined, Pelling, and more recently Michael Worboys, have demonstrated, with most British medical practitioners occupying a centrist, multifactoral, or contingent-contagionist approach.[29] In this context, Snow's theory was instrumental because it allowed for indirect as well as direct transmission. The etiological claim for indirect transmission, namely through mediums, or vehicles such as water, milk, and food, was essential to the epidemiological framework of tracing the spread of disease in populations.

Historians have thus far been only speculative as to the appeal and initial influence of Snow's theory.[30] We know, for instance, that the official stance of the General Board of Health's Committee for Scientific Inquiries was a refusal of Snow's

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[26] On Farr's zymotic theory see; John Eyler, *Victorian Social Medicine,* 97-122.

[27] Vinten-Johansen, et al., *Cholera, Chloroform, and the Science of Medicine*, 379.

[28] The classic work on contagionism and anti-contagionsim is Erwin Ackerknecht, "Anticontagionism Between 1821 and 1867," *Bull. Hist. Med.* (1948), 22: 562-93.

[29] Margaret Pelling, *Cholera, Fever, and English Medicine,* 275-77, Michael Worboys, *Spreading Germs,* and Vinten-Johansen, et al., *Cholera, Chloroform, and the Science of Medicine,* especially chapter seven.

[30] Eyler has masterfully compared the very different contemporary reception of Snow and Farr's ideas. See, John Eyler, "The Changing Assessments of John Snow's and William Farr's Cholera Studies," *Sozial und Praventivmedizin,* (2001), 46:225-232.

theory.[31] Likewise, most of the medical press, Thomas Wakley at the *Lancet* included, found that while Snow's theory was interesting, it ultimately lacked experimental proof. While it is true that most British medical practitioners were skeptical of Snow's theory in the 1850s and 1860s, John Simon himself a doubter until the late 1860s, Snow clearly had an impact on British epidemiology. Tracing 'Snowsian' ideas to the burgeoning science of epidemiology, and in turn to the younger generation of British epidemiologists who followed Snow, yields a different historical narrative of the growth of Victorian epidemiology. And while the full historical picture of Snow's influence remains unknown, this study suggests several initial considerations.

The Epidemiological Society of London; a Disciplinary Awareness

In 1979 David Lilienfeld provided the first substantial historical analysis of the founding of the Epidemiological Society of London.[32] Tracing the epidemiological movement in Britain and the United States to French statistical methods, Lilienfeld argued that British epidemiology flourished from the 1850s to the 1860s, when epidemiologists studied socially pressing epidemic diseases such as cholera. By the middle of the 1860s, Lilienfeld claimed, most of the founding members such as Benjamin Guy Babington and Gavin Milroy had died, leaving "a new generation of epidemiologists

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[31] Vinten-Johansen, et al., *Cholera, Chloroform, and the Science of Medicine*, especially chapter 13.

[32] David Lilienfeld, "The Greening of Epidemiology: Sanitary Physicians and the London Epidemiological Society (1830-1870)," *Bull. Hist. Med.,* (1978), 52:526. Lilienfeld uses the acronym 'LES' to stand for London Epidemiological Society. However, from the middle of the 1850s society members preferred 'ESL' designating Epidemiological Society of London. Throughout I use both of the latter terms. For more on the origin of the Epidemiological Society and its first president, Benjamin Guy Babington, see Alun Evans, "Benjamin Guy Babington: Founding President of the London Epidemiological Society" *Int. Journal of Epidemiology* (2001), 30: 226-230.

[who] were to take over the LES and all those institutions associated with epidemiology." As of yet, though, historians have failed to take up Lilienfeld's call to explore the new generation of British epidemiologists who led the discipline from the mid 1860s. I would suggest this is because of the belief, largely stemming from Lilienfeld, that "beginning in 1870 and until 1910, the Bacteriological Era overshadowed epidemiology. During these 40 years, epidemiology hibernated in Francis Galton's and Karl Pearson's biostatistical laboratory."[33] Lilienfeld's claim is interesting, but ultimately problematic, considering his lack of historical study into epidemiological practices in the second half of the nineteenth century. Instead, epidemiology was alive and well in the second half of the nineteenth century. This follows Anne Hardy's recent claim that late nineteenth century epidemiology, unlike its American and German counterparts, was cautious in adopting the theories, methods, and practices of laboratory-based bacteriology.[34] Hardy argues that late nineteenth century British epidemiologists remained committed to field based and observational approaches, while still maintaining the statistical tradition with which the discipline arose. My examination of epidemiological studies of typhoid fever confirms this claim, rebuffing Lilienfeld's older

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[33] Ibid, 527.

[34] Anne Hardy, "Methods of Outbreak Investigation in the 'Era of Bacteriology', 1820-1920," in *A History of Epidemiologic Methods and Concepts,* (ed.) A Morabia (Berlin: Birkhauser Verlag, 2004), 199. See also Michael Worboys, "Was There a Bacteriological Revolution in Late Nineteenth Century Medicine?" *Stud. Hist. Phil. Biol. Biomed. Sci.,* (2007), 38:20-42, and Anne Hardy, "On the Cusp: Epidemiology and Bacteriology at the Local Government Board, 1890-1905," *Medical History* (1998), 42: 328-46.

hypothesis.[35] In chapters four and five, I nuance Hardy's claim to suggest possible inter-dependent relationships between epidemiology, bacteriology, chemistry, and pathology.

This chapter identifies and locates the major centers of epidemiological practice in the second half of the nineteenth century. I argue that epidemiological networks were intricately connected between three centers, at the Epidemiological Society of London (ESL), where epidemiologically-minded sanitarians debated larger theoretical, conceptual and methodological frameworks, in the work of Medical Officers of Health (MOsH) who applied epidemiology to local sanitary problems, and at the Medical Department of the Privy Council (later the Local Government Board), where epidemiology was fused between central and local levels. Although epidemiology was being practiced in a variety of institutional contexts, examining the epidemiological practices at these three centers confirms Hardy's yet unsubstantiated hypothesis that late nineteenth century British epidemiology was field-based, observational, and statistical. Epidemiologists were interested in a wide variety of infectious diseases, from cholera, smallpox, diphtheria, and typhoid fever, and more broadly in theoretical questions such as the origins of life, spontaneous generation, and etiological models, or germ theories. They were also concerned with statistical modeling, geographical and geological mapping. As Graham Mooney has argued, late nineteenth century epidemiology relied on ecological and

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[35] Other critical and more recent historical work on the history of epidemiology is Olga Amsterdamsk, "Demarcating Epidemiology," *Science, Technology, & Human Values* (2005), 30:17-51. Amsterdamsk provides a critical analysis of how epidemiologists claimed epistemic status as scientific, but concentrates her discussion to the twentieth century. I argue that twentieth century claims were predicated upon an earlier discourse established in the second half of the nineteenth century, explored in this study.

environmental thinking, two closely connected nineteenth century discourses.[36] The remainder of this chapter focuses on epidemiological studies of typhoid fever, which were at the center of epidemiological debates and epidemiological practice in the late nineteenth century.

Typhoid Research at the Epidemiological Society of London

Interest in typhoid fever at the ESL can be traced to the founding of the society in 1850. At the inaugural meeting on 2 December 1850, the founding members, including Thomas Addison, Benjamin Guy Babington, Richard Bright, John Snow, John Simon, and Gavin Milroy, created several special committees. These consisted of the Smallpox Committee, Vaccination Committee, Cholera Committee, Hospital Committee, Epizootic Committee, and the Continued Fever Committee.[37] The two latter committees are of particular significance. The welcoming of epidemiologically-minded veterinarians such as Britain's leading veterinary reformer James Simonds, who chaired the Epizootic Committee demonstrates the early commitment of the ESL to exploring complex etiological questions not limited only to diseases in humans. In turn, the veterinary profession lauded the efforts of the ESL.[38] Throughout the second half of the nineteenth century there were often close relationships between epidemiologists and veterinarians, although as I show in chapter five, the two professions could be antagonistic to one another. It is clear that the 1865 cattle plague (rinderpest) intensified epidemiological

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[36] Graham Mooney, "Infant Mortality, A Spatial Problem: Notting Dale Special Area in George Newman's London," in E. Garrett, C. Galley, N. Shelton and R.I. Wood (eds), *Infant Mortality: A Continuing Social Problem* (Aldershot: Ashgate, 2006), 169-189.

[37] The original meeting books of the ESL are located at the Royal Society of Medicine, London, Archives, ESL/B/1 Meeting Minutes.

[38] William Percivall, "Editorial Observations," *The Veterinarian* (1851), 24:537-539.

interest in epizootics, as did frequent outbreaks of pleuro-pneomonia and later bovine tuberculosis.[39] However, often overlooked is the role of typhoid fever in first merging, and then separating, epidemiological and veterinary interests. This was most apparent from 1865 to the 1890s, when many prominent epidemiologists and veterinarians, John Gamgee the most outspoken, believed that milk-borne outbreaks of typhoid could be traced to diseased cattle, explored more fully in the next chapter.

Early members of the Continued Fever Committee followed Jenner's distinction between typhoid and typhus, and several papers were read at early meetings of the ESL between 1850 and 1860 that provided corroborated local evidence.[40] In an 1862 paper Edward Headlam Greenhow, distinguished London physician and early epidemiologist aptly summarized the complex state of etiological knowledge on typhoid;

> Although the aetiology of continued fever has engaged the attention of so many able inquirers during the last few years, it must still be regarded as unsettled,

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[39] Susan D. Jones, "Mapping a Zoonotic Disease: Anglo-American Efforts to Control Bovine Tuberculosis Before World War I," *Osiris* (2004), 19:133-148. See also, Keir Waddington, *The Bovine Scourge* (Woodbridge: the Boydell Press, 2006), Abigail Woods, *A Manufactured Plague: Foot and Mouth Disease in Britain, 1893-2001* (London: Earthscan, 2004), and Anne Hardy, "Pioneers in the Victorian Provinces: Veterinarians, Public Health, and the Urban Animal Economy," *Urban History* (2002), 29: 2002, 372-387.

[40] The topic was the main feature of the ESL meeting on 2 April 1855. One was by Frederick James Brown titled "On Typhoid Fever, and the Absence of Typhus, in the towns of Chatham and Rochester, during the year 1854," and the other was by William Camps titled, "On the Occurrence of Fever at Sible Hedingham, Essex, and at Cowbridge, South Wales." Other examples include Charles Murchison's early work on typhoid which was read on 7 February 1859 titled "On the Causes of Continued Fever," and Edward Headlam Greenhow's "History of an Outbreak of Fever at Over-Darwen in the Autumn of 1861" read on 7 April, 1862. See Anon., "Epidemiological Society" *Medical Times and Gazette* vol. 10, 1855, 476-78, and *Transactions of the Epidemiological Society of London*, vol., I, II, (London: T. Richard, 1855).

> seeing that such various views are entertained on the subject by observers who may equally lay claim to ability and impartiality.[41]

Scientific interest in typhoid fever from an etiological point of view was most intense from 1860, around the time when Greenhow made the above remarks, until around 1880, when etiological disputes on the disease were less volatile, and the overall incidence of the disease was seemingly in decline.[42] In that roughly twenty-year period, the two main etiological views on typhoid were represented by William Budd and Charles Murchison.[43] Budd, the Bristol physician, saw typhoid as a contagious, self-propagating disorder. Largely following John Snow's theory on the etiology of cholera, Budd argued that typhoid was a specific disease, with the most virulent part of the specific poison contained in the diarrheal discharges of typhoid patients. The drain, Budd famously argued, was a continuation of the intestine. However, Budd was not a strict contagionist, believing for most of his life that air and water could disseminate both typhoid and cholera. What was most important to Budd was the prevention of typhoid through the specific disinfection of diarrheal discharges. Murchison, assistant physician to the London Fever Hospital, agreed with Budd and Jenner on the distinction between typhoid

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[41] Edward Headlam Greenhow, "History of an Outbreak of Fever at Over-Darwen in the Autumn of 1861," *Transactions of the Epidemiological Society of London* vol. I (London: John W. Davies, 1863), 337.

[42] On the statistical rise and decline in the incidence of typhoid I had largely followed Anne Hardy. Hardy argues that typhoid incidence peaked somewhere between 1860 and 1870, and thereafter declined (although unsteadily). See, Anne Hardy, *The Epidemic Streets,* 151-90.

[43] The debate between Budd and Murchison has been well documented by Margaret Pelling. See Margaret Pelling, *Cholera, Fever, and English Medicine, 1825-1865*. At a time when many British medical practitioners clung to the belief that the continued fevers constituted the same disorder, the two at least agreed that typhoid and typhus were two distinct diseases. For contemporary examination of the subject, see Benjamin Ward Richardson, "The Present Position and Prospects of Epidemiological Science," delivered 2 November, 1863, *Transactions of the Epidemiological Society of London* vol. II (London: Robert Hardwicke, 1867), 119.

and typhus, but thought typhoid arose spontaneously from decomposing organic filth.[44] According to Murchison, typhoid was never spread by direct contact; the fresh stools of typhoid sufferers, in other words, were never directly infecting. So confused by contemporary debates about the nosology of typhoid, Murchison suggested a new name, "pythogenic fever," meaning bred of filth, which many contemporaries preferred due to the cultural mileage of the discourse surrounding filth. Murchison's pythogenic fever was a product of the fermentation of excreta, which was often, although not exclusively, he argued, transmitted from a previous case of the disease. The crucial difference between Budd and Murchison rested on how the two defined the process of infection, particularly Murchison's insistence on decomposition and spontaneous generation. Although the two etiological views were incommensurable with one another, it is important to realize that etiological camps were ill defined throughout the Victorian period. Instead, most British medical practitioners occupied a more centrist perspective, one that was multifactoral, or as Pelling has called contingent-contagionist.[45] As Michael Worboys has recently argued, there were a multiplicity of germ theories, and the ascendance of a single, unified germ theory did not to appear until the early twentieth century.[46]

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[44] Charles Murchison, *Treatise on the Continued Fevers of Great Britain* (London: Longman's Green, & Co., 1862). See also Pelling, *Cholera, Fever, and English Medicine,* 288-89. Murchison is indicative of many British medical practitioners who maintained into the 1870s that typhoid originated spontaneously. So vociferous were the arguments for spontaneous generation, that they were fiercely debated at the Annual Meeting of the British Medical Association in Edinburgh, August 1875. See, Cornelius B. Fox., "Is Enteric Fever ever Spontaneously Generated?" *BMJ* (1876), 795: 373-77.

[45] Pelling deserves the most credit for nuancing the role of contingent-contagionism. See Pelling, *Cholera, Fever, and English Medicine*, 284-85.

[46] Worboys, *Spreading Germs*, 1-5.

Etiological confusion over typhoid typifies such an understanding. One could argue in the Victorian period, for example, that typhoid was a specific disease sometimes spread through water supplies, but not specify how exactly that water came to be infected. Most British medical practitioners, Budd included, argued that air and water spread typhoid, and that the disease was preeminently spread by indiscriminate filth (based on the older filth and fever definition framed by Edwin Chadwick and Thomas Southwood Smith).[47] The etiological picture of typhoid was more nuanced by the late 1860s and early 1870s, however, as many practitioners leaned towards Budd's theory that typhoid could only be spread via the intestinal discharges of the sick. However, even within such an exclusivist theoretical framework, one could side with Budd that typhoid discharges were infective immediately after leaving the sick typhoid sufferer's body, and the widely popular theory launched by the Germany physician Max von Pettenkofer that typhoid discharges were only infective after undergoing a fermentation-like process in the soil.[48] Aside from such intense etiological debating, which most rank-and-file practitioners often eschewed, by the early 1860s most could at least agree that infectious

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[47] On Chadwick's etiological beliefs the most influential account is Christopher Hamlin, *Public Health and Social Justice in the Age of Chadwick*. On Southwood Smith and early epidemiological concepts of filth, see a more recent article by Michael Brown, "From Foetid Air to Filth: the Cultural Transformation of British Epidemiological Though, ca. 1780-1848," *Bull. Hist. Med.,* (Fall 2008), 82:515-544.

[48] Pelling, *Cholera, Fever, and English Medicine,* 284. Pettenkofer's idea was extremely influential in Britain, not least because it was etiological specific and yet environmental. See John Simon, *English Sanitary Institutions* (London: John Murray, 1897) second edition, 287. Hermann Weber, Physician to the German Hospital in London, compared the views of Snow and Pettenkofer in an 1865 paper read to the Epidemiological Society of London. See, Hermann Weber, "On Professor Pettenkofer's Theory of the Mode of the Propagation of Cholera," Transactions of the Epidemiological Society of London, Vol II (London: Robert Hardwicke, 1867), 404-413.

diseases were specific entities.[49] Benjamin Ward Richardson, in his 1863 opening address before the ESL called it the "one universal principle of causation that each disease has its specific, organic, physical cause, which may not, it is true, have been discovered by the eye, but which exists nevertheless, and obeys the same influences of motion and rest, as other bodies more substantial and more readily demonstrable."[50] It is difficult to assess the relative importance of Murhicson and Budd in this context; in practice most medical practitioners praised both as 'fever experts.' Murchison had presented his pythogenic theory to the ESL in 1859, and from contemporary accounts it is clear that Murchison was regarded by many in Britain as the most important authority on typhoid fever. William Budd never presented his theory of the water-borne transmission of typhoid to the ESL, but many members must have been familiar with his work, since it had been published in the *Lancet* and the *British Medical Journal*, among other places. Although there was a diversity of opinion regarding the specificity and mode of propagation of epidemic disease, it seems that most members of the ESL shared theoretical alliances with Budd in most instances, although Murchison's views at times held sway. In an address delivered to the ESL on 2 November 1863 Benjamin Ward Richardson argued that the idea, or what he termed, "law of propagation," that epidemic diseases are specific entities capable of spreading throughout the population via direct

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[49] The best study of the general British medical profession in this time period remains Jeanne Peterson's *The Medical Profession in Mid-Victorian London* (Berkeley: University of California Press, 1878).

[50] Benjamin Ward Richardson, "The Present Position and Prospects of Epidemiological Science," *BMJ* (5 December 1863), 153: 597-601, 598. The original address was delivered before the Epidemiological Society on 2 November 1863.

contagionist means such as in smallpox or indirect means such as water "has been almost universally recognized in this Society from its foundation." Richardson cited the earlier work by his close friend John Snow in 1849 and 1855, and the Scottish physician Robert Christison, who in an 1863 address to the Public Health Department of the Social Science Association had also made similar etiological arguments.[51] We should perhaps be critical of Richardson for claiming that the exclusivist water-borne theory was all but universal from the inception of the ESL, particularly because of his reputation as Snow's most staunch defender. Nonetheless, his remarks do at least signify some degree of theoretical uniformity at the ESL, which is consistent with a historical reading of the ESL's *Transactions* and archival records in the period under discussion.

Given the complex etiological climate surrounding typhoid in the 1860s and 1870s we should perhaps expect that there were discrepancies between epidemiologists. For example, concluding his paper at the ESL in 1862, Greenhow, mentioned above, lamented, "these facts are of so various a character that, taken separately, they are capable of affording evidence in support of any one of the several existing theories of the origin and mode of propagation of Typhoid Fever."[52] Such confusion can also be seen in papers such as Edward Harvey's "On an Outbreak of Typhoid Fever at Wing, Bucks," read on 1 June 1863. The importance of the Epidemiological Society of London was that it provided a forum for testing etiological hypotheses such as the water-borne theory.[53] It also provided an opportunity for early epidemiologists to define professional boundaries

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[51] Ibid. Richardson became a regular member of the ESL in 1852, when Snow nominated him. See, Royal Society of Medicine, Archives, ESL/B/1 Meeting Minutes for 5 April, 1852.

[52] Greenhow, "Outbreak of Fever at Over-Darwen," 352.

[53] Peter Vinten-Johansen, et al, *Cholera, Chloroform, and the Science of Medicine,* 239.

and make programmatic statements concerning the nature, methods, and scope of what many considered was an emerging profession.

In his 1863 opening address, for example, Benjamin Ward Richardson proclaimed, "let us, then, as scientific epidemiologists, join hands with the sanitarian; let us not, for a moment, think little of his labours, nor breathe a breath that shall reduce them in the public estimation. Let us ask him simply not to embarrass his good work with untenable theories as to origins of disease."[54] Here Richardson was attempting to distinguish between "sanitarians" and "scientific epidemiologists." The crux of the difference, according to Richardson, centered on one's etiological viewpoint; sanitarians believed in the older Chadwickian model that bad smells were sufficient causes of epidemic outbreaks, while scientific epidemiologists believed in pathological, statistical, and epidemiological data which argued that epidemic diseases were specific entities capable only of producing similar diseases and spread by direct or indirect infection. Claims of scientific validity were presented on both etiological sides, however, and we should be cautious in affording one authority greater scientific rigor than the other in the middle decades of the nineteenth century.

It was in this etiological climate, one of competing scientific authority, that epidemiological research on typhoid fever became socially, politically, and scientifically significant. In his first presidential address in 1866, William Jenner argued that "while we know nothing of the nature of the contagious or zymotic substance of any one of them,

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[54] Benjamin Ward Richardson, "The Present Position and Prospects of Epidemiological Science," 127.

we do know that it is present in a special state of activity in different excreta in different diseases: thus, in the gastro-intestinal secretions in typhoid fever, cholera, and cattle-plague."[55] As epidemiological attention increasingly turned to the mode of propagation of infectious diseases by the mid 1860s, many epidemiologists considered typhoid of utmost importance. It was also during this time, as Jenner's comments above suggest, that typhoid was being increasingly associated with cholera. This etiological connection was predicated upon Snow and Budd's concept of indirect transmission, most importantly through water. As Jenner continued in his 1866 presidential address,

> It is now placed beyond question by the labours of Dr. Snow, confirmed as they have been by experience, that water is one of the great agents in diffusing cholera; and, if possible, it has been more unequivocally proved that typhoid fever is carried from individual to individual in the same way.[56]

The solution, according to Jenner and increasingly many other sanitary reformers by the late 1860s, was the rigid supervision of the "special vehicles" by, as Jenner argued, "the application by law of a Sanitary Act capable of being worked from a central authority by the means of inspectors… the inspectors, and not the inhabitants, should set the law in motion."[57] Jenner's recommendations mirrored those made by other public health leaders at the time such as John Simon, Henry Rumsey, and William Stokes in Dublin, who were

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[55] William Jenner, "Address Delivered at the Opening of the Session, 1866-67," Transactions of the Epidemiological Society of London, vol. III, sessions 1866 to 1876 (London: Hardwicke and Bogue, 1876), 1-14.

[56] Ibid, 10.

[57] Ibid, 12-13.

increasingly becoming known as catalysts in the movement towards 'state medicine.'[58] Indeed, the Parliamentary mandate that made the hiring of medical officers of health compulsory upon local authorities in 1872, along with the rigorous system of local inspection by John Simon's inspectors at the Medical Department, already in place in 1866, were in essence the object of Jenner's pleas.

Epidemiology on the Ground: the Importance of Medical Officers of Health

Etiological hypotheses on the communication of typhoid fever were extensively tested throughout Britain by medical officers of health (MOsH). As Anne Hardy has argued,

> The campaign against endemic infectious disease which began in England in the 1850s was fought essentially at local-government level. Infectious disease was viewed as a local problem, to be dealt with by local authorities. The establishment of local sanitary departments, spearheaded by medical officers of health (MOHs), marks the beginning of serious preventive medicine in England.[59]

MOsH were first appointed by two local authorities, Liverpool, who hired William Henry Duncan, and the City of London, who hired John Simon. From the early 1850s to the early 1870s the establishment of MOH posts was uneven throughout Britain. Progressively minded local authorities might invest in a qualified MOH and remunerate him with sufficient income to forego private medical practice, but in most cases MOsH were poorly paid and largely subject to the wants and whims of local authorities, whose

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[58] Henry Wyldbore Rumsey, *Essays on State Medicine* (London: John Churchill, 1856), and William Stokes, "A Discourse on State Medicine," *Brit. Med. Journ.* 13 April, 1872, 385-89.

[59] Anne Hardy, *Epidemic Streets*, 4.

civic activism was not always progressive.[60] Nonetheless, similar to epidemiologists at the ESL, MOsH did have an institutional basis, first founded by the network of MOsH in Metropolitan London. In 1855 the Metropolis Local Management Act required that all of London's vestries appoint an MOH. The following year, in 1856, all forty-eight metropolitan MOH formed the Metropolitan Association of Medical Officers of Health (MAMOsH). They voted, somewhat fittingly, John Simon as their president.[61] As more local authorities appointed MOsH, and through political clamoring by public health reformers such as Simon, William Henry Rumsey, and Henry Acland, Regius Professor of Medicine at Oxford, in 1872 Parliament made the hiring of MOsH compulsory to all urban and rural sanitary districts. One year later the MAMOsH expanded to include MOsH throughout the country, and refashioned itself as the Society of Medical Officers of Health (SMOsH). [62]

Similar to the committee-forming ethos of the ESL, the MAMOsH from its onset in 1856 founded several specific committees. The first four were designated the Trade Nuisances Committee, The Adulteration of Food and Drugs Committee, The Etiological Committee, and The Meteorology Committee. The scope of these committees helped to

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[60] David Davies, "The Trials and Difficulties of a Health Officer," *BMJ* (30 September 1871), 561: 377-78, T.J. Dyke, "The Work of a Medical Officer of Health, and How to Do It," *BMJ* (16 November 1872), 620:543-45. See also, Christopher Hamlin, "Muddling in Bumbledom: On the Enormity of Large Sanitary Improvements in Four British Towns, 1855-1885," *Victorian Studies* (1988) 32: 55-83.

[61] Letter dated 6 May 1856, to all Metropolitan MOHs. Society of Medical Officers of Health, Wellcome Archives, London, SA/SMO/G2/1/1.

[62] On the development of MOHs, see Sidney Chave, *Recalling the Medical Officer of Health* (London: King Edward's Hospital Fund, 1987), and Anne Hardy, "Public Health and the Expert: the London Medical Officers of Health, 1856-1900," in R.M. MacLeod (ed.) *Government and Expertise: Specialists, Administrators, and Professionals, 1860-1919* (Cambridge: Cambridge University Press, 1988), 128-42.

define the practical nature of Metropolitan MOH duties and concerns.[63] Trade nuisances, particularly urban cow-sheds, as well as food adulteration, were common topics of interest at monthly MAMOsH meetings. At most meetings, however, MOsH shared their experiences and debated the nature of infectious disease, much similar to ESL meetings; some members unsurprisingly attended both meetings.

Although, as Anne Hardy has argued, we should not generalize the experience of either successful urban MOsH or prominent rural MOsH, many contemporaries did indeed see the validity and usefulness of MOsH by the 1860s. In a paper before the Epidemiological Society of London in 1867, T. Clifford Allbutt (later Sir), consulting physician in Leeds, wrote that,

> These gentlemen, dealing as they do with the health of communities rather than individuals, claim thereby a more important place in Society. They are indeed at present awaiting a higher perfection of their own science, a science as full of difficulties as it is full of promise…scientific industry has seldom seen a more successful issue than the issue of late researches into the origin of the cholera, cattle plague, and the continued fevers.[64]

Exemplarily of Allbutt's statement was the meeting of the MAMOsH on 21 March 1868, where Henry Letheby, who in 1858 replaced John Simon as the City of London's MOH,

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[63] Minutes of MOH Meetings, Wellcome Archives, London, SA/SMO/B.1/1. Subsequent committees were added in later years. For example, in 1857 Edward Ballard, MOH for Islington, proposed that John Gamgee and John Burdon Sanderson chair a committee on diseased meat, which was unanimously approved.

[64] T. Clifford Allbutt, "On the Prevention of Disease by the Reconstruction of the Dwellings of the Poor," Transactions of the Epidemiological Society of London, vol. III, 1876 (London: Hardwicke and Bogue, 1876), 106.

read a paper on the London cholera outbreak of 1866, the final visitation of epidemic cholera in Britain.[65] In the late 1970s William Luckin wrote the definitive historical account of the 1866 cholera outbreak. The basic narrative is well known; between late July and early November 1866, upwards of four thousand metropolitan Londoners largely living in the East End died, leading to extensive political and social unrest and scientific investigation. The 1866 outbreak has been seen has significant no doubt because it marked the last visitation of cholera in Britain and a thenceforth political commitment, at least in theory, to reforming the public health infrastructures to an efficient sewerage system and a clean, filtered, and continuous water supply. It also marked the ascendance of "progressive," to follow Luckin's terminology, scientific methods of controlling epidemic disease. By "progressive" Luckin meant the combination of the statistical analysis of mortality data exemplified by William Farr at the Registrar General's Office, the chemical analysis of water exemplified by Edward Frankland, and the epidemiological case-tracing exemplified by John Netten Radcliffe. The three had, after all, teamed to condemn the East London Waterworks Company at fault for the 1866 outbreak. Luckin concludes that the 1866 cholera outbreak demonstrates the "extraordinarily diverse spectrum of attitudes towards water-transmitted disease which were in competition for intellectual and social hegemony in Britain in the mid-1860s."[66] By the mid to late 1860s, Luckin suggests, and Worboys has recently confirmed, there were still a multiplicity of etiological theories, with only the "*avant garde* in the nascent

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[65] Henry Letheby, ""On the Cholera Epidemic of 1866 contrasted with former epidemics of the disease, and an examination of the question whether the water supply had any connection with the disease." Society of Medical Officers of Health, Wellcome Archives, London, SA/SMO/G2/1/1.

[66] William Luckin, "The Final Catastrophe- Cholera in London, 1866," *Medical History*, (1977), 21: 32-42.

profession of epidemiology which gave unqualified support to the view that the outbreak of 1866 was decisively carried by water."[67] Henry Letheby's 1868 paper read to the ESL in 1868, and the discussion which ensued, confirms Luckin's suggestion.

Unconvinced of the water-borne theory of cholera transmission, Letheby had argued from the outset of the 1866 outbreak that no proof existed of direct water pollution with choleraic discharges. Letheby's view was a mix of Farr's more inclusive zymotic theory and Pettenkofer's idée fixe that cholera or typhoid discharges needed to undergo a fermentation like process in the soil to become infective. He believed that discharges could be infective only between the fourth and eighteenth day after leaving the body.[68] Per the 1866 outbreak, Letheby was struck by several anomalies; inhabitants receiving the same water as those affected, but in higher elevation, remained cholera free, and even at the center of the 'cholera field' (Farr's term), some persons were unaffected.[69] Even more, Letheby argued, was that some inhabitants outside of the 'cholera field' were affected with the disease.[70] Furthermore, as was commonly argued, Letheby pressed that there was no known demonstration of the actual cholera 'poison.'

At the conclusion of Letheby's reading, John Netten Radcliffe, not a MOH, but prolific epidemiologist directly involved in the 1866 investigation and regular attendee of MAMOsH and ESL meetings, raised several contentions against Letheby. As an

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[67] Ibid, 33.

[68] Ibid. See also, Anon., "Metropolitan Association of Medical Officers of Health," *Medical Times and Gazette* (1868), 1, 354-55.

[69] On Farr's ideas see John Eyler, *Victorian Social Medicine,* chapter five.

[70] Ibid. See also Letheby's testimony in *Select Committee on the East London Water Bills,* Parliamentary Papers, 1867; IX: 363, and *Royal Commission on Water Supply,* Parliamentary Papers, 1868-9: XXXIII: Q3, 906.

inspector under the direction of John Simon, Chief Medical Officer of the Medical Department of the Privy Council, Radcliffe had been instructed to conduct a full investigation during the height of the 1866 outbreak. Throughout the second half of the nineteenth century Radcliffe was the Medical Department's resident expert on water-borne diseases; he was, as Luckin notes, an "*elite* within an *elite*," convinced of John Snow's water-borne theory from at least the late 1850s. In 1850, at the age of twenty-four and while living in Leeds Radcliffe was elected a non-resident member of the newly formed Epidemiological Society of London. A Yorkshireman, Radcliffe was educated at the Leeds School of Medicine. After qualification for M.R.C.S. in 1853, he spent time in the Crimea as a surgeon attached to the headquarters of the Turkish Commander, Omar Pasha.[71] From early in his career Radcliffe was keenly interested in infectious diseases and epidemiology. Upon returning to Britain, Radcliffe moved to London, was appointed medical superintendent of the Hospital for the Paralyzed and Epileptic in Queen Square, London, and then joined the inspectorate staff of the Medical Department of the Privy Council, where he remained until his death in 1884.[72] Three of Radcliffe's earliest papers delivered to the Epidemiological Society demonstrate his early concern with epidemic disease and sanitation; they were titled, "The Hygiene of the Turkish Army, From the Sanitary Point of View," "On Scurvy Among the Crew of the Ottoman Brig Fezri Sefet," and "Fever on Board the Turkish Line of Battleship Tesherefieh."[73]

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[71] Obituary for John Netten Radcliffe, Transactions of the Epidemiological Society of London, vol. 4. (1885), 121.

[72] Radcliffe was influenced by his brother Charles Bland Radcliffe, a prominent London neurologist, which might help explain the former's position at the Queen's Square institution.

[73] Transactions of the Epidemiological Society of London, Series I, vol. I, 1857, 24, 39, 1858, 13

Connecting Typhoid to Cholera: John Netten Radcliffe and the Water-borne Hypothesis

Radcliffe's story is indicative of many young epidemiologists who shaped the nascent profession of epidemiology in the middle decades of the nineteenth century. Probably exposed to Snow's water-borne theory through his involvement with the ESL, Radcliffe conducted his first local investigation of cholera in Theydon Bois, Essex in 1865. The story of Radcliffe's investigation of the Theydon Bois cholera epidemic is a useful exploration into the local context of epidemiological research. It demonstrates the ways in which epidemiological practices were environmental, observational, and dependent on a wide range of scientific networks. Moreover, and to the point of this chapter, typhoid was considered a water-borne disease by the late 1860s, but only through its epidemiological connection to cholera, making investigations such as Radcliffe's crucial to understanding how British medical scientists debated and understood typhoid.

In the summer of 1865, Britain had been free from cholera for nearly a decade. Medical reports from Russia and Germany, however, began streaming into British medical journals and the Privy Council detailing the return of the deadly scourge. By the early autumn of 1865, the port town of Southampton was the first affected. While most of the early reports came from the major port towns, one isolated outbreak occurred inland at Essex, in the town of Epping, and the parish of Theydon Bois. Theydon Bois was a small parish; in 1865 it had only about 600 inhabitants. Fearful of the return of epidemic cholera, John Simon, Chief Medical Officer of the Medical Department of the Privy

Council, sent Radcliffe to investigate. Simon had good reason: the 1848-49 cholera epidemic had killed approximately 55,000 Britons and the 1853-4 epidemic had tallied around 25,000 deaths (while more tame, the 1865-6 outbreak would kill around 14,000). Radcliffe's eventual report, titled, "On the Outbreak of Cholera at Theydon Bois, Essex, in 1865, With Special Reference to the Propagation of Cholera by Water as a Medium," was important for several reasons. It demonstrates the willingness of the Privy Council to investigate localized disease outbreaks, even before the Sanitary Act of 1866; it sheds light on the importance of local epidemiological investigations; it also suggests how epidemiological methods might differ when the focus was an isolated rural outbreak rather than a widespread metropolitan outbreak, crucial to later studies of typhoid fever. Perhaps more importantly, as the title suggests, his investigation of cholera in Essex illuminates Radcliffe's theory of disease causation. Specifically, Radcliffe was committed to Snow's exclusive water-borne theory of transmission. By the 1860s cholera was seen by a growing number of members in the ESL, drawing on recent biological arguments, as having a specific, living agent, or poison (the causative agent was often left vague) that enters the body through the alimentary canal, is reproduced in the bowels of cholera victims, and is chiefly carried through the medium of water.[74]

Epidemiologically, the outbreak of cholera in Essex afforded Radcliffe a unique research opportunity. The isolated nature of the outbreak, which Radcliffe showed had originated on one particular farm, enabled him to trace each individual case. Because the

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[74] Charles Darwin's *Origin of Species* was first published in 1859, and many epidemiologists were willing to engage in evolutionary debates. Evolutionary and etiological debates coalesced in this period around the contentious issue of spontaneous generation.

total number of cases was small (twelve residents were affected with cholera and nine died), Radcliffe was able to isolate the "special localising causes" of the disease, meaning that he was able to correlate the environmental characteristics of the particular location to the personal predispositions and behaviors of those affected.[75]

Radcliffe suspected and was able to isolate the role of water as a medium in cholera transmission because of his exposure to Snow's exclusive theory of cholera and the remarkable limitation of the outbreak to one family and one house. Although Radcliffe was committed to Snow's theory, the kind of epidemiological evidence he used to substantiate the claim that the outbreak was communicated through a water supply infected with the discharges of previous victims was significantly different than Snow's. Snow had used a combination of large metropolitan studies of water companies and a more detailed analysis of one location, Broad Street, while Radcliffe's investigation was small scale and rural.

Radcliffe first thoroughly inspected the drainage and water supply of Theydon Bois. The well water, he noted, was "very turbid and abominably fetid…it was clear that the water was laden with decomposing organic matter."[76] Concerned, Radcliffe sent a sample of the water for chemical analysis to his colleague in London, Professor William Allen Miller at King's College. Miller's analytical test confirmed Radcliffe's suspicions; "there was obviously," Miller remarked in his report, "some leakage from the cesspool

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[75] John Netten Radcliffe, "On the Outbreak of Cholera at Theydon Bois Essex in 1865, with Special Reference to the Propagation of Cholera by Water as a Medium," Transactions of the Epidemiological Society of London, vol. III, Sessions 1866 to 1876. Read April 1st, 1867, 85-98. See Also, *Rep. Of the Med. Officer to the Privy Council for 1865* (Eighth Report), 438.

[76] Ibid, 92.

into the well."[77] Radcliffe conducted a simple experiment which verified his theory that cholera discharges had seeped into the well. He first found two leaks, one in the sink drain, and one in the soil-pipe. By pouring water into the drain in the house and examining the two leaks, Radcliffe noted,

> The escaped matters penetrated downwards along the outer wall of the house, passed beneath the foundation, saturated the earth in the angle between the pump and the well, and so reached the latter. Water having been poured down the water-closet, in ten minutes a portion had passed along this tract and was dripping into the well.[78]

Radcliffe was thus satisfied that the cholera discharges of one individual had ended up in the mouth of the next. This theory rested on the fundamental idea that cholera was a specific living agent able to be transmitted through the medium of water. Compare Radcliffe's investigation to John Snow' Broad Street investigation in 1854. Radcliffe and Snow shared fundamental assumptions about the nature of epidemic disease and the necessary methods of epidemiological investigation. Interestingly, Radcliffe was keen to relate the two epidemiological studies.[79] At the end of the Theydon Bois report Radcliffe was clear about the connection between the two studies,

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[77] Ibid, 93. On Miller see his obituary in the *Lancet*, vol. 2 (8 October 1870), 523.

[78] Ibid.

[79] Perhaps just as telling, the following paper in the ESL report was that of the Reverend Henry Whitehead, titled, "Remarks on the Outbreak of Cholera in Broad Street, Golden Square, London, in 1854." This paper was read on May 6th of 1867, nearly a month after Radcliffe's paper. Whitehead's aim in the above report was to show that the cholera outbreak in Broad Street had already started to decline before Snow requested to remove the handle. Nonetheless, Whitehead confirmed Snow's 'exclusive' theory that cholera discharges had found their way into the area's drinking water.

> Both this outbreak [Snow's Broad Street, 1854] and the outbreak at Theydon Bois furnish invaluable data in estimating the probable effect of water contaminated with diarrhoeal discharges in determining explosions of cholera, when the influence of such a cause of contamination has to be estimated chiefly, if not solely, from the facts of the explosion alone.[80]

The two investigations are similar in another important way. Although Snow's Broad Street investigation was not wholly conclusive, many of his contemporaries found specific parts of the evidence convincing. Take the example of the cholera investigation by the Committee for Scientific Enquiries in 1854 and 1855, which was an arm of the temporary Board of Health formerly under Edwin Chadwick and then headed by Benjamin Hall. The Committee's members included Neil Arnott, William Baly, William Farr, and John Simon.[81] Snow was requested by the Committee to draw up a report on cholera in the Parish of St. James, Westminster.[82] The Committee negatively responded to Snow's report, noting that there was "not sufficient evidence" to show that the water had been directly contaminated with cholera discharges.[83] Nonetheless, the Committee commended Snow's example of the Hampstead widow, Mrs. Eley. Many months before the outbreak, Mrs. Eley had moved from Broad Street to Hampstead. She had acquired a taste for the water of the Broad Street well. While there was no outbreak of cholera in Hampstead during the time of the Broad Street outbreak, Snow determined that "a cart

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[80] Ibid, 98.

[81] *Cholera Inquiry Committee Report*, London: Churchill, July 1855.

[82] John Snow, "Report on the Cholera Outbreak in the Parish of St. James, Westminster, during the Autumn of 1854," in *Cholera Inquiry Committee*, 97-120, London: Churchill, July 1855.

[83] Cholera Inquiry Committee, *Report on the Cholera Outbreak in the Parish of St. James, Westminster during the Autumn of 1854* (London: J. Churchill, 1855), 52.

went from Broad Street to the West End every day, and it was the custom to take out a large bottle of the water from the pump in Broad Street as she preferred it."[84] The Committee appreciated this example, according to Margaret Pelling, because it "fulfilled the definition of 'a crucial experiment.'"[85] Yet, this kind of rejection of Snow's exclusive theory was not uncommon. Pelling has argued that it was probable the Committee admitted, "that the water of the well did act as the vehicle of the cholera infection, but this did not mean that infection depended on the specific material alleged…the Broad Street pump had participated in the atmospheric infection of the district."[86] Perhaps in 1855 British physicians were not ready to accept the evidence from 'a crucial experiment' because not enough similar evidence had been accumulated. Because it incorporated a wide-range of factors, the miasmatic theory still also held remarkable explanatory power. Also, as Eyler as argued, "such partial accommodation to Snow's theory was quite common."[87] Even Simon was uncommitted to Snow's exclusive theory throughout most of the 1850s and 1860s.[88] In such light, Radcliffe's Theydon Bois experiment can be seen as an extension of the growing evidence in support of Snow's theory. Radcliffe's study comprised not of one 'crucial experiment', but several carefully followed 'crucial experiments.'

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[84] John Snow, "Report on the Cholera Outbreak in the Parish of St. James," 106.

[85] Pelling, *Cholera, Fever, and English Medicine*, 224.

[86] Ibid, 225.

[87] John Eyler, *Victorian Social Medicine,* 119.

[88] It was possible that Simon was fully convinced of Snow's theory by 1869 after he had read John Burdon Sanderson's paper included in Simon's *Twelfth Annual Report of 1869,* titled "The Intimate Pathology of Contagion."

By 1866 cholera had spread throughout Britain. In London, statistical studies of cholera mortality by William Farr, Statistical Superintendent at the Registrar General, and chemical analysis of London's water supply by Edward Frankland, official analyst of the London water supply for the Registrar General, were increasingly implicating the East London Waterworks Company for a particularly fierce outbreak in east London. Simon hired Radcliffe to investigate the outbreak probably because of Radcliffe's 1865 report.[89] In late 1865 Radcliffe also published "On the Sources and Development of the Present Diffusion of Cholera in Europe," an international report on the transmission of cholera throughout Europe.[90] Throughout the 1866 London outbreak, it is most likely that Farr, Frankland, and Radcliffe were working together, although all three published separate reports.[91] It is interesting that Farr's 1866 report has been given credit by Eyler and Frankland's 1866 report has been given credit by Hamlin as providing the crucial evidence to the link between cholera and sewage contaminated water.[92] More broadly, Luckin has argued that the "experience in London in 1866 played a crucial long-term role in undermining existing notions about how the disease was transmitted, and prepared the way, at least among a minority of public health specialists, for acceptance and dissemination of the germ theory of disease."[93] Perhaps the 1866 investigation finally

[89] Radcliffe made two reports, both of which appeared in the *Reports of the Privy Council* as "On the East London Cholera Epidemic" in 1866 and "On Cholera in London" in 1867.

[90] *Eighth Annual Report of the Medical Officer of the Privy Council*, 1865, 306.

[91] See Hamlin, *A Science of Impurity*, for a thorough analysis of Frankland. For Farr's report see *Report on the Cholera Epidemic of 1866 in England*. Supplement to the 29th Annual Report of the Registrar General, 1868. For Radcliffe's report, see *Report of the Medical Officer to the Privy Council for 1866*, p. 266.

[92] Christopher Hamlin, *A Science of Impurity*, 159.

[93] William Luckin, *Pollution and Control* 70.

convinced Farr and Frankland, but it is clear that Radcliffe was already committed to Snow's exclusive theory. What has been left unanswered by historians is the role of Radcliffe's 1866 report and his relationship with Farr and Frankland. Clearly he had been more receptive than either Farr or Frankland to Snow's theory before the 1866 outbreak. All three reports are similar, but Eyler has viewed the situation largely as a problem (and victory) for vital statistics, and Hamlin has viewed it as a problem (and victory) for chemical analysis. Although out of the scope of this project, we may fairly ask the value of epidemiology. Perhaps it was the triumvirate of Farr's statistical studies, Frankland's water analysis, and Radcliffe's epidemiological investigations that more firmly established Snow's theory after 1866.[94] Even after the 1866 cholera outbreak, if we follow Luckin, it was only a minority of public health specialists who finally accepted the water-borne theory of cholera.[95]

Radcliffe's 1866 metropolitan investigation provides an interesting contrast to his rural investigation at Theydon Bois. Although his theory about the nature and transmission of the disease remained the same, Radcliffe was forced to use alternative methods because of to the nature of the outbreak. Epidemiologically, the metropolitan outbreak was much more complex. Further comparison with Snow is of particular

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[94] For a thorough description of Radcliffe's report, see William Luckin, *Pollution and Control*, 41-45.

[95] Radcliffe's 1866 metropolitan report noted, "To this report (Radcliffe's 1865 Theydon Bois investigation) I would refer for the authenticated facts which throw the clearest light upon the diffusion of the epidemic. They seem to me to compel the conclusion that the chief agents in the dissemination of the present epidemic have been the sick from the malady in its slighter as well as more marked and characteristic forms; a conclusion, I may add, which has been adopted absolutely of epidemic cholera by the International Sanitary Conference which met last year in Constantinople." 288. See also, Anne Hardy, "Cholera, Quarantine and the English System of Medicine, 1850-1895," *Medical History*, (1993), 37:250-269.

interest. Radcliffe first contacted Farr at the Registrar General to obtain the weekly mortality rates.[96] He then, similar to Snow, made a spot map of the cholera deaths over the metropolis, further proving what Farr had shown that there was a cluster of deaths in East London. In creating the spot map, Radcliffe was drawing on Snow's tradition of geographically mapping cases of disease by using mortality records from Farr. Radcliffe's map was more complicated however, as he sought the help of the eminent British geologist William Whitaker in mapping the surface geology of London with the water supply.[97] Radcliffe's epidemiological methods shows that he was intimately linked with Snow, and further demonstrates the explanatory power of the spot-map.[98] Radcliffe used the spot-map to speculate about the transmission of the outbreak over the metropolis, and to indict the East London Waterworks Company for facilitating the spread of the disease in East London. Tracing cholera deaths in East London back to the onset of the epidemic, Radcliffe (with the assistance of the Reverend Henry Whitehead) thoroughly investigated the local water supply and sanitary infrastructure of the index cases.[99] Equally important, Radcliffe was more explicit about his views on disease causation in the 1866 report. For example, Radcliffe firmly refuted Pettenkoffer's ground water theory, which was widely accepted by most British physicians at this time.

