



THE LONDON SCHOOL  
OF ECONOMICS AND  
POLITICAL SCIENCE ■

Economic History Student Working Papers

No: 040

---

Who Flushed First? What  
characterised the early  
adoption patterns  
of private drainage in  
London, 1812-1847?

Ursula Hall

*Submitted as partial fulfilment of the BSc in  
Economic History 2023-24*

January 2025

# Who Flushed First? What characterised the early adoption patterns of private drainage in London, 1812-1847?

*Ursula Hall*

## **Abstract**

In order to push back against the narrative that the sanitary revolution in early 19<sup>th</sup>-century England was primarily an initiative of the government, this study investigates the characteristics of drainage adoption before it was legislated under state-provision after 1848. Whilst it finds that drainage adoption during 1812-1847 was both substantial and characterised by a sanitary impulse, it also uses Mokyr's model of Household health and knowledge consumption to hypothesise that its provision on the commodity market resulted in an adoption pattern described by an inverse relationship between drainage adoption year and income, for which servant number is used as a proxy. Whilst an inconclusive correlation between average adoption year and average servant number rejects this hypothesis, it finds that this is in large part explained by a redistributive characteristic of adoption that occurred outside the model of household consumption. More specifically, the finding that those in the wealthiest income percentile were the primary remunerators for drainage adoption amongst the poorest members of the distribution supports the cautious conclusion that drainage adoption gave rise to a 'learning' process amongst this group, which resulted in the increased dissipation of drainage technologies across the period and potentially provided a productive impulse for later reform

## **1. Introduction**

European mortality decline across the 19<sup>th</sup> century is a story often told. It's causes, therefore, are as often disputed<sup>1</sup>. Of these, one in particular, highlights the contributions made by a 'sanitary revolution' that historians have decided began in England in the mid-19<sup>th</sup> century with the state's implementation of public sanitary legislation and infrastructure<sup>2</sup>. One mainstay of this argument

---

<sup>1</sup> For seminal works on this topic, see Thomas McKeown, *The Modern Rise of Population* (London: E. Arnold, 1976); Massimo Livi Bacci, *A Concise History of World Population* (Cambridge: Blackwell, 1989). Brian Mitchell, *European Historical Statistics* (London: Macmillan, 1975)

<sup>2</sup> For examples, see Sheila Ryan Johansson, "Food for Thought: Rhetoric and Reality in Modern Mortality History," *Historical Methods: A Journal of Quantitative and Interdisciplinary History* 27, no. 3 (July 1994): 101–25, <https://doi.org/10.1080/01615440.1994.10594227>. P.112. See also,

recalls the legislated provision of a mains sewerage network after 1858<sup>3</sup>, which itself succeeded the mandate ten years prior that all houses required connection via drainage to a public sewer<sup>4</sup>.

Reacting to these arguments, historians such as Mokyr have nobly highlighted the role that private changes in household behaviour and consumption patterns had in health outcomes and resulting mortality decline around this time<sup>5</sup>. Mokyr, however, does not extend this framework of analysis to the context of drainage and private sewerage in the first 40 years of the 19<sup>th</sup> century. If his work is an attempt to combat the understanding that the genesis of sanitary improvements was an initiative of government reform, this decision is curious, considering the indication provided by the history that early drainage technologies were supplied by the market as early as the late 18<sup>th</sup> century<sup>6</sup>. And so, we are left with questions: Who was adopting private drainage and sewerage in the years before 1848, and why? Was there a substantial sanitary incentive before 1848? Towards these questions, this study investigates the adoption characteristics of private sewerage and drainage, both as sanitary technologies in and of themselves, and as a proxy for the adoption of drained sanitary technologies – the flush-toilet, cisterns, basins – before 1848.

To be clear, this investigation cannot extend to an analysis of the health benefits of drainage, and therefore cannot contribute new insight into the reasons for mortality decline. It can, however, refocus the debate tracing London's sanitary

---

Simon Szreter, "The Importance of Social Intervention in Britain's Mortality Decline: A Re-Interpretation of the Role of Public Health," *Social History of Medicine* 1, no. 1 (1988): 1–38, <https://doi.org/10.1093/shm/1.1.1>, 25.

<sup>3</sup> G Cook, "Construction of London's Victorian Sewers: The Vital Role of Joseph Bazalgette," *Postgraduate Medical Journal* 77, no. 914 (December 1, 2001): 802–4, <https://doi.org/10.1136/pgmj.77.914.802>, 802.

<sup>4</sup> Michelle Allen, "From Cesspool to Sewer: Sanitary Reform and the Rhetoric of Resistance, 1848–1880," *Victorian Literature and Culture* 30, no. 2 (August 27, 2002): 383–402, <https://doi.org/10.1017/s1060150302302018h>, 386.

<sup>5</sup> Joel Mokyr, *The Gifts of Athena: Historical Origins of the Knowledge Economy* (Princeton: Princeton University Press, 2005), 169, figure 3.

<sup>6</sup> James Webb, *The Guts of the Matter: A Global History of Human Waste and Infectious Intestinal Disease* (Cambridge: Cambridge University Press, 2019), 65.

impulse by seeking the consideration of early sanitary incentives in these histories.

This study begins with a review of the existing literatures to explain why early drainage histories have been overlooked within these. It then reviews Mokyr's model of household knowledge and health consumption<sup>7</sup>, explaining it in line with relevant 19<sup>th</sup> century contexts to hypothesise that although drainage adoption during 1812-1847 was characterised by a sanitary impulse, it's provision on the commodity market resulted in a socioeconomically unequal adoption pattern, described by an inverse relationship between drainage adoption year and income.

Irrespective of the unequal adoption patterns hypothesised, indicative findings in Chapter 4 are supported by analysis of sanitary incentives in Chapter 5.5 to find a substantial sanitary incentive towards drainage adoption existed under market conditions before 1848. Whilst Chapter 5 of the study finds a weak and inconclusive correlation between average adoption year and average servant number – used as a proxy for income – the rejected hypothesis is mitigated by findings in Chapters 5.3 and 5.4 that among the lowest income distribution, adoption was characterised by a redistributive process that occurred outside of the household consumption model. More specifically, it found that the wealthiest percentile of society who received drainage on average 8.4 years earlier than the rest of the sample operated in the same social networks as the individuals who were involved in adopting drainage for the poorest 30% of streets, who themselves received drainage on average up to 1.57 years earlier than the 40<sup>th</sup> and 50<sup>th</sup> percentiles. In a discussion of these findings, the role that social networks played in this process is highlighted. In particular, it is suggested that these findings are important because they interject the narrative expounding the importance of state-involvement within London's story of sewerage provision to the extent that early drainage adoption was characterised by a 'learning' process

---

<sup>7</sup> Joel Mokyr, *The Gifts of Athena: Historical Origins of the Knowledge Economy*. (Princeton University Press, Princeton, 2002), 168

amongst the upper class, which encouraged the dissipation of drainage technologies down the income distribution and later may have supported the demand for drainage infrastructure as a public-health good.

## 2. Literature Review

### 2.1 Two Oversights: The Sanitary Revolution

Historiography claiming a ‘sanitary revolution’ in London first arose with the revisionist accounts of Mortality Decline in Europe from c.1850-1914<sup>8</sup>. Supported by important findings of historical demographic work<sup>9</sup>, these formed a rebuttal of the McKeown Thesis, which postulated a mortality decline premised on the ‘invisible hand’ of rising living standards, particularly in the form of increases in per capita nutritional consumption<sup>10</sup>. In their attempts to rebut McKeown’s suggestion that sanitary measures could only have had at the maximum level the potential to eliminate roughly 25% of all deaths<sup>11</sup>, they largely directed attention to the contributions made by the public health movement and its locally administered preventive health measures towards combating urban congestion created by industrialisation<sup>12</sup>.

As a result, sanitary improvements have been defined in subsequent histories as a product of official administrative involvement. This is most productively

---

<sup>8</sup> For examples, see Simon Szreter, “The Importance of Social Intervention in Britain’s Mortality Decline: A Re-Interpretation of the Role of Public Health,” *Social History of Medicine* 1, no. 1 (1988): 1–38, <https://doi.org/10.1093/shm/1.1.1>, 25. See also, Knut Ringen, “Edwin Chadwick, the Market Ideology, and Sanitary Reform: On the Nature of the 19th-Century Public Health Movement,” *International Journal of Health Services* 9, no. 1 (January 1979): 107–20, <https://doi.org/10.2190/lr4g-x2nk-9363-f1ec>, 118.