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[96] John Netten Radcliffe, "On The Various Outbreaks of Cholera," *Ninth Annual Report of the Medical Officer of the Privy Council.* PP. 1866-67, 285.

[97] William H. George, "William Whitaker (1836-1925)- Geologist, Bibliographer and a Pioneer of British Hydrogeology," *Geological Society, London, Special Publications* (2004) vol. 225, 51-65.

[98] Kari McLeod, "Our Sense of Snow: The Myth of John Snow in Medical Geography," *Social Science and Medicine* (2000), 50:923-35.

[99] John Netten Radcliffe, "On The Various Outbreaks of Cholera," *Ninth Annual Report of the Medical Officer of the Privy Council.* PP. 1866-67, 285.

Radcliffe argued that "although the outbreak in East London occurred mainly on the porous gravel on both sides of the river Lea-- the gravel being for the most part surcharged with excrementious matters, and so in accordance broadly with Pettenkofer's views--the outbreak was limited to only a comparatively small area of this soil, the contiguous portions differing in nowise, for the most part in levels, state of surface, and population." Following Snow, Radcliffe also argued that "the line of limitation was marked by a contour as remarkable as defined, and having an obvious relation to houses, not to soils."[100] This was a clear indication that Radcliffe was more aligned with Snow, and thought that Pettenkofer's ground water theory was not sufficient to explain the links of transmission. In his 1866 report Radcliffe also noted that he first suspected water as a medium as a result of the experience of previous outbreaks, claiming that,

> From the commencement of the localization of cholera in the East Districts the probable association of this circumstance of cholera in the East Districts the probable association of this circumscription with an impure water supply was forced upon the mind. The predominant lesson derived from the outbreaks of 1848-49 and 1853-54 was, that the localities of chief prevalence of the disease were mainly if not solely, determined by the degree of impurity of the water supply.[101]

Radcliffe cited the work of Snow, and also referenced John Simon's 1856 report, "On the Cholera Epidemics of London in 1848-49 and 1853-54 as affected by the Consumption of Impure Water," where Simon acknowledged Snow's contributions but ultimately left

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[100] Ibid, 292.

[101] Ibid, 295.

open the possibility that water and air could transmit diseases such as cholera and typhoid. The rest of Radcliffe's 1866 metropolitan report was a meticulous analysis of how the East London Waterworks Company had distributed water from an unfiltered reservoir and subsequently caused the outbreak in East London.[102] For comparative purposes, the 1866 report shows how Radcliffe used Snow's theory and his methods, particularly the use of the spot map. Radcliffe's report also demonstrates that epidemiological investigations were essentially eclectic in Victorian Britain; Radcliffe worked with engineers, geologists, MOsH, local physicians, statisticians, and a host of other public health officials to answer what was, nonetheless, principally framed by him as an epidemiological problem.

The above discussion of John Netten Radcliffe's two most important mid century cholera studies, that of Theydon Bois, Essex in 1865 and London in 1866, demonstrate the ways in which Snow's ideas of disease etiology were being put into epidemiological practice in the late 1860s. Radcliffe was crucial to the epidemiological investigation of typhoid fever was well, as we will see in the following chapter. Etiological questions on typhoid, such as whether the disease was ever spontaneously generated, persisted into the 1870s. Such was the chief subject of the 1875 Public Health Section of the Annual Meeting of the British Medical Association in Edinburgh, for example.[103] However, it was a result of the epidemiological connection between cholera and typhoid made by early epidemiologists such as Radcliffe that subsequent etiological questions could be

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[102] See also John Simon, *Twelfth Annual Report of the Medical Officer of the Privy Council*, 1869 (London: Eyre and Spottiswoode, 1870), 27-31.

[103] Cornelius B. Fox, "Is Enteric Fever Ever Spontaneously Generated," *BMJ (*25 March, 1876), 374-77.

sorted. In the early 1870s, as a medical inspector at the Medical Department, Radcliffe undertook a massive study of the diffusion of cholera throughout the Europe and Asia. He argued that there was a "close aetiological affinity… between the diffusion of cholera and the diffusion of typhoid fever."[104] Using Radcliffe's report to clamor for sanitary reform, John Simon, Chief Medical Officer of the Local Government Board (LGB) argued that,

> In proportion as common sanitary improvement takes from typhoid fever its present deplorable and disgraceful power of spreading among our population, in such proportion will England have better security against Cholera than any imaginable system of quarantine could have given her, and will be able to receive with comparative impunity whatever importations of Cholera-contagium may thenceforth accrue to her form abroad.[105]

Simon's rhetoric maintained that sanitary practices that prevented typhoid, in other words, could also prevent another visitation of cholera, a serious fear until the late 1890s. Forging an etiological affinity between cholera and typhoid was vital for early epidemiologists attempting to test disease theories and to put theory into practice. This epidemiological affinity was established at the Medical Department of the Privy Council, where John Simon, in his *Twelfth Annual Report as Medical Officer of the Privy Council,* noted,

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[104] Radcliffe's report was summarized by John Simon in a confidential memorandum sent to the President of the LGB, dated 30 June, 1874. National Archives, Kew. MH 113/12, 5.
[105] Ibid.

> Hitherto I have spoken only of cholera, but another and even more important disease claims also to be mentioned. Among the circumstances which we find associated with outbreaks of Typhoid Fever, there is none of more frequent occurrence, none which we are more entitled to consider directly causative of the disease, than the consumption of polluted water. It has been one of our most familiar experiences, one which my reports for many years past have again and again been obliged to exhibit in all its nauseous details.[106]

State Supported Epidemiology at The Medical Department

Sir John Simon entered the sphere of British public health in 1848 when he was appointed the City of London's first medical officer of health. He spent the next seven years industriously attempting to improve the health of what was arguably the unhealthiest city in Europe. He witnessed two cholera epidemics and the constant threat of a host of other great Victorian killers; smallpox, scarlet fever, typhoid, typhus, tuberculosis, rickets, and diphtheria. The task was a daunting one, witnessed by frustration noted in Simon's annual MOH reports from 1848 to 1855, first published in *The Times* and in 1854 published together as *Reports Relating to the Sanitary Condition of the City of London*. Simon made quite the reputation for himself during these formative years, calling for widespread public health reform in water supply, drainage,

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[106] John Simon, *Twelfth Annual Report of the Medical Officer of the Privy Council, 1869* (London: Eyre and Spottiswoode, 1870), 31.

burial practices, food adulteration, and housing.[107] It was during his years as MOH that Simon experienced the actual environmental and health conditions that were developing in industrial centers throughout Britain. Simon also learned how to manage a staff of public health workers, from inspectors to clerical staff, a task he excelled at during his time as Chief Medical Officer of the Medical Department. In his last MOH report Simon aptly summarized these views, noting,

> I venture to believe that my successor will find his path the easier for his not being the first to tread it; not only because the chief difficulty of applying your acts of Parliament to the sanitary improvement of the city has now been overcome, and legal precedents have been established; nor only because the grosser forms of domestic uncleanliness have be immensely abated; but especially because your inspectors have grown so familiar with the duties in question, and your copying clerk so practised in keeping accounts of all sanitary business, that this department of your work now moves almost with the regularity of a machine.[108]

While Simon's rhetorical calls for reform gained him widespread popularity amongst sanitary and middle class reformers, in his early years Simon largely stayed away from the polarizing rhetoric of a centralized public health system envisioned by England's head of the General Board of Health, Edwin Chadwick. Whereas Chadwick's obtrusive

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[107] For example, on water supply see; John Simon, "The Supply of Water to the City," *The Times* (8 March 1850), 6. On burial practices, see; John Simon, "City Interments," *The Times* (26 September, 1853), 12.

[108] John Simon, "The Sanitary Condition of the City of London," *The Times* (16 November 1855), 10.

and heavy-handed tactics made him an unpopular reformer in the mid 1850s, Simon's political activism was more tactful. Indeed, Simon was initially a defender of local self-government, seen in chapter one by his early comments on food adulteration reform. When in 1855 Sir Benjamin Hall appointed Simon to act as the Chief Medical Officer of the General Board of Health, Simon looked back on his days as London MOH as fruitful and enjoyable. He noted,

> In passing to the central office, I carried with me a grateful recollection of the years during which I had been a local Officer of Health. It was not merely that the City Commissioners had always treated me with favour and confidence, notwithstanding all I had had to preach to them of needs for amendment within the province of their affections; but especially I felt, and this even more strongly as time went on, that seven years familiarity with the spirit and working of local representative government had taught me lessons I could not otherwise have learnt, as to factors which in this country are essential to social progress.[109]

These lessons enabled Simon to craft the most important government sponsored public health research institution, the Medical Department of the Privy Council. The latter was formed by Parliament as part of the Public Health Act of 1858, which dissolved the General Board of Health and sought to better organize public health activity in the nurturing administrative confines of the Privy Council. The Medical Department was to have two primary duties, superintend public vaccination by managing the roughly 3,500 Vaccination Districts in England and Wales, and, when deemed necessary, conduct

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[109] John Simon, untitled, personal manuscript, John Simon Collection, Royal College of Surgeons, England. 67.h.5 Letters & Papers re: College affairs, 28-29.

investigations concerning outbreaks of epidemic disease in view of the public's health.[110] Simon was simply transferred to his new, albeit vague role as Chief Medical Officer of the Medical Department. In a confidential memo in 1867 Simon noted that neither he, nor probably Parliament, "had any very definite notion what I was to do."[111] The official Parliamentary statement included in the 1858 Act did note that "the Medical Officer shall from time to time *report to the Privy Council* in relation to any matters concerning the public health, or such matters as may be referred to him for that purpose," and it expressly provided that the Medical Officer should, year by year, *report for Parliament* all proceedings taken under the Act.[112] The peculiarity of the Medical Department, put another way, was that it occupied a unique legislative niche; it combined the typical duties of an administrative office with many of the functions of an inquiry, or Royal Commission.

As he later described it in the 1890s, Simon's vision for the Medical Department was to "develop a scientific basis for the progress of sanitary law and administration."[113] Simon's goal was to unify a cohesive system of public health between central and local governmental levels, fundamentally called state medicine. In the two decades between 1850 and 1870 the failure of a Chadwick inspired centralization of public health led to a recommitment to local self-government and a decreased interference by central

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[110] John Simon, confidential report to LGB President, dated 30 November, 1867. The National Archives, Kew MH 113/2, 2.

[111] Ibid.

[112] Ibid, italics in original.

[113] John Simon, *English Sanitary Institutions*, 287.

authority.[114] Simon had, after all, won prominent public health positions as a champion of local public health authority. Nonetheless, Simon did face the hostile reaction to Chadwick's failed attempt to centralize sanitary reform and a longstanding tradition in Britain of the autonomy of local self-government.[115] Fear of government centralization began to be mitigated in the early 1860s by a new social and cultural ethos in Britain that increasingly saw the British Government as both a receptacle of current scientific knowledge on disease causation and an agent able to take action.[116] In this way the Medical Department was at the forefront of the larger movement in the late nineteenth century towards a modern, technocratic state.[117]

From the start of his position at the Medical Department of the Privy Council, Simon believed that he needed industrious young physicians whose progressive, reform-minded views coincided with his own. At the Medical Department, Simon began facilitating a series of investigations devoted to understanding the cause and communication of infectious diseases that were both local and national in character. Because Parliament did not allow the appointment of permanent inspectors until 1869, Simon relied on a vast network of connections to public health and epidemiological minded physicians, chemists, and veterinarians whom he hired on a contract basis. The

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[114] Lewis Angell, "What are the Most Convenient Administrative Areas for Sanitary Purposes, and what are the Best Means of Administering the Sanitary Laws?" *Transactions of the National Association for the Promotion of Social Science* (1874) 413-418.

[115] Simon's emergence is well laid out by Royston Lambert in *Sir John Simon.* Chadwick's failures are shown in Christopher Hamlin, *A Science of Impurity*, 605.

[116] Anon. "Centralisation in Health Matters," *The Sanitary Record* (15 May 1875), 319-320.

[117] One contemporary in 1875 called the Medical Department a "nucleus of a genuine Public Health Department." See Anon., "The Scientific Aspect of Epidemics," *The Sanitary Record* (19 June 1875), 404.

Medical Department had a part time secretary, a full time clerk, several vaccination inspectors, and a laundry list of part-time, contracted inspectors on infectious disease. Among the earliest were; John Syer Bristowe (1827-1895), (Sir) George Buchanan (1831-1895), Edward Hedlam Greenhow (1814-1888), William Augustus Guy (1810-1885), Gavin Milroy (1805-1886), William Ord (1834-1902), Edmund Alexander Parkes (1819-1876), (Sir) John Burdon Sanderson (1828-1905), Edward Smith (1819-1874), Joseph Swayne (1819-1903), (Sir) Richard Thorne-Thorne (1841-1899), Gwynne Harries (1840-1873), Johann Wilhelm Thudichum (1829-1901), John Gamgee (1831-1894), John Netten Radcliffe (1826-1884). Epidemiological investigations by Simon's inspectors became more standardized as permanent inspectors were employed. The pattern of investigation was usually the same; Simon would receive information concerning a local outbreak, the local authority would be warned, and an inspector would be sent. Investigations could last days or several weeks, depending on the details of each case and severity of the outbreak. They could also be dangerous; Gwynne Harries, for example, a promising young inspector, died in 1873 after contracting scarlet fever while on investigation in the north of England.[118]

Simon's political shrewdness enabled him to dramatically increase the size of the department's inspectorate. Radcliffe and Buchanan were the first permanent inspectors hired specifically to focus on infectious disease inspection, but most inspectorship posts were secured by way of vaccination inspection. In a letter to Treasury on 10 December 1861 Simon listed four vaccination inspectors, Edward Seaton, George Buchanan, John

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[118] Obituary for Gwynne Harries, *BMJ* (15 November 1873), 590.

Burdon Sanderson, and Henry Stevens, although all of these inspectors spent considerable time doing epidemiological field-work.[119]

Although many of the early inspectorate reports from 1858 to 1865 were based on the contentious issue of smallpox vaccination, investigations of typhoid fever and other infectious diseases were of prime importance.[120] Simon had firsthand experience of the public health reality of metropolitan London, and as president of the Metropolitan Medical Officers of Health Association, he was well connected with the workings of London's MOsH. The investigative reports by the inspectorate staff of the Medical Department provided Simon with a national vision. These reports were crucial to Simon's influence in Parliament, which rested on the clarity and forcefulness of his annual reports. Simon had three intentions when writing his annual reports; to inform Parliament of the latest scientific research into disease and thus improve sanitary laws, to provide the public with knowledge about disease, and, through rigorous research, to keep sanitary officials and scientists throughout Britain abreast of current research.[121] In the decade between 1865 and 1875, when Simon resigned as Chief Medical Officer of the Medical Department, he had transformed the Medical Department from a relatively obscure public

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[119] John Simon, memo to H.M.S. Treasury, dated 10 December 1861. National Archives, Kew. PC 8/19/643. Sanderson, Buchanan, and Stevens were all paid 3 guineas per diem, and therefore unsalaried. Seaton was initially the only vaccination inspector to leave London, his rate of pay being 5 guineas per diem when outside the metropolitan area.

[120] Simon reasoned that the Jenner's great discovery had not come to fruition in Britain because of the inadequacy of the poor law unions, who under the 1838 New Poor Law were given responsibility for vaccination. See Frazier Brockington, *Public Health in the Nineteenth Century* (Edinburgh and London: E. & S. Livingstone, 1965), 227. In addition, the Vaccination Act of 1853, which made vaccination compulsory on all newly born infants, was proving extremely difficult in rural areas.

[121] John Simon, confidential report to LGB President, dated 30 November, 1867. The National Archives, Kew MH 113/2, 4.

health office into one of the most important centers of scientific research in Europe. Roy MacLeod has argued that the Medical Department fell into disarray after Simon's departure in 1876 due to the bureaucratic weight of increased sanitary duties and a tighter control by Treasury over expenditure and salaries.[122] While examination of the Medical Department's files after Simon's tenure indicates an increased level of bureaucratic frustration on the part of the Chief Medical Officer (Seaton, Buchanan, and Thorne), it is nonetheless clear that the nature of the department's epidemiological investigations remained thorough and far-reaching. I will return to this issue in chapter five.

By the end of the 1860s Radcliffe, Edward Seaton, and George Buchanan were Simon's greatest epidemiological allies. When Parliament allowed Simon to hire two permanent inspectors in 1869, Radcliffe and Buchanan were two logical choices; they were young, aspiring, and outspoken about their views on sanitary reform. Seaton was also given a permanent post, but was older and nearing the end of his career. Remuneration for Simon's permanent inspectors was rather high for civil servants, especially considering that many inspectors held part time posts at London hospitals or occasionally practiced medicine privately. In a private letter to Treasury in 1870 Simon listed the annual pay of the permanent inspectors as thus; Seaton: £1,100, Buchanan: £1,000, Stevens: £800, Radcliffe: £800. Blaxall and Beard, who were solely vaccination inspectors, were paid £500 per annually, increasing by £25 per year up to £600.[123] Simon was keen to further pressure Parliament for an increased inspectorate; he was able to

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[122] Roy MacLeod, "The Frustration of State Medicine, 1880-1899," *Medical History* (1967) 11:15-40.

[123] John Simon, "Statement Respecting the Inspectorial staff of the Medical Department of the Privy Council Office" undated. National Archives, Kew, PC8/170.

appoint three new inspectors in 1870 and 1871 including Richard Thorne-Thorne and Edward Ballard. When he resigned from the post of Chief Medical Officer in 1876 Simon left his successor, Edward Seaton, with an Assistant Medical Officer and nine inspectors.

Simon has often been characterized by historians as careful, diplomatic, and tactful in his approach to public health reform.[124] He was cautious with Parliament, local administrators, and even with the vast network of British physicians, chemists, veterinarians, and bacteriologists. Likewise, we can characterize his theory of disease causation as conservative. For example, Simon (at least publicly) was a relatively late convert to Snow's exclusive theory. In 1858 Simon summarized what he called Snow's 'peculiar doctrine" that,

> Cholera propagates itself by a 'morbid matter' which, passing from one patient in his evacuations, is accidentally swallowed by other persons as a pollution of food or water; that an increase of the swallowed germ of the disease takes place in the interior of the stomach and bowels, giving rise to the essential actions of cholera, as at first a local derangement; and that 'the morbid matter of cholera having the property of reproducing its own kind must necessarily have some sort of structure, most likely that of a cell.[125]

Simon's summary of Snow's position indicates that he was willing to concede some etiological ground to the water-borne hypothesis. It is interesting therefore, that Simon surrounded himself with more radical thinkers such as Radcliffe, Richard Thorne Thorne,

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[124] Jeanne Brand, "John Simon and the Local Government Board Bureaucrats, 1871-1876," *Bull. Hist. Med.* (1963), 37:184-194.

[125] John Simon, *Introductory Report by the Medical Officer of the General Board of Health* (1858)," xiv.

and John Burden Sanderson, who were from early in their careers contagionists. This suggests that Simon may have been more radical in his personal beliefs about disease causation, but believed that politically he could not disclose such information.

It is clear that by the late 1860s Simon felt that the Medical Department was one of the leading scientific institutions in Britain; it had, in Simon's words, "now attained such ripeness of organization that only slight addition to its inspectorial staff was wanting to complete its ideal of adequacy for the functions it expected to fulfill."[126] This was in part due to Simon's involvement in fashioning The Sanitary Act of 1866, which compelled local authorities to improve local conditions and remove nuisances, such as improper sewage, contaminated water, or unclean streets. The Act provided universally for a supply of water, extended the definition of 'nuisance' and required local authorities to take more action regarding local sanitary problems. Under the Act every town was to appoint sanitary inspectors, and the central government was empowered to take action against local authorities if nuisances were not removed. The system was largely top down, with John Simon and his inspectors keeping a careful watch over the sanitary matters of all of Britain. We should, however, be cautious in granting too much power to the Medical Department, as its real function lay in reporting and advising. The power of the 1866 Act was that it fashioned a new relationship between local and central sanitary authorities, one of Simon's chief goals. Looking back on the years between 1867 and 1871, Simon noted,

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[126] John Simon, draft of obituary of Robert Lowe. John Simon Collection, Royal College of Surgeons, England, 12.

> During the three or four last-mentioned years (1867-71) while the Medical Department was often having to consider such general sanitary questions as have been named, it was becoming more and more familiar with detailed local demands for its attention in respect of the ordinary infectious diseases of the country, and with the responsibilities which it ought to be prepared to meet, with regard to the local outbreaks of such diseases. From the time of the passing of the Sanitary Act of 1866, with provisions which made express claim for local sanitary exertions, we could not but see that a definite new line of usefulness, virtually therefore a new line of duty, lay open for us. We should as before have to criticize local excesses of disease; but now with stronger influence than before to promote the abatement of such excesses.[127]

In a later confidential letter to the president of the LGB, Lord Granville, dated 10 July 1868, however, Simon still lamented the lack of legislative cohesiveness in managing sanitary reform in local areas. To be sure the system was chaotic. In most rural areas several parishes would unionize together under the same Board of Guardians. Boards of Guardians typically divided duties for the registration of births and deaths, poor relief, and public vaccination. Two problems often arose, Simon thought; divisions were made independent of parochial boundaries, and at the parish level vestries were still responsible for managing water supply, sewerage, and drainage. Summarizing the problem in 1868 Simon bemoaned,

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[127] John Simon, *English Sanitary Institutions*, 314.

> In effect, a town may have one authority for its cesspools, another for its sewers, a third for its common lodging-houses, a fourth for its labouring classes' lodging-houses, a fifth for its burials, a sixth for its baths and wash-houses, and perhaps others which I do no now remember; and all this more or less disconnecetedly from its registration of births and deaths, and its arrangements for medial relief and vaccination; and in some cases the same, or nearly the same, function is allotted in the same place to two different authorities.[128]

To remedy the patchwork of legislative boundaries, Simon believed that the Medical Department could increasingly supervise all local sanitary matters. Rigorous lines of communication were needed between central and local authorities, because oftentimes Simon was not aware of local outbreaks of disease. In his *Eleventh Annual Report to the Privy Council*, Simon lamented that, "this is constantly happening with regard to typhoid fever and other nuisance-diseases of the country."[129] In the late 1840s and early 1850s Chadwick's General Board of Health had occasionally sent physicians to investigate local outbreaks of disease, but these investigations, as Lambert has argued, were "very much subordinate to its routine legal-engineering tasks.[130] Under Simon, however, the Privy Council increasingly became more active in supervising local sanitary matters.[131] This was in part due to the relationship between Simon and the Privy Council's Liberal Vice

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[128] John Simon, confidential memorandum sent to President of LGB, dated 10 July 1868. The National Archives, Kew, MH 113/2

[129] John Simon, *Eleventh Annual Report of the Medical Officer of the Privy Council* 1868 (London: Eyre and Spottiswoode, 1869), 23.

[130] Royston Lambert, *Sir John Simon*, 352.

[131] Ibid. Lambert estimates that between 1858 and 1866 the Privy Council conducted around seventy-four local disease outbreak investigations.

President of Education (the Medical Department being under that jurisdiction) Robert Lowe (Viscount Sherbrooke).[132] Writing Lowe's obituary in the early 1890s, Simon made clear that it was also Lowe to whom "almost singly, we were indebted for entertaining that conception of a Central Medical Department in the public service, and for enabling it to be for the most part realized."[133]

Early Epidemiological Investigations of Typhoid Fever at the Medical Department

By the 1870s an overwhelming majority of elite urban-centered British medical practitioners agreed that typhoid and typhus were separate and distinct diseases. There is evidence however, that diagnostic problems remained until a later period. To Victorian epidemiologists the distinction was a crucial one, particularly for registration statistics. Conducting an epidemiological investigation of typhoid fever in Bradford and Yorkshire in 1871, John Netten Radcliffe argued that,

> The registers of death indicate very imperfectly the extent to which *enteric fever* is prevalent in the borough. The distinctive terms of the different forms of continued fever are now being much more commonly used by medical practitioners in certifying deaths from continued fever; but, still, the word *typhus* is largely adopted as a generic term, and the less understood forms of enteric fever are still commonly designated as "simple" or "continued" fever, or "febris." A

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[132] Theodore L. Sourkes, "John Simon, Robert Lowe, and the Origin of State-Supported Biomedical Research in Nineteenth Century England," *Journal of the History of Medicine and Allied Sciences*, (1993), 48:436-453.

[133] John Simon, draft of obituary of Robert Lowe. John Simon Collection, Royal College of Surgeons, England, 13. Simon echoed this in his biographical memoir, see John Simon, *Personal Recollections* (London: Spottiswoode, 1898), 21-22.

> considerable proportion of the deaths registered as from "typhus" and "continued" fever, I have no doubt, were instances of enteric fever.[134]

While it is possible that diagnostic confusion regarding typhoid fever remained until the development of the serum antigen, or Widal Test, in the 1890s, more important in the second half of the nineteenth century was the epidemiological profile of typhoid. William Cayley, in his 1880 Croonian Lecture on typhoid delivered at the Royal College of Physicians of London, corroborated as much, prefacing his speech by noting,

> I do not, however, propose again to discuss the distinction between typhoid and other fevers, or to give any clinical account of the disease, but to confine myself to the consideration of some points about which more or less difference of opinion and practice still prevails. And I shall first consider the causation and mode of dissemination.[135]

As Cayley indicated, the causation and mode of dissemination of typhoid were of prime importance in the second half of the nineteenth century. This trend can perhaps best be identified as an epidemiological impulse, argued above.

Examining the reports of Simon's medical inspectors at the Medical Department substantiates the claim that the science of epidemiology was at the center of the formation of state medicine in Britain. Investigating typhoid throughout Britain, Simon's inspectors were able to test etiological hypotheses, such as the water-borne theory, but also to

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[134] John Netten Radcliffe, "Report on certain Defects in the Sanitary Administration of Bradford (Yorkshire), and on the recent prevalence in the Borough of Enteric Fever and other Diarrhoeal Diseases," May 1871. National Archives, Kew. MH 113/10.

[135] William Cayley, "On Some Points in the Pathology and Treatment of Typhoid Fever," Croonian Lectures (London: J&A Churchill, 1880), 4.

demonstrate the need for more centralized control of sanitary services throughout the country. In this way, typhoid served as a sanitary index of the health conditions of a local area. Examining a few of the early reports will suffice as exemplary.

In late 1869 Simon called on John Netten Radcliffe to conduct an investigation of an outbreak of typhoid fever in Stamford, an ancient market town in the county of Lincoln having "a high local reputation for healthiness."[136] Local residents had complained of the incidence of typhoid for many years, but 1868 and 1869 seemed to be worse. Radcliffe conducted a thorough sanitary survey of the area, investigating the local geology, housing conditions, waste disposal, water supply, and distribution of disease. He consulted local physicians, carried out house-to-house visitations where typhoid had struck, sent water to be analyzed by Professor Miller and John Burden Sanderson, and constructed a spot map showing the typhoid distribution in Stamford from September 1868 to September 1869. Radcliffe marked a circle at each house where typhoid had been present, and added to the map the location of cesspools, wells, and the condition of the soil, whether sand or gravel, clay, or oolite. The deplorable local conditions clearly indicated to Radcliffe that the Stamford water supply had long been polluted; "it is no exaggeration of terms to say that the inhabitants… drink water which is polluted with

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[136] John Netten Radcliffe, "Typhoid Fever at Stamford," Confidential draft to John Simon, dated 6 February 1870. National Archives, England. MH 113/2, 2. There was a general feeling amongst Britons in the first half of the century that rural districts were healthier than urban cities. This sentiment carried into the 1870s, but was gradually replaced by the fear of backwards and unsanitary rural districts. See, Andrew Fergus, "Excremental Pollution a Cause of Disease, with Hints as to Remedial Measures," *Transactions of the National Association for the Promotion of Social Science* (1872) 450-458.

their own stools," he noted.[137] The Stamford outbreak demonstrates Radcliffe's commitment to geographical, or spatial thinking in terms of his use of the epidemiological spot map. Radcliffe was also keen to challenge the popular preconception that Stamford was a healthy town. Condemning the improper use of mortality statistics, Radcliffe argued, "the healthiness of localities with low death-rates cannot be judged by the death rate alone, but has to be estimated by the absence or prevalence of certain causes of death, and certain forms of sickness, particularly fever and diarrhoeal diseases."[138] Here Radcliffe was making the larger argument that the measurement of a town's death rate could be what he called a "fallacious index."[139] The incidence of typhoid and diarrhea were better indices, Radcliffe thought, largely because the two diseases were caused and spread by unsanitary, but preventable conditions. The Samford case also illustrates Radcliffe's willingness to plea for the early notification of infectious diseases. The Stamford typhoid case was indicative, in that of 152 cases in the year from September 1868 to September 1869, only 8 deaths occurred. However, as Radcliffe noted, "the damage to a community from sickness not ending in death, particularly during epidemics, unfortunately cannot yet be stated with any near approach to accuracy, and its magnitude is too commonly overlooked or lightly estimated."[140] Radcliffe extrapolated the Stamford case by arguing that,

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[137] John Netten Radcliffe, "Typhoid Fever at Stamford," Confidential final report to John Simon, dated 9 March 1870. National Archives, England. MH 113/2, 12.

[138] John Netten Radcliffe, "Typhoid Fever at Stamford," Confidential draft to John Simon, dated 6 February 1870. National Archives, England. MH 113/2, 3.

[139] Ibid, 2.

[140] Ibid, 4.

> Even the comparatively small mortality of the cases hardly lessens the seriousness of the outbreak, and does not in the least degree diminish its importance as an indication of grave defects in the health-conditions of the inhabitants. This small mortality is an illustration of the fallacious conclusions which may be arrived at if the health of inconsiderable populations were to be judged of by the returns of mortality alone.[141]

Historians often argue that nineteenth century epidemiology relied exclusively on mortality statistics and death rates. The above example indicates the frustration some epidemiologists were beginning to have by the early 1870s with the sole use of crude death rates. While the use of morbidity statistics would not be formalized in Britain until the 1890s, evidence from the Medical Department suggests we should perhaps reconsider the ways in which British epidemiologists used other epidemiological tools such as spot mapping, case tracing, and geological surveys.

Most inspectorate reports included a list of immediate recommendations, which could include everything from specific disinfection of discharges of the sick to the destruction of soiled linens or closing of wells. They often included permanent recommendations, which ranged from the improvement of a local water supply and the rectification of privies, to the amendment of house drainage. Water supply and waste disposal were constant problems from the 1860s to 1880s, particularly in rural areas. Having already had extensive epidemiological experience, in 1869 George Buchanan and John Netten Radcliffe conducted an extensive survey of the various systems in place for

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[141] Ibid, 5.

excrement disposal in the North of England. They compared the midden closet prevalent in Manchester, the Goux closet system in Salford, the Tough water closet in Liverpool, the Dry Earth System in Lancaster, and the Tumber water closet system in Leeds.[142] Buchanan and Radcliffe's goal was to better understand the relationship between excrement disposal and diseases such as typhoid.

Richard Thorne-Thorne (later Sir) was perhaps the most active of Simon's inspectorate to investigate typhoid fever between 1865 and 1880. Thorne's path to the Medical Department was perhaps unique amongst the inspectorate, as he had not previously served as a medical officer of health. Thorne was exceptionally trained as a physician; a medical student at St. Bartholomew's Hospital in the early 1860s, Thorne qualified for M.R.C.S. in 1863 and M.R.C.P. in 1865. From that time Thorne began work as a temporary inspector at the Medical Department. Achieving the rank of permanent inspector in 1871, Thorne continued to work in close proximity to Simon, Buchanan, Radcliffe, and Ballard until he was appointed Chief Medical Officer in 1892 to replace Buchanan (Seaton having succeeded Simon in 1876, and Buchanan having succeeded Seaton in 1879). Of his early epidemiological work on typhoid fever, Thorne's 1867 investigation at Terling, Essex is particularly notable.

Thorne first investigated the outbreak of typhoid in Terling, Essex, a rural population of about 900 inhabitants on 21 December 1867. The local outbreak had attracted national news, as about 300 of the 900 inhabitants were struck with typhoid in

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[142] John Netten Radcliffe and George Buchanan, "The Systems in use in Various Northern Towns for Dealing with Excrement" *Twelfth Annual Report of the Medical Officer of the Privy Council 1869* (London: Eyre and Spottiswoode, 1870), 111-140.

less than two months.[143] Thorne remained there four days, and returned on 6 January 1868 for another seven days. As was typical, Thorne conducted a thorough investigation of the sanitary state of the village, including its water supply, drainage, sewerage, housing conditions, and local geological features.[144] He found the sanitary conditions appalling, noting early in his report that "all the nuisances which are generally associated with outbreaks of typhoid fever exist in great and unusual abundance."[145] His eventual condemnation of the Terling water supply was typical of epidemiological investigations of typhoid fever, yet the Terling case had many peculiarities.

Examining the mortality returns Thorne also noticed that age and sex were a determinate factor in the outbreak; of 145 cases where he was able to obtain the age of the victim, Thorne found that 79 were children under 14, and of the remaining 66, 50 were females. A curious statistic, no doubt, and one that Thorne presumed could be accounted for in the fact that men and boys over 14 spent most of their time away from home laboring in the fields, and drank mostly beer, rather than water. Thorne's epidemiological sleuthing of the unique demographic profile of the Terling outbreak was coupled with his insistence that he had found the first, or index case of the outbreak, which he argued occurred at a local dairy. It is interesting to note that Thorne considered it a possibility that "milk supplied from this dairy, could, after having been diluted with

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[143] John Simon, "Occasional Proceedings," *Tenth Report of the Medical Officer of the Privy Council* (London: Eyre and Spottiswoode, 1867), 11. See also, Alfred Haviland, "Special Report on the Epidemic at Terling," *Medical Times and Gazette* (11 January 1868), 40.

[144] Richard Thorne-Thorne, "Reports on an Epidemic of Typhoid Fever at Terling," *Tenth Report of the Medical Officer of the Privy Council* (London: Eyre and Spottiswoode, 1867), 41-56. Thorne was also keen to use a map of the area which included houses where the disease was present, the local river, and several wells.

[145] Ibid, 42.

the river water, have caused the general outbreak."[146] Although Thorne could not find sufficient evidence for the milk-borne hypothesis, it is likely, considering the demographic prolife, that milk was a factor in communicating the disease.[147]

By 1874 Simon found the near universal prevalence of typhoid so pressing that in his annual report was devoted to the subject. Simon's opening remarks on the report, which he famously titled "Filth Diseases and their Prevention," was so popular it was reprinted in pamphlet form. While some historians have alluded to the importance of this report, it has not been mentioned that "Filth Diseases" was merely an introduction to a special report on typhoid fever. Simon had amassed an exhaustive list of inspectorate investigations of typhoid fever from 1870 to 1873, including full reports by Blaxall on typhoid in Sherborne, Buchanan on typhoid in Caius College, Cambridge, two reports by Ballard on typhoid in Leeds and Birmingham, and one by Radcliffe on typhoid in London.

Conclusion

Epidemiological investigations at the Medical Department were crucial for several reasons; they solidified the water-borne hypothesis, made clear the extensive need for sanitary reform in the countryside, particularly the reform of the nation's water supply, and established epidemiology as a state supported science worthy of Parliamentary and popular attention.[148] Yet the Medical Department was not the sole

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[146] Ibid, 45.

[147] Although it seemed to corroborate the water-borne hypothesis, Thorne's Terling investigation was attacked by T. Clifford Allbutt in the *BMJ*. See; *BMJ* (7 May 1870), 480.

[148] Ballard noted in 1880 that the department's inspectors followed a fairly standardized methodology, one which he characterized as "'*via exclusionis*,' the favourite method in the

contributor of epidemiological knowledge in the middle decades of the nineteenth century. There were intimate connections between members of the Epidemiological Society of London, where young and aspiring epidemiologists debated etiological hypotheses, and medical officers of health, who experienced the identification and control of infectious disease such as typhoid fever first-hand. This chapter has demonstrated the intricate links that existed in British epidemiology around the middle decades of the nineteenth century. Epidemiological research on typhoid was dependent, I argue, on previous research on cholera, particularly the water-borne hypothesis. The latter was further solidified by MOsH and Medical Inspectors at the Medical Department as a result of epidemiological investigations that used the water-borne hypothesis to suggest that vehicles other than water could also spread disease. The most important vehicle was milk, and later foodstuffs such as shellfish and vectors such as flies. Yet, as the next chapter illustrates, arguing that milk could spread disease was much different than arguing that water could spread disease. The ramifications of this argument, particularly considering that milk culturally embodied nature's most perfect food, were extensive.

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department, and indeed the only one application to such difficult inquiries." See, Edward Ballard, "Observations on Some of the Ways in Which Drinking Water May Become Polluted with the Contagium of Enteric Fever," *BMJ* (17 January 1880), 82-84, 82.

Chapter Three: The Epidemiology of Milk-borne Typhoid in Islington and Marylebone

In late 1874 Edward Klein, the Slavonian born, Vienna educated bacteriologist then working concurrently at the Brown Animal Sanatory Institute and the Medical Department of the Local Government Board, announced that he had discovered the ‘germ’ of typhoid fever.[1] Klein’s claim, based on extensive histological based microscopical research, was that typhoid was caused by a ‘parasitic fungi’ which could routinely be found in the epithelial cells of patients’ small intestines. In the context of heated etiological debates about the cause, origin, and spread of infectious diseases, Klein’s pronouncement provoked serious interest inside and outside of the scientific and medical professions. The famed but polemical Victorian physicist John Tyndall, for example, perhaps the most vociferous advocate outside of the medical profession to argue for a living and singular ‘germ theory’, widely praised Klein’s research.[2] In what became known in the medical press of the mid 1870s as the ‘Tyndall-Typhoid Controversy’, the discovery of the supposed typhoid germ intensified the etiological question of whether typhoid fever was ever created *de novo*, or spontaneously. Klein’s findings also heated up

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[1] Edward Klein, “On the Minute Pathology of Enteric Fever: Preliminary Notice,” *BMJ* (5 December 1874), 699-700. Edward Klein, “Research on the Smallpox of Sheep,” *Proceedings of the Royal Society of London* (1874), 22: 388-91. See also, T. Lauder Brunton, “Dr. Klein and the Pathology of Small-pox and Typhoid Fever,” *Practitioner* (1875), 14: 5-10. On the founding of the Brown, see Lise Wilkinson, *Animals and Disease: An Introduction to the History of Comparative Medicine* (Cambridge: Cambridge University Press, 1992), 163-181.

[2] Michael Worboys, *Spreading Germs*, 134-139.

tense debates between the relative scientific importance of microscopy, pathology, bacteriology, chemistry, and epidemiology.

While Klein's discovery highlighted the promise of bacteriology, in the mid 1870s epidemiology was perhaps the more founded scientific tool of public health. It was in 1874 that William Budd produced his magnum opus *Typhoid Fever*. It is telling then that the scientific battle over Klein's discovery was short lived; it did not attain the worldwide popular attention that Koch's discovery of the anthrax bacillus did in 1876, the same year Klein's typhoid germ was discredited by Charles Creighton as "some albuminous matter."[3] On one hand, this incident demonstrates the nascent anticipation of the promises of bacteriological germ hunters. On the other, it represents the failure of bacteriology in the mid 1870s to answer much debated etiological questions. More important, as this chapter explores, was the role of epidemiological studies. It was typhoid fever, as Pelling has argued, that remained the most important testing ground for scientific discovery. It was in the decade between 1870 and 1880 that British epidemiologists, expanding on studies of water-borne typhoid, began to explore the role of other 'mediums' of disease. The most important medium was milk, although by the early 1880s the role of shellfish, ice cream, and flies increasingly became vital research areas that not only helped to professionalize the discipline, but also substantiate the role of epidemiology in the eyes of the British public.

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[3] Ibid, 137. See also, C. Creighton, "Note on Certain Unusual Coagulation Appearances Found in Mucus and other Abdominal Fluids," *Proceedings of the Royal Society of London* (1876-7), 25: 140-41. On the discovery of the anthrax bacillus, see Susan D. Jones, *Death in a Small Package: A Short History of Anthrax* (Baltimore: Johns Hopkins, 2010), especially chapter one.

These studies, which were conducted by epidemiologists connected via the networks explored in the last chapter, expanded the explanatory framework of epidemiology. They gave the burgeoning science the ability to make extensive claims about its role in answering public health questions. This chapter examines the first set of epidemiological studies which connected typhoid fever to milk and rural dairy practices. Linking typhoid to milk was an important scientific discovery, no doubt, but more important were the ways in which milk-borne investigations necessitated that British epidemiologists ask new types of questions, acquire new types of knowledge, and devise new types of public health practices. The milk-borne hypothesis was an extension of the water-borne hypothesis established in the 1860s, but it was not without new etiological, political, and environmental complications. A continuation of the contagionist logic that water could act as a vehicle in spreading typhoid was consistent with the suggestion that milk polluted with contaminated water could also harbor dangerous germs. However, fear of the zoonotic transfer of epidemics, highlighted by the 1865 cattle plague, led many British scientists, and particularly veterinarians, to suggest that perhaps milk-borne typhoid was borne from diseased cows themselves. Etiological confusion aside (the subject of chapter two) the problem of milk adulteration was serious enough to warrant a national public discourse (explored in chapter one). Epidemiological studies of milk-borne typhoid fever in the 1870s heated up already contentious debates about food safety, agricultural productivity, veterinary and public health supervision of agriculture, and governmental regulation of food production. As an agricultural product that represented rural pastoralism and cultural purity, milk was thought by many Victorian Britons to be the perfect food (the popular 'milk-diet' attests to its role in curative medicine).

Establishing the milk-borne hypothesis was crucial to the development of British epidemiology in the second half of the nineteenth century, but also demonstrates both the frustration of epidemiological practice, and the necessity of co-operation between epidemiologists, chemists, bacteriologists, veterinarians, and auxiliary public health officials.[4]

Michael Taylor and the Origins of the 'Milk Hypothesis'

In his inaugural address as president of the Epidemiological Society of London in 1888, Richard Thorne-Thorne observed that,

> Even in places where works aiming at the safe disposal of the solid and liquid refuse of populations, and at the provision of wholesome water-services, had been carried out, periodic, and at times large, outbreaks of enteric fever still occurred, and it remained for those engaged in epidemiological research to discovery those more obscure channels through which the infection of this fever was at times conveyed to man.[5]

The first of those obscure channels to which Thorne referred was milk, although by the time of his writing in 1888 epidemiologists had also demonstrated the role of contaminated shellfish and flies in transmitting typhoid fever.

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[4] Some general material in this chapter is based upon an article published while this dissertation was in progress. See, Jacob Steere-Williams, "The Perfect Food and the Filth Disease: Milk-borne Typhoid and Epidemiological Practice in late Victorian Britain," *Journal of the History of Medicine and Allied Sciences*, vol. 65, no. 4 (October 2010), 514-545.

[5] Richard Thorne-Thorne, *On the Progress of Preventive Medicine during the Victorian Era* (London: Shaw and Sons, 1888), 26.

It was in the early 1870s that British epidemiologists, using the etiological framework and methodological practices of investigating water-borne typhoid, began to explore how other foodstuffs, primarily milk, spread disease. In somewhat unknown circumstances, a proto milk-borne hypothesis was first suggested to the British medical profession in an article by Michael Taylor titled "On the Communication of the Infection of Fever by Ingesta," published in the *Edinburgh Medical Journal* in 1858. Taylor was a rural physician and antiquarian in Penrith, located in the Lake District of northwest England. It would be foolish to assume, however, that Taylor's rural medical practice obstructed his scientific notoriety; he had an extensive medical training at Edinburgh University, worked with renowned botanist John Hutton Balfour, and was one of the earliest presidents of the Hunterian Medical Society.[6] Moreover, as stated in the previous chapter, typhoid was predominately a disease of rural Britain in the second half of the nineteenth century, making Taylor's interest in the disease consistent with rural medical practice.

Taylor's 1858 article described a particularly violent outbreak of typhoid in Penrith and the surrounding countryside that peaked in the autumn of 1857. Being a rural physician Taylor knew the area well and traced the source of the outbreak to initial cases at a dairy farm. He was struck by the epidemiological profile of the outbreak, as it mostly affected children. Conducting an investigation of the dairy farm in question, Taylor found the water supply sound and the cows in a healthy condition. He learned from questioning the family however, that "the cows were milked by the hands of a women who was

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[6] Obituary for Michael Waistell Taylor, *BMJ* (10 December 1892), 1315.

nursing cases of typhoid fever on the premise; the milk cans were brought into the room in which the sick were lying, and remained there until sent away to the customers."[7] Taylor, who we might describe as contingent-contagionist following Pelling's model described earlier, was clearly multi-factoral in his etiological views. He believed that "it was during the process of milking, while the thin warm stream was flowing, or whilst standing exposed to this atmosphere of fever-miasms, that the warm freshly drawn fluid absorbed the fever-virus, and afterwards communicated the disease to those who drank it."[8] Taylor's article went largely unnoticed in the British medical press, either perhaps because he was a rural and relatively unknown physician, or because his epidemiological methods were unclear. His argument that "the poisonous effluvia and cutaneous exhalations of fever may be absorbed by fluids (such as milk) which, when used as ingesta, may constitute one means of spreading the disease," was as Taylor professed, "a new one in the etiology of fever."[9] Taylor's interest in the role of milk and disease did not end in 1858, although looking back Thorne-Thorne noted in 1888 that Taylor's 1858 hypothesis "received but little publicity."[10] In 1867 Taylor's views gained notoriety when he argued that scarlet fever could also be spread via milk.[11] Although several notable

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[7] Editor, "Milk as a Vehicle of Infection," *BMJ* (6 September 1873), 299.

[8] Ibid.

[9] Michael W. Taylor, "On the Communication of the Infection of Fever by Ingesta," *EMJ* (*1858*), 3: 993-1004.

[10] Richard Thorne-Thorne, *On the Progress of Preventive Medicine during the Victorian Era,* 26. Taylor published a later article on typhoid in 1872, one which he had read before the Cumberland and Westmoreland Branch of the British Medical Association. See, Michael Taylor, "Notes of a Recent Epidemic of Typhoid Fever, and its Mode of Propagation," *EMJ* (August 1872) 18: 124-133.

[11] Michael W. Taylor, "On the Transmission of the Infection of Fevers by Means of Fluids," *BMJ* (1870), 519: 623-25. See also, Leonard Wilson, "The Historical Riddle of Milk-borne Scarlet Fever," *Bulletin of the History of Medicine* (1986), 60: 321.

epidemiologists and public health authorities, including Thorne-Thorne, Edward Ballard, John Simon, and John Netten Radcliffe, referred back to Taylor's 1858 article in the late 1870s and early 1880s citing it as sparking interest in studies of milk and disease, it is unclear whether they accepted Taylor's etiological views from that date, or were anachronistically using it to bolster their own epidemiological claims, which in turn were actually rather different than Taylor's.

It is plausible that British epidemiologists did not pursue the milk-borne hypothesis until the early 1870s because they had not sorted out the more contentious water-borne route of disease transmission. Christopher Hamlin, in *A Science of Impurity* has demonstrated the multi-faceted ways that epidemiologists and chemists debated water quality issues in the middle decades of the nineteenth century.[12] Debates over the role of water in spreading disease were complicated by the supposed purification of rivers, Hamlin argues, but also because of a lack of chemical studies proving that water harbored dangerous disease germs. Many progressive leaning Medical Officers of Health and epidemiologists were content to simply assume the presence of the microbial origins of disease, but many public health authorities were unconvinced of the direct transmission of disease in water through the 1870s. One could, it should be remembered, recommend the sanitary supervision of clean water supplies to fulfill a variety of etiological hypotheses. The importance here is that the milk-borne hypothesis could be contained within the water-borne hypothesis, in that most epidemiologists of the early 1870s claimed that milk was dangerous only when adulterated with water loaded with the

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[12] Christopher Hamlin, *A Science of Impurity,* particularly the introduction.

dejecta of previous sufferers of an epidemic disease. However, the transition from water to milk was not an easy extension of etiological logic; the economic system of milk provision in Britain was vastly different than water provision. Compared with water, milk served a different social and cultural role in British society. Zoonotic fears that cow's milk itself could spread disease also complicated such a simple proviso.

It is interesting that British epidemiologists, Taylor aside, did not consider the milk-borne hypothesis until the 1870s when put into the context of fierce debates over food adulteration which began in the mid 1850s. It was not until the analytical studies by microscopist Arthur Hill Hassall, explored in chapter one, connected to Thomas Wakley's Analytical Sanitary Commission of *the Lancet*, that it became clear to the British public that the adulteration of milk was a widespread practice. Moreover, public health debates about the quality of milk did occur from the 1850s to the 1870s, precipitated by the work of Hassall, Henry Letheby, and others, but the crux of the argument against the adulteration of milk was that mixing water with milk deprived milk of its beneficial nutritional qualities. The problem, before the 1870s therefore, was that milk adulterators were morally dishonest and economically fraudulent. Milk adulteration was constructed as a moral and economic problem, one that perhaps needed administrative reform against malicious practice, but not necessarily major public health reform. This substantially changed once British epidemiologists provided the evidence that milk adulterated with water could spread deadly infectious diseases. This created what many contemporaries began to call the 'milk problem'. Before turning to the first set of epidemiological investigations that linked milk to typhoid fever, the next section examines the complex ways British public health officials, agriculturalists, and veterinarians understood milk in the Victorian period.

Nature's Perfect Food

H. Hodson Rugg epitomized the mid Victorian attitude towards dairy milk in 1850 when he noted that,

> Of all animal productions, milk appears to be that which was intended by nature should constitute to man in general, and children in particular, an agreeable and nutritious food; as it contains all the elements of animal and vegetable life most beautifully balances and arranged. It is thus a most perfect diet.[13]

Connecting milk to purity was not new to the Victorian age, however, and Rugg's chief interest in the London milk supply was to call for a complete reform of the dairy industry in Britain. Scientific interest in milk before the mid nineteenth century was in three forms; chemical studies which sought to understand the constituents of milk and what made it such a nutritious article of diet, agricultural studies which sought to improve animal husbandry and commodify the production of milk, and public health studies which sought to situate milk in debates about the role of milk in wet-nursing. All three endeavors, as Barbara Orland has recently shown, were intimately connected to the eighteenth century Enlightenment project to objectify natural knowledge;

> Milk of the late eighteenth century thus was an object of inquiry that remained to some extent elusive, resisting chemical analysis. Although chemists divided the

[13] H. Hodson Rugg, "Observations on London Milk, showing its unhealthy character, and poisonous adulterations; with remarks on the food of the cows, their pestilential places of confinement; with suggestions for remedying the evil," (London: Bailey and Moon, 1850), 1.

> fluid into parts and separated those parts into several components, the object was supposed to be a substance with its own identity and physiological meaning. Milk was a material object with a sensual, ascertainable complexity, a substance with multifarious properties, affinities, and abilities. By no means primarily an aggregate of elements, it was an entity in its own right, signifying metabolic processes as well as enlightened beliefs about mother's milk as nature's only and best infant food.[14]

Samuel Ferris is perhaps most representative of late eighteenth century British attitudes towards milk. A medical student at Edinburgh in the early 1780s, Ferris became a licentiate of the Royal College of Physicians of London in 1785 and was elected a Fellow of the Royal Society in 1797. In 1782, while a student at Edinburgh and follower of William Cullen, Ferris set to work on a dissertation on milk which won the annual prize of the Harveian Society and was subsequently published in 1785.[15] Ferris' dissertation was a wide-ranging treatise extolling the nutritional benefits of milk and suggesting ways to improve the quantity and quality of agricultural production. Many early modern medical and chemical authorities, such as the Dutch physician Herman Boerhaave, recognized that milk could be a dangerous threat based either on the quality of food consumed by dairy cattle, or by nervous excitement while in lactation.[16] Many early

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[14] Barbara Orland, "Enlightened Milk: Reshaping a Bodily Substance into a Chemical Object," in Klein, U. and Spray, E.C., *Materials and Expertise in Early Modern Europe: Between Market and Laboratory* (Chicago and London: University of Chicago Press, 2010), 195.

[15] Samuel Ferris, *A Dissertation on Milk, in which an Attempt is Made to Ascertain its Natural Use; to Investigate Experimentally its General Nature and Properties; and to Explain its Effects in the Cure of Various Diseases*. (London: T. Cadell, 1785).

[16] Ibid, 19-22.

modern authorities likewise recognized that the taste and the smell of cow's milk had an intimate relationship to feeding habits. It was noticed that cows that ate wild garlic, horsemint, or treacle mustard produced quite unpleasant smelling and tasting milk. Likewise, cows could be fed on herbs directly designed to help heal a future patient. Medical and veterinary observers noticed similar phenomenon in human milk, where the frequent drinking of strong spirits by a nursing mother was said to cause infant intoxication. Some, Ferris included, went as far as to say that the mother's psychological disposition, or state of mind could affect their milk. Milk was also widely recognized from the eighteenth century as an essential part of *materia medica*, typically arranged as a demulcent or emollient, used to treat a wide range of inflammatory conditions and fevers.[17]

Chemical studies of the constituents of milk continued into the early nineteenth century, and milk was also increasingly at the center of debates about infant mortality and the health of the laboring population of the new industrial classes. Edward Smith, who worked as a part-time inspector for John Simon at the Medical Department of the Privy Council in the 1860s, produced a series of reports on the relationship between poor health and poor food. As Michael Worboys, John Pickstone, and Bill Luckin have shown, middle-class reformers in the mid nineteenth century held a wide "range of views on the nature and causes of poor public health, and of what should be done to improve matters… a number of practitioners [who] maintained a very broad view of the determinants of

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[17] Ibid, 146-147.

health and that such factors included poverty, diet, and physical exhaustion."[18] Smith, following the cultural ethos of milk as a perfect food, exemplified earlier by Rugg, noted that "milk, next to bread, is as truly a necessary food as any which enters into the dietary of the adult, and should be obtained by every person in the kingdom… new milk is the most perfect food which exists."[19]

The consumption of raw cow's milk varied throughout the nineteenth century, particularly in terms of gender, age, occupation, and geographical location. It was widely known that milk was commonly adulterated with water, but other reports claimed unscrupulous dairymen used flour, chalk, or even sheep's brains. Charles Cameron, public health leader in Dublin, noted for example in 1868 that, "milk is rarely obtained in a state of absolute purity in towns."[20] Women and children in rural agricultural areas typically drank larger volumes of raw milk, but as Edward Smith found in 1864, "even in counties where milk is abundant, it is rare to find the husband having his basin of milk-porridge morning and night."[21] Consumption and quality of milk was often substantially different in urban areas. George Ross, Medial Officer of Health for St. Giles, for

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[18] M. Sigsworth and M. Worboys, "The Public's View of Public Health in mid-Victorian Britain," *Urban History* (October, 1994), 21:239. See also, J.V. Pickstone, "Dearth, Dirt and Fever Epidemics: Rewriting the History of Public Health, 1750-1850," in T. Ranger and P. Slack (eds), *Epidemics and Ideas* (Cambridge, 1992), 126-46, and B. Luckin, "Death and Survival in the City: Approaches to the History of Disease," *Urban History Yearbook* (1980), 52-63.

[19] Edward Smith, *Practical Dietary for Families, Schools, and the Labouring Classes*, (London: Walton and Maberly, 1864), 90-91. See also, Parliamentary Papers, 1863, *Fifth Annual Report of the Medical Officer of Health to the Privy Council for 1862*, Appendix V, "Report by Dr. Edward Smith, F.R.S. on the Nourishment of Distressed Operatives," 320, and Parliamentary Papers, 1864, *xxvii, Sixth Annual Report of the Medical Officer of Health to the Privy Council for 1863*, "Conditions of Nourishment, 11-17, and Appendix VI, "Report by Dr. Edward Smith, F.R.S. on the Food of the Poorer Labouring Classes in England," 216-329.

[20] Charles Cameron, *Lectures on the Preservation of Health* (London: Cassell, Petter, and Galpin, 1868), 99.

[21] Edward Smith, *Practical Dietary for Families, Schools, and the Labouring Classes*, 201.

example, made it abundantly clear in his annual report for 1869 that, "I have hardly ever known a child in a poor family supplied with the quantity of milk which experience has shown to be necessary for its due nourishment and growth."[22] In urbanized areas, particularly by the middle decades of the nineteenth century, the consumption of cow's milk was largely confined to the wealthy due to the increased cost of milk resulting from the abandonment of urban cowsheds to more sparsely populated metropolitan areas and the transportation of milk via railroads. In London, the majority of milk production shifted from the 1840s from the city center north to Islington, and by the 1860s milk was being trucked in via railroads from throughout the England.[23] Medical Officers of Health were vital to the sanitary supervision, and eventual dissolution of urban cowsheds, particularly after the outbreak of cattle plague in 1865. Rugg, who was perhaps the most outspoken critic of urban cowsheds in Britain, questioned whether,

> Is it possible for the London milk to be such as it ought, being drawn from cows confined in ill-constructed, ill-ventilated, and improperly drained places- their milk at the same time being formed by such unnatural and improper foods as distillers' wash, and distillers and brewers' grains.[24]

Such a stance was consistent with earlier fears of the degeneracy of the physical and moral well-being of urban industrial laborers. The influential Whig political John Christian Curwen, M.P. for Carlisle, for example, wrote in an 1806 pamphlet that urban

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[22] George Ross, *Report on the Sanitary Conditions of the St. Giles District, During the Year 1869 to Vestry of St. Giles District* (London: Those, Penny, 1870), 13.

[23] Gavin Smith, *Islington: The Second Selection* (Stroud, Gloucestershire: Tempus Publishing, 2002).

[24] H. Hodson Rugg, "Observations on London Milk, 2.

laborers faced a "great scarcity of milk, and consequent sufferings of the poor, especially where there are young families, from the impossibility of obtaining, for the greatest part of the year, a supply at any price."[25] By the mid 1850s the inspection of urban cowsheds was permissible under the Nuisance Removal Acts, but rigorous sanitary supervision often depended upon both a progressive Vestry and an active Medical Officer of Health. Later Parliamentary legislation such as the Contagious Diseases (Animals) Act, passed in 1869 bolstered the inspection and supervision of slaughterhouses and butchers, but problems remained throughout the second half of the nineteenth century, examined in chapter five. Writing in 1857, the zealous reformer and veterinary surgeon John Gamgee lamented that,

> The cow-houses with which London abounds, are practically exempt from inspection; although, with extreme zeal, several of the Medical Officers of Health have, accompanied by the Inspector of Nuisances of their respective districts, visited those localities. But such inspection, to be valid, must be systematically frequent, and performed by professional men practically acquainted with the diseases of cattle.[26]

Gamgee had already gained a reputation for rousing the veterinary profession when in 1857 he opened the New Veterinary College, Edinburgh, and later the Albert Veterinary

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[25] John Christian Curwen, *On the Means of Supplying Milk for the Poor* (London: W. Bulmer and Co., 1806), 3.

[26] John Gamgee, "The Cattle Plague and Diseased Meat, in their Relation with the Public Health, and with Interests of Agriculture," A letter to the Rt. Hon. Sir George Bart (London: T. Richards, 1857), 8. On Gamgee see, John R. Fisher, "Professor Gamgee and the Farmers," *Veterinary History* (1979-81), 1:47-63, and Sherwin A. Hall, "John Gamgee and the Edinburgh New Veterinary College," *Veterinary Record* (1965), 87:1237-41.

College, London to directly challenge the Royal Veterinary College. Etiologically speaking Gamgee was a fierce advocate for the contagiousness of animal diseases and the establishment of rigorous inspection and use of quarantines.[27] In turn, Gamgee was an open antagonist to the more conservative and anti-contagionist leaning leader of the veterinary profession and principal of the Royal Veterinary College, James Beart Simonds. Gamgee and Simonds crossed paths several times throughout the 1860s and 1870s, particularly around the issue of the 1865 cattle plague, a subject that has received a substantial amount of attention from scholars. Worboys and Romano have demonstrated the complex ways in which the 1865 cattle plague was a vital testing ground for the multitude of nuances that were part of an emerging 'germ theory.' The widespread and public nature of the 1865 outbreak facilitated an increased network of communication between medical authorities and veterinarians, they show, but also intensified mid Victorian fears of zoonotic and epizootic diseases. Numerous well-known scientific authorities chimed in, including John Burden-Sanderson, Benjamin Ward Richardson, Lionel Beale, and Charles Murchison. Medical interest in the 1865 cattle plague should perhaps not be surprising, considering that many of the scientists sought to use the episode to prove their own etiological hypotheses on the contagiousness or non-

[27] C.A. Spinage, *Cattle Plague: A History* (New York: Plenum, 2003), 222-224. Michael Worboys, *Spreading Germs*, 48-51. R. D'Arcy Thompson, *The Remarkable Gamgees: A Story of Achievement* (Edinburgh: Ramsey Head, 1974). In 1862 Gamgee was appointed by the Privy Council to investigate on the role of diseases meat and milk in cattle diseases. See, S.A. Hall, "The Cattle Plague of 1865," *Medical History* (1962), 6:45-58. T.M. Romano, "The Cattle Plague of 1865 and the Reception of the 'Germ Theory' in Mid-Victorian Britain," *Journ. Hist. Med.* (1997), 52: 51-80.

contagiousness of infectious diseases. Relatively unexplored, however, are the ways in which the 1865 cattle plague intensified fears of the dangerousness of milk.

Numerous veterinarians and public health authorities feared that the consumption of milk and meat of diseased cows was harmful to human health. Edward Ballard, Medical Officer of Health for Islington and active member of the Metropolitan Association of Medical Officers of Health, led a committee on the dangers of diseased animal products in the late 1850s and early 1860s. The Committee included John Burdon Sanderson and John Syer Bristowe, and also worked closely with Gamgee.[28] On 18 April 1863 Gamgee was invited to the monthly MAMOsH meeting to give a speech titled "The Diseases of Animals in relation to Public Health and Prosperity," where he laid out an extensive argument for the contagiousness of cattle diseases such as pleuro-pneumonia, foot and mouth disease, and rinderpest. Gamgee argued to metropolitan MOsH that the meat and milk of diseased animals was eminently harmful to humans.[29] Metropolitan MOsH were sympathetic to Gamgee's views, noting that "the Association also has reason to believe that much disease is produced in the human subject by the consumption of meat of diseased animals."[30] Although the management of cattle diseases was not in the direct purview of MOsH, "it could not fail to have considerable interest for them, as illustrating general epidemic laws, and practically as affecting the milk supply and the

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[28] Gamgee had a particular interest in zoonotics and especially the dangerous state of diseased meat. See, Abigail Woods, *A Manufactured Plague? The History of Foot and Mouth Disease in Britain* (London: Earthscan, 2004), 6-19.

[29] John Gamgee, The Diseases of Animals in relation to Public Health and Prosperity," read 18 April, 1863. Society of Medical Officers of Health Collection, Wellcome Archives, London, England. SA/SMO/G2/1.

[30] Ibid.

management of cow-houses within the Metropolis."[31] In his 2006 *The Bovine Scourge: Meat, Tuberculosis and Public Health, 1850-1914*, Keir Waddington comprehensively demonstrates how the fears of bovine tuberculosis contributed to more rigorous control of meat and milk supplies in the second half of the nineteenth century.[32] However, fears of bovine tuberculosis did not intensify in Britain until the early 1880s. A reinvestigation of the period between the 1865 cattle plague and the 1880s reveals that zoonotic fears over tuberculosis and pleuro-pneumonia were widely present in the British scientific community, but often coalesced on the threat of milk-borne typhoid fever.

Pathological and epidemiological interest in the 1865 cattle plague was present at various Victorian scientific institutions. Lionel Beale and John Burdon Sanderson conducted pathological studies with the Royal Cattle Plague Commission, and John Simon at the Medical Department of the Privy Council initiated a series of milk related studies. Interest at the Medical Department in milk first began with an 1862 investigation by John Gamgee. Gamgee, citing both his experience in Britain and that in continental Europe with Professors Hertwig in Germany and Huzard in France, warned that cows with certain diseases, particularly the mouth disease epizootic aphtha, could spread disease in humans via milk.[33] Henry Letheby, MOH for the City of London agreed, noting that pleuro-pneuomina and aphtha "are contagious, and they give to the milk

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[31] Secretary Report for 1865-1866, *Annual Report of the Society of Medical Officers of Health,* Wellcome Archives, London, England. SA/SMO/G2/1, 4.

[32] Keir Waddington, *The Bovine Scourge: Meat, Tuberculosis and Public Health, 1850-1914* (Woodbridge: The Boydell Press, 20060, especially chapters two, five, nine, and ten.

[33] John Simon, *Public Health Reports*, edited for the Sanitary Institute of Great Britain, by Edward Seaton. EXTRACT FROM THE SECOND REPORT TO THE PRIVY COUNCIL, 1862, Vol. II, (London: Offices of the Sanitary Institute, 1887), 75-90.

properties which cannot fail to be injurious to those who make use of it."[34] An outbreak of foot and mouth disease in 1869 led Parliament to ask John Simon to formally investigate the role of milk in spreading disease. Simon put Richard Thorne-Thorne on the task. Thorne's brief report was given considerable attention by Simon in his annual report for 1869. Working with Simonds at the Veterinary Department, Thorne conducted a thorough survey of areas where the epizootic was widespread, particularly in Suffolk. In some towns, such as Beccles and Bungay, where foot and mouth was nearly universal in striking the dairy stock, Thorne found an increased number of children sick with "soreness and vesicular eruption about the mouth."[35] Thorne concluded that in some instances milk from diseased cows could infect humans, but not in all cases. This was, to be sure, new epidemiological ground for Thorne and the Medical Department's staff; charting new ground meant devising new methodologies and encountering new frustrations. Aggravated by the lack of compliance of dairy farmers, Thorne lamented,

> The differences encountered in making this inquiry have been very much increased by the careful reticence observed by farmers and dairymen whenever questioned as to the quality of the milk supplied by them at given dates, and the

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[34] Henry Letheby, "Cows in Cow-Houses, and their Milk," *BMJ* (15 February 1862), 185. A plethora of anecdotal evidence can also be found in; John McBridge, "Report on Cases of Contagion of the Foot-and-Mouth Exanthema to the Human Subject," *BMJ* (13 November 1869), 536-37.

[35] Richard Thorne-Thorne, "Effects produced on the Human Subject by consumption of Milk from cows having Foot-and-Mouth Disease," *Twelfth Annual Report of the Medical Officer of the Privy Council*, 1869, 295.

> almost invariable impossibility of tracing the milk of any special cow, to any particular person or persons.[36]

Where Thorne left the etiological question more vague and instead focused on practical methodology, Simon was more interested in political outcome and preventive measures. Simon noted "I am clearly of opinion that the milk of cows with foot and mouth disease ought not to be unrestrictedly sold for human consumption," reflecting a more politicized and practical public health stance.[37]

The zoonotic threat of milk was complicated by auxiliary hypotheses such as those by the chemist Alfred Smee, of Croydon, who argued that milk could spread epidemics of typhoid fever when dairy cows were fed with sewage grass. Smee's theory combined Murchison's belief that disease causing germs needed to undergo a period of fermentation in the soil and Pettenkofer's ground water theory.[38] As early as 1859 Smee several times wrote to John Simon warning him of the effects of sewage-contaminated water in Croydon. Simon, ever the cautious politician, replied that the Privy Council "has no authority to stop such nuisances as that which you state to be occurring by the discharge of sewage into the river (nor indeed any authority to stop any nuisance)."[39] Nonetheless, sewage contamination, Smee described, did receive considerable attention

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[36] Ibid, 298.

[37] Ibid, 62.

[38] Alfred Smee, *Milk, Typhoid Fever, and Sewage: A Series of Letters* (London: W.H. & L. Collingridge, 1873). See also, Alfred Carpenter, *Some Points in the Physiological and Medical Aspect of Sewage Irrigation,* (London: Hardwicke, 1870).

[39] Letters from Alfred Smee to John Simon, dated 19 December 1859 and 20 December 1859, and reply from John Simon to Alfred Smee, undated. Royal College of Surgeons of England, John Simon Collection, 67.h.5 Letters & Papers, re: College Affairs. For a more general discussion of milk as a vehicle in disease, see, editor, "Milk as a Vehicle of Infection," *BMJ* (6 September 1873), 299.

in the British medical press, as it was a useful rhetorical tool, being so closely linked with filth, for either opponents or proponents of spontaneous generation.

This section has shown that scientific interest in the role of milk in spreading epidemic disease before the 1870s centered on zoonotic fears that the drinking of milk from diseased animals might produce harmful conditions in humans. Such zoonotic fears could be used to bolster the anti-adulteration movement and assist in the sanitary supervision of the British dairy supply, but such an argument was in its infancy in the 1860s.[40] This radically changed in the next decade, above all because of a series of epidemiological studies that showed that milk could play an important role in the spread of epidemics of typhoid fever, scarlet fever, diphtheria, and tuberculosis. British epidemiologists first investigated milk-borne outbreaks of typhoid fever, making it a model epidemiological disease for milk-borne studies into the 1880s and 1890s. There were hundreds of epidemiological studies of milk-borne typhoid fever in the period between 1870 and 1900. Studies were diverse, of course, and my examination of two of the earliest and most important studies serve as important, but nonetheless typical examples. They are not, however, fully indicative of the breadth of epidemiological work in this period, which deserves further study.

Edward Ballard: The Medical Officer of Health for Islington

That typhoid fever was the first epidemic disease to be indicted in milk-borne studies in perhaps not surprising considering the elevated status it had to Victorian scientists in answering etiological questions. On 24 September 1870, in a correspondence

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[40] John Gamgee, “Food and Disease,” *The Food Journal* (5 Feb. 1870), 20-28.

to the *British Medical Journal*, eminent Birmingham gynecological surgeon Lawson Tait feared that "milk is an extremely dangerous agent for the spread of contagion." In strikingly predictive form Tait warned,

> If we bethink ourselves of any instances of disease which might in certain instances be communicated by milk, typhoid fever stands out with fearful probability. Enteric fever is nowhere more common nor more fatal than in country farm-houses, where means for the removal of the dejections are not sufficiently well adapted for security, and much too convenient for safety.[41]

Tait's comment aptly summarizes the problems inherent in late Victorian public health. While reforming water supplies, housing, and sewage removal were gaining in popularity in urban and largely progressive areas, rural health and rural sanitary infrastructure remained problematic. Typhoid could be characterized, as Tait indicated, as the emblematic disease of rural Britain, but it was also in rural areas where milk was likely to be adulterated with sewage contaminated water. Tait's warning could have been predicated upon an earlier discourse about the dangers of milk and disease issued first by Michael Taylor or Penrith, or revised after the 1865 cattle plague. It is more likely, however, that Tait was responding to an ongoing epidemiological investigation of milk-borne typhoid conducted by Edward Ballard, Medical Officer of Health for the London district of Islington.

Edward Ballard was born in 1821 to a well off family who lived in Islington. His father, Edward George Ballard, worked for a short while in the Stamp and Excise Offices

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[41] Lawson Tait, "The Influence of Milk in the Propagation of Contagious Disease," *BMJ* (1870), 508: 344.

before devoting himself solely to writing independently, penning articles for *Imperial Magazine, Literary Magnet,* and *the Gentlemen's Magazine*.[42] Apart from his literary interests, the elder Ballard did have a curiosity in natural history; he was a founding member of the Islington Literary and Scientific Association, and in 1829 he wrote a small manuscript titled *Microscopic Amusements; or, Complete Companion to the Microscope*.[43] Whether or not his father stoked such an interest, the young Edward Ballard was keenly interested in natural history. Educated at the more progressive and non-conformist University College London to become a physician, Ballard excelled in his studies, winning various scholarships and gold medals.[44] While still a student at University College he conducted a massive and first of its kind study of the plants indigenous to his home district of Islington that took him over five years to complete.[45] He spent his early professional years of medical practice in the 1840s splitting time as physician to the St. Pancras Royal General Dispensary, and as medical tutor at University College London. His 1845 treatise titled *Elements of Materia Medica and Therapeutics* showed a propensity for botanical classification, and two publications on nutrition and digestion, titled *On Pain After Food* (1854) and *On Artificial Digestion as a Remedy in Dyspepsia, Apepsia, and their Results* (1856) provide insight into Ballard's aspiring

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[42] Obituary for Edward George Ballard, *The Gentlemen's Magazine* (January-June 1860), 412-413.

[43] E.G. Ballard, *Microscopic Amusements: or, a Complete Companion to the Microscope*, (London: F. West, 1829).

[44] In 1891 Ballard donated a series of his UCL lecture notes to the UCL archives, including two volumes of William Sharpey's lectures on anatomy and physiology, two volumes of Dr. C.J.B. William's lectures on medicine, and one volume of Robert Grant's lectures on zoology. See, University College London, Special Collections, Edward Ballard Lecture Notes, MS. ADD.286/1

[45] Edward Ballard, "Catalogue of Plants Indigenous to Islington (co. Middx) and its Vicinity: made up from personal observation made by Edward Ballard from 1837 to 1842," Hackney Local Archives, London. M4004.

interests.[46] In 1856 the Vestry of Islington appointed Ballard as the Medical Officer of Health, a post he held until John Simon convinced him to join the cutting edge team at the Medical Department in 1871.[47]

In all, Ballard spent sixteen years as MOH in Islington. His annual reports alone, still preserved at the St. Mary Islington Local Records Office, stand as a powerful testament to the difficult practices of public health in the mid-Victorian period. Throughout this sixteen year period Ballard was involved in a wide range of sanitary activities; he investigated outbreaks of scarlet fever, smallpox, diphtheria, cholera, typhoid fever, and diarrhea, and also assessed the health effects of trade nuisances (such as urban cow-keeping) and overcrowding. Ballard was a zealous sanitary reformer and keen advocate of the professionalization of public health at an early period. His proficiency in the use of vital statistics and epidemiological mapping led John Simon to say of him that, "in 1871 he was already among the foremost representatives of English sanitary knowledge and practice."[48]

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[46] Edward Ballard, *Elements of Materia Medica and Therapeutics* (London: Taylor and Walton, 1845), Edward Ballard, *On Pain After Food: Its Causes and Treatment* (London: Walton and Marbely, 1854), and Edward Ballard, *On Artificial Digestion as a Remedy in Dyspepsia, Apepsia, and their Results* (London: Walton and Maberly, 1856). In the mid 1850s he also supervised a comprehensive clinical study of post-mortem observations through the London Medical Society. On the latter see, Edward Ballard, *What to Observe at the Bed-Side and After Death in Medical Cases* (London: John Churchill, 1854).

[47] On public health in Islington before Ballard, see Gerry Kearns, "Cholera, Nuisances, and Environmental Management in Islington, 1830-1855," *Living and Dying in London* William Bynum and Roy Porter (eds.) *Medical History*, Supplement, 11. London: Wellcome Institute for the History of Medicine, 1991.

[48] Obituary, Edward Ballard, *BMJ* (30 January 1897), 1883:281-282.

It is difficult to categorize Ballard's etiological views during the period of his employment as MOH. His annual reports show that early in his career he was wedded to William's Farr zymotic classification of epidemic diseases, which also explains his use of vital statistics. Professional involvement with the Epidemiological Society of London and the Royal Medical and Chirurgial Society of London (formerly the Westminster Medical Society) would have put him into contact with emerging leaders such as Farr, John Simon, William Jenner, and even John Snow. On the latter, although Ballard never mentioned Snow in his writings as MOH, in a paper he read in 1879 at the Annual Meeting of the British Medical Association in Cork, he called Snow, "my old friend," perhaps indicating his etiological allegiance to Snow's water-borne theory.[49] Likewise, Ballard's annual report in 1865 on the last visitation of cholera in London included a map similar to Snow's earlier work, and a keen awareness of the water-borne hypothesis. Publicly Ballard only became a strict contagionist and early supporter of a singular germ theory in the mid 1870s. During his MOH years he was more, similar to Simon, multi-causal in his etiological beliefs. In 1867, for example, he published an extensive longitudinal study of the relationship between fluctuations in the weather and sickness local to his parish of Islington. The study was comprised of meteorological and vital statistics Ballard had personally collected from the period 1857 to 1865 and represented 217,000 cases.[50] Interest in the ways in which weather influenced outbreaks of disease

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[49] Edward Ballard, "Observations on some of the ways in which Drinking Water may Become Polluted with the Contagium of Enteric Fever," *BMJ* (1880), 994: 82-83, 82.

[50] Edward Ballard, *A Study of the Influence of Weather and Season upon Public Health: Made upon above 217,000 cases of sickness newly occurring at various institutions for the relief of the sick poor in Islington, during the nine years, 1857-1865,* (London: J.E. Adlard, 1867).

was nothing exceptional to mid Victorian ideals of health. The uniqueness of Ballard's study was its painstaking attention to detail and its focus on morbidity, not mortality; he compared the amount and type of sickness week by week, month by month, quarter by quarter, and year by year, with various meterological conditions of each period, particularly focusing on fluctuations of sickness at times of variation in weather. Interest in morbidity was vital, according to Ballard, because,

> The indications derivable from the mortality are fallacious, inasmuch as conditions of weather that may bring about a fatal termination of diseases already affecting a population, are not necessarily such as to occasion or favour attacks of illness in persons already in average health. I have frequently been struck, in the preparation of reports upon sickness and mortality, with the great discrepancy in this respect between the tables of sickness and the mortality tables for the same period of time.[51]

Ballard's illustrious career at the Medical Department, from 1871 until his death in 1897, was presaged by his experience as a leading metropolitan MOH. His transition to the Medical Department was based upon an already extensive public health resume, but in 1870 he conducted what was to become perhaps his most important epidemiological investigation while still Islington's MOH.[52] Recollecting the most important

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[51] Ibid, 1.

[52] Ballard's industry at the Medical Department was evident from his first set of duties, which was to inspect local vaccination practices in Warrington. Ballard found the local physician in charge of vaccination incompetent, using dirty instruments and causing much mischief, including several cases of erysipelas. See, Letters from Edward Ballard to John Simon, dated 28 November 1871, and two on 30 November 1871. National Archives, Kew. MH 25/22, Medical Department, LGB, Miscellaneous Files.

contributions to public health in the Victorian period, John Simon, one of Ballard's most intimate colleagues, stressed Ballard's 1870 achievement, noting,

> In 1870, Dr. Ballard contributed most importantly to open a new line of epidemiological accuracy, by shewing that a considerable outbreak of enteric fever at Islington had been consequent on the distribution of a particular (presumably contaminated and infected) supply of milk.[53]

In his Annual Report to the Vestry of St. Mary, Islington, in 1870 Edward Ballard reported,

> At no time during the year was Typhoid Fever unusually prevalent among our population *generally*, but between 3 July and 10 September in one circumscribed locality no fewer than 168 individuals of different ages, and the inhabitants of 67 different houses were attacked with this form of Fever, and of them 26 died.[54]

Although Islington was a rather large metropolitan district, the number of cases and the confined nature of the outbreak to a one-quarter mile radius, meant that the outbreak warranted Ballard's full MOH attention. The confined nature and suddenness of the typhoid outbreak at first left Ballard "somewhat staggered," but his cautious and investigative methods showed more to the case than anything he had ever encountered.[55]

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[53] John Simon, Untitled Manuscript, perhaps notes for his *English Sanitary Institutions*, Royal College of Surgeons of England. John Simon Collection, Sir John Simon PRCS, 67.h.5 Letters & Papers re: College affairs.

[54] Edward Ballard, Annual Reports of the Medical Officer of Health for Islington, 1870, 7. In his final report, published separately, Ballard tabulated that the outbreak struck 70 families, 175 cases, and 30 deaths.

[55] Edward Ballard, "On a Localised Outbreak of Typhoid Fever in Islington," *Med. Times Gaz.* (1870), 2: 611-617.

He considered it a “remarkable feature” that the distribution of cases was almost exclusively from the upper class section of Islington. He noted that, “the persons who suffered were not of the class among whom fevers are most commonly observed, but were persons in very comfortable positions in society, attended by private medical men, and residing in some of the best houses in the parish.”[56] While controversial, relating class specific habits or environments to typhoid fever was not new. Ballard would have been familiar with the famous attack of typhoid fever that killed Prince Albert in 1861. Such anecdotal cases could be dismissed as mere happenstance to most Victorian observers, as little scientific evidence had shown that wealthy Briton’s were either equally or more susceptible to epidemics such as typhoid. This was complicated by the social understanding that typhoid was a ‘filth disease’, and in this way Ballard’s study was explicitly challenging the Victorian association between disease and poverty. The wealthy inhabitants, many of who were physicians Ballard found, had properly drained houses and privately hired physicians, thought to be preventives to filth-borne epidemics. William Luckin has argued that by the 1870s Victorians began to fear that typhoid was perhaps the most serious epidemic threat to middle and upper class Britons. This may have been due to the gradual insistence that private types of sanitary reform, such as domestic plumbing, were equally as important as public types of sanitary reform, such as municipal water supplies. We might also consider, as Anne Hardy has suggested, the death of the Prince Albert in 1861 and the case of his son, Edward, the Prince of Wales, who contracted a severe case of typhoid in 1871, as providing what Hardy has called a

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[56] Edward Ballard, *Annual Reports of the Medical Officer of Health for Islington*, 1870, 8.

"royal impetus" in the fear of typhoid in the popular Victorian imagination.[57] A third, and yet unexplored option must also be considered, namely a series of epidemiological studies, starting with Edward Ballard's 1870 investigation of Islington, that linked typhoid to milk consumption, as heavy consumption of fresh milk was largely confined to middle and upper class inhabitants able to afford it. We must also consider that milk-borne outbreaks perhaps actually were more dangerous to wealthy Britons. This possibility shifts our understanding of the class and moral based ways that Victorians understood and experienced the so-called "filth diseases."

Consulting with local physicians and conducting a thorough sanitary review of the local environment, and examining the mortality statistics, Ballard entertained the four most popular hypotheses: (1) an alternation of the railway that bisected the area had cut into several disused sewers and drains, releasing deadly sewer emanations, (2) a local 'dung-shoot' or dung heap produced typhoid gases, (3) specific homes of the affected had faulty domestic drainage or water supply, or (4) a single source of milk had been polluted with typhoid laden water.[58] Examining the distribution of cases, Ballard found some hypotheses to be more fruitful than others; typhoid appeared to pick out certain houses on streets and not others. Within houses the disease seemed to favor certain members of the family. The distribution seemed random, and to a multi causal observer with contingent-contagionist leanings any of the first three hypotheses could have provided explanatory proof. Hypotheses one and two fit nicely with an older Chadwickian ethos of

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[57] Anne Hardy, *Epidemic Streets*, 167-168.

[58] Edward Ballard, "On a Localised Outbreak of Typhoid Fever in Islington," *Med. Times Gaz.* (1870), 2:612.

predisposing and miasmatic causes, and the third theory about domestic drainage found support even with Ballard at times during the investigation. Ballard's method was, as the *British and Foreign Medico-Chirurgical Review* applauded, a thorough process of scientific deduction "by the process of exclusion."[59] However, his extensive training and expertise in investigating outbreaks as MOH, coupled with his knowledge of the local area and use of vital statistics, perhaps made his sanitary probing more focused and alert than others may have been. Ballard was also well attuned to etiological theories of water-borne communication. On 19 November, for example, he read a paper at the meeting of the Association of Medical Officers of Health titled, "On the Practical Aspect of the Previous Sewage Contamination Question," where he clearly sided with the view that the most important danger to public health was contamination of water by specific morbid discharges from the bowels of people suffering from epidemic diseases.[60]

Per the Islington case, Ballard found that attacks within families followed general milk consumptions habits, substantiating the fourth theory. Adult females and children, who habitually drank more fresh milk than men, Ballard related, made up 69 percent of those attacked. The preference of the disease for females perplexed Ballard, as he noted, "I am not aware that under ordinary circumstances typhoid shows any such decided preference for the female sex."[61] It is unclear why Ballard seriously entertained the milk-borne hypothesis, but at the end of his Annual Report for 1870 to the Vestry of St. Mary,

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[59] Editor, "Typhoid Fever in Islington," *British and Foreign Medico-Chirurgical Review* (July to October 1871), 48: 25-26.

[60] Edward Ballard, "On the Practical Aspect of the Previous Sewage Contamination Question," read at the 19 November, 1870 meeting of the Association of Medical Officers of Health. See, Wellcome Archives, London, England. SA/SMO/G2/1/1.

[61] Edward Ballard, *Annual Report of the Medical Officer of Health for Islington*, 1870, 9.

Islington, he told that, “I have long suspected the possibility of the propagation of Typhoid Fever by milk in this way, the water added to it being contaminated.”[62] Perhaps Ballard had read Michael Taylor’s 1858 article; or, maybe his experience as MOH investigating water-borne outbreaks of cholera and typhoid predisposed him to the milk-borne route. At any rate, Ballard focused his attention on the milk-borne nature of the Islington outbreak.

Ballard’s investigation was assisted by the fact that the neighborhood where the typhoid outbreak occurred was predominately supplied of milk from one local dairy farm. Equally surprising, perhaps, was the fact that the dairy provided Ballard with a list of their customers. Comparing the dairy’s list with his own list of typhoid sufferers, Ballard found that,

> That the fever was confined to persons who had consumed milk from one particular dairy…in particular streets, rows of houses &c., the typhoid poison picked out as it were the customers of the dairy, leaving the others free from the attack.[63]

He proceeded to conduct a thorough sanitary investigation of the implicated dairy farm, where he found that the owner of the farm and several other persons, either the dairy workers or members of the family, had died or contracted typhoid directly preceding the Islington outbreak. This did not prove the fault of the dairy in spreading the disease, but the milk-borne theory was strengthened by a geographical survey and drainage

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[62]Ibid, 18.

[63] Ibid, 8-9.

excavation of the farm's water supply and sewerage. Ballard found that an old underground wooden water tank had become rotten, and hosted a series of rat burrows that freely connected the tank to the water closet drains. As part of his full report Ballard included a surveyed plan of the dairy, showing the defective drains and the supposed link between the sewer and the water supply.[64] The crux of the problem, Ballard thought, was the unsanitary state of superficial wells and the use of out-dated wooden drains, which led to deaths from waterborne diseases both in this particular case and around the country, as they led to the direct contamination between sewer lines and drinking water pipes.

With the milk-borne theory fully solidified in his mind, Ballard then had to surmise how the milk became infected. He argued that the earliest cases on the dairy farm compromised the water supply, loading it with the discharges of typhoid sufferers. Once in the water supply, milk could be contaminated in two ways; the milk was either deliberately adulterated with water, or the milk pails were washed with the typhoid charged water. Definitive proof on the matter could not be found, however, as none of the farm workers admitted to watering their milk, a practice Ballard called "all but universal among milk sellers in London."[65] Nefarious milk practices of adulteration were not the sole problem, however, as Ballard also condemned social attitudes towards such practices. He argued,

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[64] Edward Ballard, "On a Localised Outbreak of Typhoid Fever in Islington," *Med. Times Gaz.* (1870), 2:616.

[65] Edward Ballard, *Annual Reports of the Medical Officer of Health for Islington,* 1870, 10.

> That it is in the nature of a fraud upon the purchasers must be generally allowed, but it is one which the public seem to unite in condoning…If the public choose to be parties to the arrangement by which an indefinite amount of dilution, according as may be convenient to the seller or necessary for his trade interests, shall be permitted, provided that the price of the article sold be not varied, no one can interfere with the tacit contract. But it is my place to proclaim the risk which the public run in thus submitting to the habitual adulteration of so common an article of food as milk, and especially to raise my voice against a practice the danger of which the poorer classes of the community cannot guard against, even if they should be aware of its extent. We take a great deal of trouble to secure the purity of the water in dwelling houses, and to guard against its contamination from house-drain emanations, and from the emanations from cesspools; but with all our care a wholesale poisoning may take place because the article received into houses and used as *milk* is diluted with water mixed with the contagium of typhoid fever.[66]

It was a vehement indictment, combining an attack on dishonest milk sellers who routinely adulterated their milk for profit, on the public for demanding cheap milk, and on local governments for not regulating the milk trade or reforming rural sanitary arrangements.

Ballard considered the Islington outbreak so important an epidemiological lesson that he read a version of the events at the meeting of the Association of Medical Officers

[66] Ibid, 11.

of Health on 19 November 1870. He warned his fellow MOsH that, "the facts elicited have a bearing upon our sanitary practice, and impart a warning to health officers and to the public alike."[67] In turn, the association praised "the careful and elaborate manner in which Dr. Ballard investigated this outbreak of fever, and traced it step by step to its apparent source, in the use of impure milk."[68] They were so impressed by his epidemiological work that the association printed the paper as a separate pamphlet and distributed it to MOsH throughout Britain. In his review of the pamphlet in the *Lancet*, James Wakley, who inherited the editorialship of *The Lancet* from his father Thomas, proclaimed, "the pamphlet is one to be read carefully, and to be possessed by every medical man, not only as a model of careful investigation in etiology, but as a history of one of the most remarkable outbreaks of typhoid on record."[69] Ballard's 1870 Islington investigation received widespread attention in the British medical press. While Taylor's 1858 study in Penrith had suggested that milk might act as a vehicle in spreading disease, Ballard's was the first to more convincingly epidemiologically trace an outbreak of typhoid to the use of a particular milk supply. In turn, the Islington study provided a framework for subsequent studies conducted throughout Britain and the British Empire. Writing Ballard's obituary for the Royal Society of London in 1897, William Henry

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[67] Edward Ballard, "On a Localised Outbreak of Typhoid Fever in Islington," *Med. Times Gaz.* (1870), 2: 611.

[68] Minutes of the meeting of the Metropolitan Association of Medical Officers of Health, Wellcome Archives, London, SA/SMO/B.1/1, for the year 1870-1871, 7.

[69] James Wakley, Review of Edward Ballard, "On a Localised Outbreak of Typhoid Fever in Islington during the months of July and August, 1870," *Lancet* (1871), 1:120-121, 120.

Power, Ballard's close colleague at the Medical Department thought that the Islington study, "necessarily served as a model to later investigators."[70]

Later investigators in the 1870s and 1880s often struggled to find the source of milk-borne outbreaks, and in this way Ballard's 1870 study was unique. Often dairy farmers were obstinate about giving away private information regarding customers and letting public officials dig about their dairy farms. Islington was also only serviced by one dairy farm that was local; in many later cases a complex mix of farms throughout the country supplied urban areas. Nonetheless, the crux of the matter is that Ballard's 1870 study opened a new line of epidemiological research. The Medical Department of the Local Government Board, where Ballard went to work as medical inspector from 1871, led the way in epidemiological research on milk-borne outbreaks. In 1872 Ballard traced an outbreak of typhoid in Armley, near Leeds to a milk source, and again in 1873 he did the same in Moseley and Balsall Heath.[71] Other inspectors at the Medical Department followed Ballard's lead, such as Richard Thorne-Thorne, William Henry Power, George Buchanan, and John Netten Radcliffe. It would be a mistake to think that milk-borne investigations were only being conducted at the Medical Department, however. Three prominent investigators were James Russell, MOH for Glasgow, Charles Cameron, MOH for Dublin, and David Davies, MOH for Bristol, who all conducted important milk-borne

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[70] William Henry Power, "Obituary Notice for Edward Ballard" *Proc. R. Soc. Lond.*, (1898), 62: iii-v.

[71] NA, MH 113/11, "Dr. Ballard's Report upon an Outbreak of Enteric Fever at Armley, in the Borough of Leeds," and "Dr. Ballard's Report upon an Outbreak of Enteric Fever at Moseley and Balsall Heath, near Birmingham." See also, M.K. Robinson, "The Cause of the Contagion of Typhoid Fever," *BMJ* (1874), 692:451-452.

studies in the 1870s and 1880s. Cameron's case is particularly useful. As Professor of Hygiene in the Royal College of Surgeons, Lecturer on Chemistry in Steevens' Hospital Medical College, and Analyst and MOH for the City of Dublin, Cameron was the most prolific public health advocate in Ireland. He was keenly aware of scientific advancements in England and on the continent.[72] His Half-Yearly Report on Public Health for 1871 began with a lengthy discussion of Ballard's Islington study, concluding that, "Dr. Ballard has undoubtedly proved that typhoid fever was largely spread through the medium of milk, and it is impossible not to believe with him that the contagium was introduced into the milk by water which had been contaminated with sewage."[73]

Nor were milk-borne epidemiological investigations limited to Britain. William Thomson is perhaps the best example.[74] Trained in Glasgow and Edinburgh, he moved to Melbourne, Australia in 1852. An early strict contagionist and supporter of Budd and opponent of Murchison's pythogenic theory, Thomson argued in 1875, "that foul drains, putridity, and impure air are common conditions of our city life is only too evident to the senses; but that *"civic miasm"* generates the poison of typhoid fever has never been demonstrated."[75] Thomson conducted his own series of milk-borne typhoid studies, but where Ballard was initially multi-causal, Thomson was adamant about the specific

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[72] See Charles Cameron, *A Manual of Hygiene* (Dublin: Hodges, Foster, & Co., 1874), where Cameron at length discusses the most recent epidemiological studies of typhoid fever, especially its spread through milk.

[73] Charles Cameron, "Half-Yearly Report on Public Health," *Dublin Quarterly Journal of Medical Science* (1871), 51: 478.

[74] Warwick Anderson, *Cultivation of Whiteness: Science, Health, and Racial Destiny in Australia* (New York: Basic Books, 2003), 48-51.