<sup>9</sup> Julia Wrigley, William Lazonick, and Bernard Elbaum, “Technical Education and Industry in the Nineteenth Century,” essay, in *The Decline of the British Economy* (Oxford: Clarendon Press, n.d.), 162–88, 168.

<sup>10</sup> Thomas McKeown, *The Modern Rise of Population* (London: E. Arnold, 1976) See also, S C Farrow, “McKeown Reassessed,” *BMJ* 294, no. 6588 (June 27, 1987): 1631–32, <https://doi.org/10.1136/bmj.294.6588.1631>, 1631.

<sup>11</sup> Thomas McKeown and R. Record, “Reasons for the Decline of Mortality in England and Wales during the Nineteenth Century,” *Population Studies* 16, no. 2 (November 1962): 94–122, <https://doi.org/10.2307/2173119>. 120

<sup>12</sup> Simon Szreter, “The Importance of Social Intervention in Britain’s Mortality Decline: A Re-Interpretation of the Role of Public Health,” *Social History of Medicine* 1, no. 1 (1988): 1–38, <https://doi.org/10.1093/shm/1.1.1>, 1

displayed by debates arguing when these improvements began. London's 'urban sanitary movement' begins for Hennock in 1838, when the Central Poor Law Commission under Chadwick commissioned an investigation towards the 'physical causes of fever in the Metropolis which might be prevented by proper sanitary measures'<sup>13</sup>. For Webb, a 'revolution' accelerated only after 1858, when sanitary reformers secured government commitment to fund the construction of a comprehensive, underground sewer system<sup>14</sup>. The common employment of the state's involvement as a measure of sanitary improvement neglects the role of private initiatives in introducing improvements. Whilst Hardy goes the furthest, acknowledging the contributions of philanthropic initiatives at a local level – clergymen, nursing sisters, pharmacists, and voluntary workers informing medical officers – she in the same breath maintains the sanitary campaign against endemic disease began in 1856 at a local government level with the establishment of regular local sanitary departments<sup>15</sup>. This trend has meant adjunct histories recording in detail the various initiatives within the sanitary movement – the campaigns for clean water and air, sewage disposal, and appropriate housing<sup>16</sup> - equally neglect serious investigation of private attempts at improvements. The effort most relevant to the context of this dissertation is that towards waste disposal.

Where private sanitary incentives to improve waste drainage have been discussed, this has occurred within the scaffold of historical analysis that seeks to explain state involvement as a necessary condition for legitimate sanitary improvements. This has discouraged inquiry into the nature and characteristics of these private incentives as a phenomenon within and of themselves. For example, Clark mentions flushing toilets, installed in vaguely 'large numbers'

---

<sup>13</sup> E. P. Hennock, "The Urban Sanitary Movement in England and Germany, 1838–1914: A Comparison," *Continuity and Change* 15, no. 2 (September 2000): 269–96, <https://doi.org/10.1017/s0268416099003550>. 270

<sup>14</sup> James Webb, *The Guts of the Matter: A Global History of Human Waste and Infectious Intestinal Disease* (Cambridge: Cambridge University Press, 2019), 65

<sup>15</sup> Anne Hardy, *The Epidemic Streets: Infectious Disease and the Rise of Preventive Medicine, 1856-1900* (Oxford: Clarendon Press, 2003), 4

<sup>16</sup> For an example, see Peter Thorsheim, *Inventing Pollution Coal, Smoke, and Culture in Britain since 1800* (Athens, OH: Ohio University Press, 2018), 15.

from 1770 onwards as a “highly localised initiative by the property-owning classes” to conclude that in the absence of a state-funded mains sewerage system, this technology was ultimately harmful<sup>17</sup>. Whilst this account honestly remembers the burden flush-toilets placed on the piecemeal sewage of the time, the systematic neglect of private sanitary initiatives has consequences for histories dating the sanitary revolution. Take Clark’s own argument, which itself evidences that substantial attempts in sanitary improvement at the household level – flush toilets - predated public efforts.