[75] William Thomson, *Typhoid Fever: its Cause and Extent in Melbourne* Third Edition (Melbourne; George Robertson, 1878), 34.

contamination of milk via polluted water; although their methodologies differed, their conclusions warranted similar sanitary overhauls in preventive public health.[76] Thomson, unlike Ballard, was cautious in turning scientific investigations of milk-borne typhoid into highly politicized warnings of moral or market failures. To Thomson, “the etiology of fever was not invented to terrify the filthy,” which as we have seen was not necessarily Ballard’s aim.[77] Ballard would have probably agreed with Thomson’s dictum that outbreaks of milk-borne typhoid served as an “instructive narrative and bitter satire on modern civilization.”[78] Thomson’s example may be a bit outside the scope of this work, yet his engagement with Ballard nonetheless emphasizes the importance of Ballard’s 1870 Islington study and the networks of epidemiological knowledge at the beginning of high imperialism.

Milk Adulteration Reframed

The widespread notoriety of Ballard’s 1870 Islington investigation not only stimulated scientific interest in epidemiologically furthering the milk-borne hypothesis; it also increased the fervor of anti-adulteration reformers. If milk could spread disease as a result of malicious trade practices, reformers such as John Gamgee and Arthur Hill Hassall thought, then perhaps Parliament and local governments would be more willing to entertain progressive reform. Gamgee argued as much as early as December of 1870, speaking before a meeting of the Association of Medical Officers of Health. Building on Ballard’s study, he pointed out that,

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[76] Ibid, 250-296.

[77] Ibid, 23.

[78] Ibid, 52.

> The simple dilution of milk has been regarded by many as the worst form of deterioration injuring the milk consumer. But when it is considered that impure water, used in washing milk-pails, or diluting the milk, transfers from the cesspool to the breakfast cup, or infant feeding bottle, the germs of enteric fever… it is high time that, as practical men, we should consider the whole subject, and devise a remedy at once efficacious, and of possible or probable application.[79]

Gamgee proposed a complete system of the sanitary regulation of the milk trade, from the supervision of dairy farms, the transportation of milk from the country to towns, and a thorough system of chemical analysis to determine the quality of milk. While reflecting a progressive ethos, Gamgee's call for reform was seen by many as impracticable; it was too complicated to manage the transportation of milk, and too expensive to hire a new class of sanitary inspectors and chemical analysts. In 1875 Parliament made it compulsory that all local governments hire Public Analysts, who were largely responsible for testing the quality of milk. However, scientific inaccuracy, political jockeying, and professional controversy mired the science of milk analysis, as we will see in the next chapter. By the mid 1880s Parliamentary reforms began to regulate the milk trade, much in line with Gamgee's over archiving views. This too, however, was met with difficulty, the subject of chapter five. For now, it is crucial to understand the impact that early epidemiological investigations of milk-borne typhoid had on refocusing the nature of adulteration debates discussed in chapter one.

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[79] John Gamgee, "Country Versus Town Milk," *Med. Times and Gaz. (*1871), 1: 38-39, 67-68.

As early as 1872, from his unique position as both an MOH and a governmental civil servant, Ballard called for Parliamentary action in solving the milk problem. It was in that year, it might be remembered from chapter one, that Parliament passed a revised Adulteration Act. The latter made the hiring of public analysts allowable, even desirable, but not compulsory. What was worse, Ballard thought, was a lack of Parliamentary legislation aimed directly as agricultural practices. He argued that,

> The Adulteration of Food Act of last Session enables local authorities to deal with persons who add water to milk; but if a dairyman's own drinking water is permitted by local authorities to be a fluid little better than sewage, is it not rather a reflection on those authorities than an aggravation of his commercial fraud that he, only meaning to dilute his milk, ignorantly supplies infection to his customers?[80]

The above clearly links Ballard's milk-borne study with earlier epidemiological investigations of water-borne cholera and typhoid. It also underscores the complex direction of sanitary improvement in rural Britain and the slow pace of sanitary reform by rural sanitary authorities.

Linking epidemiological fieldwork to cultural practices of milk consumption brought science into a new public domain, particularly in trade and agricultural journals. *The Food Journal*, first issued in February of 1870, whose motto was "appetite runs, while Reason lags behind," was among the first to point to Ballard's study. The issue for 2 January 1871 noted that "such revelations as these are most alarming, for it would seem

[80] NA, MH 113/11, "Dr. Ballard's Report upon an Outbreak of Enteric Fever at Armley, in the Borough of Leeds," 11.

that the most simple and health-giving of nature's food was in danger of becoming a scourge of society instead of a blessing."[81] Likewise, the founding of *The Milk Journal* in January 1871 appeared to be a more direct result of Ballard's 1870 study, containing a lengthy leading article which accepted the epidemiological premise that milk could spread disease.[82] The early reception of *The Milk Journal* is interesting because the primary readership was agricultural dairy farmers. It is likely that some dairy farmers championed the use of science as a way to curb nefarious and competitive practices such as adulteration. The editor of *The Milk Journal* was well aware of Ballard's study, and asked the latter to write an article for the first issue. Titled, "On Some Sanitary Aspects of Cowkeeping, and the Trade of Milk in London," Ballard argued that it was the unsanitary practices of cowkeeping together with the transportation of milk which led to milk being contaminated with disease germs.[83] Ballard must have had the support of the journal's editor, as his article demonized dairymen who adulterated their milk. He argued that,

> From this time forth, the water supply upon the premises of a dairyman will be jealously scrutinized by public authorities. Let us hope, too, that another session of Parliament will not slip away, without imposing upon milk adulterators, such a punishment as the gravity of their delinquency warrants. From henceforth no one

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[81] Editor, Untitled, *The Food Journal* (January 1871), 2:666.

[82] *The Milk Journal*: *A Monthly Review of the Dairy, Dairy Produce, and Poultry Yard*, (London, 1871), 1: 2-3.

[83] Edward Ballard, "On Some Sanitary Aspects of Cowkeeping, and the Trade in Milk in London," Ibid, 6-8.

> can plead ignorance- no one ought to be permitted to plead the 'custom of the trade'.[84]

Arthur Hill Hassall saw the value in epidemiological evidence in promoting anti-adulteration reform, and the social value of agitation journalism as well.[85] Hassall started his own polemical journal, *Food, Water, and Air* in 1871, which was a combination of Hassall's now well-known penchant for microscopy but now coupled with analytical chemistry and epidemiology.[86] By the early 1870s Hassall was less likely to get caught up in inter-professional squabbles such as the one he had with Letheby. While, as Hamlin notes, Hassall was still more apt to agree with Edward Franklin's brand of analytical chemistry through the 1870s, he nonetheless promoted contemporary advances in epidemiology. The appearance of public forums, in the form of Victorian specialist journals, is evidence that the anti-adulteration cause had significantly changed course by the early 1870s. The growth of epidemiology was crucial to this transition, particularly epidemiological evidence that linked food to disease. But while epidemiologists perhaps provided a catalyst for a renewed anti-adulteration movement, they were not alone, as analytical chemists also served as scientific arbiters between milk consumers, dairymen, and local governments.

By 1873 a growing number of Victorian scientists and some dairy producers agreed that under the right unsanitary conditions, milk could spread epidemics of typhoid

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[84] Ibid, 8. This was in spite of the widespread recognition that the "ordinary dairy farmer knows nothing of the meaning of purity as applied to water, or of hygienic regulation of his farm and his dairy," Anon., "The Regulation of the Sale of Milk," *The Sanitary Record* (18 September 1875), 199-200.

[85] Arthur Hill Hassall, *Food, Water, and Air*, particularly in the years 1871-1873.

[86] Christopher Hamlin, *A Science of Impurity,* 220-223.

fever, scarlet fever, and diphtheria. Ballard and Taylor's epidemiological studies were the most frequently cited, but we should remember that both studies left many etiological holes unfilled. This would change in the fall of 1873, however, when the most notorious outbreak of milk-borne typhoid struck a wealthy neighborhood in the west-end of London. It was the 1873 'Marylebone Milk Crisis', as it was often called, that revealed that the milk-borne hypothesis was not simply an interesting etiological question, but rather a cause for widespread notice of public health officials, Parliament, and the British public. It is worth carefully detailing the case, as I do below, because it demonstrates a unique episode in the history of public health and is crucial to understanding how milk became understood as a public health problem.

The Marylebone Milk Crises of 1873

As more progressive leaning journals such as *Food, Water, and Air* and *The Food Journal* advocated anti-adulteration reform, more traditional and widely read medical periodicals such as the *British Medical Journal* joined the fray as well. The *BMJ's* involvement is largely due to the sagacity of its sometimes controversial editor Ernest Hart. Hart originally worked as a medical journalist from 1858 with *The Lancet*, but after a quarrel in 1866 with James Wakley, Thomas Wakley's son and successor, Hart jumped from *The Lancet* to the *British Medical Journal*, where he remained editor until his death in 1898. Hart was keen to use the *BMJ* as a platform for the professionalization of public health; the *BMJ* was able to actively participate in debates about germ theories, and to still speak to general practitioners.[87] It is interesting then to compare Hart's involvement in the 1870s and 1880s in the cause of anti-adulteration reform and Thomas Wakley's similar aims in the 1850s as editor of *The Lancet*. Perhaps the elder Wakley and Hart both saw the anti-adulteration cause as a way to reform and professionalize medical practice.[88] If so, then epidemiology, and to a lesser extent analytical chemistry, were the means by which such ends could be achieved.

In 1881 at the International Medical Congress held in London, Hart, who was then President of the British Medical Association, gave an influential paper that sketched a decade's worth of epidemiological research that linked typhoid fever, scarlet fever, and diphtheria to milk.[89] He had a professional interest in giving the talk because he sought to communicate vital British epidemiological research to an international audience. It was presaged, however, by personal experience on the part of Hart with what was perhaps the most well-known milk-borne outbreak in the Victorian era in 1873. In that year Hart's family, along with several of his closest medical colleague's families, including Charles Murchison and William Jenner, were struck with a particularly severe outbreak of typhoid. Looking back, in 1881 Hart wrote that Radcliffe's 1873 Marylebone investigation "made so clear that the then sceptics became perforce converted to a belief in milk infection. The demonstration of this infection has indeed, by this [1881] time

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87 George K. Behlmer, "Ernest Hart and the Social Thrust of Victorian Medicine," *BMJ* (Oct. 3, 1990), 301,6754: 711-713. For a more general history of the *BMJ* see P.W.J. Bartrip, *Mirror of Medicine: A History of the British Medical Journal* (Oxford: Clarendon, 1990).

88 W.F. Bynum and Janice Wilson, "Periodical Knowledge: Medical Journals and their Editors in Nineteenth Century Britain," in *Medical Journals and Medical Knowledge*, W.F. Bynum, Stephen Lock, and Roy Porter (eds.), (New York: Routledge, 1992), 29-48.

89 Ernest Hart, "The Influence of Milk in Spreading Zymotic Disease," in *Transactions of the International Medical Congress*, 7th session, *3* (London: J.W. Kolckmann, 1881), 491-505.

become so complete in this country, that its acceptance has now become practically universal."[90]

In late July and early August 1873 five of Charles Murchison's young children were struck with typhoid fever. Consulting with medical colleagues in his west-end neighborhood of Marylebone, Murchison found that 32 other families also had children diagnosed with typhoid; in all there were upwards of 100 fresh cases. "Satisfied that the outbreak could not be traced to defective drainage or to a polluted water supply," Murchison called upon the local MOH, John Whitmore.[91] Murchison initially hypothesized that a local source of milk might have been contaminated, perhaps due to the fact that mostly children seemed to be suffering from typhoid, and, as indicated in the quote above, the sanitary arrangements of the houses in Marylebone had been given top priority. The largest supplier to west-end was the well-known Dairy Reform Company. Whitmore was sympathetic to Murchison's initial theory, particularly after he conducted his own sanitary investigation of the neighborhood. Whitmore found all in sanitary order, noting,

> I could have no doubt of their being in a good structural condition… inasmuch as the occupants of them were medical men of eminence, and other persons who

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[90] Ibid, 492. Most MOsH, even those in rural areas, had most likely accepted the milk-borne hypothesis by the early 1880s. Many were etiological converts much earlier, such as Horace Swete, MOH for Droitwich. See, Horace Swete, "Milk Adulteration," *Sanitary Record* (14 August 1875), 118.

[91] Unpublished letter from Charles Murchison to editor of *The Times* dated 8 August 1873. Royal College of Physicians, London. Charles Murchison, Personal Papers, MS 710.

> were fully alive to the importance of living under the best and most perfect sanitary conditions that it was possible to obtain.[92]

Following Murchison's lead Whitmore interviewed the manager and secretary of the Dairy Reform Company, whose central office and distribution center was in Marylebone; milk was received by rail at King's Cross Station from dairies across the midlands around Oxfordshire, sorted in Marylebone, and delivered by cart to individual households. The initial meeting was complicated by that fact that Whitmore saw nothing amiss at the Marylebone office. He concluded that "the company were in no way responsible for the supposed contamination of their milk, and that the causes must be looked for at the farms from whence it was supplied."[93] Murchison's fear grew as typhoid cases rose through the first week of August. Learning of Whitmore's meeting with the Dairy Reform Company Murchison pled that Whitmore take a second visit, and this time to demand that the company cease the sale of their milk. Whitmore agreed, visiting again on 5 August when he asked the company to suspend their sale of milk. Perhaps unsurprisingly, the outraged Dairy Reform Company said the only way they would comply was if the Marylebone Vestry would compensate for "the loss and injury they may sustain in loss of profit and reputation."[94] The Vestry of course did not act, and as MOH, Whitmore had no legislative power to force such a suspension of milk.

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[92] James Whitmore, St. Marylebone, "On the Recent Epidemic of Typhoid or Enteric Fever," *Annual Report of the Medical Officer of Health*, dated 23 September 1873, in Parkes Pamphlet Collection, Wellcome Library, Box 89, Volume 53, page 2.

[93] Ibid.

[94] Ibid, 3. Later epidemiologists and MOsH were sometimes successful in persuading dairy farmers to temporarily stop the sale of their milk. In 1875 John Spear, MOH for Jarrow, was even able to close a local school when a dairy farmer's child had a case of milk-borne typhoid. See,

Instead, on 7 August he called an impromptu meeting of the Marylebone Vestry to warn the parish of the outbreak. He also sent a circular to local physicians in the area, and wrote a letter to John Simon at the Medical Department asking for assistance. The latter was, according to Whitmore, not "because I felt personally incompetent to the task, but because it was apparent that the origin of the outbreak was to be sought for in places far away from the Parish of St. Marylebone, beyond which I could exercise no power of authority."[95] Murchison was busying himself on the case as well; on 8 August he penned a letter to *The Times* warning London that an outbreak of fever was on the rise in the west-end of London, and to be suspicious of milk from the Dairy Reform Company.[96] Murichison had enlisted the help of distinguished physician and fever expert William Jenner, who also lived in Marylebone. The two spent roughly the next month flooding the London press with warnings about the extent and cause of the milk-borne outbreak in London, which they totaled upwards of 470 cases. Murchison and Jenner also sent enflamed letters directly to the Dairy Reform Company accusing them of malicious practices. Hart at the *BMJ* took a special interest in the whole affair, publishing the personal letters exchanged between Murchison, Jenner, Whitmore, and the Dairy Reform Company from August to December 1873. It was a mix of gentlemanly advocacy of a

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John Spear, "Report of an Epidemic of Typhoid Fever at Jarrow, Due to the Distribution of Infected Milk," *The Sanitary Record* (18 September 1875), 195-197. Other investigators were unsuccessful in persuading dairy farmers to cooperate in the 1880s and 1890s due to the complex nature of rural farmers' contracts with large distribution dairy companies. This is further explored in chapter five.

[95] Ibid.

[96] Unpublished letter from Charles Murchison to editor of *The Times* dated 8 August 1873. Royal College of Physicians, London. Charles Murchison, Personal Papers, MS 710.

professional nature and personal embattlement that led Murchison and Jenner to become involved.

Whitmore, on the other hand, clearly needed assistance, and it came in the form of Simon's team of Medical Inspectors at the Local Government Board. Simon promptly responded, sending John Netten Radcliffe to conduct an investigation of the outbreak. Radcliffe first met with Whitmore, Murchison, and Jenner on 8 August to obtain as much information as possible. He then conducted his own sanitary investigation of Marylebone, examining the local water supply which came from either the West Middlesex or Grand Junction Companies. He also inspected the domestic arrangements of houses where typhoid prevailed, finding that "the drainage of the house had, some time before the outbreak, been placed in thorough order."[97] Radcliffe, it should be remembered, was in 1873 one of Britain's leading epidemiologists of water-borne diseases. He was well experienced in the nature and spread of typhoid fever, and had been exposed to milk-borne outbreaks as a colleague to Ballard at the Medical Department. It was only after inspecting the water supply that Radcliffe concluded, "we have exhausted the known conditions which foster or determine the prevalence of enteric fever with one important exception, namely, the possibility of distribution of the infective material of the disease with some article of food… the distribution of the infective material in milk."[98]

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[97] John Netten Radcliffe and W.H. Power, "Report on an Outbreak of Enteric Fever in Marylebone and the Adjoining Parts of London," in Report of the Medical Officer of the Local Government Board," *Annual Report to the Local Government Board*, n.s. 1, Parliamentary Papers, 1873, 109.

[98] Ibid, 112.

As of 1873 there was not a precise methodology for how to conduct a milk-borne investigation. Radcliffe inquired at each household when typhoid had occurred, obtaining details about who was sick, when they came down with the disease, and if the family knew the source of their milk. Murchison's early suspicion was vindicated when Radcliffe found that of the 244 cases in Marylebone, 218, forming nine-tenths, were in households who obtained their milk solely from the Dairy Reform Company. It was as if, Radcliffe noted, the disease "picked out the streets to which the milk was distributed, and the houses in those streets which received the milk."[99] Anecdotal evidence further substantiated the milk-borne hypothesis, as within particular households only those who drank large quantities of milk came down with typhoid. Radcliffe's methodology was a mix between careful observational case tracing, exemplified by his shoe-leather process of household inquiry, and large-scale statistical analysis of mortality data. While both types of evidence were crucial to establishing epidemiological links, historians have tended to privilege quantitative types of statistical analysis. Less explored have been epidemiological practices of case tracing. Radcliffe's 1873 study exemplifies the importance of observational methods; his report was full of examples such as the following,

> The mistress and the kitchenmaid were the only persons in a family who habitually drank uncooked milk: they both had enteric fever. Two children in the same family who did not take milk in this form escaped. A physician, in the habit

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[99] Ibid, 115.

> of taking nightly half a pint or more of cold milk, 'as it came from the dairy,' was the only person in his household who did so, he alone had enteric fever.[100]

Similar types of epidemiological practices can be found in the reports of Edward Ballard, Richard Thorne-Thorne, and George Buchanan. The power was in seeing the patterns of seemingly anecdotal and observational types of evidence that emerged after collecting large amounts of information. In Radcliffe's case such evidence pointed strongly towards milk as a factor in spreading the epidemic, and particularly the role of the Dairy Reform Company. However, it was not definitive proof. For that, Radcliffe turned his investigation to the infrastructure of dairy production in Britain.

Together with Whitmore, Radcliffe met with the director of the Dairy Reform Company, Mr. Hope. Perhaps because of the fear of a governmental inspector, or possibly because the Dairy Reform Company was truly concerned about the quality of their milk, Mr. Hope allowed Radcliffe and Whitmore to conduct a sanitary investigation of the eight farms that supplied milk to the Marylebone distribution center. Hope only stipulated that the company send two of their own independent inspectors to join the investigation, Chalmers Morton, a Rivers Pollution inspector, and William Corfield, Professor of Hygiene at University College London and an expert on sewage and domestic sanitary arrangements. Employing Morton made a certain amount of sense, as the Dairy Reform Company insisted that water from the metropolitan water companies was to blame instead of their milk. And, although Corfield was an intimate colleague with Radcliffe, the two serving as joint secretaries of the Epidemiological Society of

[100] Ibid, 116.

London from 1870 to 1872, he was a recognized authority on local sanitary arrangments. The investigation began on 11 August, and many in the London press called the team akin to a ‘royal commission.’

It was with a certain amount irony that the Dairy Reform Company was even being accused distributing adulterated milk. Throughout the several month investigation, even after conclusive reports on all sides were published, the managers of the company maintained that their milk was clean, fresh, and wholesome. It was with no little irony then that the company was founded on anti-adulteration principles; theirs was a ‘new’ enterprise whose aim was to correct a market flooded with adulterated milk in the metropolis. For example, in an advertisement that the Dairy Reform Company put out in the first edition of *The Milk Journal* in 1871, they proudly publicized that, “this Company established four years ago for the sale of Pure Milk and Cream, has met with such continued and hearty support from the Public, that its deliveries now cover a very large portion of London.”[101] The advertisement went on to insist that they were committed to seven standards: unadulterated produce, correctness of imperial measures, moderate prices, regularity of delivery, punctuality and correctness of accounts, immediate investigation of all complaints, and weekly payments, and for small quantities, cash on delivery. And, although the company pleaded ignorance of the milk-borne hypothesis, it is probable that they too were aware of Ballard’s 1870 Islington investigation. In February of 1871 the Dairy Reform Company applied to conduct their business thenceforth under the law of limited liability, which would provide the owners with a

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[101] *The Milk Journal* (1871), 1: 6**.**

kind of shareholder immunity if the company were persecuted under the law.[102] Further evidence from an advertisement again in *The Milk Journal* corroborates such an interpretation, where later in 1871 the company wrote, "the means the Directors possess of preventing Adulteration of the Produce… are complete and absolute, and [we] will continue in the future as in the past to give that personal attention to the business which has made its success."[103] The point is that by the 1873 Marylebone outbreak, it is probable that the Dairy Reform Company was familiar with the etiological theory that adulterated milk could spread disease. As their comments above indicate however, such an admission would ruin the entire platform on which the company was based.

Having four experienced sanitarians thoroughly inspect eight different dairy farms in various rural locations must have been a difficult task. It could have also been an opportunity for scientific and professional conflicts to come to the fore. Whitmore's report indicates that the four, Radcliffe, Morton, Corfield, and himself, had the shared goal of comparing five facts at each farm: (1) what was the system of drainage and nature of the soil, (2) what was the quality and quantity of the water supply, (3) what were the general conditions of the cows themselves, and the nature of their food, (4) what was the health of the occupants and the laborers on the farm and the surrounding parishes, and (5) what was the mode by which the washing and cooling of the milk cans was carried out at each farm; what was the quality of such water, and the arrangements generally adopted for preserving the milk free from pollution of any kind.[104] Although detailed reports

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[102] NA, BT 31/1591/5277.

[103] *The Milk Journal* (1871), 3: 30, and *The Pall Mall Gazette* (1871), 1870: 46.

[104] John Whitmore, St. Marylebone, *Annual Report of the Medical Officer of Health*, 1873, 3-4.

pertaining to the inspection of each farm did not survive, we do know that the group was struck by the atrocious sanitary conditions of the eighth farm, called the Chilton Grove Farm, situated in Oxfordshire. The other telling feature was that the farm's owner, Mr. Jessop, and several other in communication with the farm, had died of typhoid directly preceding the London outbreak. Communicating with local physicians, the group attempted to tabulate all who had contracted typhoid in the area from June to August 1873. Radcliffe and Corfield, the two most experienced in the group, led the sanitary survey of the dairy farm, looking for defects in drainage, water supply, and sewerage.

Corfield and Radcliffe were a formidable pair, and it is clear that the former was not swayed by the income he was deriving from the Dairy Reform. The system of drainage on the farm was particularly problematic. According to Radcliffe's report, the two found that the well was located at the bottom of a shallow funnel, and liable to soakage from the privy, the sewer drains, and the pigsty. Radcliffe learned that the family had stopped drinking the well water on account of its increasing 'distastefulness.' And, while they obtained drinking water from a nearby spring, they still used the well water for dairy purposes, including cleaning dairy utensils and buckets. A series of drain excavations on the farm found several leaks in the drainage pipes, including those located near the pigsty and ash-heap.[105] This type of hands-on investigative field work was crucial, not least because Radcliffe had learned that the family physician instructed the typhoid discharges of the farm's owner to be placed in the ash-heap, instead of the privy, so that other members of the family would not be exposed to dangerous miasms when

[105] John Netten Radcliffe and W.H. Power, "Report on an Outbreak of Enteric Fever in Marylebone and the Adjoining Parts of London," 125.

using the privy. Such a situation must have been frustrating to Radcliffe, a convinced contagionist, who noted that,

> By an unhappy and altogether unforeseen chance, and in carrying out precautions to obviate any possibility of mischief the matters from which mischief was most apt to arise were deposited in perhaps the only spot on the farm premises where they would certainly find their way into the water used for dairy purposes.[106]

The dairy workers at the Chilton Grove farm denied adulterating their milk with the contaminated water, although they readily admitted to freely washing utensils and cleansing churns with the water. And, although it was not definitive proof, Radcliffe and the others were fully satisfied that they had located the mischief and solved the case. On 13 August, while still at the Chilton Grove farm, Radcliffe sent a telegram to Murchison in London which simply said, "source dis-covered and stopped."[107] In similar fashion, Corfield and Morton sent word to the Dairy Reform Company pleading with them to stop the sale of their milk.[108]

The Dairy Reform Company eventually admitted that the milk from the Chilton Grove farm had been contaminated with typhoid charged water.[109] On 26 August, 1873 the *Pall Mall Gazette* published a letter from the company which announced that they would from thenceforth be scrupulous with weekly sanitary, veterinary, and chemical

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[106] Ibid.

[107] Telegram from Radcliffe to Murchison, 13 August 1873, Murchison, Personal Papers, MS 710.

[108] *Marylebone Mercury* (23 August 1873), newspaper clipping from Murchison Personal Papers, MS 710.

[109] D. Maconochie, "The Late Typhoid Epidemic," *The Times* **(**1873), 27778: 8.

inspections at all of their dairy farms. There was also to be increased inspection at the Marylebone distribution center, and the company noted that they would hire a veterinary surgeon, two analytical chemists, and provide that any metropolitan MOH could visit any farm upon request.[110] The damage to the company however, was already done. The company was vociferously attacked both in the medical and general press. Sanitarians such as Alfred Smee, wrote that, "the defiant tone of Mr. Hope, after the lamentable events which have lately occurred from the want of sagacity shown by the Dairy Reform Company, under his management, is as much to be wondered at as deplored."[111] Aimed at a more general readership, *The Daily Telegraph* noted that "the light thrown by this report upon the powers of Science ought to arouse, and must arouse, the activity of those who are entrusted with the power to protect society," which was in clear support of Radcliffe's report.[112] Murchison, for his part in the initial investigation, was given a formal testimonial from both the Marylebone Vestry, and the customers of the Dairy Reform Company.[113] Accepting the public recognition, Murchison believed that the Marylebone case led to three important outcomes: it gave increased publicity to the fact that milk-borne typhoid was not an etiological obscurity but a frequent occurrence, it encouraged preventive Parliamentary and local legislation to curb unsanitary dairy practices, and it made milk consumers more aware of the potential dangers of adulterated

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[110] *The Pall Mall Gazette*, 1873, *2261*, 8.

[111] Alfred Smee, *Milk, Typhoid Fever, and Sewage: A Series of Letters*, (London: W. H. & L. Collingridge, 1873), 5.

[112] The *Daily Telegraph* (1873), clipping in Murchison, Personal Papers, MS 710.

[113] *The Marylebone Mercury* (4 October 1873); *The Daily Telegraph* (13 December 1873); *The Observer* (19 April 1874); *Medical Times and Gazette* (25 April 1874). All clippings from Murchison, Personal Papers, MS 710.

milk.[114] It was a seen by many contemporaries as a powerful lesson in Victorian public health. William Budd, in his 1873 masterpiece *Typhoid Fever*, echoed Murchison's sentiment, noting that "in order to have a just estimate of the share it takes in the propagation of this fever, we must include the cases in which fever-tainted water is drunk as a diluent of milk… I have no doubt that this mode of infection is much more common than it is generally supposed to be."[115] Budd's anxiety played out throughout the last quarter of the nineteenth century.

Purity Questioned, Purity Redefined

Epidemiological studies of milk-borne typhoid continued throughout the 1870s and into the 1880s and 1890s, as Ernest Hart's continued interest in the milk problem into the late 1890s demonstrates. In 1897 Hart produced an expanded version of his 1881 address, listing all of the milk-borne epidemiological studies from the 1870s to the late 1890s.[116] However, the sanitary management of the dairy industry through Parliamentary legislation, explored in chapter five, was complicated by several factors, including the political power of agriculture, but also by conflicting types of scientific evidence. In chapter five I will explore how epidemiological studies in the 1880s and 1890s responded and adapted to such socio-political problems. For now, a careful analysis of the two earliest milk-borne epidemiological studies in Islington (1870) and Marylebone (1873) will suffice as exemplary. It is important to note that etiological clarity was not fully seen

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[114] *Med. Times and Gaz.* (1874), 456, clipping in Murchison, Personal Papers, MS 710.

[115] William Budd, *Typhoid Fever*, (London: Longmans Green & Co., 1873), 103.

[116] Ernest Hart, "The Influence of Milk in Spreading Zymotic Disease," *BMJ* (8 May, 15 May, and 22 May, 1897). Most were either conducted by MOsH or inspectors at the Medical Department.

by the early 1880s. Francis Vacher, MOH for Birkenhead, noted in 1881 that scientists now agreed that disease could be spread in food in three different ways; the food itself might be in a pathological state, the food could serve as a medium or nidus for the multiplication of disease germs, or the food could serve simply as a vehicle where germs rested.[117] What was unclear throughout the 1880s and into the 1890s, however, was whether milk could act in all three ways, or was exclusive to one or two.

Conclusion

Analysis of the Islington and Marylebone studies illustrates the important ways in which epidemiological investigations of milk-borne typhoid were crucial to the ascendency of the germ theory of infectious disease and the dawn of preventive medicine in Victorian public health. Ballard's study was largely metropolitan based; he was also assisted by the dairy farmer in question, and had an intimate knowledge of both the local environment and the health of the population. In later studies MOsH might have similar advantages, particularly in rural areas where population densities were low and networks of communication and the exchange of materials well known. Urban MOsH, particularly those whose constituents received milk from the countryside, widespread by the mid 1870s, had a much more difficult time in conducting epidemiological studies. This was apparent to John Whitmore, the MOH for Marylebone in 1873, when his only recourse was to enlist the support and assistance of John Simon at the Medical Department. This of course did not always solve the jurisdictional problem, as rural sanitary authorities still

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[117] Francis Vacher, "The Influence of Various Articles of Food in Spreading Parasitic, Zymotic, Tubercular and other Diseases," in Transactions of the International Medical Congress, 7th session, *3,* (London: J W Kolckmann, 1881,) 489-490.

maintained control over the production side of dairy farming. Parliamentary legislation, which was pushed by Simon and other public health advocates, increasingly tried to nationalize the supervision of dairy production and milk transportation. It was only through epidemiological practices, such as carefully tracking cases of typhoid fever in rural populations and excavating drain pipes to search for leaks, that such legal and sanitary supervision was increasingly seen as necessary. This was not a linear process, however, as chapter five illustrates.

Early milk-borne studies challenged the Victorian assumptions about filth and disease. Both the Islington and the Marylebone outbreaks were largely confined to wealthy upper class Britons. Class was so tied to outbreaks of milk-borne typhoid that an 1874 review of William Budd's *Typhoid Fever* noted that Budd's work, "concerns a fever which is pre-eminently fatal among the rich."[118] Yet, where an older generation of British sanitarians might have placed blame on personal or moral faults, essential to the cultural meaning attached to the 'filth disease', a new generation of sanitarians that emerged from the 1870s shifted their focus to routes of disease transmission. This was predicated upon what I called in chapter two an 'epidemiological impulse'. It could be the personal fault of wealthy milk consumers in London in creating the preconditions for a milk-borne outbreak, as Ballard suggested, but such an argument was more importantly used to dovetail with and enlarge the anti-adulteration movement. Crucial here was a transferring of blame from individual milk consumers to milk producers. Whereas dairy farmers were the epitome of rural agrarianism and the sturdy British constitution in the middle of the

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[118] Editor, Review of William Budd, *Typhoid Fever*, *Edinburgh Medical Journal* (1874), 19: 820.

nineteenth century, by the late 1870s and early 1880s the dairy farmer was increasingly seen as focal point of a deadly network fostering infectious disease. Dairy cattle too were seen as imminent public health problems, but the focus by the 1890s largely shifted to a renewal of zoonotic fears over milk-borne tuberculosis. The agricultural farmland became seen, to use the words of James Russell, Glasgow's MOH, "the breeding place" of epidemic disease.[119] Russell concluded a lecture on 3 December 1878 in Glasgow by clearly summarizing the state of the milk problem. He noted,

> Take the case of milk infection, where by some abominable carelessness of the farmer, or some willful adulteration with sewage water, that wholesome fluid has become like the diluted mixture of vaccine particles and water. How many may partake of the mixture and not happen to hit upon a portion of the total bulk which contains a sufficiency of the enteric particles to infect; how many may take just enough to derange their health, to cause a short febrile diarrhoea, just as Darwin tells us, "That the plants produced by the imperfectly fertilized seeds never attained their proper dimensions, and bore flowers of remarkably small size."[120]

Ultimately, the main question epidemiological studies of milk-borne typhoid in the 1870s raised was thus; if milk diluted with contaminated water could spread disease under certain circumstances, how could adulteration be detected? To answer this question

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[119] James Russell, *Lectures on the Theory and General Prevention and Control of Infectious Diseases* (Glasgow: James Maclehose, 1879). Russell was keenly interested in the milk problem as it related to public health in Scotland. See, James B. Russell, *Report on an Outbreak of Enteric Fever in the West-End of Glasgow and Hillhead: with a Memorandum on the Milk-Supply of Glasgow in Relation to the Dissemination of Infectious Disease by Milk,* (Glasgow: Robert Anderson, 1878), and James B. Russell, *Report upon Certain Epidemic Outbreaks of Enteric Fever* (Glasgow: Robert Anderson, 1880).

[120] Ibid, 52.

epidemiological evidence would not suffice, and public health officials increasingly turned to the fledgling science of analytical chemistry, the subject of the next chapter. Analytical chemists played a crucial role in the milk problem, which can be aptly summarized by a quip in the *Sanitary Record* for 4 July 1874, that concluded, “it is on whole, more easy to put up with watered milk at 5*d*. per quart, and take the chance of typhoid epidemics, than to struggle against the adulterator.”[121] Epidemiologists could track epidemics of milk-borne typhoid only after an outbreak had occurred. Analytical chemists were supposed to be on the other side of the public health spectrum, analyzing milk supplies in order to curb epidemics from occurring in the first place.

[121] Editor, “Adulterated Milk,” *Sanitary Record*, Vol. I, (1874), 11.

Chapter Four: A Conflict of Analysis

As a result of epidemiological fieldwork in the early 1870s the role of milk in spreading deadly infectious diseases such as typhoid fever, scarlet fever, and diphtheria was elevated to higher prominence in debates over public health policy. Commenting on the 1873 Marylebone milk-borne outbreak discussed in chapter three, Arthur Hill Hassall argued in his journal *Food, Water, and Air*, "that such cases are of frequent occurrence is undoubted, that they have often been overlooked is equally so; but in the future, now that the medical profession and the public are on their guard, we may expect that they will be more frequently discovered."[1] At the Medical Department of the Local Government Board, epidemiological investigations of milk-borne disease became commonplace. Medical inspectors simply added the milk supply as one more variable to a complex set of practices aimed to elucidate the spread of disease in local communities. Richard Thorne-Thorne, for example, investigating an outbreak of enteric fever in 1880 in Prittlewell, near Southend-on-Sea, noted in his final report that "it appears quite evident that milk had no influence either in the origin or the spread of the infection."[2] Thorne traced that outbreak to a polluted water supply.

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[1] Arthur Hill Hassall, "The Recent Outbreak of Typhoid Fever in Marylebone," *Food, Water, and Air* (October, 1873), 24: 120-123.

[2] Richard Thorne-Thorne, "Dr. Thorne-Thorne's Report to the Local Government Board on an Extensive Prevalence of Enteric Fever at Prittlewell, in the Urban Sanitary District of Southend, and on the General Sanitary Circumstances of the District," *Report of the Medical Officer of the Local Government Board*, 8 June 1880, 2.

The revelation that milk could spread disease fundamentally challenged models of milk production, distribution, and consumption. Besides fueling an already established anti-adulteration reform agenda that began around the middle of the century (explored in chapter one), the pioneering milk-borne epidemiological studies conducted in the mid 1870s (explored in chapter three) initiated reform from both milk producers and local authorities, who sought to prevent milk supplies from adulteration at the farm. Calls for reform often came from opposing interests. Trade associations such as the Manchester and Salford Dairy Association, the largest of its kind, was adamant about dairy supervision for economic reasons.[3] By the 1880s the milk business was simply more profitable than it had been in previous decades. Local authorities also sought to protect local businesses, whereas members of Parliament based reformist claims on moral and economic grounds. The Local Government Board, specifically through Medical Department, often pushed for reform for health reasons.

Dairy supervision through rigorous inspection was one solution to the milk problem, but even that remained controversial and largely unguided. Many local MOsH were already over-burdened with sanitary inspection, this despite the fact that they thought dairy inspection was uniquely in their professional purview, as we will see in chapter five. By the mid 1880s veterinary inspectors (of the Privy Council's Agricultural Department) were largely employed to inspect diseased animals and maintain healthy

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[3] Manchester, Salford, and Surrounding Townships Milk Dealers' Protection Society, "Rules" (Manchester, Cuthbertson & Allan, 1872) in N.A. Kew, FS 27/2. The Manchester area dairymen society was perhaps the most active. Formed in 1871, they were said to have 277 members by 1898. See also Arthur Mash and J.B. Smethurst, *Historical Directory of Trade Unions* vol. 5 (Aldershot: Ashgate, 2006), 127.

cattle populations, but this only confused the practical roles of MOsH, public analysts, and veterinary inspectors.[4] As the chapter five demonstrates, the fragmented state of agricultural and sanitary inspection was a product of increased governmental growth which often resulted in central-local administrative conflicts. Above all, the crucial matter was the permissive nature of Parliamentary legislation, which only began to change in the 1890s. The reliance of local authorities on analytical chemists, a group before the 1870s that was largely undefined, became a vital tool for protecting milk supplies. Their aim was to detect adulteration and provide certificates of chemical authenticity. Yet, as the next chapter demonstrates, analytical chemists only provided one type of expert authority in milk-related matters.

While the staff of the Medical Department and local Medical Officers of Health were instrumental in establishing the priority of the milk-borne hypothesis and milk-related studies continued into the early twentieth century, these groups initially could do little to prevent milk-borne outbreaks. To be sure, Parliamentary legislation in the 1890s relied extensively on local MOsH and veterinary inspectors, as we will see in chapter five. By then the goal was clearly the prevention of milk-borne outbreaks through rigorous sanitary inspection. Effective Parliamentary legislation in curbing milk adulteration and thus milk-borne outbreaks, however, necessitated that such legislation not only be comprehensive but also compulsory. Compulsory legislation on matters of public health was still controversial in the mid 1870s when British epidemiologists began clarifying the etiological role of milk in spreading disease. Legislative inroads to prevent

[4] Anne Hardy, "Professional Advantage and Public Health: British Veterinarians and State Veterinary Services, 1865-1939," *Twentieth Century British History* (2003), 14: 1-23.

milk adulteration were made with the 1875 Sale of Food and Drugs Act (SFDA), particularly the clause that forced all local authorities to hire a public analyst. Yet, as we will see in this chapter, the practical application of the 1875 Act was fraught with competing scientific interests and disputed professional boundaries.

This chapter explores the implementation of early public health policies aimed to prevent milk adulteration by focusing on the struggles of the nascent profession of analytical chemistry. Yet, before 1875 public analysts had little professional or institutional identity. Being employed by local authorities, they typically struggled to combat adulteration at the local level against powerful trade interests, an unsystematic methodology, and a legal machinery whose small fines rarely deterred convicted adulterators. Even after a more rigid Parliamentary framework emerged with the 1875 SFDA, and an institutional identity with the formation of the Society of Public Analysts (SPA) in 1875, the chemical experts continued to struggle. I argue that this was a result of two opposing practices, those which followed section 22 of the 1875 SFDA that enabled accused traders to appeal their cases to the Government Laboratory of the Inland Revenue Service at Somerset House, and those that came established official standards of adulteration adopted by the Society of Public Analysts in 1875. These two avenues for redress led to a series of bitter contests between local public analysts, through their professional organization and the Somerset House chemists. These disputes, I argue, centered on methodology and the definition of adulteration. The feud between the two illustrates the important ways in which intra-professional scientific conflict could obstruct the control of food adulteration. Milk loomed large in debates over analytical methodology and in defining adulteration, as it was the most commonly adulterated food public analysts investigated throughout the second half of the nineteenth century. As several epidemiologists had shown by the mid 1870s, milk was also the most dangerous threat amongst commonly adulterated foods.

The rise of analytical chemistry was fraught with discipline promotion vis-à-vis defining the discipline's professionalization. Public analysts attempted to gain scientific authority using new and often contested scientific methodologies in food analysis. This claim follows Christopher Hamlin's argument that "too frequently we assume that public health improvement was a coherent enterprise, its scope well-defined, its goals clear, with minor disagreements occasionally existing only as to means."[5] An examination of how public analysts used the problem of milk adulteration to delineate professional interests furthers Hamlin's critique. The development of standards for milk adulteration was a product of a complex and contingent discourse in which various scientific arguments were waged within the field of chemistry, and across the disciplines of epidemiology, bacteriology, and veterinary medicine.

Structural Problems and Early Frustrations: the First Public Analysts

Legally, local authorities could hire public analysts as permitted by the 1860 'Act for Preventing the Adulteration of Articles of Food and Drink', and some local authorities even had informal part-time contracts with chemists before 1860. However, the 1860 Act, as explained in chapter one, was permissive in nature, and only progressive local authorities hired analysts. Even then, many authorities simply placed analytical duties on already overburdened MOsH. The *Chemical News*, edited by famed Victorian chemist

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[5] Christopher Hamlin, *A Science of Impurity*, 5.

William Crookes, noted in 1874 that of 171 boroughs and 54 counties in Britain, only 26 boroughs and 34 counties had appointed analysts.[6] Edward Ballard's career as MOH and public analyst in Islington was perhaps a prime example, although Ballard took on the extra duties enthusiastically despite his lack of training in analytical chemistry.

Charles Cameron, Medical Officer of Health for Dublin, also took on additional analytical duties, although he had considerably more experience than others such as Ballard.[7] In the decade from 1862, when Cameron was jointly appointed public analyst and Medical Officer of Health, he conducted 2,600 official analyses of food, drugs, and drink. Cameron found that around 1,500 were adulterated. In turn, he was able to elicit 342 convictions, with samples of milk adulteration being the most frequent at 286 of the 342.[8] Cameron's reformist ethos and success at providing conclusive scientific evidence of adulteration were perhaps unique amongst early public analysts as a whole, particularly before 1875 when the Society of Public Analysts was formed. Cameron was influential in directing Dublin's sanitary matters and was well supported by local authorities and respected in the community.[9] It is also possible that Dubliners were more alarmed by the problems of food adulteration, and thus more receptive to public health reform. Under the 1860 Act, most analyses were paid for by the consumer, not the local authority, which might explain the general lack of much business for food analysts before

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[6] *The Chemical News* (July 17 1874), 23. On Crookes see: William H. Brock, *William Crookes (1832-1919) and the Commercialization of Science* (Aldershot, Ashgate, 2008).

[7] Cameron's interest in analytical chemistry and food adulteration was fostered under his training with Justus von Liebig at the University of Giessen.

[8] Wentworth Lascelles Scott, "Food Adulteration and the Legislative Enactments Relating Thereto," *Journal of the Society of Arts* (1875), 23,1167: 429.

[9] Anon., "Milk Adulteration," *Food, Water, and Air* (December 1871), 2:34.

the mid 1870s. However, Cameron noted in 1868 that his fees ranged from 10s to 2s 2d, what he called "a purely nominal charge, and merely intended to render the transaction *bona fide*."[10] Even in areas where public analysts like Cameron were particularly active however, clever traders and manufacturers quickly found ways to skirt the detection of counterfeit goods. Many traders were said to have kept both pure and adulterated goods on hand; the former would go to the analyst or the local Inspector of Nuisances, MOH, or Inspector of Weights and Measures, and the latter to the public.[11] Arthur Hill Hassall, in the first issue of his reformist periodical *Food, Water, and Air* argued as much for the case of milk, noting that,

> Milkmen keep what they call different qualities of milk, charging various prices for it, according to the customers who apply. Thus, for 'nursery milk' they will charge 6d a quart, while for the inferior kinds we have known as small as a sum as 2 ½d. to be paid. Now, nursery milk means pure milk of fair quality, and the lower priced samples are nothing but a mixture of milk and water, sold by people for whom imprisonment would not be at all too bad, under the much abused name of milk.[12]

This kind of deceit was only possible under a provision of the 1860 Act which stipulated that analysts or inspectors needed to state to the seller that the article was being purchased for analysis. It was defended as a safety measure, in order that the seller might

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[10] Charles Cameron, *Lectures on the Preservation of Health* (London: Cassell, 1868), 97-98.

[11] Ernest Hart, "Adulterated Milk," *The Sanitary Record: A Journal of Public Health*, (1874), 1: 10-11.

[12] Arthur Hill Hassall, "Milk and its Adulterations" *Food, Water, and Air* (1871), 1: 4.

accompany the buyer to the analyst's office and thus avoid tampering. Aside from local market trickery by street peddlers, there were other structural problems in actually hiring public analysts that further complicated the on-the-ground practices of public analysts. Representative here is the case of Wentworth Lascelles Scott.

In November of 1872 the Sanitary Committee of the Borough of Wolverhampton announced their interest in hiring a person "possessing competent Medical, Chemical, and Microscopical Knowledge as Analyst."[13] Scott, who was then the public analyst for the northern division of the county of Staffordshire, applied on 30 November. Scott's application would have been common, as the small remuneration of a single borough or county could be supplemented by taking on the duties of two or three separate public counties. Scott had prepared a substantial application packet that included letters of recommendation from Charles Cameron, mentioned above, William Crookes, editor of the *Chemical News*, A.W. Hofmann, Scott's mentor, Edwin Lankester, MOH for St. James, Westminster, and Benjamin Ward Richardson, President of the Medical Society of London.[14] Scott's rival for the position was E.W.T. Jones, who had from time to time conducted analyses for Wolverhampton on an informal basis. Jones received recommendations from Sir John Morris, the Mayor of Wolverhampton, and Charles B. Mander, Board of Township Commissioner, giving him what appeared to be a decided insider's advantage.[15] Scott was perhaps the more qualified of the two, having been educated in the new branch of practical chemistry at the Royal College of Chemistry

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[13] NA, Kew. MH 25/24.

[14] Ibid, titled "Testimonials from Eminent Chemical, Medical, and other Authorities as to the Professional Qualifications of Wentworth Lascelles Scott."

[15] Ibid, Testimonials for E.W.T. Jones.

under the tutelage of its first director, A.W. Hofmann (one of Justus Liebig's students at the University of Giessen).[16] Jones however, was the inside candidate and political favorite for the position. Scott received an official rejection letter on 15 January 1873. Infuriated, he sent a letter to the Local Government Board complaining about the nepotism in the Wolverhampton Town Council in favoring Jones.[17] Scott argued that when the Town Council met on 13 January to make their final decision, his candidacy was rejected on grounds that "the majority were afraid of the Adulteration Act being carried out <u>too</u> well if a person of my special acquaintance with the subject were appointed."[18] Besides having little authority on the matter, the Local Government Board maintained its support for the relative autonomy of local governments throughout the 1860s and 1870s.[19] In his marginal comments to Scott's letter, John Simon noted that, "Mr. Scott may possibly be a much fitter person, but, with the comparative question, the Board of course has nothing to do."[20] The passing of the 1875 SFDA changed the passive

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[16] On the German-based chemists, see Robert Kohler, *From Medical Chemistry to Biochemistry: The Making of a Biomedical Discipline* (Cambridge: Cambridge University Press, 1982), especially chapter two. On Liebig, see W.H. Brock, *Justus von Liebig: The Chemical Gatekeeper* (Cambridge; Cambridge University Press, 1998).

[17] Ibid, letter from Wolverhampton Town Clerk to W.L. Scott, dated 15 January 1873. See also, ibid, letter from W.L. Scott to Local Government Board, dated 21 January 1873, and E.W.T. Jones, "Public Analysts for Staffordshire," *Chemical News* (7 November 1873), 238.

[18] Ibid, letter from W.L. Scott to Local Government Board, dated 21 January 1873. Scott also wrote the LGB on 10 January 1873 pleading his case. See, letter from W.L. Scott to LGB, dated 10 January, 1873. N.A. Kew, MH 25/24.

[19] Royston Lambert, "Central and Local Relations in Mid-Victorian England: The Local Government Act Office, 1858-71," *Victorian Studies* (December 1962), 6: 121-150. See also, Christopher Lawrence, "Sanitary Reformers and the Medical Profession in Victorian England," in Teizo Ogawa (ed) *Public Health* (Tokyo: Taniguchi Foundation, 1981), 159-163.

[20] W.L. Scott to LGB, dated 10 January, 1873. N.A. Kew, MH 25/24. John Simon's marginal comments. Scott continued to act as analyst for N. Staffordshire until 1877, when, frustrated with Jones and the Wolverhampton authorities, he resigned. See, *The Analyst* (1878), 2: 104.

stance of the Local Government Board by stipulating that the selection of public analysts had to be approved by the LGB.

As far as the specific issue of milk was concerned, there were essentially two problems in curbing milk adulteration between the enactment of the 1860 Act and overhaul in 1875 with the Sale of Food and Drugs Act. One, the legal definition of adulteration was ill defined, making court prosecutions difficult, and two, local authorities had little idea who was competent to practice as a public analyst, leaving many to simply neglect the position altogether. Legal definitions were difficult to sort out in practice even after the 1875 SFDA, however, as that act vaguely defined a public analyst as someone possessing “sufficient medical, chemical, and microscopical knowledge.”

In addition to the qualification of public analysts, the crucial question of what constituted adulteration was largely one of methodology and standardization. Public analysts typically examined a wide variety of foodstuffs, but milk was the most difficult to define. The standard properties of pure and adulterated milk were not universal because in practice analytical chemists often devised their own methods of milk analysis. While most Victorian chemists agreed that milk analysis was a matter for chemistry, there was a great divergence of opinion amongst chemists on what constituted milk adulteration and what methods were to be used for detecting such adulteration. Even the commonest adulterant to milk, water, proved to be extremely difficult to detect, as cow’s milk contains mostly water in its normal state. Often a sample of milk would be declared adulterated by a local public analyst only to be declared of normal quality by either another analyst or, after 1875, the Government chemists, who acted as official referees in all disputed cases under the 1875 SFDA.[21]

A more general obstacle was the fact that the milk production and transportation system was a complex network whereby rural dairy farmers sent milk to cities, where it was held by local distributors who often mixed or adulterated milk from various sources before peddling it on the streets or later, delivering it to households. Locating the source of an adulterated supply, in other words, meant more than simply supervising the sanitary arrangements on dairy farms, although the latter remained a significant problem until the early 1900s.[22]

Competing Methodologies in 'Pure' and 'Applied' Chemistry

The first generation of public analysts had little by way of formal education in the analysis of adulterated food, drugs, and drink. Analytical training was often an offshoot of medical or pharmaceutical training in some elite British universities. Hassall's pioneering studies with the *Lancet's* Analytical Sanitary Commission in the 1850s were formalized into book form in 1855, titled *Food and its Adulterations*, providing some

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[21] Chris Otter has briefly pointed this out, see; Chris Otter, "The Vital City: Public Analysis, Dairies and Slaughterhouses in Nineteenth-Century Britain," *Cultural Geographies* (2006), 13: 517-537. So too has Christopher Hamlin, see Christopher Hamlin, "The City as a Chemical System? The Chemist as Urban Environmental Professional in France and Britain, 1780-1880," *Journal of Urban History* (2007), 33: 715.

[22] David Taylor, "London's Milk Supply, 1850-1900: A Reinterpretation," *Agricultural History* (1971), 45: 33-38. See also, Peter Atkins, "The Growth of London's Milk Trade, 1845-1914," in *The European Cities and Technology Reader* (London: Routledge, 1978), 208-226, and Peter Atkins, "The Intra-Urban Milk Supply of London circa 1790-1914," *Transactions of the Institute of British Geographers* (1877), new series 2: 383-399.

direction to practicing analysts.[23] The strength of Hassall's *Food and its Adulterations* was its depth in identifying which goods were most frequently adulterated and with what substances. Its over 150 engravings of both pure and adulterated foods was also be useful for practicing chemists. One potential problem was that Hassall's methodology was primarily microscopical, and largely ignored compositional analyses that would have been more familiar to traditionally trained chemists. Also problematic was the simple fact that Hassall's book was 659 pages, and perhaps too hefty to use as an everyday guide to analytical practice. William Marcet, lecturer on physiological and pathological chemistry at Westminster Hospital, wrote his book, *On the Composition of Food and How it is Adulterated*, in 1856 as a practical manual to replace to Hassall's 1855 publication. Marcet noted in his preface that Hassall's book was "rather to be considered as a collection of voluminous reports, than as a guide for the medical practitioner."[24] Marcet stood on the outside of the vociferous debate between Hassall and Letheby, and looked for a more united front between analytical chemistry and microscopy.

In addition to Marcet's volume there were numerous alternatives that appeared from the mid 1850s. Analytical chemists more properly trained in practical chemistry would have turned to Alphonse Normandy's *The Commercial Hand-Book of Chemical Analysis*, first published in 1850.[25] Normandy's volume, as the subtitle suggested, was

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[23] Arthur Hill Hassall, *Food and its Adulterations* (London: Longman, Brown, Green, and Longmans, 1855).

[24] W. Marcet, *On the Composition of Food and How it is Adulterated* (London: John Churchill, 1856), ix.

[25] Alphonse Normandy, *The Commercial Hand-Book of Chemical Analysis* (London: George Knight and Sons, 1850).

aimed to guide practical chemists in determining the commercial or intrinsic value of substances used in agriculture and manufacturing.[26] Normandy relied on analytical methods in detecting the adulteration of foods, but like Hassall's book, Normandy's could hardy claim to be a practical guide at 640 pages. An updated version of the "*Handbook*" (as William Crookes said most chemists simply called it) was published in 1865, much to the regret of chemists who "found they had purchased an exact reprint of the original work."[27] In 1875 a substantially revised edition appeared under the skilled editorial work of the well-known chemist and physicist Henry Minchin Noad. Noad listed in the preface to the 1875 edition that he had "endeavoured to make the work a 'Handy Book' for the efficient analyst discharging his duties under the new Adulterations Act."[28] Other practical manuals in analytical chemistry appeared in the mid 1870s as well, including the widely popular *A Manual of Practical Chemistry: the Analysis of Foods and Detection of Poisons* by Alexander Wynter Blyth, MOH and public analyst in London, which first appeared in 1879.[29]

Analytical chemists first relied on the methods of the more general branch of applied, or practical chemistry. But by the 1870s a specialist literature on food

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[26] A review in the *Medical Times* noted that "we strongly recommend it to our readers as a guide indispensable to the housewife as to the pharmaceutical practitioner." Editor, review of Normandy's *The Commercial Hand-Book of Chemical Analysis,* in *Medical Times* (1850), 1: 240-241.

[27] William Crookes, review of Normandy's *"The Commercial Handbook of Chemical Analysis*, in *The Chemical News* (4 June 1875), 31: 248.

[28] A. Normandy, *The Commerical Handbook of Chemical Analysis*, new edition, Henry M. Noad, ed. (London: Lockwood & Co., 1875).

[29] Alexander Wynter Blyth, *A Manual of Practical Chemistry: the Analysis of Foods and Detection of Poisons* (London: Charles Griffin, 1879). See also Alexander Wynter Blyth, *Foods: Their Composition and Analysis* (London: Charles Griffin, 1882).

adulteration had been firmly established. This was reinforced, as explored below, by the formation of a distinct institutional identity with the Society of Public Analysts. As Robert Bud and Gerrylynn Roberts have argued, the opposition between applied (or practical) and pure (or academic) chemistry was the defining tension in mid Victorian British chemistry.[30] The rise and development of analytical chemistry played a distinct role in these debates, as “analysis was at the centre of the debate, for all the chemical skills required for the new statutory positions were in essence analytical. However, these skills had to be applied in very specific contexts rather than in the abstract manner of the academic laboratory.”[31] It was in this context that the analysis of milk became a highly politicized battleground where different chemical specialists could stake professional claims.

Methods in Milk Analysis

From the 1850s the vast majority of analytical chemists believed that milk could be adulterated in two ways, the borrow the words of Alphonse Normandy, “frauds by addition, and frauds by subtraction.”[32] Normandy, like many chemists in mid Victorian Britain, relied extensively on the measure of specific gravity. He thought that genuine milk had a mean density of around 1.031 or 1.030. Using a hydrometer, or lactometer as it was branded for milk analysis, Normandy figured that milk adulterated with 25 percent

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[30] Gerrylynn Roberts, “A Plea for Pure Science: the Ascendency of Academia in the Making of the English Chemist, 1841-1914,” in David Knight and Helge Kragh (eds), *The Making of the Chemist* (Cambridge: Cambridge University Press, 1998), 107-119.

[31] Robert Bud and Gerrylynn K. Roberts, *Science versus Practice: Chemistry in Victorian Britain* (Manchester: Manchester University Press, 1984), 158.

[32] Alphonse Normandy, *The Commericial Hand-Book of Chemical Analysis* (London, George Knight and Sons, 1850), 372.

water yielded a specific gravity of 1.021, while 33 percent water would measure 1.020. The quality of milk might also be measured, in conjunction with the lactometer, with a galactometer, which would measure the quantity of cream contained in a given sample of milk.[33] By the 1870s it was easy and relatively cheap for a public analyst living in a large town such as London, Manchester, or Edinburgh to purchase a lactometer and a galactometer. These instruments could also be ordered via post, and many manufacturers advertised their instruments in chemistry trade journals by that time.

While general books in chemistry proliferated in the 1870s and 1880s, some of which dealt marginally with food analysis, the first specific treatise solely devoted to the analysis of milk was James Alfred Wanklyn's 1873 *Milk-Analysis.*[34] Wanklyn's volume was the culmination of several years of work on milk analysis; in 1871 he was hired by the newly created *Milk Journal* to conduct "many hundreds of analyses of milk purchased in different parts of London."[35] He had also investigated the milk supplied to the Metropolitan Workhouses under a part-time contract with the British Government. Similar to Noad's comments in the preface to Normandy's 1875 revision, Wanklyn was acutely aware of the impact of analytical chemistry in solving the food adulteration problem. Wanklyn ended the first edition preface of *Milk Analysis* by noting that, "at the present time, when a new class of men has been constituted to watch over the food of the country, there is need for special manuals of this description."[36] At 73 pages, it was also

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[33] Ibid, 378.

[34] James Alfred Wanklyn, *Milk-Analysis: A Practical Treatise on the Examination of Milk and its Derivatives, Cream, Butter, and Cheese* (London: Trubner & Co., 1873).

[35] Ibid, 3.

[36] Ibid, 4.

short enough to be particularly useful for analysts not wanting to be burdened with a 600-page textbook.

Wanklyn's method for analyzing milk was to measure two different details of the solid constituents of milk- solids not fat, and solids fat. By the 1870s many chemists agreed that the sole measure of specific gravity was insufficient in detecting adulterated milk. Wanklyn's process was to evaporate the constituent parts of water from the sample, typically for 3 hours at 212 Degrees, get rid of the fat by adding either petroleum ether or benzoline, and measure the residue of solids not fat. The lower the reading of solids not fat, the higher the water content in a given sample, demonstrating adulteration. Wanklyn suggested that genuine, unadulterated milk contained no less than 9 percent of solids not fat, and 2.5 percent of solids fat.

Wanklyn made a strong case against the hydrometer, or lactometer, as adulterators could easily sophisticate their milk to fit normal lactometer readings. Wanklyn noted that,

> A certain trick of the milk trade is fostered by the employment of the lactometer. The milk is partially denuded of cream (accomplished conveniently by adding a certain quantity of skimmed milk to the fresh milk), and thereby raised in gravity. That being accomplished, it is dosed with water, and its gravity is thereby lowered to the normal standard.[37]

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[37] Ibid, 15.

Also problematic was Normandy's favorite instrument, the galactometer, which measured cream. Wanklyn admonished it as well, arguing, "let no one think that he would discover such a trick by making an estimation of cream; for water milk throws up its fat in the form of cream more perfectly than unwatered milk."[38]

Fundamental to Wanklyn and many other analytical chemists was the belief that the composition of milk varied only slightly based on species, location, and feeding habits. Quantity of milk could certainly vary, most argued, but quality, or composition, remained relatively constant in pure milk. Ernest Hart, editor of the *British Medical Journal*, called this principle "one of the cardinal truths respecting milk."[39] There could be slight variation, Wanklyn noted, between country milk and town milk, and between different species, such as the popular milk of the Alderney cow. However, the overall premise was that if an analyst used Wanklyn's method properly, adulteration could easily be detected anywhere in the country (or the Empire). Wanklyn, similar to Hart above, noted that "this constancy of composition is a cardinal fact in milk analysis. If milk were variable in strength, as urine is, chemical analysis would fail to detect the watering of milk. That milk is a secretion of constant, or only slight varying composition, lies at the very root of the subject of this treatise."[40] Wanklyn reinforced this stance by comparing his own analysis in London with that of F.N. Macnamara's chemical analysis of milk in

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[38] Ibid.

[39] Ernest J. Hart, "Milk Reports in India," *BMJ* (23 August 1873), 232-233.

[40] Wanklyn, *Milk Analysis*, 12.

Calcutta, India. Macnamara, using Wanklyn's methods, found that Bengali cows produced less milk, but of similar composition to those in Britain.[41]

This was not a universal argument amongst chemists. Leading the opposition was a group of agricultural chemists led by Augustus Voelcker, the Frankfort born, Liebig trained Professor of Chemistry at the Royal Agricultural College, Cirencester, and consulting chemist to the Royal Agricultural Society of England. From the late 1850s Voelcker became interested in the analysis of milk, and through the 1890s his views held tremendous sway amongst chemists. In 1863 Voelcker published a lengthy article in the *Journal of the Royal Agricultural Society of England* simply titled "On Milk," which described in exhaustive detail the constituents of milk, dairy practices, and the health of cows. Unlike Wanklyn, Voelcker argued that a wide range of factors influenced the quantity *and* quality of milk. These included when a cow was milked, the distance from the time of calving, the season of the year, the food intake of the cow, the race or breed, and size of the animal.[42] He also drew on continental experiments in France, Sweden, and Germany, and those in the United States. Voelcker agreed with many public analysts that milk adulteration existed to a large extent, with the principle adulterants being the subtraction of cream and the addition of milk. Reinforcing popular social rhetoric

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[41] Ibid, see also Macnamara's paper in *Indian Medical Gazette* (1 July 1873), and Wanklyn, *Milk Analysis*, 12.

[42] Augustus Voelcker, "On Milk," *Journal of the Royal Agricultural Society of England*, (1863), 24: 286-320.

Voelcker noted, "the cow with the iron tail, indeed, is said to be the best friend of the milkman, perhaps not without good reason."[43]

The crux of Voelcker's argument, which he continued to make into the 1880s and 1890s, was that it was impossible to fix a universal standard of the chemical purity of milk because normal milk varied too much in composition. Voelcker maintained that "it is a reckless proceeding on the part of any analyst to assert that milk has been adulterated with exactly 8 percent of water or with 13.75 percent of skimmed milk… such assertions can only be made by young and inexperienced men."[44] The latter jab was specifically directed against public analysts, who Voelcker thought had neither the experience nor the professional standing to direct the public control of food adulteration. Historian Robert Kohler has argued that both agricultural and medical chemistry had a lower professional standing before 1900.[45] Kohler's generalization might help explain the tension between agricultural chemists such as Voelcker, and medical chemists such as those at the SPA. I would add that in Britain a larger transition was occurring in the second half of the nineteenth century, whereby the professional status of agricultural chemistry was being increasingly challenged by new forms of medical chemistry, particularly with new legislative acts such as those on food and water reform.

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[43] Ibid, 312. As explored in chapter one, the phrase "the cow with the iron tail" was popularized by an article in the Dickensian magazine *Household Words*. The phrase itself referred to the common practice of adulterating milk with water. Thus the water pump euphemistically was known as "the cow with the iron tail."

[44] Quote from Voelcker in A. Normandy, *The Commerical Handbook of Chemical Analysis* (London: Lockwood & Co., 1875), 267-268.

[45] Robert Kohler, *From Medical Chemistry to Biochemistry: The Making of a Discipline* (Cambridge: Cambridge University Press, 1982), 96.

There were others who endorsed Voelcker's contingent stance on the vexed question of universal milk standards, including John Charles Morton, the widely published agriculturalist and editor of the *Agricultural Gazette*, and James Bell, head of the Government Laboratory of Somerset House. Morton argued in an 1868 article that "the milk of every cow has its own natural standard of quality… her milk is rich or poor, *first*, according to her nearness to the time she calved; and *secondly*, according to the quality of her food."[46] As a whole, agricultural chemists concurred, such as the eminent Edinburgh chemist Stevenson Macadam, who in addition to writing the popular 1872 manual *Practical Chemistry,* published a specific treatise on milk analysis in 1874.[47] Macadam echoed Voelcker's sentiment noting,

> The Adulteration Act was framed for the protection of the public, and, if properly worked out, would undoubtedly lead to the suppression of adulteration in food, drink, and medicine, and would, at the same time, be of national service, and a protection to the honest merchant against the dishonest and fraudulent dealer. But if anything is calculated more than another to render the Act inoperative and untrustworthy it is the framing and setting up of a standard of genuineness which can seldom be reached by the genuine article itself, and, by blind adherence to

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[46] John Chalmers Morton, "Town Milk," *Journal of the Royal Agricultural Society of England* (1868) 4: 89.

[47] Stevenson Macadam, "On the Quality of Milk Supplied to Towns," reprinted in *The North British Agriculturalist* for 1 April, 1874. Newspaper clipping from N.A. Kew, Inland Revenue Service, DSIR 26/247.

> which, the majority of the samples of the genuine and unadulterated material must be declared to be mixed and adulterated.[48]

The plea of the agricultural chemists, as we will see below, was ultimately passed aside by public analysts, in general, and by the Society of Public Analysts, in particular. The widespread belief amongst public analysts was that the only way to curb adulteration was to fix official standards by which all milk could be measured. This stance pitted public analysts against the Somerset House chemists, led by their Principal James Bell, who vehemently disagreed with the fixing of official standards.

Despite the mounting conflict between public analysts and agricultural chemists, Wanklyn's process of milk analysis gained significant authority and was widely used by both groups of chemists. It was relatively simple and produced more consistent results than the measure of specific gravity, which before the 1870s was the most common analytical measure. Wanklyn's was a compositional methodology, which broke milk down to its constituent parts- water, fat, casein, milk-sugar, and ash. While it could be time consuming, it was relatively inexpensive and required only simple laboratory instruments. When the Society of Public Analysts formed in 1875, where we will turn next, they adopted Wanklyn's methods as well as his proposed limits for solids fat and solids not fat, the two most important measures according to the 'Wanklyn method.'

The increased social and scientific concern over milk adulteration can also be seen in the rise of specialist periodicals, many of which date to the early 1870s.[49] Arthur

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[48] Ibid.

[49] One interesting development in 1872 was the formation of the Anti-Adulteration Association, whose aim was secure compulsory legislation that eventually took form in the 1875 SFDA. The

Hill Hassall's *Food, Water, and Air* featured numerous articles on milk adulteration. Even more specialist were *The Cowkeeper and Dairymen's Journal* and *The Milk Journal*: *A Monthly Review of Dairy, Dairy Produce, and the Poultry Yard*. First issued in January of 1871, *The Milk Journal* was the leading agricultural journal devoted to the topic of dairy production, sanitary farming, milk transportation, and, of particular interest here, milk analysis. The first issue of *The Milk Journal* also praised epidemiological studies by Michael Taylor and Edward Ballard, explored in the last chapter, making it clear that at least some agriculturists were aware of epidemiological studies. As a trade journal aimed to educate dairy farmers, it was keen to endorse what it saw as cutting-edge scientific theories and methods in epidemiology, analytical chemistry, and veterinary medicine.[50]

In the second issue of *The Milk Journal* in February 1871 the editor noted that he had hired Wanklyn to conduct a series of milk analyses and fitted him with a laboratory. The leading article explained that, "it is by no means a light undertaking for any journal to take the place of a public analyst."[51] It was precisely because of the fact that few competent analysts were practicing that *The Milk Journal* had solicited Wanklyn's services. The use of Wanklyn's chemical analysis for *The Milk Journal* largely followed the policy earlier advocated by Thomas Wakley and Arthur Hill Hassall with the *Lancet's*

association had its own short-lived journal as well, titled *The Anti-Adulteration Review*. See their advertisement in *Food, Water, and Air* (February 1872), 4: 118, and Anon., "The Sale of Food and Drugs Bill," *The Pharmaceutical Journal and Transactions* (27 March 1875), 777. See also, Anon., "The Adulteration Act," *BMJ (*1872), 2: 201. See also, Anon., "The Analysts and Somerset House," dated February 1876, clipping from N.A. Kew, Local Government Board-Miscellaneous Files, MH 25/26.

[50] *The Milk Journal: A Monthly Review of the Diary, Dairy Produce, and Poultry Yard* (London), first published on 2 January, 1871.

[51] Editor, "The Analysis of Milk," *The Milk Journal* (1 February 1871), 2: 39-40.

Analytical Sanitary Commission. *The Milk Journal* published, “without fear of favour” the names of tradesmen who sold adulterated milk.[52] They were, as a trade journal, careful to protect honest tradesmen, cautioning that no seller’s name would be published before numerous samples were purchased at different times of the day, week, and month. Wanklyn found that after several months of inquiry, out of fifty firms selling milk in London alone, only thirteen regularly sold genuine milk.[53]

In practice, many public analysts eschewed complex theoretical questions in favor of practical solutions to what worked on-the-ground. This might help explain the popularity of the Wanklyn process in determining milk adulteration, and the collective sentiment amongst public analysts that universal standards for the quality of milk needed to be uniform. The early career of Alfred George Anderson, public analyst for the London vestry of Paddington, is illustrative of the daily struggles of a metropolitan public analyst.[54] In his first two *Quarterly Reports* for 1875, the year Anderson was hired as public analyst, apart from “several repairs to the Laboratory,” he conducted fifty-five analyses- comprised of butter, port wine, ale, whiskey, milk, tea, and sugar.[55] He found several of the milk samples to be adulterated with water, and “delivered the certificates accordingly; but as is frequently, I find, the case of late, no prosecution was attempted.”[56]

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[52] Ibid, 40.

[53] Editor, “Milk Revelations,” *The Milk Journal* (1 March 1871), 3: 57.

[54] Alfred George Anderson, Report of the Public Analyst to the Vestry of Paddington, from 1875 in City of Westminster Archives, London. Anderson was also the public analyst to the Vestry of St. Martins-in-the-Fields, the Board of Works for the Poplar District, and the Professor of Practical Chemistry at Queen’s College, Birmingham. Numerous posts were often needed, as Anderson’s public analyst duties for Paddington only paid £150 per annum.

[55] Ibid, *Quarterly Report for October 1875*, dated 18 October 1875.

[56] Ibid.

Convictions, of course, depended not only on the analyst's certificate, but more importantly on the sentiment of the local vestry. In 1876 Anderson analyzed sixteen samples of milk, seven of which were adulterated with water that ranged from 5 percent to 23.46 percent.[57] Anderson continued in each of his *Quarterly Reports* in the late 1870s to find numerous samples of milk adulterated. He also noticed local patterns of deception amongst milk sellers, bemoaning,

> A systematic mode of "preparing" milk is now practiced- it is skillfully brought to the "average" that the Public Analyst can pass it. In this way good milk bears the addition of a large proportion of water of adulteration, and yet securely goes to the purchasers free from interference. These are instances of some of the conditions which frequently came under the Analyst's observation in regard to substances he called upon to examine: notably milk. They call for the utmost, and often for prolonged, Philosophical investigation; which renders the post of Public Analyst one of much anxiety and responsibility.[58]

Anderson's narrative is demonstrative of the fact that the fixing of a universal standard of milk purity, as advocated by the Society of Public Analysts in 1875, explained below, could have practical repercussions in the local marketplace. Anderson became severely ill in late 1877, and was replaced by Alfred W. Stokes, who continued extensive laboratory analyses and sought to expand the scope of adulteration prosecutions. In his first report for October 1878 Stokes exclaimed that "milk adulteration, therefore, seems as rampant

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[57] Ibid, *Quarterly Report for Lady Day, 1876.*

[58] Ibid, *Quarterly Report for September 1877*, dated 29 September, 1877.

as ever."[59] The Paddington vestry seemed sympathetic to Stokes' laboratory work, and throughout the year began to increase dramatically the number and severity of prosecutions of convicted milk adulterators. So much so that Stokes was able to assertively note in his last report for 1878,

> Happily for this district a legal decision was given in favour of the general consumers, and not for the adulterators, and a number of milk vendors were somewhat heavily fined at the instance of this Vestry. The Vestry deserves well of the general community in having had the boldness to prosecute offenders while adverse decisions were being given in other districts.[60]

Like many public analysts, Anderson and Stokes struggled throughout the 1870s to establish a working methodology and to identify the most problematic adulterations in the Paddington district. Their success, and here we might compare them to Medical Officers of Health, largely depended on a progressive vestry willing to prosecute accused vendors according to the certificates of the local analyst. This was not always the case, evidenced by Anderson's early frustrations. By the late 1870s the Paddington vestry seemed to be more receptive however, perhaps indicating a general change in the approach of metropolitan vestries. This is confirmed by an examination of the *Quarterly Reports of the Public Analyst for Hackney* John Tripe. Tripe, also the Medical Officer of Health, was only successful in obtaining convictions for milk adulterators in the late 1870s.[61] Also corroborative are the reports of John Whitmore, Medical Officer of Health and

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[59] Alfred W. Stokes, *Quarterly Report for October 1878*, dated 2 October 1878.

[60] Ibid, *Quarterly Report for Christmas 1878*.

[61] *Quarterly Reports for the Public Analyst for the Board of Works for Hackney*, Hackney Local Archives, London, L/V/C/26.

public analyst for Marylebone.[62] Conflict did remain, however, even when local authorities were willing to issue court prosecutions. As we will see, court prosecutions were the defining arena where contests of scientific priority took place.

The 1875 SFDA and the Formation of the Society of Public Analysts

Debating the SFDA Bill in the House of Commons on 19 April 1875 Anthony Mundella, Liberal M.P. for Leicester declared that "the two great articles which were the subjects of adulteration were milk and butter."[63] Also instrumental in the Commons was the eminent chemist, scientific advocate, and M.P. Lyon Playfair, who was a fierce supporter of the 1875 clause that mandated all local authorities appoint analysts.[64] As Robert Bud has noted, Playfair was one of the first entries under the new category of 'analytical chemist' in the 1854 edition of the London Post Office Directly, and thus had some stake in the chemistry profession as a whole.[65] While some M.P.s worried that competent analysts were nowhere to be found, reinforcing fear made by agricultural chemists such as Augustus Voelcker, Playfair claimed that,

> There could be no doubt that some incompetent analysts had been appointed, who had produced analyses unfortunate for themselves and for traders. But that was

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[62] John Whitmore, *Report on the Adulteration of Milk and other Articles of Food, &c.,* (London: Vestry of St. Marylebone, 1873).

[63] House of Commons Debate, *Hansards* (19 April 1875), 223: 1266.

[64] On Playfair see, Anne Hardy, "Lyon Playfair and the Idea of Progress: Science and Medicine in Victorian Parliamentary Politics," in D. Porter and R. Porter (eds.) *Doctors, Politics, and Society: Historical Essays* (Amsterdam: Rodopi, 1993), 81-106.

[65] Robert Bud, *Science Versus Practice: Chemistry in Victorian Britain* (Manchester: Manchester University Press, 1984), 87.

> very much the fault of Parliament, which provided no safeguards for the selection of competent men.[66]

Playfair was acutely aware of a "general mistrust of science," by government bureaucrats, and his clamoring on the side of analytical chemistry clearly showed how Playfair believed that "the time has now arrived when science must be trusted in government."[67] This was certainly the position W.L. Scott had favored in attempting to become the analyst for Wolverhampton. Playfair maintained that the 1875 Act should stipulate, "that the Local Government Board should lay down rules as to the qualifications to be required, and then both boroughs and counties might be trusted to appoint proper men."[68] The declaration in the 1875 SFDA that public analysts be persons "possessing competent medical, chemical, and microscopical knowledge," was sufficiently vague to cause a great deal of confusion. Some thought only properly trained chemists should be appointed analysts, while others thought admission to the British Medical Register would suffice. The Pharmaceutical Society, which administered its own certificates of qualification, wrote the Local Government Board as early as 1872 claiming that analytical chemists could simply follow its guidelines.[69] After 1875 the LGB was responsible for confirming the competency of analysts, but rarely did they disagree with local authorities.

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[66] House of Commons Debate, *Hansards* (6 May 1875), 224: 200.

[67] Lyon Playfair, "An Address on the Progress of Sanitary Reform," *BMJ* (10 October 1874), 2: 461.

[68] Ibid.

[69] Memo from Pharmaceutical Society to Local Government Board, dated 12 December 1872. N.A. Kew, Local Government Board- Miscellaneous Files, MH 25/23.

As briefly discussed in chapter one, the three most important changes to food regulation in Britain contained in the 1875 SFDA was the mandate that all local authorities appoint a public analyst, that these posts needed to be approved by the Local Government Board, and that vendors could dispute the certificate of local public analysts by sending accused samples to the Government Laboratory at Somerset House whose staff would act as chemical referees. The 'Somerset House Clause', as it became colloquially known, was first suggested by none other than Augustus Voelcker, and was thought by M.Ps in the House of Commons to be a vital protection against inaccurate certificates by local public analysts. The pertinent fear of M.P.'s, as echoed by Playfair's comments above, was a scarcity of qualified public analysts.

There was push back from public analysts, some of whom were present as scientific witnesses at the parliamentary debates in 1874. These included Alfred Allen, Theophilus Redwood, and James Alfred Wanklyn. Wanklyn, an early outspoken critic, suggested that the Somerset House Clause "might indeed have emanated from the office of *Mr. Punch*."[70] The system would simply dissolve, many public analysts like Alfred Allen foresaw, into one where "local analysts are to be stultified, and no credence given to their certificates or evidence till endorsed by the chemists at Somerset House."[71] Allen, who had trained with Arthur Hill Hassall and A.W. Hofman, had suggested that an independent panel of referees could be annually elected by public analysts themselves. Others thought that Edward Frankland and his colleagues at the South Kensington Laboratory could serve as referees, but both ideas were rejected in favor of the Somerset

[70] *The Chemical News* (July 24 1874), 39.
[71] Ibid, 38.

House Clause. Although in practice the Somerset House Clause quickly became a catalyst in antagonizing the relationship between public analysts and the Government chemists, growing institutional hostilities also contributed to widening the professional gap. From the late 1860s Wanklyn was caught in a feud with Edward Frankland in a priority dispute over water analysis; Wanklyn's 'ammonia process' was pitted against Frankland's 'combustion process.'[72] Frankland also worked closely with James Bell, Principal of the Government Laboratory, and with Voelcker.[73] Frankland, Voelcker, and Bell were all leading members of the Institute of Chemistry.

Matters escalated in late 1874 when a group of around 25 public analysts, led by Theophilus Redwood, Charles Heisch, and George Wigner, met to bemoan the potential threat of the Somerset House Clause. Seeking to protect the interests of public analysts they formed the Society of Public Analysts (SPA).[74] From 1874 to 1876 reports and proceedings of the SPA were published in the journal *Chemical News*, edited by William Crookes, who was sympathetic to the SPA's mission. The SPA coverage quickly became too much for Crookes' *Chemical News*, however, and in 1876 the SPA formed its own specialty journal, titled *The Analyst*. The aim of *The Analyst*, as outlined in the first issue, was twofold; to communicate up-to-date knowledge about scientific methods in

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[72] On the feud between Wanklyn and Frankland over water analysis see, Christopher Hamlin, *A Science of Impurity*, 184-190.

[73] On Edward Frankland's water analysis see, Edward Frankland, *Water Analysis for Sanitary Purposes* (London: John van Voorst, 1880). On Wanklyn's water analysis see, J.A. Wanklyn, *Water Analysis: A Practical Treatise on the Examination of Potable Water* (London: Trubner & Co., 1868). See also, Colin A Russell, *Edward Frankland: Chemistry, Controversy, and Conspiracy in Victorian England* (Cambridge, Cambridge University Press, 1996), particularly pages 374-380. See also, P.W. Hammond and H. Egan, *Weighed in the Balance* (London: HMSO, 1992), 88-90.

[74] William Crookes, who was an early supporter of the SPA, detailed the initial meeting in *The Chemical News* for 14 August, 1874.

analytical chemistry, and to publish cases of adulteration, parliamentary proceedings, and other matters "though not scientific, [but] of vital interest to Public Analysts as such."[75]

The formation of the SPA in 1875 was clearly a way to bring analytical chemists together to share analytical techniques and advance scientific knowledge. But, as we have seen, it was also a means of protecting the interests of local public analysts against the newly appointed Government Laboratory at Somerset House. The professional mission of the SPA, as outlined in their initial meeting in 1874, was threefold:

1. To promote and maintain the efficiency of the laws relating to adulteration.
2. To promote, and as far as possible to secure, the appointment of competent public analysts.
3. To improve the processes for the detection and quantitative estimation of adulteration, and to secure uniformity in the statement of the results by holding periodical meetings for the reading and discussion of original papers on chemical and microscopical analysis, especially with reference to the detection of adulteration.[76]

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[75] *The Analyst* (1876), 1: 1.

[76] *The Chemical News* (11 December 1874), 268. The early records of the Government laboratory from the 1820s can be found at N.A., Kew, DSIR 26/91. The early history of the SPA is also briefly covered in Bernard Dyer, *The Society of Public Analysts and other Analytical Chemists: Some Reminiscences of its First Fifty Years* (London: W. Heffer & Sons, 1932).

Moreover, the SPA was formed in part to elevate the status of analytical chemists, and to distinguish 'actual practicing chemists' from 'amateur and theoretical ones.'[77] Despite charges from agricultural chemists such as Voelcker and M.P.'s, it seems as though public analysts too were concerned with the problem of incompetent analysts. Crookes was aware of the irony, noting in *The Chemical News* that the aim of the SPA was, "the 'exclusion of incompetent and dishonorable intruders," "the maintenance of a strict professional ethic," and "the elevation of the professional status."[78]

In addition to drawing up a constitution, the first committee of the SPA formalized a definition of what constituted adulteration, which was, as explained above, a contentious issue amongst chemists. An article should be deemed adulterated, according to the SPA,

> If it contain any ingredient which may render such article injurious to the health of a consumer. If it contain any substance that sensibly increases its weight, bulk, or strength, unless the presence of such substance be due to circumstances necessarily appertaining to its collection or manufacture, or be necessary for its preservation, or be acknowledged at the time of sale. If any important constituent has been wholly or in part abstracted, without acknowledgement being made at the time of sale. If it be a colourable imitation of, or be sold under the name of, another article.[79]

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[77] *The Analyst* (1876), 1: 19.
[78] *The Chemical News* (14 August 1874), 69.
[79] *The Chemical News* (11 December 1874), 269.

Having a shared standard of what constituted adulteration was crucial to unifying public analysts throughout Britain. Nonetheless, in practice the SPA's definition remained vague for a number of individual foodstuffs, the most important being milk. From the mid 1870s until the end of the nineteenth century milk was the most commonly analyzed food. As such, the scientific authority of public analysts on matters of milk adulteration largely rested upon a standardized methodology. In the case of milk the 'Wanklyn process', detailed above, served as the primary method used by public analysts. Because the 'Wanklyn process' was a measure of the constitutive properties of milk, it was conducive to the fixing of universal standards. In *Milk Analysis* Wanklyn had argued that a fair measure of normal, genuine milk was 9% solids not fat, and 2.5% solids fat. When the SPA formed in 1874 they officially adopted Wanklyn's standards, which Alfred Allen called "fair and extremely liberal to the milk dealer."[80] Establishing a shared milk standard was crucial to public analysts, because, as Allen, an early leader of the SPA argued,

> As there is no more important article of diet than cows' milk, and as no kind of food is more subject to adulteration, it becomes a matter of the greatest importance to Public Analysts, as well as to milk consumers, that a safe and proper standard of the quality of cows' milk should be generally accepted. Such a standard is a great desideratum on many grounds.[81]

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[80] Alfred Allen, "Milk Standards," *The Analyst* (1876), 1: 45. Wanklyn's standards remained the official ones of the SPA until the 1890s, when they formally adopted 8.5 percent solids not fat and 3 percent solids fat the official standards.

[81] Ibid, 40.

An overwhelming majority of local public analysts agreed with Allen's views. In practice, however, the adoption of universal standards pitted local public analysts against the Somerset House chemists.

At stake between the SPA and the Government chemists was professional status vis-à-vis the guardianship of scientific methodology and knowledge (namely whose conceptualization of adulteration was more scientifically viable). The crux of the argument made by public analysts against the Government chemists was that before the 1870s the Government chemists were only experts in analyzing taxable goods, namely tobacco, snuff, tea, and alcohol. The 1875 Act, however, provided that the Government chemists act as referees for all disputed cases of adulteration, the most numerous articles being milk, butter, and bread. Public analysts maintained that the Government chemists had neither experience nor expertise in the analysis of these foodstuffs, particularly milk. However, as I argue below, while public analyst's fears were of very real concern, in reality Bell and the Government chemists had already undertaken a massive investigation of the proper methods of milk analysis and the normal range of variation in pure milk.

The Somerset House Chemists

The Somerset House chemists refused to adopt a fixed standard of pure milk, and claimed that normal milk varied according to cow species, feeding practices, milking patterns, environmental conditions, time of year, and a myriad of other factors. In this way the Somerset House chemists followed the viewpoint of agricultural chemists such as Voelcker and Macadam. Despite an ongoing investigation from 1874 into the average constituents of milk, Bell and the Somerset House Chemists were routinely accused of being ignorant and unacquainted with milk analysis. This was in part due to the secrecy with which they conducted their operations, informing neither the public nor the SPA of their methods in determining the constituents of milk or how they determined a sample to be adulterated.

The Government Chemical Laboratory at Somerset House was an extensive operation.[82] By 1876 there were four classes of officers in the laboratory, chief among them were James Bell, the Principal, who made a hefty £900 pounds per annum, and Richard Bannister, Deputy Principal, who made a comfortable £550 (rising after 5 years to £650) per annum. Others included analysts of the first class, those of the second class, and keepers of chemicals. First and second class analysts, as explained by Bell in a private memo to the Treasury on 18 May 1877, were selected among the best Officers of the Excise- those involved with the inspection of breweries, distilleries, and tobacco manufacturers- who had also undergone a course of training in chemistry at the South Kensington School led by Edward Frankland.[83] Writing in a private memo to Treasury in 1884 attempting to increase the pay of laboratory staff, Bell claimed that in 1873 they analyzed a little over 14,000 samples per year, while in 1884 they were routinely analyzing over 24,000 samples per year.[84] Bell himself, born in 1825 at Altnamaghan, outside of Belfast, Ireland, was taught chemistry at University College London by the

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[82] An early history of the Government Laboratory can be found in P.W. Hammond and Harold Egan, *Weighed in the Balance: A History of the Laboratory of the Government Chemist* (London: HMSO, 1992). Peter Akins has also written a comparison of the Government analysts in London and Paris, see, Peter Atkins, "A Tale of Two Cities: A Comparison of Food Systems in London and Paris in the 1850s," in Peter Atkins, P. Lummel, and D.J. Oddy, *Food in the City in Europe since the late Eighteenth Century* (Aldershot: Ashgate, 2007), 25-38.

[83] Memo from James Bell to Treasury, dated 18 May, 1877. N.A. Kew, Inland Revenue Service, DSIR 26/133.

[84] Memo from James Bell to Treasury, dated 15 September, 1884. N.A. Kew, DSIR 26/134.

German expatriate A.W. Williamson.[85] In 1846 Bell became George Phillips' assistant at the Somerset House Laboratory, eventually becoming the Principal upon the Phillips' retirement in 1874.[86]

Within the Government Laboratory, Bell and his staff used a similar, albeit to their understanding more effective process of milk analysis compared to Wanklyn's, one similar to the methods adopted by the SPA after 1882. Richard Bannister, Bell's longtime assistant, later called the process of milk analysis used in the laboratory the "maceration method," and that public analysts largely relied on the "coil method."[87] Although Bell never officially set a limit for adulterated milk, he warned his assistants that milk which fell below 8.5 percent solids not fat and 2.75 percent fat should be seriously doubted as genuine.[88] The main difference, however, was that the Government chemists did not necessarily think a sample to be adulterated if it fell below the SPA's standard. Each case was contingent. This meant that there were frequent clashes between the Somerset House chemists and local public analysts. Two extended examples will suffice, one in 1876

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[85] On Williamson, see J. Harris and W.H. Brock, "From Giessen to Gower Street: Towards a Biography of Alexander William Williamson (1824-1904)," *Annals of Science* 31; 2, 95-130.

[86] K.R. Webb, "James Bell, 1825-1908," *Journal of the Royal Institute of Chemistry* (September 1958), 82: 582-585.

[87] Evidence of Richard Bannister, dated 11 July 1894. *Report from the Select Committee on Food Products Adulteration*, (253) 1894, 38-39.

[88] In official testimony before the Select Committee on Food Products Adulteration in 1894 Bannister nicely summarized the Laboratory's position, noting that "the word 'standard' is a very awkward word to use." Bell and Bannister preferred the word 'limit' instead, although Bannister made it clear that the Laboratory used the 'limits' of 8.5 percent and 2.75 percent. See, Ibid, 51. See also, memo from James Bell to Treasury, dated 8 August, 1893. N.A. Kew, Inland Revenue Service, DSIR 26/133.

called "The West Bromwich Milk Case" and another in 1883 called "The Manchester Milk Case."

The West Bromwich Milk Case

On 10 February 1876 E.W.T. Jones, who we have already seen was public analyst for the county of Staffordshire, routinely analyzed two samples of milk, marked 40c and 43c that came from milk vendors in West Bromwich. Following J.A. Wanklyn's method of milk analysis Jones found that 40c contained 4.96 percent solids not fat, and 2.57 percent solids fat. Sample 43c, in turn, contained 8.15 percent solids not fat and 3.50 percent solids fat. Repeating the analysis for consistency, a common practice amongst analytical chemists, Jones corroborated that 40c contained 14 percent and the sample 43c had 12 percent of added water.[89] As was typical, Jones issued two certificates of adulteration and sent them to the West Bromwich Police Court. The defendants, George Gough and Thomas Leighton, denied adulterating their milk. As was permissible by the 1875 SFDA, they elected to have the inspector's samples sent to the Government chemists at Somerset House.[90]

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[89] E.W.T. Jones, "West Bromwich Milk Cases," *The Analyst* (1876), 1: 74. See also, editor, "The Alleged Milk Adulteration at West Bromwich," *The Free Press*, newspaper clipping from N.A. Kew, Inland Revenue Service, DSIR 26/247, dated 24 June 1876.

[90] According to the 1875 SFDA three articles of a suspected sample were to be taken by the local food inspector- one was to be sent to the public analyst, a second to be kept by the vendor, and a third to be kept by the inspector, in cases where a sample needed to be sent to the Government Chemists. See memo from Inland Revenue Service to Local Government Board advising the latter to issue a circular to all local authorities on the transportation of samples to the Government laboratory, dated 20 September 1875. N.A. Kew, MH 19/79. The three sample measure was largely a plea from the early members of the SPA. See, Letter from SPA to Local Government Board, dated 7 June 1875. N.A. Kew, MH 25/25.

On 9 May 1876 James Bell, Principal of the Government Laboratory received the two samples of milk, which were sealed and respectively numbered 40c and 43c.[91] Conducting his own analyses in conjunction with R. Bannister and G. Lewin, Bell's laboratory assistants, he found that both samples were in an advanced stage of decomposition. 40c was too much decomposed to even be analyzed, and, making an allowance for decomposition, Bells' analysis of 43c showed 8.14 percent solids not fat and 3.50 percent solids fat, nearly the exact same results as Jones' previous analysis. In his official report to the West Bromwich Vestry, however, Bell noted in opposition to Jones' conclusions that, "when the necessary allowance for solids not fat lost by the decomposition of the milk has been made, the amount is lower than is present in samples of milk of first quality, but not less than is found in milk of low quality… Under these circumstances we do not feel justified in pronouncing the milk to be adulterated with water.[92] In other words, while the two chemists used similar methods to come to the exact same figures, one certified the milk adulterated while the other claimed it fell within the range of normal, unadulterated milk.

When the West Bromwich Police Court reconvened in late June to sort out the conflicting testimony between Jones and Bell, at stake was which chemist's conclusions held more sway when both issued the same chemical figures. Although the court did not send for Bell or his assistants to testify, a common practice throughout the 1870s and

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[91] James Bell, Annual Report of the Government Laboratory of the Inland Revenue Service, 1876, dated 18 May, 1876. N.A. Kew, DSIR 26/120.

[92] James Bell, Annual Report of the Government Laboratory of the Inland Revenue Service, 1876, dated 18 May, 1876. N.A. Kew, DSIR 26/120.

1880s, they did take seriously the evidence of the Government Laboratory.[93] Much to the frustration of Jones, the court, probably confused over the conflicting scientific evidence, dropped the charges on Gough and Leighton.

Jones responded by writing a lengthy article in *The Analyst* condemning the Somerset House Chemists. Jones thought it only fair that the Government chemists should have concluded that, "we do not feel justified in pronouncing the milk to be adulterated with water," a statement which they routinely made.[94] Dissatisfied, Jones concluded that, "if prosecutions cannot be sustained against vendors of such milks as these, the quality of our milk must go back to the old state, and milk examination be practically useless."[95] Jones' frustrations were echoed by public analysts throughout Britain, and the West Bromwich case was only one of several which ended in similar fashion, including the Manchester case, explored below.