## 2.2 Two Oversights: 19<sup>th</sup> century water-borne disease

A second history that has overlooked the role of early drainage adoption is disease histories. More specifically, the modern understanding that the long-cycle transmission of 19<sup>th</sup>-Century Europe’s faecal-oral diseases was waterborne has welcomed a retroactive focus from disease historians into the improvement of water supply. Goldin for instance has shown the importance of clean water supply alongside sewerage as necessarily complementary interventions that account for one-third of the decline in log child mortality from 1880-1920 in Massachusetts.<sup>18</sup> This understanding has biased investigation into London’s experience of water-borne disease towards measuring the impact of clean-water supply on mortality decline<sup>19</sup>. As important as these studies may be for aetiological knowledge, they confuse the history of water-borne disease prevention in London by encouraging the perception that improving water-supply formed the primary agenda of preventing water-borne disease. Overlooked is the fact that the Victorians’ commitment to the now abandoned miasma paradigm of disease encouraged the adoption of waste-drainage, to remove the foul odours believed to have caused disease<sup>20</sup>. Waste-drainage, not

---

<sup>17</sup> Clare Clark, *The Great Stink* (Orlando, FL: Harcourt, 2006), 84

<sup>18</sup> Marcella Alsan and Claudia Goldin, “Watersheds in Child Mortality: The Role of Effective Water and Sewerage Infrastructure, 1880–1920,” *Journal of Political Economy* 127, no. 2 (April 2019): 586–638, <https://doi.org/10.1086/700766>, 16

<sup>19</sup> Francisca M. Antman, “For Want of a Cup: The Rise of Tea in England and the Impact of Water Quality on Mortality,” *Review of Economics and Statistics* 105, no. 6 (November 2023): 1352–65, [https://doi.org/10.1162/rest\\_a\\_01158](https://doi.org/10.1162/rest_a_01158), 1355

<sup>20</sup> James Webb, *The Guts of the Matter: A Global History of Human Waste and Infectious Intestinal Disease* (Cambridge: Cambridge University Press, 2019), 65

water supply, captures the greater portion of Victorian prophylactic efforts. Considering the preliminary indications put forward by Webb and others as to the substantial amount of waste drainage adopted by private incentive in the first half of the 19<sup>th</sup> century, it surprises that this phenomenon has received little attention in the social histories of disease prevention.

Together, these two historical oversights leave us wondering whether there was any private incentive for early drainage adoption, and if there was, what processes and patterns characterised this. As Mokyr and Easterlin have stressed, these histories are important because they challenge the failure of scholars to take private technology into account when explaining the European mortality decline in the 19<sup>th</sup> century<sup>21</sup>. Mokyr, for instance, highlights the sanitarian and hygienic movement which began after 1815 at the household level, listing the ventilation and vinegar spraying which contributed to mortality decline by bringing health improvements<sup>22</sup>. Whilst understanding the actual health implications of early drainage adoption falls outside the remit of this dissertation, it *can* attend to a seemingly overdue analysis of early drainage adoption.

### 2.3 Mokyr's Model of Health and Household Knowledge

Mokyr's heavily cited model of Health and Household Knowledge<sup>23</sup> provides an appropriate framework for addressing these questions because it understands drainage technologies as a health-enhancing good. Whilst this study is not concerned with whether drainage had health effects, or what they were, Mokyr's model nonetheless explains the reasons for the adoption of a health-enhancing good, taken as drainage for this study. Figure B represents a classical household

---

<sup>21</sup> Richard A. Easterlin, "Industrial Revolution and Mortality Revolution," *Journal of Evolutionary Economics* 5, no. 4 (December 1995): 393–408, <https://doi.org/10.1007/bf01194368>, 401. See also, Joel Mokyr, "Technological Progress and the Decline of European Mortality," *American Economic Review* 2, Papers and Proceedings, no. 83 (1993): 324–30, 326 and Joel Mokyr, *The Gifts of Athena: Historical Origins of the Knowledge Economy*. (Princeton University Press, Princeton, 2002), 168