However, upon closer historical inspection it appears that the case against the Somerset House Chemists that was widely waged by public analysts was not as straightforward as public analysts presented it. In public and private correspondences throughout the 1870s, 1880s, and 1890s Bell maintained that most of the appeals to Somerset House actually corroborated the scientific evidence provided by the local public analyst. Writing to the West Bromwich vestry after that case had already been closed, Bell noted that "it is very important that milk samples should be analysed with as little

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[93] Bell had anticipated having to attend the West Bromwich court proceedings and had re-analyzed the milk to the same results. See, letter from James Bell to M.F. Blakiston, Clerk of the West Bromwich Vestry, dated 24 June, 1876 in N.A. Kew, DSIR 26/118.

[94] E.W.T. Jones, "West Bromwich Milk Cases," *The Analyst* (1876), 1: 75.

[95] Ibid.

delay as possible, and that prosecutions for milk adulteration should be expedited as sometimes decomposition in milk samples is very rapid."[96] It could take weeks for local courts to bring charges upon a vendor accused by a local public analyst of adulterating their milk. Several more weeks might pass until the accused sample was sent to Bell's laboratory at Somerset House. Decomposition was a very real problem in milk analysis, and Bell stated several times in correspondences to local courts throughout the 1870s, 1880s, and 1890s that he had made every allowance for the effects of decomposition.[97] While local public analysts continually bemoaned the decisions of the government chemists, in a private memo to the Local Government Board on 24 June 1882, Bell wrote that he felt "considerable sympathy for analysts with whose results and conclusions we are unable to agree."[98]

In reality blame was placed on all sides. Many clearly sided with the public analysts and blamed the pesky and secretive Government chemists. The editor of the specialist journal *Food, Drugs, and Drink*, for example, was still complaining of the "well-known and studied resistance of Somerset House to the efforts of public analysts," as late as 1892, which had, in their mind, "reached such a stage as to become a public nuisance."[99] To Victorians who supported the public analysts, the Somerset House

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[96] Letter from James Bell to M.F. Blakiston, Clerk of the West Bromwich Vestry, dated 24 June, 1876 in N.A. Kew, DSIR 26/118

[97] N.A. Kew, DSIR 26/120, Laboratory Notebooks.

[98] Memo from James Bell to Inland Revenue Service and forwarded to Local Government Board, dated 24 June 1882. N.A. Kew, MH 19/80.

[99] Editor, "Items of Interest," *Food, Drugs, and Drink* (20 August 1892), 8.

Laboratory was the preeminent Dickensian Circumlocution Office.[100] *Food, Drugs, and Drink* again proclaimed in 1892 that "it is high time that Parliament checked this attitude of Somerset House…the public health is of much more importance than any incompetent "circumlocution" office, and Somerset House must be taught this."[101]

Others vilified incompetent public analysts and lauded the Government chemists. One striking example was a comical ballad that appeared in *The Bedford Bee* on Wednesday 3 September 1879, titled "The Milkman and the Analysts." It deserves to be quoted in full, as it clearly articulates the complex reality of curbing food adulteration in late Victorian Britain, and how the public could turn against public analysts. The ballad which was set to the classic Robert Burns tune "A Man's a Man For a' That," read,

> In Bedford town a tradesman lived, who dealt in milk and a' that,
> When some officials smelt a rat- Or thought they did-and a' that,
> For a' that, and a' that, Official skill and a' that,
> Oft times the smart ones make mistakes, And get found out- and a' that
> One day the Inspector called, and looked Mysterious and a' that,
> 'A pint of milk I want, mum, please, to analyse and a' that.'
> The milk into clean bottles three He put, corked, sealed, and a' that,
> 'And now, mum, we shall shortly see, if it's watered much, and a' that.'
> Straight to the Borough Analyst he took the milk and a' that,
> Who soon declared that cream he missed, and butter fat, and a' that;

[100] Charles Dickens, *Little Dorrit* (London: Bradbury and Evans), 1855-1857. See also, Trey Philpotts, "Trevelyan, Treasury, and Circumlocution," *Dickens Studies Annual* 22 (1993), 283-302.
[101] Editor, "Somerset House Again," *Food, Drugs, and Drink* (10 September 1892), 11.

Then signed, as Borough Analyst, M.D., M.O., and a' that,

A certificate that proved the milk was *not* good milk and a' that.

But now our milkman showed his strength, sent milk, corks, seals, and a' that,

[Just as the Inspector put it up] to London men and a' that.

Straight to the Government went he, the first M.D.'s and a' that,

Who quickly proved our Analyst wrong, his verdict false and a' that.

They analysed with skill and care, and proved it clear by a' that,

the cream was half as much again as *our* man swore, and a' that.

The milkman- who by the Police had been dragged up and a' that-

Now won- the Bench dismissed the case, "certificate," and a' that.

A king can make a belted knight, a marquis, duke, and a' that,

But Analysts- well skilled and sure- are rarer far than a' that.

Then, as *we* pay we surely may insist on skill, and a' that,

For should be libel honest men through blunderers and a' that?

And why- when officers are paid for *skill* and *care* and a' that-

Should we- who pay them- still be made, to pay for *slips* and a' that,

An analyst should make no slips that slander men and a' that,

But if he does- 'tis *he* should bear the blame, *the costs*, and a' that.

What though on hamely fare we dine, wear hodden gray, and a' that,

The honest man, though e'er sae poor, is king o' men for a' that,

The Milkman was unjustly served- the milk was pure for a' that![102]

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[102] Anon. "The Milkman and the Analysts," a Bedford Ballad, *The Bedford Bee*, 3 September 1879, newspaper clipping from N.A. Kew, Inland Revenue Service, DSIR 26/247.

Although many traders and manufacturers favored the seemingly more lax stance of the Government chemists, there was a general indictment against all forms of analytical chemistry, evidenced by such article titles in *The Grocer* such as "Analytical Tomfoolery."[103]

By the late 1870s public analysts at the SPA realized, through cases like the West Bromwich one explored above, that the most pressing issue between local public analysts and the Government chemists was the vexed question of universal standards. In order to simplify local analytical practices and avoid future conflict with the Government Laboratory, many local public analysts wrote individually to Bell to ask his process of milk analysis and the standards of purity his laboratory employed. One example was Robert McAlly, borough analyst for Falkirk, who wrote to Bell on 3 March 1877 simply asking, "I have been appointed Public Analyst for this borough, and as Milk is a substance that will likely require frequent examination, and as any disputed analysis is to be referred to the Chemists at Somerset House under that "Food and Drugs Act," I will esteem it a favour it you would state to me what standards you use, in deciding upon the genuineness or otherwise of sweet milk."[104] Bell promptly responded that

> We have at present laid down no fixed standard for the constituents of milk in determining the genuineness of any sample. In dealing with a sample we take into account the proportion in which all the constituents are present. The results of the analysts of a large number of samples milked in the presence of one of our

[103] Quoted in Anon., "Advocatus Diaboli," *The Sanitary Record* (20 November 1875), 368-369.
[104] Letter from Robert McAlly to James Bell, dated 3 March 1877. N.A. Kew, Inland Revenue Service, DSIR 26/118.

> assistants lead to the conclusion that considerable variations occur in the composition of genuine milk, and that the adoption of say 9 percent of solids not fat as a minimum amount which should be present would inflict a serious hardship on many honest vendors of milk.[105]

Numerous other public analysts wrote to Bell in similar fashion, as too did the Manchester and Salford Milk Dealers Association. All were met with a similar reply from Bell, who reinforced his position in a letter to George Jackson, Secretary to the Manchester and Salford Milk Dealers Association,

> The question of the practicability of fixing a standard for milk has during the last two years received a large amount of attention in this department and the more the subject is investigated the more I am convinced of the difficulty of adopting a fixed quantity of any particular constituent as a standard which in determining the genuineness of a milk would be alike just to the milk trade and to the consumers.[106]

So frustrated were members of the SPA that at their anniversary meeting on 16 January 1878 they unanimously agreed to send a letter to Bell and the Somerset House Laboratory asking Bell to present a paper at the next SPA meeting on "the standards you have adopted in your Laboratory for the analysis of butter, milk, and other adulterated articles."[107] The SPA was genuinely attempting to heal the festering wound between the

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[105] Reply from James Bell to Robert McAlley, dated March 1877, Ibid.

[106] Letter from James Bell to George Jackson, dated 13 August, 1877, Ibid.

[107] Editor, "The Society of Public Analysts and the Somerset House Analysts," *The Analyst* vol. 2, 1878, 233. Original correspondence can be found at N.A. Kew, Inland Revenue Service, DSIR 26/118.

two groups, noting in their original letter to Bell on 22 January 1878 that they would "place the entire evening on the 20th February at your disposal, and give you and those of your assistants whom you may choose to call every opportunity for reply."[108] Bell replied rather coldly on 30 January noting, "after careful consideration it appears to me that the object you have in view would not be likely to be attained by the course proposed."[109]

Bell's secrecy can perhaps best be explained by considering what the Government chemists thought of as their role as independent referees. Fixing similar standards and methods with the SPA, Bell argued, with not only undermine the authority of the Government Laboratory, but would also betray the intentions of Parliament and the interests of farmers and traders. It was a matter of scientific and professional authority and of methodology, and Bell refused to rescind what he thought was the professional high ground. The SPA wrote to Bell on 12 February to again plead their case; they feared that Bell must have "misunderstood the wish of this Society." The SPA's object, they now clearly pointed out to Bell, was "to ascertain the standards which you and your assistants have adopted in dealing with disputed cases under the adulteration act- having special reference to butter and milk."[110] Bell again simply refused.[111] In a later memo to

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[108] Ibid.

[109] Letter from Bell to G.W. Wigner, on behalf of SPA, dated 30 January 1878, Ibid.

[110] Letter from C. Heisch and G.W. Wigner to James Bell, dated 12 February 1878 Ibid.

[111] As late as 1893 the SPA bemoaned the secrecy of Bell's laboratory. In a memo to the Treasury about the longstanding feud the SPA noted, "As the certificates of Public Analysts are based upon the results of analysis, which results are, to a great extent, dependent upon the details of the methods of analysis adopted, it is obvious that the closest communication and co-operation should exist between Public Analysts and the Chemical Officers at Somerset House. Unfortunately, however, for the satisfactory working of the Food Acts, such relations have hitherto not existed, in spite of the efforts of Public Analysts and if repeated invitations on behalf to eh Society of Public Analysts to the Principal of the Laboratory and his colleagues, to favour Public Analysts, through the Society, with information as to the methods of analysis adopted by

Treasury in 1893 Bell reinforced his opinion that the SPA was trying to "undermine our position as independent referees."[112] Despite his secrecy, which itself was a product of what Bell saw as an essential element to the independent nature of the Government laboratory, he did work towards improving food regulation. In a private memo to both the Inland Revenue Service and the Local Government Board in 1882 Bell concluded,

> Although we are anxious that the intention of the Legislature to suppress adulteration should be carried out as fully as possible, we are certain that it was never intended that innocent persons should be publicly punished simply because the natural products in which they deal, though genuine, fall below any standard of quality which the Public Analysts may choose to set up.[113]

Milk analysis was the key issue. Although the Somerset House Chemists were routinely accused of being ignorant of the analysis of milk, Bell undertook a massive investigation of cow's milk throughout Britain in 1874 that lasted for several years. Laboratory notebooks show that Bell's group studied numerous aspects of how milk was influenced by cow species, age, time of last calving, feeding practices, milk patterns, environmental conditions, location, time of year, and a myriad of other factors.[114] It was an impressive

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them and as to the standards of composition upon which their reports and certificates were based. Differences which might easily have been avoided have therefore been not infrequent, and have resulted in serious injury to the working of the Food Acts and in unfair reflection upon Public Analysts." See letter from Robert Davies and Bernard Dyer, SPA secretaries to Treasury, dated 4 May, 1893. N.A. Kew, DSIR 26/133.

[112] Letter from James Bell to Treasury, dated 8 August 1893, N.A. Kew, DSIR 26/133.

[113] Memo from James Bell to Inland Revenue and Local Government Board, dated 24 June 1882. N.A. Kew, MH 19/80.

[114] Government Laboratory of the Inland Revenue Service at Somerset House, Laboratory notebooks, DSIR 26/134. In particular see, Memo from James Bell to Treasury, dated 19 February, 1876.

study and perhaps the first longitudinal one of the various aspects of cow's milk to be conducted in Britain. Methodologically Bell and his staff measured the specific gravity (the lowest, highest, and mean figures), as well as percentage of cream by volume, total percentage of solids, solids not fat, fat, ash, and water.[115] In large part because of Bell's continued secrecy and the growing antagonism between the SPA and the Government chemists, battles continued to be waged in courtrooms throughout Britain into the 1880s and early 1890s. One exemplary case began in Manchester in 1883, explored below.

The Manchester Milk Case

On Wednesday, June 27th, 1883, a routine case was settled in the Manchester Police Court. Richard Wardle, a Derbyshire dairy farmer, was charged with selling milk, which, according to the certificate of the local Public Analyst, Charles Estcourt, contained four percent of added water. Wardle appealed the conviction, an action permitted under the 1875 SFDA, and sample was sent to the Government Laboratory at Somerset House.[116]

Here the Wardle case got complicated, as the analysis by the Government chemists found that the sample was unadulterated. On 6 October, 1883, the Manchester Court reconvened to hear the appeal, and to sort out the conflicting scientific evidence between the local public analyst, who had determined Wardle's milk adulterated, and the

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[115] Bell's laboratory conducted a similar study of butter, see, James Bell, "Memo on Butter," N.A. Kew, DSIR 26/134.

[116] Editor, "Milk Adulteration: Conflict as to the Standard of Analysis," *The Manchester City News*, and 'Somerset House and Purity of Milk," newspaper clipping from N.A. Kew, Inland Revenue Service, DSIR 26/247.

Government Laboratory, who had deemed it within the normal range found in genuine milk.

The Court questioned Wardle, the dairyman, Estcourt, the public analyst, and James Bell, Principal of the Government laboratory.[117] The questions centered on why the two certificates had differed. It could be, the Magistrates questioned, that the analytical methods in determining milk adulteration differed between the two chemists. Or, perhaps the two held different standards of adulteration, of which the 1875 Parliamentary Act had left, chemically speaking, relatively undefined.

The Court Magistrates were faced with a difficult, but all too common problem; how were they to determine if a dairy farmer had adulterated their milk? Moreover, how were they to curb the rampant adulteration that was universally known in Victorian Britain, if those responsible for providing the scientific evidence of adulteration, namely local Public Analysts, and, if necessary, the Government Chemists, were in conflict with one another? Whose scientific evidence, in other words, was to trust? The typical outcome of such cases, as in the case against Wardle, was that local Magistrates, usually frustrated, confirmed the appeal and dismissed the original conviction. The dairy farmer, in other words, was sent back to the farm to pat the cow with the iron tail.

I use this case and the earlier one in West Bromwich because they are representative of hundreds of cases of milk adulteration from 1870 to 1890. The pattern was usually the same; a local Public Analyst would certify that a farmer had adulterated their milk with anywhere from 5 to 30 percent of water; the local court would convict; the

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[117] Ibid.

farmer would appeal; the sample would be sent to the Government laboratory, only to be sent back with a certificate of authenticity. It was so common that The *Grocer*, the leading British journal devoted to food manufacturers, noted that “We advise the trade… to refer samples, in prosecutions under the Sale of Food Act, to the chemists at Somerset House for independent analysis, and very frequently such reference results in the dismissal of the summons.”[118]

Conclusion

The rise of analytical chemistry in the Late Victorian period can be aptly described by what Chris Hamlin has called an “adversary context.”[119] Hamlin, using the case of disputes over water analysis, has concluded that Victorian chemistry failed to gain cognitive authority over urban cities because it failed to acquire a single distinct identity.[120] However, scientific conflicts between chemists were vital for sorting out professional identities, institutional affiliations, and scientific credibility. This chapter not only confirms that debates over milk analysis were as indecisive as those over water analysis, thus conforming to Hamlin’s model, but also helps explain why no single identity was agreed upon among Victorian chemists.[121] Scientific credibility was disputed on many fronts, between the type of expert witnessing that analytical chemists were expected to engage in, where larger theoretical claims were often disputed- and either

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[118] Editor, “Somerset House Again,” *Food, Drugs, and Drink* (10 September 1892), 11.

[119] Christopher Hamlin, *A Science of Impurity*, especially pages 213-215.

[120] Christopher Hamlin, “The City as a Chemical System? The Chemist as Urban Environmental Professional in France and Britain, 1780-1880,” *Journal of Urban History* (2007), 33: 716.

[121] This conclusion also speaks to Robert Kohler’s earlier conclusions about the nascent development of biochemistry. See, Robert Kohler, *From Medical Chemistry to Biochemistry: The Making of A Biomedical Discipline* (Cambridge: Cambridge University Press, 1982.

pure science or front-line public health work. As Hamlin has argued, "one's credibility hung to a great degree on the apparent credibility of one's analytical process"[122]

The question of how scientific expertise was to be applied to public health problems in Victorian Britain was often unproblematic. This is aptly illustrated in the rise of analytical chemistry as a public health tool in the second half of the nineteenth century. In the case of milk analysis, the more pressing question was what actually constituted scientific expertise. As Hamlin has remarked, "instantiating the public good, stating analytic truth wherever needed, put chemists on the front lines of many of the external conflicts of the city: between buyer and seller, state and defendant, emitter and recipient of toxins…in practice, on almost any important issue of urban environmental quality, chemists served on both (or all) sides."[123] It is tempting to conclude that the intra-professional conflict between the SPA and the Government chemists highlights the growing pains of a nascent profession, attempting to work out theories, practices, methodologies, and a larger disciplinary awareness. This conclusion is probably warranted, particularly in the case of the Society of Public Analysts, who struggled throughout the second half the century to obtain a cohesive collective identity.

However, that kind of professionalization story, even if it went unfulfilled, is not the conclusion I want to draw from this chapter. The more important implication, I would suggest, is that the feud between the SPA and the Government chemists tells us more

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[122] Christopher Hamlin, *A Science of Impurity*, 213.
[123] Christopher Hamlin, "The City as a Chemical System? *Journal of Urban History* (2007), 5, 33: 716.

about the complex, and often complicated, nature of public health in Victorian Britain, and about the larger issue of food adulteration.

Writing their own history in the early twentieth century, analytical chemists such as Bernard Dyer argued that the nineteenth century struggles of the SPA were only temporary roadblocks on the path towards professionalization- a view seconded by Chirnside and Hammence in the 1970s.[124] Moving past a kind of professionalization story, if we understand analytical chemistry as part of an intricate network of public health practice, we might better explain Hamlin's conclusion about no single identity being reached in chemistry. There was, of course, no single identity reached in Victorian public health either, despite the rhetoric of public health leaders such as John Simon. Protecting the public from milk-borne epidemics, necessitated that a coordinated discourse exist between chemists, epidemiologists, veterinarians, Medical Officers of Health, bacteriologists, and local and central governments. That there was struggle between different factions of public health should not be surprising; expert knowledge in public health, as Roy MacLeod has shown, was continually being contested.[125] My point is that we need to situate these struggles not only in terms of vies for professionalization, but also in complex discourses of public health practices.

In cases of disputed milk analysis, the rhetorical claims for credibility were often predicated upon a difference in methodology, for instance between Voelcker's

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[124] Bernard Dyer, *The Society of Public Analysts and other Analytical Chemists: Some Reminiscences of its First Fifty Years, and 'A Review of its Activities*, by C. Ainsworth Mitchell, (London, Heffer & Sons, 1932), and R.C. Chirnside and J.H. Hammence, *The Practicing Chemists: A History of the Society for Analytical Chemistry* (London: Society of Analytical Chemistry, 1975).

[125] Roy MacLeod, *Government and Expertise*, 3-24.

agricultural chemistry and Wanklyn's analytical chemistry. Public analysts' authority was tied to their position at the forefront of public health practice in safeguarding the health of the public from food-borne and water borne disease. The Government chemists thought of themselves as practicing pure chemistry; Bell called the Somerset House laboratory a place of "scientific research and public utility."[126] This in part reflected the unique history of the Government Laboratory; it originated in the Excise department, and its function was to protect the Government's revenue through the analysis of tobacco, tea, beer, and gin. Milk, butter, and other adulterated foods were only added after the 1875 SFDA. The initial impetus, therefore, was to protect the collective purse, not the collective health of British society. This is crucial historical context, I would argue, although it certainly did not preclude Bell and his staff from conducting very extensive studies of milk and butter, as they clearly did. We can contrast this with the rise of the public analyst, and more specifically the SPA, who worked as an on the ground public health officer for a local authority.

By the mid 1890s these hostilities were beginning to weaken, and public health attention gradually turned to the sanitary supervision of dairy farms. Between 1881 and 1883 Bell also began to publish his analytical methods of food analysis; published in a three-part series titled *The Analysis and Adulteration of Foods*, the culminated volumes were put together and titled *The Chemistry of Foods*. Although it is clear that problems continued between the Somerset House chemists and public analysts, Bell's treatise must

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[126] Memo from James Bell to Inland Revenue Officers dated 15 November 1876. N.A. Kew, Inland Revenue Service, DSIR 26/133.

have done some deal to ease tensions. Analytical methods in determining milk adulteration were also more advanced by this time, and public analysts were more aware of the normal range in variation of cow's milk. At the SPA's annual meeting in 1893, Bell accepted an invitation to be the evening's honored guest. He prophesied that era of antagonistic relations between the two groups of chemists was officially over, and by the 1930s Bernard Dyer noted that the two now sat "side by side."[127]

[127] Bernard Dyer, *The Society of Public Analysts and other Analytical Chemists* (London, Heffer & Sons, 1932), 40.

Chapter Five: State Medicine and Scientific Expertise in Dairy Farming

Looking back on the vast array of changes that occurred in the British agricultural landscape in the last third of the nineteenth century, prominent agricultural writer and longtime professor at the Royal Agricultural College, Cirencester, J.P. Sheldon pronounced in 1908:

> The process of transformation which has been going on since 1870, in respect to the milk supply of our great urban communities, has fundamentally modified various habits, and rules and customs… we are indebted to scientific men-chemists, microscopists, bacteriologists, and others- whose tireless quest has revealed many interesting and important secrets of nature in connection with milk.[1]

Sheldon had been a long-standing supporter of a kindred relationship between the dairy industry and science, evidenced from his early agricultural musings in the 1870s.[2] His early writings exemplify the sentiment of self-professed progressive late Victorian agriculturalists who saw that the dairy industry, and particularly the milk business, was undergoing a sea-change. [3]Facilitated by technological improvements such as stable refrigeration techniques and the development of sturdy milk churns, rural dairy farmers in the 1880s were able to send milk to urban cities from as far away as 200 miles through an

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[1] J.P. Sheldon, "Dairy Farming: Fifty Years Ago and Now," *Journal of the Bath and West and Southern Countries Society*, fifth series (1907-1908), 2: 86-101, 94.

[2] J.P. Sheldon, "Dairy Farming," *Live Stock Journal Almanac and Year-Book for 1878* (London: Cassell, Petter, & Galpin, 1878), 49-54. Sheldon there prophetically claimed that "thus it follows that the milk-trade will develop; it is already very large, and it promises to become in the future- what it already is to many- the sheet-anchor of the great bulk of our dairy-farmers." Ibid, 53.

[3] R. Henry Rew, "An Inquiry into the Statistics of the Production and Consumption of Milk and Milk Products in Great Britain," *Journal of the Royal Statistical Society* (June 1892) 55: 244-286.

intricate networks of railroads. Milk, in turn, became “the *cuisine* of the household” by all social classes in the last two decades of the nineteenth century, but not unproblematically.[4] Urban cow-sheds were quickly becoming a relic of an out-dated, backwards, urban-confused agrarian past. Yet, rural dairy farmers looking to expand into urban markets could not, economically speaking, do it alone, encouraging the rise of large-scale, aggregate dairy companies who contracted with rural farmers, mixed, separated, and bottled milk, and distributed it to households throughout cities. The impetus for many dairy farmers was to protect their trade interests through a process of professionalization, and it was during this time that progressive farmers established the British Dairy Farmers’ Association in 1878 and later the British Dairy Institute at Aylesbury in 1888, the latter the leading center for dairy education in Britain until the early twentieth century. The question that remained for all dairy farmers, whether rural and independent or large-scale and aggregate, as assumed by Sheldon’s 1908 quote above, was whether to encourage or eschew a new cohort of medical and agricultural scientists who claimed particular expertise in all dairy operations, everything from the sanitary management of dairy farms to the health of cows and human milkers, and even the constituents and quality of milk. Although inherent in the agricultural uses of science in the late nineteenth century was the dichotomous relationship between pure and applied science, the more poignant social derision was between the once vaulted cultural status of rural farmers as representative of British public virtue, and the rising political and economic power of large-scale dairy farmers who claimed to be progressive-and thus

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[4] Ibid, 49. Impoverish Britons demanded and consumed less fresh milk because canned, preserved milk was much cheaper. See, Anna Davin, “Loaves and Fishes: Food in Poor Households in Late Nineteenth-century London,” *History Workshop Journal* (Spring, 1996), 41: 167-192.

more representative of a new brand of Britishness- vis-à-vis the use of agricultural, veterinary, and public health sciences.[5]

Sheldon's 1908 sentiment was clearly in favor of the scientific management of, or at least a scientific application to (the semantic difference was important) the process of dairy operations. Enthusiasm for dairy-related science was largely driven, I argue in this chapter, by prominent agricultural writers such as Sheldon, and progressive, large-scale dairy companies such as the Aylesbury Dairy Company, who integrated new dairy technologies with the employment of full-time health officers, veterinarians, public analysts, and sanitary engineers. Embracing new types of scientific knowledge-whether from epidemiologists on the potential health risks of contaminated milk or from public analysts about the analytical proof of adulteration-was part of a complex set of push-and-pull motivations. The push for dairy reform came from Parliamentary legislation, particularly in the form of public analysts under 1875 Sale of Food and Drugs Act, and veterinary inspectors under the 1885 Dairies, Cow-sheds, and Milk-shops Order. The pull for dairy reform came from within the dairy industry, I argue, primarily by large-scale aggregate companies who increasingly demanded that science was essential to proper dairy management. Both agricultural scientists and agriculturists advocated for dairy reform predicated upon on a shared environmental conceptualization; milk could only spread disease or be adulterated based on sanitary conditions and personal behavior. The fruits of an intimate link between science and agriculture would eliminate the potential

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[5] For similar developments in the United States, see Charles Rosenberg, "Unintended Consequences: The Ideological Shaping of American Agricultural Research, 1875-1914," in *No Others Gods: On Science and American Social Thought* (Baltimore: The Johns Hopkins University Press, 1997), 185-199.

epidemiological problem of milk-borne disease, many argued, but it could no doubt also yield an economic profit. Because they had the resources and scientific expertise, large-scale companies could either drown out or contract with smaller competitors, a tactic that lay outside of the scope of want for more Parliamentary regulation.

However, as this chapter demonstrates, dairy-related science was without uniformity, despite the unifying ethos with which some dairy companies embraced science as an unproblematic whole.[6] "In many minds," David Cahan has argued, "'the nineteenth century' and 'science' become synonymous with 'progress."[7] Parliamentary legislation aimed at the control of the dairy industry was still largely permissive into the early twentieth century, although notable compulsory measures began to appear in the 1890s, explored below. I have previously contended that epidemiological studies that linked typhoid fever to milk in the 1870s provided the impetus for the social reordering of the dangers of milk in spreading disease, a cultural sorting of the relationship between filth and class, and a scientific justification for state medicine. While epidemiological studies continued into the last two decades of the nineteenth century, chemical studies increasingly became vital to public health reformers attempts to prevent milk adulteration and thus the unnecessary loss of life to infectious disease. The motivation for dairy reform, in other words, could come from the threat of milk-borne outbreaks of infectious disease. What might be called an 'epidemiological-chemical' framework continued to inform the theoretical framing and practical application of public health concepts about

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[6] David Cahan (ed.) *From Natural Philosophy to the Sciences: Writing the History of Nineteenth-Century Science* (Chicago: University of Chicago Press, 2003), 1-15.
[7] Ibid, 4.

milk both centrally at the Medical Department of the Local Government Board and the Government Laboratory of the Excise Department, and locally through the daily operations of medical officers of health (MOsH) and public analysts. By the 1880s public health authorities also had to sort out new results being published by laboratory-based bacteriologists and veterinary experts. Like Parliamentary legislation on the dairy industry, dairy-related science was complex and fractured, and even scientific clarity rarely transitioned into the practical and straightforward reform of dairy practices.

By the 1890s there was widespread acceptance across various lines of vested interest that despite progressive calls for milk-related reform, the milk problem loomed as large as ever. This chapter ends by examining debates that surfaced at the Select Parliamentary Committee on Food Products Adulteration that met in the mid 1890s. Fiercely debated there was the long-standing question explored in chapter one of fixing a standard on normal milk, which was finally accomplished in 1901 under the Sale of Milk Regulations Act. Yet, milk adulteration continued to be a serious problem, and the 1901 Act set no standard for bacterial purity and left numerous practical administrative questions vague and unanswered. Thus, my conclusion does not support the thesis that the milk-problem was solved by the end of the nineteenth century. Instead, my central argument in this chapter is that the motivations for dairy reform could combined reliance on scientific expertise with either reluctance for or embrace of greater legislative control. Dairy reformers used science as a wedge to bolster and administer reform, but they did so in the context of various, and sometimes competing scientific methodologies that were available to dairy farmers in the last two decades of the nineteenth century. This chapter first examines the continued role of epidemiological, chemical, and bacteriological studies of milk, particularly at the Medical Department and by MOsH. This chapter then moves to examine the fractured state of dairy related Parliamentary legislation, which often pitted sanitary authorities against veterinary authorities. Finally, a case study of the Aylesbury Dairy Company illustrates the ways in which large-scale, consolidated dairies used different types of scientific practitioners to call for dairy reform in the absence of clear Parliamentary legislation.

Epidemiology in the 'Age of Bacteriology' –The Medical Department of the Local Government Board

Pressure to reform the British milk system in the last two decades of the nineteenth century continued to be reinforced by epidemiological investigations at the Medical Department of the Local Government Board and by local investigations under Medical Officers of Health (MOsH). Bacteriological studies increasingly became important as well. Michael Worboys has recently demonstrated that while bacteriological theories and practices influenced British public health as early as the mid 1860s, it was not until the mid 1890s that laboratory-based bacteriologists assumed dominance in British public health.[8] Anne Hardy, likewise, has suggested that British public health officials remained committed to field-based, observational, and statistical approaches dominated by epidemiology.[9] That is not to say that bacteriological methods and practices were outside of the scope of public health in the transitional period from 1860

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[8] Worboys, *Spreading Germs*, 234.

[9] Anne Hardy, "Methods of Outbreak Investigation in the 'Era of Bacteriology', 1820-1920," in *A History of Epidemiologic Methods and Concepts,* ed. A Morabia (Berlin: Birkhauser Verlag, 2004), 199.

to 1890.[10] Instead, there was an interdependent relationship between the emerging fields of epidemiology, chemistry, pathology, and bacteriology during this period. Scientific practitioners in these areas often coalesced around specific public health problems, such as the one explored here of the threat of outbreaks of milk-borne disease. At an institutional level this was nowhere more apparent than at the Medical Department of the Local Government Board, where from the late 1860s John Simon employed chemists such as August Dupre and J.L.W. Thudichum to undertake what Simon first termed 'Auxiliary Scientific Investigations', which ranged from simple water analysis and more complicated chemical studies of the brain to crucial pathological investigations by John Burden Sanderson into what the latter called "the intimate pathology of contagion," research which, as Terrie Romano has argued, was vital for sorting out the multiplicity of germ theories and framing the concept of scientific medicine in governmental circles.[11] The Auxiliary Scientific Investigations at the Medical Department were often practical in nature. Dupre and Thudichum, for example, routinely analyzing water samples suspected by the Medical Department's inspectors to be adulterated. This not only demonstrates the relative significance of analytical chemistry and pathology in framing the larger importance of state medicine, but also, at a practical

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[10] It has been a recent historiographical trend to dichotomize the late nineteenth and early twentieth century field sciences and laboratory sciences. See, Robert Kohler, *Landscapes and Labscapes: Exploring the Lab-Field Border in Biology* (Chicago: University of Chicago Press, 2002).

[11] In a private letter to Treasury on 16 March 1874 Simon requested £2,000 for the year devoted to "Auxiliary Scientific Investigations." These included £300 to Sanderson, £500 to Thudichum, and £1,200 to 'Laboratory Expenses.' See memo from John Simon to Treasury, dated 16 March 1874, N.A. Kew, PC8/158. On Sanderson see, Terrie M. Romano, *Making Medicine Scientific: John Burdon Sanderson and the Culture of Victorian Science* (Baltimore: Johns Hopkins University Press, 2002). See also, John Burdon Sanderson, "Intimate Pathology of Contagion," *Twelfth Annual Report of the Medical officer of the Privy Council for the year 1870* (1871).

level, shows that laboratory-based scientific investigations co-existed with and supported the numerous field-based epidemiological inquiries.[12] By the mid 1870s, particularly after Simon's resignation, the Auxiliary Scientific Investigations at the Medical Department became a diverse mix of chemical, pathological, and bacteriological theories and practices.[13] This was in large part due to the central work of Edward Klein, who, as Worboys has argued, embodied a malleable scientific figure between chemistry, pathology, and bacteriology.[14] Klein, although embattled in a number of significant scientific controversies, was particularly important in framing British public health debates about food-borne and water-borne diseases into the early twentieth century.

Roy MacLeod has maintained that following John Simon's resignation in 1876 the Medical Department faced a number of significant problems that stemmed from the rise of Gladstonian economic restriction and thus severe treasury control over the medical activities of the department.[15] Royston Lambert and Jeanne Brand have echoed this argument by examining how central-local relations were hampered by an inherent tension at the Local Government Board between extending the state control of sanitary services

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[12] This connection was made explicit by George Buchanan in his nineteenth annual report. See, *Nineteenth Annual Report of the Medical Officer of the LGB*, x.

[13] Thudichum developed a keen interest in the chemistry of the brain, a subject he investigated in the 1880s. See, J.L.W. Thudichum, "Further Researches on the Chemical Constitution of the Brain," *Twelfth Annual Report of the Medical Officer of the Local Government Board*, 221-263.

[14] Michael Worboys, *Spreading Germs*, 216, 265-66. Klein was aware of research by Pasteur and Koch, and throughout the 1880s and 1890s sought to use animal models and non-human cultural media to prove the existence of specific germs, particularly diphtheria, scarlet fever, typhoid fever, and anthrax.

[15] Roy MacLeod, "The Frustration of State Medicine, 1880-1899," *Medical History*, 11 (1967), 15-40.

while exercising budgetary restraint at the Medical Department.[16] John Simon (see chapter two), was outstandingly deft in expanding the scope of the Medical Department from the late 1850s to the early 1870s. Most historians have argued that after Simon's departure in 1876 the Medical Department lost a substantial amount of influence in directly guiding the shape and implementation of sanitary policy in Britain. This claim warrants careful consideration. Contemporaries noticed a dramatic change in the power of the department, no doubt. Ernest Hart, editor of the *BMJ,* wrote in 1878 that that Medical Department "is falling into decay…being strangled by red-tape and starved to death by the cold neglect of its unappreciative foster-parent."[17]

Simon's successors as Chief Medical Officer were hand-picked insiders: Edward Seaton (who served from 1876 to 1880), George Buchanan (who served from 1880 to 1892), and Richard Thorne-Thorne (who served from 1892 to 1899). The question of why the Chief Medical Officers of the Medical Department that followed Simon received less direct access to ministerial control has received significant historical attention. Historians have generally neglected, however, the actual scientific work conducted by the department's inspectors in the period from the mid 1870s through the 1890s.[18] In the case

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[16] Royston Lambert, *Sir John Simon*, chapter 23, and Jeanne Brand, "John Simon and the Local Government Board Bureaucrats, 1871-1876," *Bull. Hist. Med*. (1963), 37: 184-194. The key issue to Simon was the Conservative Government's scheme to redirect the system of vaccination Simon had implemented from 1858 to a general scheme administered not by Medical Department inspectors, but general inspectors. It seemed to Simon, in other words, that expert medical knowledge was being replaced by lay fiscal control. See Lambert, *Sir John Simon*, 570-71. See also, Christine Bellamy, *Administering Central-Local Relations, 1871-1919: The Local Government Board in Its Fiscal and Cultural Context* (Manchester: Manchester University Press, 1988).

[17] Ernest Hart, "The Decadence of the Medical Department of the Local Government Board," *BMJ* (12 October 1878), 565.

[18] Anthony Wohl, *Endangered Lives*, 160-162.

of food-borne investigations, the Medical Department continued to push scientific boundaries and to influence the direction of public health policy. Ballard, for instance, in 1879 traced an outbreak of acute diarrheal disease to persons partaking of pork and beef at a luncheon where the Duke of Portland's estate was being sold in Welbeck.[19] In 1880 Ballard began an extensive and groundbreaking investigation of epidemic diarrhea (otherwise known as "summer diarrhea"), and also undertook a massive study of the health affects of trade nuisances.[20] Ballard's investigations, while noteworthy, were not atypical amongst other Medical Department inspectors during this period.

Epidemiology in the 'Age of Bacteriology' –Medical Officers of Health

Local MOsH effectively pressed for the reform of the British dairy industry in the last three decades of the nineteenth century. While medical inspectors at the Medical Department frequently investigated milk-borne outbreaks, local MOsH played an important role in understanding the intricacies of dairy production and the spread of epidemic disease in milk in their areas. The link between local and central sanitary activity was the defining feature of late Victorian public health, as Edward Seaton noted, "in regard to the highest interests of sanitary administration- namely, scientific research, collective investigation, and the determination of problems of practical epidemiology,

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[19] Edward Klein found the bacillus in the meat to be "previously unknown." See, Edward Ballard, "Report on an Acute Specific disease Characterized by a Peculiar Diarrhoea, Epidemic Among Persons who had Partaken of Refreshments Provided at a Sale on the Duke of Portland's Estate at Welbeck," and Edward Ballard, "Report on a Series of Cases of Acute Specific Disease (Similar to that observed in the Welbeck Outbreak), following the Eating of Hot Baked Pork Purchased at a Shop in Nottingham," and Edward Klein, "Additional Observations made in Connection with the Two Preceding Reports," *Tenth Annual Report of the Medical Officer of the Local Government Board*, 36-66.

[20] *Eleventh Annual Report of the Medical Officer of the Local Government Board*, x-xi.

etc., dependent thereon, central and local organisation cannot be too closely allied."[21] MOsH were particularly important; "It is especially to them," William Thomson, MOH for Peterborough (different from the William Thomson of Melbourne examined in chapter three), argued in 1879 with respect to the pressing endemic problem of typhoid fever, "that we must look for the most recent information on the subject [enteric fever], and not to text-books and physicians in well regulated hospitals in large towns, as the latter have not the opportunities and facilities now possessed by sanitary officers for studying and investigating the spread of infectious diseases."[22] Attempting to gauge the widespread opinion of MOsH in Britain on the question of the contagiousness of typhoid, Thomson sent one hundred circulars to MOsH across the country, asking if they considered typhoid contagious. Eighty MOsH responded, with seventy replying in the affirmative, nine in the negative, while one was undecided.[23]

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[21] Edward Seaton, "Evolution of Sanitary Administrtation in the Victorian Era," *BMJ*, vol. 1 no. 1903 (19 June 1897), 1639. By the mid 1870s there was a greater cohesiveness between MOsH and the Medical Department. Medical inspectors almost always consulted MOsH when conducting local epidemiological investigation. MOsH, likewise, often wrote to the Medical Department for advice or assistance. Because both the Medical Department and MOsH were administered by the Local Government Board, MOsH reports went directly to the Medical Department by the late 1870s. See the memorandum sent by Edward Seaton as Chief Medical Officer in 1876 to all MOsH, *Sixth Annual Report of the Medical Officer of the Local Government Board*, 304-308.

[22] William Thomson, "Typhoid Fever: Contagious, Infectious, and Communicable," *BMJ*, 8 March 1879, 344. In his review of Michael Worboy's *Spreading Germs*, Warwick Anderson confuses the two William Thomson's'. One was a British born expatriate and epidemiologist who lived in Melbourne, while the other was a MOH for Peterborough, England. See Warwick Anderson, review of Michael Worboys*, Spreading Germs*, in *Health and History* (2003), 5: 141.

[23] William Thomson, "Typhoid Fever: Contagious, Infectious, and Communicable," *BMJ* (8 March 1879), 344. George Buchanan, in his first Annual Report as Chief Medical Officer in 1879 noted that while some MOsH were incompetent, most provided "distinct proof of progress afforded by the reports of many others; of progress in the officers' power of research, in the value and importance of their advice, and in the trust in which they are held by their sanitary authorities." *Ninth Annual Report of the Medical Officer of the Local Government Board for 1879*, vii.

Numerous MOsH were sagacious investigators of milk-borne typhoid epidemics in the 1880s, including James Russell, MOH for Glasgow, Shirley Murphy, MOH for St. Pancras, David Davies, MOH for Bristol, L. Woodman, MOH for Exeter, C. Green, MOH for Gateshead, and W.N. Thursfield, MOH for Shropshire.[24] Ernest Hart, who complied a list of milk-borne investigations that occurred between 1880 and 1897, listed 48 milk-borne investigations of typhoid fever. Most were conducted by MOsH.

By the late 1870s many MOsH rhetorically framed the milk problem within a larger concern over the health effects of various trades, in other words an industry-specific problem. In 1876 Cornelius Fox, MOH for Essex maintained that the dairy industry should be regulated "under proper sanitary control, in the same way as we at present have slaughterhouses."[25] To Fox, as to many other MOsH, controlling the spread of typhoid fever by careless dairymen at unregulated dairy farms was as important as the spread of scarlet fever in public-houses, measles in schools, and smallpox in restaurants. The solution, according to many MOsH, was increased sanitary control, particularly the establishment of compulsory legislation that would allow MOsH, if necessary, to close schools, public houses, or dairies. This occupation-specific view was supplemented by an extensive investigation by Edward Ballard at the Medical Department from 1875 on

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[24] See Ernest Hart, "A Report on the Influence of Milk in Spreading Zymotic Disease," *BMJ* (22 May 1897), 1295-1299. David Davies' 1878-1879 investigation of milk-borne typhoid is particularly illustrative. See, David Davies, *Report on a Localised Outbreak of Typhoid Fever in Bristol, During the Months of July and August 1878, Traced to the Use of Impure Milk* (Bristol: Rose and Harris, 1879). See also, Shirley F. Murphy, "Report on the Recent Outbreak of Enteric Fever in St. Pancras," dated October 1883. *Annual Report of the Medical Officer of Health of St. Pancras*.

[25] Cornelius B. Fox, "The Dissemination of Zymotic Disease Amongst the Public by Tradespeople," *BMJ* (9 December 1876), 745.

"effluvium nuisances."[26] Ballard studied seventy different types of businesses, attempting to show the public health threat of offensive trades.[27] Such behavioral tactics were part of a larger shift in British public health from the 1880s that gradually relied on individual, or 'person-centered' exclusive approaches that replaced older inclusive approaches.[28] By locating infectious disease in individual bodies and focusing on personal hygiene and individual behavior, MOsH could more precisely identify and break the links in the communication of disease.

In practice, MOsH and the Medical Department remained committed to the rhetorical use of filth when calling for public health reform.[29] By the early 1880s the older Chadwickian, indiscriminate notion of filth was adapted to fit a multiplicity of proto-germ theories. As Robert Hudson, physician in Redruth noted in 1877, "destroy the specific germs before they mix with the filth; look on filth as the agent for the dissemination of the poison, not the poison itself, and you are more likely to be rewarded by success."[30] This was a nuanced, but crucial reframing of the importance of filth that had practical implications for how medical scientists, and in turn the British population,

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[26] For a more general history of occupational health in the nineteenth century see Paul Weindling (ed.) *The Social History of Occupational Health* (London: Croom Helm, 1985).

[27] Ballard produced a series of reports. See, Edward Ballard, "Report on the Effluvium Nuisances Arising in Connexion with Various Manufacturing and Other Branches of Industry," *Eighth Annual Report of the Medical Officer of the Local Government Board,* 42-321. Other reports are found in from the *Fifth Annual Report of the Medical Officer of the Local Government Board*.

[28] Ibid, 235.

[29] Anon., "Filth Disease," *The Sanitary Record* (4 September 1875), 168. See also, for example, Edward Ballard, "Report on the Effluvium Nuisances Arising in Connexion with Various Manufacturing and Other Branches of Industry," *Eighth Annual Report of the Medical Officer of the Local Government Board,* 42-321.

[30] Robert H. Hudson, "The Germ-Theory of Enteric Fever," *BMJ* (16 June 1877), 741.

understood the communication of infectious diseases.[31] John Simon, in his relatively unknown "Essay on Contagion: Its Nature and Mode of Spreading," written in April 1878 as the entry for 'contagion' in Quain's *Dictionary of Medicine* (1879) aptly summarized the complex ways in which the very term contagion had changed in the past fifty years. Simon noted,

> The rationale of the word "contagion", as now used, is that the property is understood to attach itself essentially to a material contact; not necessarily that, when infection is spread from individual to individual, the contact of the individuals must have been immediate; but that in all cases there must have been such passage of material from the one to the other.[32]

Drawing on pathological, epidemiological, and biological evidence Simon added,

> The various specific matters which effect contagion in the living body, the respective "contagia" of the given diseases, seem all to have in common this one characteristic: that in appropriate media (among which must evidently be counted any living bodily texture or fluid which they can infect) they show themselves capable of self-multiplication.. and when it is said that all contagia are self-

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[31] I employ the term "medical scientists" as a practical one, meaning those scientists who had been trained in medical fields, broadly defined. Elsewhere I employ the term "scientific medicine" which relates to the progressive spirit with which medicine gained social authority in the late nineteenth century. See, Michael Hagner, "Scientific Medicine" in David Cahan (ed.) *From Natural Philosophy to the Sciences*, 49-87.

[32] John Simon, "An Essay on Contagion: its Nature and Mode of Action," *BMJ* 13 December 1879, 923. It was also published in Quain's *Dictionary of Medicine*. Simon's characterizations sheds interesting light on the larger narrative of Peter Baldwin in *Contagion and the State in Europe, 1830-1930* (Cambridge: Cambridge University Press, 1999).

> multiplying things, this is at least very strongly to suggest that perhaps all contagia are things endowed with life.[33]

By the 1880s the indirect communication of infectious disease through mediums was an incontrovertible truth in sanitary science that lay at the core of contagionist doctrine.[34] How public health authorities were to prevent the communication of infectious diseases remained a controversial matter, particularly its application to curbing milk-borne outbreaks.