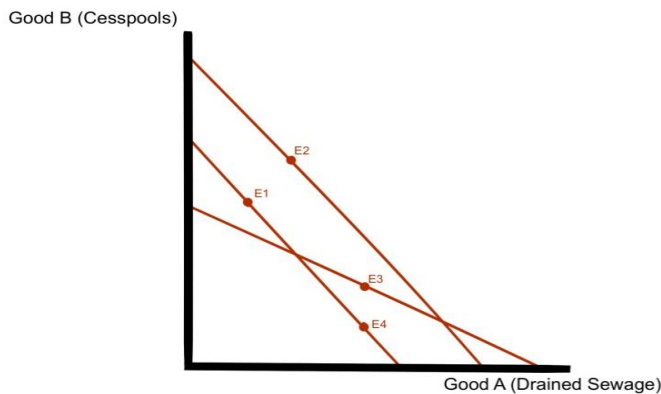
<sup>22</sup> Joel Mokyr, *The Gifts of Athena: Historical Origins of the Knowledge Economy*. (Princeton University Press, Princeton, 2002), 181

<sup>23</sup> *Ibid*, 171, figure 4



consumption diagram, where Good A represents drainage, a health-enhancing good. Good B is health-indifferent, and represents prior alternatives to drainage, open sewers and drains, or cesspits.

Figure 1: Mokyr’s model of household health and technology as applied to drainage



The model provides three reasons why the consumption of drainage technologies from the equilibrium E1 may increase. The first represents an increase in income which causes a rise in consumption of both drainage and alternative sewage systems, assuming drainage is a normal good, to the point E2. The second postulates a decrease in the relative price of drainage, either through government intervention in public health, or technological progress within in the market. This would move the equilibrium consumption decision from point E1 to E3, the position of E3 dependent on the elasticity of drainage. The final mechanism identifies changes in the ‘learning effect’, where an increase in household understanding of the health-enhancing benefits of drainage causes an increase in its consumption to point E4<sup>24</sup>.

The relevance of this model to our question lies in the ‘learning effect’. To the extent this study wants to characterise the patterns and incentives of drainage adoption, it understands the demand-side determinants of this market as the

---

<sup>24</sup> Ibid, 170

primary indicator of a response to sanitary knowledge. A key consideration regarding this effect is the reasons why the consumption of a health-enhancing good by a household may not always equal the best-practise knowledge of the time.

#### 2.4 Inequality in the adoption of Sanitary Technologies in the 19th Century

What historical factors might corroborate with the reasons for the gap between best-practice knowledge and household adoption of the corresponding health-enhancing goods? The obvious contribution is income. The higher a household's income, the lower the relative price of the good as a proportion of income than for a poorer household. Understanding that income might explain health inequalities is reinforced by Chadwick's findings from the 19<sup>th</sup> century context in England explaining that inequalities in life expectancy associated with poor sanitary conditions were primarily a function of occupational level and income<sup>25</sup>. Deaton offers an indication of the contribution technological adoption may have made to these inequalities, highlighting the advances in medical technology in Britain from the 1750's that enabled social elites to start investing in technological improvements that increased health and longevity<sup>26</sup>. Davenport more specifically has suggested the increased release of sewage into the River Thames by the wealthy, in part as a result of flush-toilets, increased mortality and inequalities in health in London<sup>27</sup>. Indeed, to the extent Szreter and Mooney have implied that flush toilets worsened conditions of water quality for surrounding households when they overflowed and thereby increased the risk of faecal contamination and instance of waterborne disease<sup>28</sup>, the adoption of flush

---

<sup>25</sup> Edwin Chadwick and M. W. Flinn, *Report on the Sanitary Conditions of the Labouring Population of Great Britain by Edwin Chadwick, 1842. Edited with an Introduction by M. W. Flinn* (Edinburgh: Edinburgh University Press, 1965), 84

<sup>26</sup> Angus Deaton, "What Does the Empirical Evidence Tell Us about the Injustice of Health Inequalities?," *Inequalities in Health*, October 18, 2013, 263–81, <https://doi.org/10.1093/acprof:oso/9780199931392.003.0018>, 264

<sup>27</sup> Romola Jane Davenport, Max Satchell, and Leigh Matthew Shaw-Taylor, "Cholera as a 'Sanitary Test' of British Cities, 1831–1866," *The History of the Family* 24, no. 2 (November 3, 2018): 404–38, <https://doi.org/10.1080/1081602x.2018.1525755>, 410

<sup>28</sup> Simon Szreter, "Economic Growth, Disruption, Deprivation, Disease, and Death: On the Importance of the Politics of Public Health for Development," *Population and Development Review* 23, no. 4 (December 1997): 693–728, <https://doi.org/10.2307/2137377>, 707-8

toilets by the propertied class pointedly impeded progress towards equal sanitary development. These findings are implicitly underpinned by Costa's work<sup>29</sup> explaining socioeconomic differences in health develop either because new knowledge and technologies diffuse first to the wealthier, or because those who are wealthier are more productive in applying new technologies. Under the market mechanism, these authors might hypothesise inequalities in drainage adoption characterised by an inverse relationship between the year of household drainage adoption and household income.

Another historical factor that considers frictions between best-practise knowledge and its adoption considers what Mokyr calls the 'tightness' of access to knowledge surrounding best-practise techniques<sup>30</sup>. For him and others, this described the process by which the notion among the upper and middle-classes that cleanliness equalled health filtered down vertically during the first half of the mid-nineteenth century<sup>31</sup>. A more specific expression of this 'tightness' is expounded by Allen, who identifies both flushing toilets, and the drainage of their discharge through the sewers, as a "trend" that a "very small and elite portion of the community had voluntarily adopted"<sup>32</sup>. Together, and acknowledging the literature on the peer effects of consumption that provide a springboard for Allen's comment<sup>33</sup>, these suggestions imply drainage knowledge was simultaneously restricted to the lower income strata and circulated amongst increasing numbers of elite society across the period. Assuming drainage was considered a best-practice technology, these implications suggest the inequalities hypothesised by the predicted relationship between income and drainage adoption year would have been exacerbated by the restriction of its

---

<sup>29</sup> Dora Costa and Richard Steckel, *Long-Term Trends in Health, Welfare, and Economic Growth in the United States*, November 1995, <https://doi.org/10.3386/h0076>, 77

<sup>30</sup> Joel Mokyr, *The Gifts of Athena: Historical Origins of the Knowledge Economy*. (Princeton University Press, Princeton, 2002), 171

<sup>31</sup> *Ibid*, 182

<sup>32</sup> Michelle Allen, "From Cesspool to Sewer: Sanitary Reform and the Rhetoric of Resistance, 1848–1880," *Victorian Literature and Culture* 30, no. 2 (August 27, 2002): 383–402, <https://doi.org/10.1017/s1060150302302018h>, 386.

<sup>33</sup> Giacomo De Giorgi, Anders Frederiksen, and Luigi Pistaferri, "Consumption Network Effects," *The Review of Economic Studies* 87, no. 1 (May 6, 2019): 130–63, <https://doi.org/10.1093/restud/rdz026>, 132.

knowledge to the lower-stratums of income, and its increasing circulation across the period among the wealthiest members of society.

Yet, an additional layer of complexity to these hypothesised distribution arrangements is the necessary consideration of the philanthropic expectation among the upper echelons of English Society in this period<sup>34</sup>. From this expectation, Trainor identifies the diverse range of philanthropic initiatives which were most often led by peers, religious men of high standing, ‘gentlemen’, merchants and leading businessmen, who also held positions in councils and local government boards<sup>35</sup>. Jenkin draws particular attention to the substantial philanthropic efforts after the 1830’s to co-ordinate public health and the relief of poverty, which in large part directed its energy towards improved sanitary provision in the wake of epidemic cholera and typhus<sup>36</sup>. Whilst there does not yet exist any serious investigation into whether these initiatives extended into drainage adoption, this study will investigate the possibility of this occurrence, and, if it is found to exist, understand whether this constituted a redistributive characteristic of drainage adoption in these years.

## 2.5 Market versus State Provision

The inequitable provision of sanitary technologies between 1812-1847 is hypothesised under Mokyr’s model of Household technology adoption. There also exists, separate from this framework, the unexplored possibility that philanthropic initiative may have provided for some of this adoption. To the extent the conditions for these hypothesised adoption patterns was ultimately primed by the functions of a private commodity market, a discussion of the relative failures of the private commodity market to provide these is called into point.