Adapting Etiologies and the Continued Threat of Typhoid Fever

Although there was still a great diversity of opinion with regards to germ theories, public health authorities increasingly agreed by the late 1880s that disease causing germs were living, ancestral, and particulate, an etiological nod to contemporary evolutionary theory.[35] Richard Thorne-Thorne argued as much on 8 April 1878 in a paper read before the Epidemiological Society of London titled "Remarks on the Origin of Infection."[36] A

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[33] Ibid, 923. This was echoed by Edward Ballard in an article he wrote in the *BMJ* in 1880. See, Edward Ballard, "Observations on some of the ways in which Drinking Water may become Polluted with the Contagium of Enteric Fever," *BMJ* (17 January 1880), 82-84. Ballard first read the paper at the Annual Meeting of the British Medical Association in Cork in August 1879. William Budd had also asserted this in his *Typhoid Fever* on page 99.

[34] This post-Darwinian view of infectious disease was echoed by James Russell, MOH for Glasgow as well, who argued in 1878 that "the infectious diseases of a country may be classified like its plants and animals." See, James Russell, *Lectures on the Theory and General Prevention and Control of Infectious Diseases* (Glasgow: James Maclehose, 1879), 33. See also, W.F. Bynum, "Darwin and the Doctors: Evolution, Diathesis and Germs in Nineteenth Century Britain," *Gesnerus* (1983), 40: 43-53.

[35] W.F. Bynum, "The Evolution of Germs and the Evolution of Disease: Some British Debates, 1870-1900," *Hist. Philos. Life Sci* (2002), 24: 53-68, Adrian Desmond, *The Politics of Evolution: Morphology, Medicine, and Reform in Radical London* (Chicago: University of Chicago Press, 1989).

[36] Richard Thorne-Thorne, "Remarks on the Origin of Infection," *Transactions of the Epidemiological Society of London*, vol. IV, sessions 1875-76 to 1880-81. Read 8 April, 1878, 234-246.

year later in 1879 Thorne honed this view in a final report on an investigation of an outbreak of typhoid fever in Red Hill, just south of Croydon. Echoing larger etiological sentiments held by contemporary sanitarians, Thorne clarified,

> In view of recent investigations into the intimate pathology of the infectious fevers, the contagion of enteric fever itself must probably be regarded as particulate, and when contained in water it must probably be viewed as held in mechanical suspension, rather than distributed throughout it after the manner of a chemical solution. Under these circumstances its distribution throughout a large body of water would probably be not wholly regular, and its passage into and through means receiving the water might not be uniform, either in point of time or in the direction taken.[37]

As an extension of the water-borne hypothesis, the particulate argument was also extended to milk. Ernest Hart made this clear at the International Medical Conference in 1881, contending that, "it must be remembered that disease-germs are in all probability particulate in their nature, and are not diffused equally through the whole mass of the milk, even if the whole came from an infected source-which is by no means invariably the case."[38] The premise of Thorne and Hart's versions of the particulate argument were certainly not new, although they gained significant strength from contemporary

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[37] Richard Thorne-Thorne, "Report to the Local Government Board on an Extensive Epidemic of Enteric Fever, affecting especially Red Hill, within the Urban Sanitary District of Reigate, and Caterham in the Rural Sanitary District of Godstone." Dated 7 April 1879, *Ninth Annual Report of the Medical Officer of the Local Government Board for 1879,* 8.

[38] Ernest Hart, "The Influence of Milk in Spreading Zymotic Disease," *Transactions of the Seventh Session of the International Medical Conference of 1881*, (London: J.W. Kolckmann), 494.

evolutionary theories. John Snow and William Budd, one should remember, had independently come to similar conclusions in the late 1850s. By the early 1880s the strength of such an argument was in its ability to extend epidemiological inquiry, particularly to bolster the well-established water-borne hypothesis. Hubert Airy, one of the Medical Department's inspectors in the late 1870s and 1880s, used this line of argumentation to explain a milk-borne typhoid outbreak in Chichester, where he concluded that, "we know that some persons habitually escape, where a number have appeared to be equally exposed to conditions productive of this fever."[39] In practice, the particulate argument allowed public health practitioners to explain a longstanding problem in etiology; why people with similar levels of exposure routinely escaped outbreaks of infectious diseases.

Because milk-borne outbreaks typically followed similar epidemiological patterns--they tended to affect women and children, the wealthy, and generally those who consumed larger quantities of milk--MOsH and Medical Department inquiries in the 1880s became more nuanced and statistically complex, incorporating new statistical methodologies such as differential mortality rates.[40] Edward Ballard's 1878 investigation of milk-borne typhoid in Ascot is an early example of such statistical trends well established by the late 1880s. Ballard was called to investigate the continued persistence of typhoid outbreaks in the small town over a period of four and a half years. In addition

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[39] Hubert Airy, "Report to the Local Government Board on an Outbreak of Enteric Fever in Chichester," *Annual Report of the Medical Officer of the Local Government Board*, dated 24 July 1879, 3.

[40] By the late 1880s MOsH and the Medical Department relied extensively on Arthur Newsholme's *The Elements of Vital Statistics* (London: Swan Sonnenschein & Co, 1889) and William Farr's *Vital Statistics: A Memorial Volume of Selections from the Reports and Writing of William Farr* (London: The Sanitary Institute of Great Britain, 1885).

to the usual statistical markers of age, sex, residence, and date of attack or death, Ballard compiled the victim's 'station in life' (either 'I' for noblemen and gentry, 'II' for middle class and tradesmen, or 'III' for labouring class and poor) and milk supply (one of three in the area). [41] The cause of the Ascot outbreak, Ballard found, was the unsanitary conditions--Ballard called them "slovenly arrangements"-- at one particular farm, the Brick-kiln Farm, which supplied milk to a vast majority of the area.[42] Such milk-borne investigations were so routine that George Buchanan, in his Annual Report for 1882, explained that "an increasing number of local outbreaks of enteric fever, of scarlet fever, and of diphtheria, have been recognised as spread through local communities by means of milk." "In such outbreaks," Buchanan continued, "contamination of the milk by the material of specific disease derived from some antecedent case in the human subject has been of necessity the first explanation that has offered itself for acceptance; and in many such outbreaks, this explanation has appeared valid and sufficient."[43] Milk-borne epidemiological studies by MOsH and Medical Department inspectors continued to have a critical impact on late Victorian sanitary reform because of their explanatory power in encompassing a wide-range of rural sanitary problems. Unsanitary dairy practices such as the improper cleansing of milk churns, cans, or utensils were often to blame. So too was the continual problem of the blatant adulteration of milk with sewage tainted water. More broadly though, epidemiological logic maintained that epidemic disease could only occur

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[41] Edward Ballard, "Report to the Local Government Board on an unusual Prevalence of Enteric Fever at Ascot during a Period of Four Years and a Half." National Archives, Kew. MH 113/14, 3-4.

[42] Ibid, 13.

[43] *Twelfth Annual Report of the Medical Officer of the Local Government Board*, vii.

if a concomitant number of factors aligned, such as a contaminated local water supply, ineffective drainage and improper removal of excrement.[44]

Epidemiologists continued to use typhoid as a model disease in the last two decades of the nineteenth century. Indeed, the more general public health approach of the 1880s and 1890s, at least in Parliament and at the Medical Department of the Local Government Board, was the fruition of Alfred Haviland's plea in 1872 that typhoid needed to become "simply local or personal; its existence will then become punishable."[45] It was in that 1872 paper that Haviland called typhoid fever a "national disgrace," and, although the annual mortality from typhoid had steadily decreased in each successive decade after 1870, the social robustness of Haviland's 1890s proclamation had been fully realized. Large-scale outbreaks of typhoid that spread across the country remained rare in the last two decades of the century, but typhoid remained a menacing endemic problem. That is not to say that local meant insignificant, whether culturally, politically, or even scientifically. Indeed, local outbreaks of infectious disease remained a justification of state and preventive medicine, and the professionalization of sciences such as epidemiology. Yet, dealing with the problem of typhoid, which was inexorably linked to longstanding problems such as water supply, sewerage, and food supply, was indicative of entrenched struggles between central and local government. It was, in other words, as Roy MacLeod has aptly characterized, the period of the "Frustration of State

[44] William Henry Corfield, for example, admonished rural dairymen who used brick sewers (he preferred glazed stoneware), as they were liable to extensive leakage and rat damage. Corfield had no doubt that many milk-borne outbreaks were influenced by sewer construction. See, W.H. Corfield, *Dwelling Houses: Their Sanitary Construction and Arrangements* (London: H.K. Lewis, 1880), 69.

[45] Alfred Haviland, "Abstract of Two Lectures on the Geographical Distribution of Typhoid Fever in England and Wales," *BMJ* (1872), 580: 148.

Medicine."[46] Some public health authorities ambitiously placed considerable hope in the Public Health Act of 1875. John Richard Wardell, Senior Physician to the Tunbridge Wells Infirmary for example, was particularly optimistic in 1876, noting that,

> There is not a little satisfaction in the reflection that the greater attention which is now being given, not only on the part of the profession, but on the part of the legislature, and on the part of the public generally, to all matters pertaining to sanitary improvements, and that consequently the death-waste from enteric fever will soon become manifestly diminished.[47]

Wardell's confidence demonstrates that by the late 1870s there was an increasing consensus by the medical profession, Whitehall, and the British public that an organized system of sanitary reform was not simply the wish of progressive sanitarians, but a social necessity.[48] However, curbing endemic problems such as typhoid fever, which were inexorably tied to both urban and rural specific problems, necessitated more than just general consensus that action was needed.[49]

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[46] Roy MacLeod, "The Frustration of State Medicine, 1880-1899," *Medical History* (1967), 11: 15-40.

[47] John Richard Wardle, "Remarks on Enteric Fever," *BMJ* (1 April 1876), 407.

[48] As Lloyd Stevenson has shown, politicians were equally enthusiastic about the 1875 Public Health Act. Chief among them was Disraeli, who invented the clever phrase *Sanitas sanitatum, omnia sanitas*. See, Lloyd Stevenson, "Science Down the Drain: On the Hostility of Certain Sanitarians to Animal Experimentation, Bacteriology, and Immunology," *Bulletin of the History of Medicine* (1955), 1-26. 1875 was also the year of Benjamin Ward Richardon's famous "Hygeia" speech, delivered before the Social Science Association in Brighton. See, B.W. Richardson, *Hygeia: A City of Health* (London: 1876).

[49] The focus on my urban and rural spaces in the history of Victorian science was laid out by Ian Insker and Jack Morrell in *Metropolis and Province: Science in British Culture, 1780-1850* (London: Hutchinson, 1983).

Christopher Hamlin's recent study of local sanitary reforms in water supply and sewerage in four British towns recasts the longstanding progress-driven narrative that despite clear centralized direction, local governments in late Victorian towns were "inactive and unprogressive" in adopting sanitary reform projects due to the *laissez-faire* coattails of ignorance, greed, and inexperience.[50] Instead, Hamlin shows, local sanitary improvements were often fraught with legal and technical problems, despite the good intentions and progressive ethos of local authorities. "Urban improvement," Hamlin concludes "really was a matter of staggering complexity."[51] Water supply and sewerage were key arenas where legal and technical problems abounded, and Hamlin's analysis significantly advances our understanding of the uneven implementation of state and preventive medicine in the late Victorian period. As I have shown in the previous chapter, food adulteration, specifically the problem of milk adulteration, was inescapably tied to legal, scientific and technical indecisiveness by local authorities, courts, and analytical chemists. This suggests that water and sewerage reform was part of a larger discourse on public health reform in the second half of the nineteenth century. Hamlin's framework also helps to understand the uneven implementation of dairy reform legislation in the last two decades of the nineteenth century.

Gauging the impact of milk-borne epidemiological inquiries has important implications vis-à-vis Hamlin's argument that some local sanitary authorities were interested and willing to reform local sanitary circumstances but bewildered with the

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[50] Christopher Hamlin, "Muddling in Bumbledom: On the Enormity of Large Sanitary Improvements in Four British Towns, 1855-1885," *Victorian Studies* (Autumn, 1988), 32: 55-83, 78.

[51] Ibid, 83.

plethora of options or too encumbered by the financial obligations attendant to such reforms. From the late 1850s reports by the Medical Department's inspectors typically gave recommendations, but these were typically short, succinct, and sufficiently vague because they encompassed a wide range of local sanitary failures. By the early 1880s the Medical Department routinely made more specific and extensive sanitary suggestions. Ballard's recommendations in his 1878 report on the Ascot milk-borne typhoid outbreak is case in point. He provided the Brick-kiln dairy with an extensive list of advice on works needed to update the old brick cesspits, the privies, and the water pump. Working with the local surveyor and sanitary inspector, P.J. Byrne, and a local member of the Geological Survey of Great Britain, Ballard also drew up an intricate plan for the proposed alterations and a cross-section of the local soil. Such practices had longstanding precedent within the Medical Department, evidenced by John Netten Radcliffe and George Buchanan's 1869 study of the various systems in place for excrement disposal in the north of England, which included a specific list of recommendations for rural local authorities.[52] When Buchanan became the Chief Medical Officer in 1879, he was confident that Medical Department reports were of the highest value to local authorities and MOsH. He noted that the reports "afford to local authorities very material assistance in the performance of their sanitary functions."[53] Dairy farmers, too, as I demonstrate below, were often bearers of such specialist scientific advice.

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[52] John Netten Radcliffe and George Buchanan, "The Systems in use in Various Northern Towns for Dealing with Excrement," *Twelfth Annual Report of the Medical Officer of the Privy Council for 1869* (London, 1870), 111-140.

[53] *Ninth Annual Report of the Medical Officer of the Local Government Board*, 1879, viii.

Historians of late Victorian public health, following MacLeod, Brand, and Lambert, have tended to argue that while John Simon was able to affect widespread sanitary reform through personal charisma and political maneuvering, the Chief Medical Officers that followed him-Seaton, Buchanan, and Thorne-Thorne- were less effective. Analysis of the actual scientific investigations conducted by the department's inspectors, in this case evidenced by inquiries into cases of milk-borne and water-borne disease, suggests an alternative explanation, and a more nuanced relationship between central and local public health officials.[54]

The Fractured State of Dairy Legislation

By the late 1870s a number of prominent and outspoken public health leaders were clamoring for increased dairy supervision. Speaking of milk-borne epidemics, Ernest Hart, the influential editor of the *BMJ*, argued at the 1881 International Sanitary Conference noted, "no assurance can be obtained that these epidemics will not be as rampant as ever unless and until some really efficient and carefully considered regulation and inspection of dairy-farms and milk-shops be insisted upon."[55] Medical inspectors at the Medical Department had been arguing the very same point from the mid 1870s, as explored in chapter three. Ending his investigation of a milk-borne typhoid outbreak at Eagley and Bolton in 1876, W.H. Power concluded that "the case is simply one more, and a serious one, added to those cases already on record which point to the urgent

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[54] See also Hubert Airy's 1879 investigation in Chichester, and his 1881 investigation at Blackburn. N.A. Kew, MH 113/18.

[55] Ernest Hart, "The Influence of Milk in Spreading Zymotic Disease," *Transactions of the Seventh Session of the International Medical Conference of 1881*, (London: J.W. Kolckmann), 494.

necessity for regulation and adequate supervision over the sanitary circumstances of dairy farms."[56] In the minds of MOsH and the Medical Department, rigorous sanitary supervision of dairy farms would substantially decrease the incidence of milk-borne outbreaks.[57] The crux of their argument, however, was that it was specifically MOsH who were best suited to inspect the sanitary arrangement of dairy farms.[58] This was an important, and as we will see controversial argument.

In 1878 Parliament passed the Contagious Diseases (Animals) Act, which permitted the officers of the Privy Council some level of regulation over dairy practice. As MOsH realized though, that legislation was framed to appease veterinary authorities. Section 34 of the 1878 Act enabled local authorities (although it did not mandate them) to make five orders:

1. For the registration with local authority of all persons carrying on the trade of cowkeepers, dairymen, or purveyors of milk.
2. For the inspection of cattle in dairies, and for prescribing and regulating the lighting, ventilation, cleansin, drainage, and water supply of dairies and cow-

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[56] W.H. Power, "Report to the Local Government Board on an Epidemic of Enteric Fever occurring at Eagley, and affecting part of the Borough of Bolton," *Annual Report of the Medical Officer of the Local Government Board*, dated 17 July, 1876, 7.

[57] George Buchanan, commenting on Edward Ballard's 1880 investigation of milk-borne scarlet fever noted that "the experience of this epidemic is one out of several indications, that the spread of scarlatina is aided more commonly than is supposed by mis-managed milk-businesses; and it confirms the policy of vesting in sanitary authorities the function of regulating such businesses." See *Eleventh Annual Report of the Medical Officer of the Local Government Board*, xii.

[58] MOsH claimed expert knowledge on the subject, and the most influential books on rural sanitary arrangement were authored by MOsH. See, William Henry Corfield, *Dwelling Houses: Their Sanitary Construction and Arrangements* (London: H.K. Lewis, 1880).

sheds in the occupation of persons following the trade of cowkeepers or dairymen.

3. For securing the cleanliness of milk-stores, milk-shops, and of milk-vessels used for containing milk for sale by such persons.
4. For prescribing precautions to be taken for protecting milk against infection or contamination.
5. For authorizing a local authority to make regulations for the purposes aforesaid, or any of them, subject to such conditions, if any, as the Privy Council might prescribe.[59]

Although potentially sweeping legislation, in practice MOsH argued that the 1878 Act only "increased the confusion already existing in our sanitary machinery," as Francis Bond, MOH for Gloucester noted in the *BMJ* in 1878.[60] MOsH faulted the Act's administration by the Privy Council, not the Local Government Board, which made police inspectors, not MOsH, responsible for dairy supervision. Police officers did have the authority to call upon veterinary inspectors, and many undoubtedly did, but often the worry was not unsanitary conditions on dairy farms that could foster an outbreak of infectious disease in humans, but rather disease in cattle such as pleuro-pneumonia or rinderpest (cattle plague).[61] Veterinary inspectors, too, had different vested professional

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[59] Great Britain, Local Government Board, Circular to Local Boards, Improvement Commissioners and Rural Sanitary Authorities. NA, Kew, MH 113/23.

[60] Francis T. Bond, "The Sanitary Supervision of Dairy-Farms," *BMJ* (5 October 1878), 541.

[61] Abigail Woods, "The Construction of an Animal Plague: Food and Mouth Disease in Nineteenth Century Britain," *Social History of Medicine* (2004) 17: 23-39.

and political interests than medical and sanitary inspectors.[62] This bifurcation had important consequences for the central management of zoonotic diseases and the control of the animal population in Britain, particularly with regards to the very serious threat of milk-borne tuberculosis.[63] In practice it was clear that many dairymen were also displeased; one dairyman said, "the milkshop regulations… what are they worth? Simply nothing."[64]

W.N. Thursfield, MOH for Shropshire argued in 1880 that there were two essential problems with the 1878 Act; local authorities were not required to adopt its provisions, and the inspection of dairy farms was left to police officers and veterinary inspectors.[65] The issue was so important to the Society of Medical Officers of Health that they issued a formal statement to the Local Government Board, noting,

> That in the opinion of this society it is desirable, having regard to the more effectual prevention of the spread of zymotic disease by the agency of milk, that the special sanitary supervision and inspection of cow-sheds, dairies, and milk-shops, should be entrusted by the local authorities to the medical officers of health, and the sanitary inspectors of the respective districts.[66]

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[62] John R. Fisher, "Not Quite a Profession: the Aspirations of Veterinary Surgeons in England in the Mid-Nineteenth Century," *Historical Research* (1993), 66: 284-302.

[63] Susan Jones, "Mapping a Zoonotic Disease: Anglo-American Efforts to Control Bovine Tuberculosis Before World War I," *Osiris* (2004), 19: 133-148

[64] Anon., "The Milkshops Regulations," *The Cowkeeper and Dairyman's Journal* (November 1881), 3: 35.

[65] Thursfield had conducted his own investigation typhoid in 1875. See, W.H. Thursfield, "On a Remarkable Outbreak of Typhoid Fever," *The Sanitary Record* (18 December 1875) 438-440.

[66] W.N. Thursfield, "On the Dissemination of Infectious Disease by Milk; with Suggestions for its More Effectual Prevention," *Transactions of the Society of Medical Officers of Health*, session 1880-1881 (London, Roberts & Leete, 1881), 44.

In 1884 Thursfield again lamented the inadequacy of Parliamentary legislation with regard to the dairy industry. Expanding on his 1880 argument, he professed that what was needed was "efficient inspection" and "responsible advice," (a) at the house of the consumer, (b) at the milk-shop of the retailer, and (c) at the dairy farm of the wholesale purveyor.[67] Individuals, Thursfield recommended, should boil any suspected sample of milk before consumption.[68] Milk retailers meanwhile, had a host of responsibilities according to Thursfield, such as the early notification of any infectious disease and the upkeep of thorough bookkeeping in the form of lists of consumers and dairy farm sources.[69] MOsH, in turn, Thursfield maintained, should have the authority to stop the sale of any suspected milk, although compensation would be provided to the retailer if the stoppage proved to be unnecessary. MOsH were primarily concerned, as Thursfield's comments indicate, with the proper working of dairy farms themselves.

Thursfield pushed for a thorough system of dairy farm registration, which was largely incomplete even in the 1890s. Simple sanitary measures, such as a clean, uncontaminated water supply and proper drainage were also of paramount importance. MOsH found that further regulation of the dairy industry could dramatically change the overall sanitary-and thus health- landscape of rural areas. This would, in turn, also

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[67] W.N. Thursfield, "On Cows' Milk as a Vehicle of Infectious and Epidemic Disease to the Community, with Suggestions for the More Effectual Prevention of Such Outbreaks," *Transactions of the Society of Medical Officers of Health*, Session 1883-1884 (London: Roberts & Leete, 1884), 180.

[68] The Medical Department recommended that Briton's should boil any suspected milk as well. See, *Fourteenth Annual Report of the Medical Officer of the Local Government Board*, xxvii.

[69] On the contentious issue of compulsory notification, see Graham Mooney, "Public Health Versus Private Practice: The Contested Development of Compulsory Infectious Disease Notification in Late-Nineteenth Century Britain," *Bulletin of the History of Medicine* (1999), 73: 238-267.

facilitate the health of urban Britons.[70] This was particularly important for the contentious issue of the notification of infectious disease, which Thursfield noted, "need not, for obvious reasons, entail publicity, but in such cases the responsibility of the necessary isolation would devolve on the medical officer of health."[71] He maintained,

> I believe, indeed, inspections may be so carried out that the inspector would come to be looked upon, not as an interloper only borne with so far as the law demands, but as one in a position, under certain circumstances of disease incidence, to give advice, valuable from a commercial as well as from a sanitary point of view.[72]

The fundamental problem with dairy legislation, MOsH realized by the mid 1880s, was the permissive nature of existing Parliamentary legislation. That MOsH framed dairy regulation as a sanitary problem which they alone could solve is perhaps unsurprising considering the breadth of sanitary work MOsH were expected to cover and the extensive epidemiological experience many MOsH had in milk-borne outbreaks.[73] Dairy regulation was a central issue to MOsH, despite the fact that many continued to complain into the twentieth century that they were under-paid and over-worked.[74]

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[70] Urban MOsH felt the same, see A. Wynter Blyth, and Alfred Spencer, "On the Protection of Milk from Contamination, and the Measures Necessary for Maintaining the Purity of Milk Supplied to the Metropolis and Other Towns," *Transactions of the Society of Medical Officers of Health*, Session 1885-1886 (London: Roberts & Leete), 73-91.

[71] Ibid, 184. The majority of MOsH were in agreement. See Alfred Hill, "The Notification of Infectious Disease: its Importance and its Difficulties," *Transactions of the Society of Medical Officers of Health*, Session 1883-1884 (London: Roberts & Leete), 186-199.

[72] Ibid. See also, Edward Seaton, "The Milroy Lectures on the Value of Isolation and its Difficulties," *BMJ* (7 March 1896), 1836: 582-584.

[73] Ernest Hart, "The Distribution of Infection by Milk," *BMJ* (1 January 1881), 1044: 20-21.

[74] Edward Willoughby, "Suggestions for the Reorganization of the Sanitary Service," *Transactions of the Society of Medical Officers of Health*, Session 1881-1882 (London: Roberts

Because of clamoring by MOsH, Parliament responded in 1885 by passing a revised Dairies, Cow-sheds, and Milk-shops Order, which mandated that all local authorities register dairymen, cow keepers, and milk purveyors.[75] And, although the 1885 Order rescinded some power back to the LGB, it was still largely administered by the Agricultural Department (with the assistance of the Veterinary Department) of the Privy Council, and thus bypassed the legal authority of MOsH. Following the advice of MOsH, the 1885 Act did increase the specificity of dairy regulation, prescribing and regulating the lighting, ventilation, cleansing, drainage, and water supply of dairies and cow-sheds. This kind of Parliamentary vacillation, which strove to bind dairy supervision as the responsibility of one administrative body, continued well into the twentieth century. In practice, most realized, as Ernest Hart noted in 1882 that "the safeguarding of our milk-supplies is not a matter in which one authority only is concerned."[76]

The Ascendency of Veterinary Science and the "Hendon Cow Disease"

The practical application of the 1885 Dairies, Cow-sheds, and Milk-shops Order helped revitalize interest in the potential health threat to humans of diseased dairy cattle, the argument made by progressive veterinary surgeons such as Arthur Gamgee after the 1865 Cattle Plague. Agricultural and veterinary fear of zoonotic outbreaks were assuaged not only by the politically charged threat of bovine tuberculosis, but also by a well-known outbreak of scarlet fever in 1885 that occurred in London that was traced by the

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& Leete), 57-59. See also, anon., "Suggestions for the Reorganization of the Sanitary Service," *The Sanitary Record* (15 May 1882), 471-472.

[75] An earlier Dairies, Cowsheds, and Milkshops Order appeared in 1879 as an additional order to the Contagious Diseases (Animals) Act of 1878. The 1885 Order was much more specific however.

[76] Ernest Hart, "The Safeguarding of Our Milk Supplies," *BMJ* (8 April 1882), 1110: 512.

Medical Department's W.H. Power to particular cows of a Hendon dairy farm suffering from an udder infection. Edward Klein, the department's scientific analyst, argued that the cow infection was of similar pathological origin to scarlet fever in humans.[77] The case is worth briefly exploring.

In December of 1885 a particularly notable outbreak of scarlet fever occurred in the west end London district of Marylebone. The outbreak was initially traced by A. Wynter Blyth, Marylebone's MOH, to a particular milk supply.[78] Blyth called upon the Medical Department for assistance, who in turn sent William Henry Power, medical inspector who had been involved in numerous milk-borne investigations, including the 1873 outbreak in Marylebone detailed in chapter three. Blyth and Power traced the Marylebone outbreak to a common milk supply originating at a dairy farm in Hendon.[79] Investigating the Hendon farm, Power, Blyth, and James Cameron, MOH for Hendon, found the dairy to be, as Power noted, "sanitarily perfect."[80] They did, however, find a

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[77] The Hendon episode has been covered by Leonard Wilson. See, Leonard Wilson, "The Historical Riddle of Milk-borne Scarlet Fever," *Bulletin of the History of Medicine* (1986),60: 321-342.

[78] W.H. Power, "Milk-Scarlatina in London in 1885," *Fifteenth Annual Report of the Medical Officer of the Local Government Board, 1885-1886,* 73.

[79] Power had previous experience investigating sanitary conditions of the Hendon area and on milk-borne scarlet fever. Richard Thorne-Thorne, in his 1888 *On the Progress of Preventive Medicine during the Victorian Era* went as far as to argue that Power had suspected scarlet fever to be passed from humans via milk directly from the cow as early as 1882. See, Richard Thorne-Throne, *On the Progress of Preventive Medicine during the Victorian Era* (London: Shaw & Sons, 1888), 34-36. See also, "Mr. W.H. Power's Report to the LGB on an outbreak of Diphtheria in the Hendon Ward of the Hendon Urban Sanitary District," dated 5 April, 1883. N.A. Kew, MH 113/203.

[80] W.H. Power, "Milk-Scarlatina in London in 1885," *Fifteenth Annual Report of the Medical Officer of the Local Government Board, 1885-1886*, 75.

number of cows suffering from a particularly odd udder infection.[81] Edward Klein, the Medical Department's scientific analyst, was called in to examine both the sufferers of the disease and the Hendon cows. Klein, who had been interested in the pathology of scarlet fever from 1876, found that "both the blood and tissues of ordinary human scarlatina have been found to exhibit organisms identical in their morphological characters and pathological properties to those which had been found in the case of the Hendon cow."[82] In their official reports to the Medical Department of the Local Government Board, Power and Klein concluded that the scarlet fever outbreak amongst Marylebone residents was caused by the consumption of milk from cows suffering from an eruptive disease of the teats. There were dissenting opinions however, by the Royal Agricultural Society, by eminent veterinary surgeon George Thomas Brown, Principal of the Royal Veterinary College, and by noted pathologist Edgar Crookshank, who all argued that the udder disease described by Klein was a well-known disorder by dairymen and veterinary surgeons called "cow-pox."[83] The typical milk-borne route, they

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[81] James Cameron, "Observations on a Certain Malady Occurring Among Cows at a Time when the Milk Produced by Them Disseminated Scarlet Fever," *Fifteenth Annual Report of the Medical Officer of the Local Government Board*, 1885-1886, 85-89. See also, Ernest Hart, "A Report on the Influence of Milk in Spreading Zymotic Disease," *BMJ* (15 May 1897), 1231.

[82] Richard Thorne-Throne, *On the Progress of Preventive Medicine during the Victorian Era* (London: Shaw & Sons, 1888), 35. On Klein's earlier research, see, Edward Klein, "Researches into the Minute Anatomy of Scarlatina," *Annual Report of the Medical Officer of the Local Government Board*, 1876, new series, no. VIII. Renewed interest in the zoonotic nature of milk-borne nature of scarlet fever came in 1882 after Power traced an outbreak of scarlet fever to milk. See, *Twelfth Annual Report of the Medical Officer of the Local Government Board*, vii. Klein produced a subsequent report in 1886 on the matter. See, Edward Klein, "Report on the Etiology of Scarlet Fever," *Sixteenth Annual Report of the Medical Officer of the Local Government Board*, 367-415.

[83] George Thomas Brown, "Report on Eruptive Diseases of the Teats and Udders of Cows in Relation to Scarlet Fever in Man," and Edgar Crookshank, "Report on a Diseas of Milch Cows in its Relation to Scarlet Fever in Man," in *Annual Report of the Agricultural Department of the Privy Council*, 1888. See also, A.M. Anderson, "Notes of a Peculiar Teat-Eruption in a Milch

maintained was the cause of the outbreak. Although it was perhaps ironic that medical, and not veterinary experts concluded that the Hendon outbreak was communicated through a zoonotic route, more to the point was that Brown and Crookshank could not repeat Klein's pathological experiments. It was not necessary that veterinary experts would also endorse the milk-borne zoonotic hypotheses, as such theories had practical implications to hurting the vested interests of the veterinary profession.

The outbreak of the so-called "Hendon cow disease" provoked a series of important questions with practical implications for the sanitary management of dairy farms. If Power and Klein were correct that scarlet fever germs in cows had the power of transmitting scarlet fever (and possibly typhoid, diphtheria, and tuberculosis) to humans, national dairy herd restrictions might hamper agricultural productivity. However, if Brown and Crookshank were right, and the "Hendon cow disease" was spread in the well-established route of human complacency and unsanitary infrastructure at dairy farms, there was a better chance of prevention through detection and isolation.[84] The fundamental etiological question, in other words, was whether milk was dangerous as a

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Cow, Coincident with an Outbreak of Typhoid Fever Amongst the Consumers of Milk," *BMJ* (16 September 1889), 116. Edgar Crookshank, "An Investigation into the So-Called Hendon Cow Disease, and its Relation to Scarlet Fever in Man," *BMJ*, vol. 2, no. 1407 (17 December 1887), 1317-1320. See also, Edgar Crookshank, "A Further Investigation into the So-Called Hendon Cow Disease," *BMJ*, vol. 1, no. 1412 (21 January 1888), 122-127. In 1879 Klein had been working on the pathological distinction between smallpox and cowpox, so it is unlikely that he would have mistakenly confused the two in 1885. See, *Ninth Annual Report of the Medical Officer of the Local Government Board, 1879,* ix. Susan Jones has clearly documented Crookshank's later scientific research with milk-borne tuberculosis. See, Susan Jones, "Mapping a Zoonotic Disease: Anglo-American Efforts to Control Bovine Tuberculosis Before World War I," *Osiris* (2004), 19: 133-148.

[84] Leonard Wilson, "The Historical Riddle of Milk-borne Scarlet Fever," *Bulletin of the History of Medicine* (1986), 60: 330.

result of an infection of the cow or in infection acquired through contamination from the environment.

At stake was a larger question of what group of experts- veterinary inspectors or MOsH-the government was to rely upon in managing the potential dangers produced at British dairy farms. The 1885 Dairies, Cow-sheds, and Milk-shops Order had firmly placed this power in the hands of the Privy Council, and thus the Veterinary and Agricultural Departments.[85] The LGB had some legislative power, however, notably through their administering of the 1875 Sale of Food and Drugs Act, which privileged the role of public analysts, in chemically testing the quality of milk.[86] MOsH received some redress in 1890 when Parliament passed the Infectious Diseases Prevention Act, which allowed MOsH to inspect dairies suspected to be the source of milk-borne outbreaks and gave MOsH increased supervision of railways. There were two cumbersome stipulations, however. A MOH had to prove that a member of his district was suffering from an infectious disease attributable to a particular dairy, and he had to obtain permission from the local authority where the dairy resided before he could inspect the dairy. In addition, an MOH could not inspect dairy cattle unless accompanied by a veterinary surgeon. The legal framework, as one MOH noted in the early twentieth century, was "quite worthless in practice, as it takes three or four days at least to get in motion, and then further delay

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[85] Anne Hardy has argued that British governmental officials typically viewed animal diseases in agricultural and economic terms. See, Anne Hardy, "Professional Advantage and Public Health: British State Veterinary Service, 1865-1939," *Twentieth Century British History*, (2003), 14: 1-23.

[86] In 1886 some administrative power in designing the Contagious Diseases (Animals) Act- and thus the Dairies, Cowsheds, and Milkshops Order- was transferred from the Privy Council to the Local Government Board. However, the Privy Council retained the authority to approve or revoke the implementation of the 1885 Act by local authorities.

may be achieved by the dairyman."[87] An MOH, in the words of F. Lawson Dodd, "who suddenly discovers one [a milk-borne outbreak] in a London borough has to go through a series of formalities and legal technicalities which rob the Act of practically all its utility."[88] Enforcement of the 1885 and 1890 Acts remained the pressing problem into the early twentieth century. According to MOsH, this was because the management of dairy farms had become too much a veterinary, and not sanitary issue. Veterinary experts, not surprisingly, claimed equal authority on milk-related issues. George Fleming's two volume 1875 *A Manual of Veterinary Sanitary Science and Police*, the most widely read veterinary manual, noted that "the inspection of milk should be no less the function of the sanitary veterinary surgeon than that of the flesh."[89]

Aside from legal restructuring, many argued by the early twentieth century that what was really needed was a more open discourse between sanitary and veterinary authorities. Well-known Manchester bacteriologist Sheridan Delepine tempered his call in 1897 for increased sanitary presence in dairy regulation by noting that "I am not, in saying this, overlooking the importance of the agricultural interests, but as the protection of human life is an object of paramount importance, I am convinced that more good will

[87] F. Lawson Dodd, *Municipal Milk and Public Health*, (London: The Fabian Society, 1905), 12.
[88] F. Lawson Dodd, *The Problem of the Milk Supply* (London: Bailliere, Tindall & Cox, 1904), 51.
[89] George Fleming, *A Manual of Veterinary Sanitary Science and Police* vol. 2 (London: Chapman & Hall, 1875), 579.

be obtained by harmonious joint action of the veterinary and medical professions than by independent action of either."[90]

Change from within the Dairy Industry

Historians of public health have tended to assume that either scientific discovery or increased legal structure through compulsory Parliamentary legislation and local enforcement provided the main impetus for large-scale sanitary reform. In previous chapters I have argued that advances in epidemiology and analytical chemistry provided direct evidence for improving the dairy industry, particularly with regards to preventing the adulteration of milk. As stated above, however, compulsory Parliamentary legislation on sanitary matters at dairies remained controversial, and thus largely went unfulfilled until the early twentieth century. I argue below that the impetus to reform dairy practices stemmed from an eclectic mix of central interference, local investigative and legal prodding by MOsH and public analysts, and from within an influential segment of the dairy industry itself.[91]

Interest in dairy reform among dairy farmers was particularly evident from the 1880s, but dairy farmers were a heterogeneous group with a diverse set of economic and professional interests. Those that called for dairy reform were generally either progressive agricultural writers or, more significantly, large-scale consolidated dairies.

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[90] Sheridan Delepine, "The Examination of Cow's Milk for the Detection of Pathogenic Properties," *The Journal of Comparative Pathology and Therapeutics* (30 September 1897), 10: 205.

[91] Anthony Wohl, for example, has shown that other late nineteenth century industries, such as those producing water or air pollution were antagonistic to reform based on economic and cultural incentives. See, Anthony Wohl, *Endangered Lives: Public Health in Victorian Britain* (Cambridge: Harvard University Press, 1983), chapters eight, nine, and ten.

Below I use the work of the most powerful of the latter, the Aylesbury Dairy Company, whose farming and business model set the standard for late nineteenth and early twentieth century progressive agriculturalists throughout Britain. The Aylesbury Company, as I argue below, represented the harmony of a model dairy farm with an agricultural research station. Aggregate dairy companies such as the Aylesbury Company demanded reform because of two fundamental assumptions such forward looking companies had reached by the 1880s; that the scientific evidence from public analysts and epidemiologists that milk could spread dangerous infectious diseases was beyond dispute, and that they therefore needed to be embraced rather than ignored, and that improving the quality of milk and standardizing dairy practices would ultimately phase out low-cost rivals, typically rural and independent small-scale dairy farmers who often adulterated their milk. The ultimate goal of late nineteenth century progressive companies such as the Aylesbury was a complete transformation of the dairy industry, whereby independent farmers and urban street peddlers could be made redundant in favor of a smaller, and more tightly controlled industry. This was foremost, I argue, an economic incentive that led to such political clamoring. But, as I show below in the case of the Aylesbury Company, medical and agricultural scientists such as Paul Vieth played an important role in shaping the ways that the new scientific dairy industry, as it was increasingly called, came to understand and accept the role that milk played in spreading dangerous infectious diseases.[92] Many MOsH and public analysts, in turn, favored the expansion of large-scale companies such as the Aylesbury, as it allowed for easier milk

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[92] Peter Atkins, Sophistication Detected: Or, the Adulteration of the Milk Supply, 1850-1914," *Social History* (Oct., 1991), 16: 324-325.

regulation and inspection. Yet, not all dairy farmers embraced this progressive, scientifically-driven ethos, and some went as far as to completely challenge scientific hypotheses and technological innovations. Late nineteenth century dairy reform, it must be conceded, was multi-sided, and reform manifested in different forms from farmer to farmer. The pattern, nonetheless, was a gradual one whereby large-scale dairy companies, embracing the new sciences of analytical chemistry, epidemiology, veterinary science, and bacteriology, steadily out-competed small, independent dairy farms unwilling to go into contract with large companies. "Only the most efficient could hope to survive," Charles Rosenberg has argued, which was "a Darwinian calculus [that] dictated that marginal farmers, those unable to incorporate the teachings of science and the logic of efficiency in their operations, must leave the land to more capable hands."[93]

The Aylesbury Dairy Company, initiated in 1865 and legally incorporated in 1868, was the nascent progenitor of early twentieth century Anglo-American model dairy farming.[94] The Aylesbury's business model was a complex mix of a balanced, integrative system: they had their own massive, 1,400 acre dairy farm located in Horsham, Sussex; they contracted over fifty additional farmers to supply milk; and they mixed and retailed the mass of milk at their formidable London milk depot at St. Petersburgh, Bayswater. "Our Company are themselves the retailers," G. Mander Allender, the Aylesbury's

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[93] Charles Rosenberg, "Unintended Consequences: The Ideological Shaping of American Agricultural Research, 1875-1914," in *No Others Gods: On Science and American Social Thought* (Baltimore: The Johns Hopkins University Press, 1997), 188-189.

[94] Aylesbury Diary Company Records, N.A. Kew, BT 31/14403/3966. See also, J.H. Bartlett, "The Aylesbury Dairy Company," *The Times* (21 December 1877), 29131: 4.

founder and director noted, "and we have complete control over our milk."[95] The aim of the Aylesbury Dairy Company was to regulate and check the quality of the milk they received from various dairy farmers, and they only went into contract with a farmer after thorough inspection by a sanitary engineer, veterinarian, public analyst, and local medical officer of health.[96] The Aylesbury Company imposed heavy fines on farmers if they failed to report the existence of any infectious disease on their farms, or if the company's public analyst found them to have adulterated their milk. The Aylesbury Company regularly inspected the farms by hiring a full-time sanitary engineer, a public analyst, and a MOH.[97] Essential to the reformist ethos of many progressive companies, the Aylesbury purposely attempted to forge an intimate relationship between the dairy industry and medical and agricultural science, as well as the British public. In 1887 the Director of the Aylesbury Company, G. Mander Allender, invited the SPA, MOsH, and prominent members of the Local Government, the Agricultural Department of the Privy Council, and the Royal Veterinary College, to visit the company's model dairy farm in Horsham.

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[95] Society of Public Analysts, "Proceedings of the Society of Public Analysts, Visit of the Society of Public Analysts to the Farms of the Aylesbury Diary Company on the 9th June, 1887," *The Analyst* (1887), 189.

[96] Ibid, 183-190. See also, Anon, "Milk Supply," *Littell's Living Age,* fifth series (1878), 21: 383-384. The Aylesbury developed their own specialty milk cans, which were said to be more resilient during railroad transportation, and won a prize competition of the Society of Arts.

[97] Harold Swithinbank and George Newman, *The Bacteriology of Milk* includes a form used by the Aylesbury Company to contract milk with dairy farmers. See, Harold Swithinbank and George Newman, *The Bacteriology of Milk* (London: John Murray, 1903), 581. Ernest Hart noted was responsible for advising company on sanitary matters. See, Ernest Hart, "The Influence of Milk in Spreading Zymotic Disease," *Transactions of the Seventh Session of the International Medical Conference of 1881*, (London: J.W. Kolckmann), 495. The Aylesbury company also reinforced sound dairy practices by establishing a competition amongst its farmers for the richest milk produced throughout the year, awarding £50, £35, and £20 per annum to the top three farmers. See, Anon., "Researches on Milk," *BMJ* (29 May 1880), 1013: 823.

The group assembled at the Horsham farm on 9 June 1887, and from the reports of the SPA in *The Analyst*, all of the members were thoroughly impressed. Alfred Allen, then President of the SPA, "thought he was in Arcadia, and on going through the premises he saw that he was in Hygeia, and he was bound to confess that these two words were not always synonymous as they were in the present case."[98] Alexander Wynter Blyth, MOH for St. Marylebone, was impressed by the company's knowledge of current chemical and epidemiological work, particularly in their acceptance of the milk-borne hypothesis. Blyth noted that this was common of large companies, indicating the important ways in which chemical and epidemiological studies could have a direct impact on the dairy industry.[99] Ernest Hart, who was as a sanitary adviser to the Aylesbury from the 1870s, was also present for the historic meeting. Hart noted that the aim of the company was,

> To take a healthy cow, to keep it under healthy conditions, and to see that their receptacles and everything coming into contact with the milk were kept free from pollution. This done, they could well afford to leave the rest to the two

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[98] Society of Public Analysts, "Proceedings of the Society of Public Analysts, Visit of the Society of Public Analysts to the Farms of the Aylesbury Diary Company on the 9th June, 1887," *The Analyst* (1887), 188.

[99] Blyth was certain that "if we are to drink milk at all the supply must be managed by large companies." Ibid, 188. Blyth had already made this and similar arguments about the control of the milk supply in a paper he read on 19 February 1886 before the Society of Medical Officers of Health. See, A. Wynter Blyth, and Alfred Spencer, "On the Protection of Milk from Contamination, and the Measures Necessary for Maintaining the Purity of Milk Supplied to the Metropolis and other Towns," Transactions of the Society of Medical Officers of Health, session 1885-1886 (London: Shaw and Sons, 1886), 73-91.

> departments of Government, who, he was sorry to see, instead of combining with each other in consultation, had appointed professors to fight with each other.[100]

Hart hoped that "those who had joined in the inspection of the farm this day would see that there was a combination of wealth and correct scientific knowledge, to produce milk which was distributed direct from the cow to the consumer… perfectly free from all disease germs."[101] This also, Hart concluded, should be the aim of every dairy company. It is clear from the comments of Hart and Blyth that numerous MOsH and public analysts supported the business model of large aggregate firms such as the Aylesbury. This particular kind of association, between industry and scientific experts, is indicative of the ways in which legislative loopholes actually worked against some segments of the dairy industry, who resorted by taking dairy reform into their own hands.

Proof that analytical and epidemiological science was crucial to the daily operations of large dairy companies by the 1880s can nowhere more clearly be found than in the case of Paul Vieth, who the Aylesbury Company hired in 1880 to serve as the dairy's public analyst, "so that they might be able to extend the system of controlling the milk, as then carried on, to the largest scale, and give their customers the greatest possible security of a regular supply of good, pure milk."[102] Vieth, a German, came to England in 1881. He had been Gustav Fleischmann's chief assistant at the Dairy School and

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[100] Ibid, 190.
[101] Ibid, 190.
[102] Paul Vieth, "On Milk Analysis," *The Analyst* (1882), 7: 56.

Experimental Station at Raden, Mecklenburg.[103] Whereas in Britain demand for milk analysis first came from either MOsH, Public Analysts, or local or central governments, in Germany, Vieth noted, demand for analytical clarity came from dairymen themselves, who established experimental stations devoted to scientific research in agriculture.[104] Thus, Vieth's involvement with the Aylesbury Dairy Company was in part a German import, although the demand for Vieth's analytical services, and more generally his scientific clout, were clearly the prescient aim of the Aylesbury. Vieth used German methods of milk analysis, which similarly measured solids not fat and solids fat, but also added the outdated (in the British context) measurement of specific gravity, explained in chapter four. Vieth's analytical methods slightly differed, and his results were thus initially difficult to compare to British counterparts.[105]

Vieth's work with the Aylesbury had an enormous impact on forging an intimate connection between the dairy industry, science, and the regulatory framework established by the 1875 SFDA. Vieth bridged the gap, because, from the early 1880s, he was a prominent member of the Society of Public Analysts (SPA). While there was still ancillary animosity between the SPA and the Government Laboratory at Somerset House, as I outlined in chapter four, Vieth's work proved that cooperation at least existed between some progressive members of the dairy industry and public analysts, MOsH, and

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[103] Vieth had considerable experience in milk analysis. See, Paul Vieth, *Die Milchprufungs-Methoden und die Controle der Milch in Stadten und Sammelmolkereien,* (Bremen: Heinsius, 1879).

[104] Ibid, 54. The first German experimental station was developed by Fleischmann in Mecklenburg, established in 1876.

[105] Vieth realized his analytical results would not be directly applicable compared to SPA standards, but argued that in practice many Public Analysts used slightly different methods.

sanitary engineers. The SPA continued to produce extensive reports in *The Analyst* on the constituents and normal range of pure milk, even issuing a "Milk Committee" that met from 1883 to 1885 and visited Vieth at the Aylesbury Dairy Company.[106] By the 1880s public analysts were more receptive to the variation of normal milk due to a wide range of factors, which James Bell and the Government Chemists had long argued. This induced the SPA to slightly alter the older standards of solids not fat and solids fat established in the 1870s by James Alfred Wanklyn. As we will later see, the SPA maintained that Parliament should pass a universal, legal standard for milk, a measure that was eventually accomplished in the early twentieth century.

In 1882 Vieth began publishing a voluminous number of reports on milk analysis which he had conducted at his Aylesbury laboratory, representing the ways in which pure, biological or chemical science could be combined with applied agricultural science. Vieth's first British report on milk appeared in *The Analyst* for 1882, where he explained his German background, methodology, and the sanitary workings of the Aylesbury Dairy Company, where his practice was to analyze between forty and sixty samples of milk per day. Vieth believed that a greater cooperation between public analysts, the dairy industry, and the public was the only way to curb milk adulteration. In 1885 he began to provide

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[106] The visit to the Aylesbury also included several well-known MOsH. See, Bernard Dyer, "Some Analyses of Milk," *The Analyst* (1881), 6: 59-62, Charles Cameron, "Results of Analyses of the Milk of Forty-Two Cows," *The Analyst* (1881), 6: 75-78, Paul Vieth, "On Milk Analysis," *The Analyst* (1882), 7: 53-60. The "Milk Committee" was comprised of several of the most well-known public analysts; A. Wynter Blyth, Dupre, Bernard Dyer, Charles Estcourt, Otto Hehner, Charles Heisch, George Wigner, and Vieth himself. See "Report of the Milk Committee," *The Analyst* (1885), 10: 216. See also, Anon., "Milk Supply," *BMJ* (18 June 1887), 1381: 1349-1350. There was an earlier visit to the Aylesbury Company in 1880 by a number of well-known MOsH and Public Analysts. See, Anon., "The Protection of Milk-Supply," *BMJ* (18 December 1880), 1042: 989.

instruction in analytical chemistry to the public, "open to both ladies and gentlemen," as advertised in *The Lancet* that consisted of four lectures with demonstrations.[107] Vieth's position that the public might have a role in suppressing adulteration was perhaps a way to augment the wider public concern about milk quality, but it could also have been a way to further unite the dairy industry, science, and the British public.

Between his arrival in England in 1881 and return to Germany in 1892, Vieth undertook a massive study of cow's milk, analyzing over 120,000 samples.[108] He was in close contact with the SPA and published many of his results in the *Analyst*. In 1887 he also published a small pamphlet titled *Easy Methods for the Examination of Milk* to make his results more accessible to the public and dairymen, again reinforcing Vieth's insistence that both the dairy industry and the public had an important role in curbing adulteration.[109] Vieth was also deft in addressing his scientific colleagues and advancing scientific methods in milk analysis. In a later publication in 1889 in the *Journal of the Royal Agricultural Society of England* Vieth produced a number of influential charts that clearly showed the complex range of values in total solids, solids not fat, and solids fat. Vieth differentiated by breed and time of year.[110] Vieth's work at the Aylesbury highlight the ways in which industry, science, and political bureaucracy were beginning to change

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[107] Advertisement for Aylesbury Dairy Company, *The Lancet* (23 May 1885), 37. Each course was limited to twelve students, and cost £2 2s.

[108] Paul Vieth, "Fat-extraction and Fat-calculation in Milk Analysis," *The Analys*t (1891), 16: 206.

[109] Paul Vieth, *Easy Methods for the Examination of Milk* (Aylesbury: The Aylesbury Dairy Company, 1887). See also a review of the pamphlet by William Crookes in *The Chemical News* for 17 June 1887, 283.

[110] Paul Vieth, "The Composition of Milk Produced on English Dairy Farms," *Journal of the Royal Agricultural Society of England*, second series (1889), 25: 180-202.

in the late nineteenth century. The dairy industry, like many others in this period, were beginning to use science as a political maneuver to gain a greater hold of the market, which was part of a larger project to connect science with social and industrial progress.

The scale of Vieth's analytical work on milk with the Aylesbury Dairy Company was unprecedented, so much so that Bernard Dyer later noted that "it would be difficult to overestimate the value to dairy chemistry of the work of Vieth."[111] Vieth returned to Germany in 1892 to the lucrative position of Director of the State Dairy Research Institute at Hemeln in Hanover, but his impact on British dairy research was lasting. Chris Otter has recently argued as much, commenting that "Alyesbury showed that technical control and monitoring were not incompatible with a successful business: the technological mediation of market and public was evolving."[112] Vieth's successor at the Aylesbury, Henry Droop Richmond published his own lengthy handbook in 1899 titled *Dairy Chemistry: A Practical Handbook for Dairy Chemists and Others Having Control of Dairies*, which relied extensively on Vieth's earlier experiments on milk.[113] By Richmond's time there were a number of technological advances in dairying, from Soxhlet's lactometer, Stokes' Tube, Beimling's Separator, and the Oleo-refractometer, all

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[111] Bernard Dyer, *The Society of Public Analysts and other Analytical Chemists: Some Reminiscences of its First Fifty Years* (London: W. Heffer & Sons, 1932), particularly 22-26.

[112] Chris Otter, "The Vital City: Public Analysis, Dairies and Slaughterhouses in Nineteenth-Century Britain," *Cultural Geographies* (2006), 13: 526.

[113] Henry Droop Richmond, *Dairy Chemistry: A Practical Handbook for Dairy Chemists and Others Having Control of Dairies* (London: Charles Griffin and Company, 1899). Richmond received excellent training in analytical chemistry by Otton Hehner, one of Hassall's earliest students.

of which increased the capacity of demand by farmers to usher in a new era of scientific dairying.[114]

As aggregate dairy companies became more commonplace in the second half of the nineteenth century, largely displacing small urban cow-keepers, they increasingly demanded official standards for the composition of milk. Influential agricultural writer James Long, in his official testimony to the 1894 Committee on Food Products Adulteration, reported that most large dairies similar to the Aylesbury Company, already had strict rules with the farmers that supplied them milk. One contract stated that "if it should be certified by the company's analyst for the time being that the milk supplied under this contract contains less than 3.25% of fat solids, or less therefof than 8.75% during the months of June to March inclusive," than the company had an official course of legal action.[115] Such practical reforms by larger farms sought to ameliorate the feculent sanitary management by small-scale and largely rural dairy farms.

Prominent agricultural writers echoed the condemnation of small rural dairy farmers. James Long's 1885 *British Dairy Farming* recommended that rural dairy farmers, like their aggregate colleagues, take sanitary reforms into their own hands. He argued that,

> The farmer and dairyman can be assisted in many ways by science, but it is of no use to help the man who will not help himself. He has a great deal to learn which he is slow to approach; he must reform his method of handling the milk from its

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[114] A full range of illustrated milk testing equipment recommended by dairy farmers and analytical chemists alike can be found in *The Dairy Messenger* (1890), 2: 4-28.

[115] Testimony of James Long, dated 20 July 1894, *Report from the Select Committee on Food Products Adulteration* (253), 114.

> leaving the cow to its dispatch from the farm; and it is no exaggeration to say that to-day, nine milk producers out of ten pursue the system of their forefathers without the least intention of changing it.[116]

MOsH could also assist the proper supervision of dairy farms. One dairy writer noted that,

> Competent medical inspectors would relieve the responsibility which often presses heavily and unduly upon the producer, but the stupid interference of ignorant country policemen only harasses and annoys, whilst, it never prevents any of the evils it seeks to eradicate. The medical officer of health is the brain, and the sanitary officers he has under him are the eyes and hands, to whose vigilance this work ought to be committed, and we hope before long the resolution above quoted may be carried into effect in every parish in the land.[117]

It is possible that heavy-handed rhetoric led both large-scale dairy companies, progressive agricultural writers and MOsH and public analysts to denounce rural dairy farmers as inept and unsanitary.[118] However, in reality it seems that the reformist claims of writers such as Long were substantially pragmatic, as an overwhelming majority of rural British dairymen were out of touch with the emerging field of scientific dairying, which included new technologies aimed at preventing milk contamination, adequate milk

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[116] James Long, *British Dairy Farming* (London: Chapman and Hall, 1885), 6-7.

[117] Anon.,"Legal Points for Milk Prosecutions," *The Cowkeeper and Dairyman's Journal* (December 1880), 2: 76.

[118] See the discussion notes for Wynter Blyth's 1886 paper read before the Society of Medical Officers of Health. Joseph Smith, a rural MOH, echoed as much. Wynter Blyth, "On the Protection of Milk from Contamination, and the Measures Necessary for Maintaining the Purity of Milk Supplied to the Metropolis and Other Towns," Transactions of the Society of Medical Officers of Health, Session 1885-1886 (London: Roberts & Leete), 73-91.

storage and refrigeration, and familiarity with milk analysis and the role of milk in spreading infectious disease. *The Cultivator and Country Gentleman,* a rural agricultural journal, for example, noted in 1887 that milk houses should be "neat, and dry, and cleanly, as in a lady's parlor," but it was clear that this was rarely the case in most dairies.[119]

MOsH, public analysts, and sanitarians in general blamed rural dairy farmers as well, suggesting a very real alliance between progressive dairymen and dairy-related scientists. Ernest Hart noted in 1881 that sanitarians had frequently chalked up milk-borne outbreaks to the improper "*washing* [of] the milk-cans," which had by then become "a convenient euphemism advisedly employed to avoid raising unpleasant questions."[120] In reality though, improper washing of milk cans and utensils often played significant roles in spreading milk-borne outbreaks. Cornelius Fox, MOH for Essex, noted in 1876 that he had witnessed a "milk-vendor milking his cows into a pail which resembled a filthy pig's bucket."[121] Hubert Airy, in a report on milk-borne typhoid in Chichester, laid out a typical milking of a local dairy farmer. His detailed narrative is a useful and glaring example, and therefore deserves to be quoted in full:

> The operation of milking is performed in an old boarded five-stalled milking-hovel…The milkman, having brought the cans clean from the dairy, takes them

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[119] Editor, "Building a Milk-House," *The Cultivator and Country Gentleman* (1887), 52: 425.

[120] Ernest Hart, "The Influence of Milk in Spreading Zymotic Disease," *Transactions of the Seventh Session of the International Medical Conference of 1881*, (London: J.W. Kolckmann), 493. Charles Booth corroborated as much, noting that "the practice of "washing" or watering the milk, though still very prevalent, is less common than it was." Charles Booth, *Life and Labour of the People in London*, 183.

[121] Cornelius B. Fox, "The Dissemination of Zymotic Disease Amongst the Public by Tradespeople," *BMJ* (9 December 1876), 745.

> straight to the hovel, never rinsing them in the stream. Having gathered his cows, and girded himself with a coarse apron, he proceeds to wash the udder of the cow he is about to milk, the udder being often soiled with the cow's own droppings or from lying in the meadow. For this purpose he resorts to a bucket which has been filled from the Lavant stream, when running. In times of drought he carries with him some water from the dairy pump instead. Having cleansed the udder and his own hands he rapidly wipes them with his apron, and proceeds with his milking. His hands occasionally are moistened with the milk, and anything remaining from the previous washing on his hands or the cow's teats is thus brought into contact with the milk.[122]

That sanitarians such as Fox and Airy were active in condemning the appalling conditions of rural dairies is perhaps not surprising, even if its use was largely rhetorical, particularly considering the keen interest with which MOsH attacked the 1878 Contagious Diseases (Animals) Act and the 1885 Milkshops Order. Such calls, as we have seen, echoed those made by progressive large-scale dairy companies and some agricultural writers, suggesting that cooperation between science, the dairy industry, and the British public was the solution to the milk problem.[123] This was perhaps a result of the near universal acceptance by all interested groups of the disjointed failure of existing

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[122] Hubert Airy, "Report to the Local Government Board on an Outbreak of Enteric Fever in Chichester," *Annual Report of the Medical Officer of the Local Government Board*, dated 24 July 1879, 3.

[123] Rural dairy practices were still being admonished by public health authorities in the early twentieth century. See William George Savage *Milk and the Public Health* (London: Macmillan, 1912), particularly chapter fifteen.

Parliamentary legislation on food adulteration and the sanitary management of the milk trade.

Interest by aggregate companies such as the Aylesbury Company to reform the dairy industry was part of a more general process of institutional and professional reform in agriculture in the late nineteenth century. Progressive dairymen could join the ranks of the British Dairy Farmers' Association from 1876, which served dairy interests throughout the country. The organization became increasingly active in the mid 1880s, particularly with the creation of the British Dairy Institute at Aylesbury in 1888.[124] Local dairy organizations were also extensively prevalent by the 1880s, including major groups in Manchester, Liverpool, Birmingham, Bristol, Edinburgh, Glasgow, Southampton, and Portsmouth.

Such professional groups lobbied for a variety of vested interests, and not all late nineteenth century dairymen favored the type of progressive reform epitomized by the Aylesbury Company. Small-scale, independent farmers tended to eschew aggregate companies as well as new trends in the scientific management of dairy farms. Their fear, it seems, was being subsumed by a larger company and forced to follow stricter regulations, making theirs an economic motivation as well. One example is the London Metropolitan Dairymen's Association, whose aim was "exclusively devoted to the interests of the dairy trade," and who published *The Cowkeepers and Dairyman's Journal*

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[124] In 1896 the Institute moved to the University of Reading. The British Dairy Institute was keen to emphasize new technological and scientific advances. It also provided dairy education to women. See, Sally McMurry, "Women's Work in Agriculture: Divergent Trends in England and America, 1880 to 1930," *Comparative Studies in Society and History* (April 1992), 34: 248-270. On the relationship between dairy education and education reform in general, see, Thomas Birkett, *State Aid for Dairy Education* (Edinburgh and London: William Blackwood and Sons, 1887).

from 1879.[125] The metropolitan group was particularly bothered about metropolitan MOsH, who had been striving from the 1850s for increased dairy regulation within London, and to metropolitan public analysts, whose fixed standards of milk were seen as unfair to small dairymen whose cows underperformed.[126] Dairymen who could not afford adequate space for dairy operations or new technologies aimed to make dairying more sanitary or ensure the purity of milk were motivated to keep the status quo of the industry, and thus, defended a murky definition of adulteration and a contempt for pesky governmental or scientific agents. One writer in *The Cowkeepers and Dairyman's Journal* claimed that concern over milk-borne typhoid in Glasgow was merely a product of the fancies of local women who,

> Argued, they entreated, they upbraided, they implored- till at length their distracted husbands, finding themselves unable to resist such cogent arguments, rushed forth in a state of desperation, and, taking to themselves infinite credit for manly, independent though, enlightened public spirit, and decision of character, they marched in one imposing phalanx to the Chief Magistrate, and demonstrated to him the absolute, urgent, and imperative necessity of convening a public meeting, on the earliest possible day, to consider the milk supply. In this way was inaugurated the great movement, which has since extended to every corner of the three kingdoms, and seems for the present to be strongest of all in London. The

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[125] *The Cowkeeper and Dairyman's Journal* (1879), 1: 1. The journal was edited by Edward George Easton, secretary to the Metropolitan Dairymen's Society. Although the journal was receptive to problems throughout the country, both urban and rural, it was more concerned with problems in the metropolis.

[126] The most contentious issue was the affixing of official standards for ventilation and cubic feet for cow-houses issued by the Board of Works in the late 1870s. Most dairymen in the metropolis assumed that all MOsH wanted dairying to be excluded from London.

> history of it is simple and natural, and reflects the highest credit on the affectionate feelings and consummate tact of the fair authors of the movement- the Glasgow ladies.[127]

Examining trade journals such as the *Cowkeeper and Dairymen's Journal* reveals that dairy farmers interchangeably called milk-borne outbreaks "milk scares," "milk fevers," "lacteal crises" and the general term "the milk problem," which gives useful insight into the conceptualization and fear of the scientifically driven milk-borne hypothesis. "What we protest against," one dairy farmer argued, "is the exaggerated and cruel amount of alarm that is from time to time raised in connection with the milk supply."[128] Such was a very real fear, and an epidemiologist or public analyst who accused a dairy farm of supplying adulterated milk which caused an outbreak of typhoid or scarlet fever risked a substantial loss of business, or even in some cases, a hefty fine if they were contracted with an aggregate company.

Although it is difficult to generalize what motivated dairy farmers in the late nineteenth century, it was probably clear even to small-scale dairymen by the mid 1880s, despite Parliamentary legislation, that the scientific management of dairy farms was the way of the future. Some dairy farmers seemed to embrace such changes, while others

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[127] Dr. Andrew Buchanan, "On Milk," *The Cowkeeper and Dairyman's Journal* (January 1880), 2: 71-74, 73.

[128] Ibid. It seems that by the early 1880s many dairy farms thought the milk-borne hypothesis was simply a popular fad that MOsH and LGB inspectors would use if no apparent etiological cause could be found. Many thought that more important were impure water, sewage contamination, defective drainage, ventilation, poverty, and general filth. There were opposing opinions on the etiological matter even in the 1870s however. One dairy farmer, writing in *The Times* stated that milk could be adulterated either by using vessels contaminated with sewage laced water, by having such water blatantly added, or by the influence of a polluted atmosphere. See, Anon. (Signed, "An Old Dairy Farmer"),"Cowhouses," *The Times* (21 April 1876), 28609: 10.

stubbornly clung to routine practices. It remains, however, that by the 1880s the impetus was clearly in favor of increased inspection and registration, "which, if properly carried out would eliminate the whole class of persons whose unhealthy surroundings render them totally unfit to have any dealings whatever with so delicate an article as milk."[129] In reality, however, the milk production and transportation system was a complex mess by the late nineteenth century. Rural dairy farmers bemoaned that milk was often adulterated after it left the farm by unscrupulous dealers, railway workers, or street peddlers. Urban milk dealers, meanwhile, calculated that mischief was chiefly due to the unsanitary state of rural dairy farms and unsound transportation practices.

No doubt dairy farmers were largely concerned about milk-borne outbreaks vis-à-vis an economic motivation to maximize profit, but it would be naïve to think that this was their only motivation.[130] Business could be hampered by news of a milk-borne outbreak, which helps explain the heightened degree of scientific skepticism on the part of some dairymen well into the 1880s, when the milk-borne hypothesis was an established etiological principle to epidemiologists, general medical practitioners, and chemists.[131] A more nuanced view is that dairy farmers unevenly used scientific evidence about milk in order to position themselves in a rapidly changing industry. Milk drinking,

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[129] Anon., "Bristol Infected," *The Cowkeeper and Dairyman's Journal* (June 1880), 2: 145.

[130] This position is well articulated in Ernest Mathews, *Economies in Dairy Farming* (London: Country Life, George Newnes, 1903).

[131] Not surprisingly, dairy farmers held a concomitant number of views. One farmer noted that milk could be contaminated in three ways; the cow could be attacked, the person milking the cow could transmit disease germs into the milk, or sickness could pervade in the store, shop, or milk house and enter the milk. See, ibid, (March 1881), 98. A later writing in *The Cowkeeper and Dairyman's Journal* noted in 1882 that "it has for many years been known that there is no more dangerous medium for the spread of typhoid fever than milk." See Anon., "How Infectious Diseases are Spread," *The Cowkeeper and Dairyman's Journal* (August 1882), 4: 183.

particularly by urban Britons, substantially increased in the 1880s and 1890s, which also helps explain the economic concern by dairy farmers. J.P. Sheldon, dairy farmer and widely influential agricultural writer put it most succinctly when he said that "the milk trade is the 'sheet-anchor' of English farming."[132] By the 1880s the milk trade was also more profitable than arable land farming. In official testimony before a 1879-1880 Parliamentary inquiry into agricultural depression, John Coleman, a land agent, noted the preference for dairy farming, which "brings the greatest return and the quickest… it is grass one day, milk the next, and money in the farmer's pocket the next."[133]

Apart from specialist periodicals such as *The Milk Journal* and *The Cowkeeper and Dairyman's Journal*, a new class of farming manuals were increasingly available to dairy farmers in the 1880s. The most popular were the already mentioned James Long's 1885 *British Dairy Farming*, J.P. Sheldon's 1880 *Dairy Farming* (which was extensively illustrated) H.M. Upton's 1888 *Profitable Dairy Farming*, Robert Warington's 1881 *The Chemistry of the Farm*, and Canon Bagot's *Hand-Book on Dairy Factories*, and Muir's 1893 *Manual of Dairy Work.*[134] Agricultural reformers recommended thorough

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[132] J.P. Sheldon, "Dairy Farming: Fifty Years Ago and Now," *Journal of the Bath and West and Southern Countries Society*, fifth series (1907-1908), 2: 86-101, 96-97. See also, David Taylor, "The English Dairy Industry, 1860-1930," *The Economic History Review* (November 1976), 29: 585-601.

[133] Testimony of John Coleman, 13 May 1880, in *Preliminary Report from Her Majesty's Commissioners on Agriculture*, 202. See also the final version of the Agricultural Commission, Henry Chaplin, *Report from Her Majesty's Commissioners on Agriculture*, dated 11 July 1882, 30.

[134] Anon., "Dairy Produce," *Quarterly Review* (July and October 1887), 165: 298-326. See also, J.P. Sheldon, "Dairy Farming: Fifty Years Ago and Now," *Journal of the Bath and West and Southern Countries Society*, fifth series, (1907-1908), 2: 86-101. See also, H.S.A. Fox, "Local Farmers' Associations and the Circulation of Agricultural Information in Nineteenth-Century England," in H.S.A. Fox, and R.A. Butlin, *Change in the Countryside: Essays on Rural England, 1500-1900* (Institute of British Geographers, 1979), 43-63.

cleanliness in all dairy operations, from well-ventilated cow-houses to the steam cleansing of dairy utensils. White uniforms became the norm for dairy workers in the 1890s, when dairymen at large companies embraced what was increasingly called the scientific management of dairy farms. Rural dairy farms however, particularly those that operated on a small-scale, continued to be of sanitary concern well into the twentieth century. The prosecution of farmers and milk sellers who adulterated their milk, facilitated by the work of public analysts and the Government Laboratory at Somerset House, also continued to strain the regulation of the dairy industry. One longstanding solution that gained legislative priority in the 1890s was the legal fixing of an official milk standard.

Setting an Official Standard- Milk Regulation in the 1890s

Arthur Angell, Public Analyst for Southampton who had been trained by Arthur Hill Hassall, lamented in 1892 that "with regard to milk…undoubtedly it is high time that some minimum standard should be set up for the whole country."[135] The late Victorian social critic Charles Booth echoed as much in 1895, arguing that the greatest dairy question of the day was the fixing of a legal standard for milk.[136] In his widely influential *Life and Labour of the People in London,* Booth concluded a section on the dairy industry by advising that, "whatever be the end of the 'battle of the standard,' it seems only right that the honest dairyman should be protected from this unfair competition, and

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[135] Arthur Angell, "Analysts and Magistrates," *Food, Drugs, and Drink*, (8 October 1892), 6.
[136] Charles Booth, *Life and Labour of the People in London*, vol. vii (London: MacMillan and Co., 1896), 183-184.

that the sellers of milk which is not 'whole' should, if possible, be forced to notify the fact to the public."[137]

Angell and Booth's comments are indicative of the nature of the adulteration debate as it progressed into the 1890s.[138] Court prosecutions of dairy farmers and other adulterators were still hampered by feuds between local Public Analysts and the Government Laboratory at Somerset House. MOsH, meanwhile, thought that dairy legislation enacted in the 1880s failed to clearly regulate the sanitary aspects of dairy farming. This was complicated by the fact, as shown above, that dairy farmers were also gradually more conducive to advocate for Parliamentary reform predicated upon the fact that dairy farming was a more lucrative economic business in the second half of the nineteenth century.[139]

Official Parliamentary response came in 1894 with the formation of the first *Committee on Food Products Adulteration*. As Michael French and Jim Phillips have explored, renewed interest in adulteration in the 1890s culminated in the 1899 revision of the Sale of Food and Drugs Act (SFDA) of 1875. Throughout the 1890s, as it had been in adulteration debates from the 1850s, milk adulteration remained a central issue. The 1894

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[137] Ibid, 184.

[138] By the mid 1880s milk consumption patterns had significantly increased, particularly in urban areas. A. Wynter Blyth, MOH for St. Marylebone, found in 1884 that Londoners consumed approximately 110,000 imperial gallons of milk per day, with an overwhelming majority (76%) supplied by rural dairy farms and transported by rail. See A. Wynter Blyth, and Alfred Spencer, "On the Protection of Milk from Contamination, and the Measures Necessary for Maintaining the Purity of Milk Supplied to the Metropolis and Other Towns," *Transactions of the Society of Medical Officers of Health*, Session 1885-1886 (London: Roberts & Leete), 74.

[139] G.E. Fussell, *The English Dairy Farmer, 1500-1900* (London: Frank Cass & Co, 1966), 330. David Taylor, likewise, has argued that "the importance of the dairy industry in the last quarter of the nineteenth century is clear to see. Milk production was the largest single sector of English agriculture and the fastest growing of the major sectors." David Taylor, "The English Dairy Industry, 1860-1930," *The Economic History Review* (1976), 29: 589.

Committee's deliberations lasted approximately two years, with the final report of the committee being issued in July of 1896. The debates were all too familiar by the mid 1890s, and frustration was echoed by dairy farmers, MOsH, public analysts, the government chemists, sanitarians, and local authorities. The issue of the milk standard was particularly important.

Christopher Middleton, dairy farmer in Yorkshire, for example, made it clear in his official testimony that increased milk regulation was to the benefit of the trade. He claimed that all dairy farmers, milk retailers, and street peddlers should be registered, and that fixing an official standard of milk composition was to the advantage of honest dairymen.[140] Public Analysts, of course, enthusiastically agreed on the latter measure, as they had been advocating for it since the 1870s. Although the official recommendation of the committee in 1896 was against fixing an official milk standard, they did not "lose sight of the advantages which may be expected to accrue from the fixing of a milk standard."[141] Many dairy farmers, it seemed, still feared that pure milk would often fall below any arbitrary standard. The Government Chemists also maintained their longstanding argument that too low a standard would simply encourage dairy farmers to water down their milk to the official standard. Despite these concerns, the issue was seemingly resolved by the 1899 SFDA Act, which, as French and Phillips have shown, allowed the Board of Agriculture to set minimum standards for not only milk, but also

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[140] Testimony of Christopher Middleton, dated 25 July 1894, *Report from the Select Committee on Food Products Adulteration* (253), 123. In his testimony agricultural leader James Long thought milk adulteration was an important issue to necessitate a separate 'Dairy Bureau.' "Dairying ought to have a special department and specially trained men, not men to-day analysing vinegar, to-morrow something entirely different, and the next day milk; they should only do work as to milk products."

[141] *Report from the Select Committee on Food Products Adulteration*, 9 July 1896, xxiv.

butter, cream, and cheese.[142] The 1901 Sale of Milk Regulations, for the first time in British history, set the minimum legal standards of milk at 3 percent of solids fat and 8.5 percent of solids not fat, the same standards used by the Society of Public Analysts.[143]

Although decisive, the fixing of official milk standards did not solve the longstanding problems in curbing milk adulteration. As French and Phillips have argued,

> The immediate impact of the regulations disappointed their supporters, failed to achieve the uniformity expected by the Committee and indicated the blurred line between *de facto* and legal standards.[144]

The question remained that once a sample fell below the official standard set by the 1901 Act, who was at fault: the cow, the farmer, the wholesale milk dealer, the railway company, the street peddler, or the consumer?

Given the social, scientific, and political complexity and entrenched historical precedent of the milk problem from the middle decades of the nineteenth century, it should perhaps not be surprising that milk adulteration remained a central issue in agricultural, administrative, and scientific circles well after World War I. By the early decades of twentieth century, as several historians have conclusively shown, the focus of the milk problem significantly shifted to that of infant welfare and the deterioration of the health of working class Britons. The solution by the early 1900s was the municipalization

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[142] French and Phillips, *Cheated not Poisoned*, 55-56.

[143] Sale of Milk Regulations, 9101, Statutory Rules and Orders, 1901, No. 657. The SPA had fixed the same official standards from the 1880s.

[144] French and Phillips, *Cheated not Poisoned*, 58. In another piece French and Phillips carry the issue into the late 1930s. See Jim Phillips and Michael French, "Adulteration and Food Law, 1899-1939," *Twentieth Century British History* (1998) 9: 350-369.

of the milk supply, the creation of model milk farms, and the enforcement of even stricter penalization of unsanitary farming practices and milk adulteration.[145]

Conclusion

Complete sanitary and agricultural reform of the dairy industry was not accomplished in the Victorian period. Leslie Mackenzie, MOH for Leith, provided a glaring example of the reality of the dairy business in 1898. He noted,

> To watch the milking of cows is to watch a process of unscientific inoculation of a pure, or almost pure, medium with unknown quantities of unspecified germs. Everywhere throughout the whole process of milking the perishable, superbly nutrient liquid receives its repeated sowings of germinal and non-germinal dirt...and this in good dairies. What must it be where the cows are never groomed and the udders are never washed, where the byres and never even approximately cleaned, where ventilators are never opened, where the pigs are a few feet away, where cobwebs are ancient and heavy, where hands are only by accident washed, where heads are only occasionally cleaned, where spittings are not infrequent, where the milker may be a chance comer from some filthy place, where, in a word, the various dirts of the civilized human are at every hand reinforced by the inevitable dirts of the domesticated cow?[146]

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[145] George Newman, "The Control of the Milk Supply," *BMJ* (27 August 1904), 2278: 421-429.

[146]Leslie Mackenzie, "The Hygiene of Milk," *Edinburgh Medical Journal* (1898) quoted in F. Lawson Dodd, *The Problem of the Milk Supply* (London: Bailliere, Tindall, & Cox, 1904), 13-14.

The problem, as articulated by agricultural writer F. Lawson Dodd, was the "ignorant and chaotic method of milk production and distribution."[147] Central oversight was not an obvious solution, despite the appeal made by aggregate dairy farms and progressive minded sanitary bureaucrats at the LGB. Even if centralization was politically viable, which it slowly became in the 1890s, the practical question remained of who was best to administer dairy-related legislation? The two best options, contemporaries realized, were either the Privy Council's Agricultural or Veterinary Department, or the Local Government Board's Medical Department. As I have shown in previous chapters, from the 1850s MOsH (and to a smaller extent nuisance removal inspectors) were in practice responsible for the sanitary supervision of both rural dairy farms and urban cow-sheds. Public Analysts also had a significant role in curbing milk adulteration as part of the 1875 SFDA. But, by the 1880s, as Parliamentary legislation increasingly became fragmented and more specialized, the Veterinary Department of the Privy Council gained a significant foothold into milk-related issues.[148] That dairy supervision was taken out of the hands of MOsH in the 1880s was a byproduct of the nineteenth century revolution in government, which brought increased levels of complexity to the central management of all aspects of Victorian life, from housing and schools to roads, fisheries, and water supplies. The 1890s ushered in a new era of the scientific management of dairy farms. Predicated upon new technologies of milk separation, refrigeration, transportation and analysis, many dairy farmers led the way in pushing for reform, although dairy farmers were, of course, a heterogeneous group. By the late 1890s some progressive MOsH, such

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[147] Ibid, 35.

[148] The Veterinary Department was transferred to the new Agricultural Department in 1883, and to the Board of Agriculture when the latter was established in 1889.

as James Niven, of Manchester, sought to integrate dairy inspection with bacteriological diagnosis (Niven worked closely with Sheridan Delepine, who relied on the Widal and Tubercular tests) and enforcement of isolation, which depended upon the knowledge and persistence of MOsH.[149] Nonetheless, most sanitarians commonly held to the belief by the end of the first decade of the twentieth century that much in the way of reform was still necessary. George Newman, for example, argued that "alarmist views and alarming measures receive ready support. But the problem in truth must be solved, as all great and complex problems, on broad lines and by slow progress."[150] Whereas the original framers of dairy and milk related legislation in the 1850s had envisioned a comprehensive and integrated system, by the turn of the nineteenth century the regulation of milk and the supervision of dairies were seen as two different problems housed in different administrative spheres. What was needed, George Newman argued in 1904, was not more legislation, but "a direct and uniform application and enforcement of the legislation which now exists," a suggestion which remained unfulfilled even by the end of the Edwardian period.[151]

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[149] James Niven, "On the Improvement of the Milk Supply of Manchester," *LSE Selected Pamphlets* (1896), 1-15. Sheridan Delepine, "Some of the Ways in Which Milk Becomes Pathogenic," *BMJ* vol. 1 issue 1934 (22 January 1898), 203-205. See also, Sheridan Delepine, "The Examination of Cow's Milk for the Detection of Pathogenic Properties," *The Journal of Comparative Pathology and Therapeutics* (30 September 1897), 10: 189-206.

[150] George Newman, "The Control of the Milk Supply," *BMJ* (27 August 1904), 2278: 421-429, 425.

[151] Ibid.

Conclusion

In late September 1887, George Buchanan, Chief Medical Officer of the Medical Department of the Local Government Board, wrote to Edward Ballard, one of the department's longtime inspectors, offering a promotion to Assistant Medical Officer. Ballard turned down the promotion. In a confidential memorandum to Buchanan on 6 October, Ballard poignantly replied,

> I regret that I cannot see my way distinctly to accepting your offer… like much greater men than my insignificant self, I am conscious of a 'mission,' a mission which is as yet incompletely fulfilled; namely, to add my quota of labour to the clearing-up of some obscure questions as to the causation of disease.[1]

Ballard's promotion to Assistant Medical Officer would have required more administrative duties, from preparing the Chief Medical Officer's Annual Reports, to drafting office memoranda and official responses to local sanitary authorities. The post carried with it more remuneration and elevated status; it was typically given to senior ranking inspectors who were nearing the end of their careers.[2] What it also meant, on a practical level, was abandoning the daily rigor of extensively traveling around Britain investigating local outbreaks of disease, a job description he began in the 1850s as the MOH for Islington. The Chief Medical Officer and his assistant instead worked full-time at the Medical Department's Whitehall office. Although Ballard was clearly unsettled at

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[1] National Archives, Kew, MH.113.8, letter from G. Buchanan to E. Ballard, 30 September 1887, and letter from E. Ballard to G. Buchanan, 6 October 1887.

[2] This has been clearly shown by John Eyler, *Sir Arthur Newsholme and State Medicine, 1885-1935* (Cambridge: Cambridge University Press, 1997.

the prospect of becoming a paper-pushing Whitehall civil servant (he called the work "uncongenial to my tastes") his chief concern appears to be his reluctance to ending his position as 'exterior' (or 'out-of-doors') Medical Inspector.[3] When the memorandum in question was written, Ballard had been one of the Medical Department's most important inspectors for over twenty years; he was particularly noted for his investigations of typhoid and scarlet fever, infant diarrhea, and industrial diseases such as arsenical poisoning and effluvia nuisances. The Medical Department's other inspectors were also chosen for their respective strengths in public health; for example, Edward Seaton specialized in vaccination inspection, and John Netten Radcliffe in water-borne and foreign epidemics, particularly cholera. The Medical Inspectorate's defining feature, perhaps, was their collective epidemiological breadth.

Ballard's austere insistence that he had yet to answer fundamental etiological questions is telling of the state of late nineteenth century epidemiology, in particular, and of late Victorian public health, in general. We have long known in the history of medicine that epidemiology played an important role in the creation of modern public health. We have assumed, however, that epidemiological methods, practices, and theories were quickly overtaken by bacteriology starting in the 1870s. This study has shown that epidemiology was at the center of public health practice in the second half of the nineteenth century, and that British public health authorities remained committed to scientific evidence about disease causation based on rural and urban field research. In the case of volatile debates over the threat of milk-borne disease, epidemiological science

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[3] NA, MH.113.8, letter from E. Ballard to G. Buchanan, 6 October 1887

was crucial in testing etiological hypotheses and locating the source and communication of infectious diseases such as typhoid fever. This was most apparent at the Medical Department of the Local Government Board and amongst medical officers of health, and this project sheds considerable historical light on the actual scientific practices and routes of communication of both. Often the staff of the Medical Department had previously served as local medical officers of health, such as Edward Ballard, John Burdon Sanderson, and John Simon. It is clear too that both MOsH and the Medical Department's staff played vital roles in professionalizing epidemiology through involvement at institutions such as the Epidemiological Society of London. A more in-depth analysis of the epidemiological practices at the Medical Department in the second half of the nineteenth century offers a promising lens through which to view the development of British public health. This study, which has largely focused on epidemiological research on water-borne and milk-borne outbreaks, only offers a tantalizing beginning to such an ambitious project.

This study confirms that Victorian public health was dependent upon a wide range of scientific experts, particularly epidemiologists, chemists, pathologists, veterinary surgeons, engineers, and bacteriologists. How these medical scientists practiced, debated, institutionalized, and attempted to professionalize is made more through examining specific public health problems such as the threat of milk in spreading deadly infectious diseases. A multiplicity of scientific expertise was needed: medical officers of health maintained watch over the health of dairy workers and the transportation of milk, veterinarians supervised the health of dairy cattle, analytical chemists tested the purity of milk, and staff at the Medical Department investigated milk-borne outbreaks in order to gain knowledge of how disease spread in communities. Yet, as I demonstrate in this study, these professional demarcations were not clear for most of the nineteenth century; veterinarians, I show in chapter five, sometimes claimed to be experts in the very same matters that MOsH or chemists did. This complex story has a great deal to tell us about how various scientific disciplines professionalized in the late Victorian period. Professional and practical lines were often obscure, and although science was beginning to obtain a culturally-specific and unified meaning in the late nineteenth century, in reality scientific practice was fractured and professional lines hotly disputed. Science became a state-supported enterprise in the last decade of the nineteenth century, largely because of a progressive cultural ethos which insisted that science could solve social problems.[4] The scientific research at the Medical Department that I explore in this study, epidemiological, chemical, and pathological, is an interesting historical precursor to a general process in the history of western science that was more fully formed by the early twentieth century.

Taking a critical lens to nineteenth century professional demarcations in science allows historians to shift their analysis to scientific practices. The latter were based on specific problems, some of which could be cast as pure science, but most were seen as applied science, relating to specific social problems. If we examine specific public health problems, as I do in this study, it becomes clear that while much was professionally at stake, there was room for collaboration in public health practice. I suspect this holds true for other public health problems in the late Victorian period, such as housing reform,

[4] George Gore, "On the Present Relation of Science to the British Government, and Public School Education," *Transactions of the National Association for the Promotion of Social Science* (1873) 279-284.

environmental pollution, or outbreaks of other infectious diseases. This study shows that veterinarians such as Arthur Gamgee and chemists such as Paul Vieth collaborated with MOsH in the 1860s and 1870s, and within the Medical Department epidemiologists such as Edward Ballard and John Netten Radcliffe depended on the pathological studies of John Burdon Sanderson and bacteriological studies of Edward Klein.

Historians of science, technology, and medicine have found productive ground in dichotomizing nineteenth and twentieth century field science from laboratory science, arguing that the two had opposing epistemiological functions and occupied different scientific spaces. Yet, this study of milk-related scientific practice does not entirely justify such a claim. Speaking of the important of both laboratory based studies by Edward Klein and epidemiological studies by the department's medical inspectors, George Buchanan noted in his *Nineteenth Annual Report of the Medical Officer of the LGB* that,

> Dr. Klein has been materially assisted in his laboratory researches by what I may call (for contradistinction's sake), the *field-observations* about the causation of diphtheria, made by Inspectors of my Department; and in return he contributes from his laboratory some precise information about the pathology, and especially the comparative pathology of the disease, available for future field-investigation into the ways of diphtheria in man.[5]

Yet this study also demonstrates some of the ways in which epidemiological science was limited in the second half of the nineteenth century. Epidemiologists were often back-end

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[5] George Buchanan, *Nineteenth Annual Report of the Medical Officer of the LGB,* page x.

medical scientists, investigating outbreaks of disease while they were either on the wane or had already subsided. Milk-borne outbreaks are an important demonstration of the problem of disease prediction, and late Victorian public health authorities realized by the mid 1870s that a vast array of scientific knowledge was needed to curb the initiation and spread of infectious disease through milk. In this context analytical chemists increasingly became important in testing milk and preventing milk adulteration. As demonstrated in chapter four, there was little official training in analytical chemistry, and local authorities faced a number of difficult and bewildering choices in responding to social and scientific pressures to keep milk safe. Even more problematic were the still poorly defined techniques and their interpretations in practical chemistry. In the case of the prevention of food adulteration, this became splintered between local public analysts and government chemists. Fierce debates between the Society of Public Analysts and the chemists at the Government Laboratory at Somerset House, explored in chapter four, centered on methodology- the best way to analyze milk- but also in interpreting results. Milk analysis became more standardized by the 1880s and 1890s as analytical chemists gradually recognized the myriad number of ways in which normal cow's milk varies, but debates over what constituted milk adulteration raged into the twentieth century.

Parliamentary legislation which vaguely defined adulterated milk and hardly punished convicted offenders did not help. Such legislation was typically permissive, and the defining feature of anti-adulteration legislation in the last two decades of the century, as I argue in chapter five, was its inability to bring together different types of scientific experts into an efficient system of disease prevention. Often veterinary officials were pitted against sanitary or chemical ones, and visa versa. At stake was professional status for scientific credibility for various groups of medical scientists, to be sure, but such debates point to a larger historical process of governmental growth, what historian Oliver MacDonagh called the "nineteenth century revolution in government."

At first glance the example of the milk problem seems to conform to MacDonagh's five-stage model (explained in chapter one), as weak and permissive legislation on milk adulteration was gradually replaced by compulsory measures through a process of scientific inspection and the closing of loopholes. Closer historical inspection of MacDonagh's model, which I have done in the previous pages, reveals several important conclusions. One, ineffective and permissive legislation was not simply the fault of bumbling Parliamentary officials, and often such problems arose out of conflicts between scientists or the inability of local administrators to effectively punish traders and manufacturers. Two, social problems became public health problems only through complex negotiations between scientists, legislators, industry, and various segments of British society. Three, in the case of the milk problem the dairy industry itself was largely responsible for curbing milk adulteration. This is a new historical finding, and one that sheds considerable light on some of the flaws of MacDonagh's model. As I show in chapter five, progressive dairy companies such as the one explored here, The Aylesbury Dairy Company, used scientific experts-veterinarians, chemists, MOsH, and sanitary engineers- in order to transform the dairy industry from a motley assortment of unsanitary rural dairy farmers to a consolidated group of large-scale and sanitary dairy companies. The trend towards scientific dairying, though, was not entirely successful, although it did successfully merge various parts of dairy-related science, industry, and the state. The importance is that this was accomplished outside of the regulatory framework of efficient Parliamentary legislation.

So how did milk become a public health problem in the second half of the nineteenth century? Perhaps unsurprisingly, the answer entirely depends on how one defines public health. It is clear from this study that public health meant different things to different people at different times. In the 1850s and 1860s milk adulteration was a public health threat as framed by Arthur Hill Hassall, Henry Letheby, and Thomas Wakley because adulterated milk had the potential to rob the customer of the nutritional benefits of milk. To many others milk adulteration was simply a social problem of the marketplace. By the mid 1870s epidemiologists such as Edward Ballard, Richard Thorne-Thorne, and John Netten Radcliffe intensified the concern over adulterated milk by showing that adulterated milk could in some circumstances spread deadly infectious diseases such as typhoid fever. This was a crucial scientific finding, and one that is at the heart of the argument made in this project. Arguing that milk could spread disease, particularly typhoid fever, fundamentally changed the way Victorians understood the relationship between disease, class, and the environment. The milk-borne hypothesis also had vital implications for how public health was shaped in the late Victorian period. Preventing milk adulteration necessitated cooperation among medical scientists, central and local inspectors, administrators, and various industries such as dairy farmers and railroad companies. This study confirms that analytical chemists, epidemiologists, sanitary engineers, bacteriologists, and veterinarians all claimed particular scientific expertise within milk-related science, which incorporated everything from the sanitary arrangements of dairy farms, the practices of milking cows and storing milk, the transportation of milk, to the health of cattle and the health of humans. At the center of the process by which milk became a public health threat was a larger cultural transformation in the ways in which Victorians understood the nutritional benefits to milk drinking.

This dissertation highlights the important role of material history in the history of science, technology, and medicine. Milk occupied a central role in late Victorian society. In the first half of the century milk drinking was often limited to those living in rural areas or wealthy urban Britons, by the last two decades of the century milk drinking became a universal cultural practice. This change was predicated upon new scientific research on the nutritional advantages of milk, but was reinforced by a longstanding cultural presumption in Europe that milk was nature's perfect food. By the middle decades of the nineteenth century this cultural awareness was heightened by imperial concerns that a healthy empire needed strong and healthy Britons. Edwin Chadwick, for example, famously noted in 1868,

> The foundation of the adult is laid in childhood and youth. Our strongest and best labourers are from milk-and-oatmeal fed, or milk-and-bread fed, or milk-and-potato-fed children. Our strongest navies are from the hill districts of Lancashire; our strongest labourers from Cumberland and Westmoreland, and from the hill-districts of Scotland, where milk is always a large portion of the food of the

> family. These, too, are the favourite recruiting grounds for guardsmen and soldiers of the greatest size and strength.[6]

Milk drinking became a universal practice in spite of the fact that it could be charged with the germs of deadly infectious diseases. The dichotomy between the nutritional advantages and potential health risks of milk consumption led to very volatile debates at the national and local levels. These debates were situated in the context of equally intense debates over the expansion of governmental protection of the health of the British population, both legislatively through Parliamentary mandate, and scientifically through state-sponsored research.[7]

Milk became a public health threat in the course of the nineteenth century, and in turn the definition of purity changed throughout this period as well. In the first half of the nineteenth century fresh milk was consumed close to where it was produced, often Britons preferring it warm from the cow. By the end of the century, as milk consumption exponentially increased, milk was sent to urban Britons from over two hundred miles away. Through this material distancing pure milk came to mean cool milk free from the presence of dangerous microorganisms. The purity of milk was not only built of consumer preference and agricultural interest, it was also deeply wedded to scientific practices, particularly by chemists, epidemiologists, veterinarians, pathologists, and

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[6] Quoted in Charles Morton, "Town Milk," *Journal of the Royal Agricultural Society of England*, 1868, page 70.

[7] Terrie Romano has conclusively argued that pathology was state-sponsored from the 1860s through John Simon's employment of pathologists such as John Burdon-Sanderson. I have shown in this project that epidemiology was state-sponsored much in the same way, but to a much greater extent at the Medical Department. See, Terrie Romano, *Making Medicine Scientific: John Burdon Sanderson and the Culture of Victorian Science* (Baltimore: The Johns Hopkins University Press, 2002), especially chapter three. See also, Peter Alter, *The Reluctant Patron: Science and the State in Britain, 1850-1920* (New York; Berg, 1987).

bacteriologists. The process by which milk became a public health threat in the course of the second half of the nineteenth century was deeply wedded to the process by which the British government came to take responsibility for the health of its citizens. Ultimately this is not a story about how the milk problem was solved in the nineteenth century, but rather a bold reminder that social problems become public health problems only through complex scientific practices, and cultural and political negotiations.

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