---

<sup>34</sup> Derek Fraser, *Power and Authority in the Victorian City* (Oxford: Blackwell, 1979), 27

<sup>35</sup> Richard Trainor, “Urban Elites in Victorian Britain,” *Urban History* 12 (May 1985): 1–17, <https://doi.org/10.1017/s0963926800007458>, 4

<sup>36</sup> Simon Jenkins, *Landlords to London: The Story of a Capital and Its Growth* (London: Faber & Faber, 2012), 176.

Arguments for the inability of the market mechanism to effectively distribute sanitation technologies clusters around two main themes. The first follows the understanding that the market function inevitably creates inequalities in consumption that follow supply and demand<sup>37</sup>, for which the most comprehensive insight is the import of modern ‘sanitation economics’ literature investigating sanitation service markets in third countries<sup>38</sup>.

A 2012 sanitation demand and supply study conducted in 16 different localities of Bangladesh, for example, identified the restricted access of areas with a large proportion of poor households to supply chain actors as a major issue in inequitable sanitation provision<sup>39</sup>. Matching echoes of modern studies with evidence from 19<sup>th</sup> century Europe is difficult, but echoes of spatial inequalities as a result of demand and supply functions do exist. Ward’s analysis of Paris in 1830 found that sanitary entrepreneurs pursued wealthier markets; only 4 of the 68 public bathing establishments operating in this year were located in poorer, suburban *quartiers*<sup>40</sup>. In line with the running hypothesis, together these studies indicate drainage adoption may have clustered around wealthier areas of London in the first half of 1800.

The second shortfall of the sanitary market mechanism is expounded by Trémolet, who explains the natural ‘public good nature’ of sanitation technologies<sup>41</sup> means the successful provision of one sanitary technology – say drainage - is dependent upon the provision of complementary infrastructures for

---

<sup>37</sup> Julien Gagnon and Sanjeev Goyal, “Networks, Markets, and Inequality,” *American Economic Review* 107, no. 1 (January 1, 2017): 1–30, <https://doi.org/10.1257/aer.20150635>, 2

<sup>38</sup> Sophie Trémolet Sophie Trémolet, “Sanitation Economics: Understanding Why Sanitation Markets Fail and How They Can Improve,” *Waterlines* 32, no. 4 (October 1, 2013): 273–85, <https://doi.org/10.3362/1756-3488.2013.029>, 273

<sup>39</sup> Jane Nabunnyax Jane Nabunnyax Mulumba et al., “Striking the Balance: What Is the Role of the Public Sector in Sanitation as a Service and as a Business?,” *Waterlines* 33, no. 3 (July 1, 2014): 195–210, <https://doi.org/10.3362/1756-3488.2014.021>, 200

<sup>40</sup> W. Peter Ward, *The Clean Body: A Modern History* (Montreal: McGill-Queen’s University Press, 2019), 41

<sup>41</sup> Sophie Trémolet Sophie Trémolet, “Sanitation Economics: Understanding Why Sanitation Markets Fail and How They Can Improve,” *Waterlines* 32, no. 4 (October 1, 2013): 273–85, <https://doi.org/10.3362/1756-3488.2013.029>, 273

its successful operation<sup>42</sup>. Such infrastructures - comprehensive mains sewerage provision and treatment systems - were notoriously absent in the first half of the 19<sup>th</sup> century<sup>43</sup>, indicating that even if this study were to find a significant private incentive for household drainage, this would not, as a technicality, be a success to the extent that their use depended on large systems of sewage infrastructure.

More generally, then, these arguments hark to Easterlin's view that market forces created information failures, externalities and public-good provision failures that explain the failure of the market to explain mortality decline in Europe across the 19<sup>th</sup> century<sup>44</sup>. This consequently explains the arguments of reactive literature which alternatively, and in agreement with Easterlin, expounded the role that incentives for sanitary reform played in the carriage of public works which hastened mortality decline across several European cities in the mid-to-late nineteenth century<sup>45</sup>. In so far as this study also necessitates a discussion on how effectively and equitably the market distributed drainage across 1812-1847, it is the relationship between these two large ideas that it aspires to discuss, without, of course, extending comment to the effects of drainage adoption on mortality decline.

### **3 Historical Context: London Sewerage**

At the beginning of the 19<sup>th</sup> century, existing public sewers in London were regulated by seven sewage commissions, and were only intended for land drainage and flooding prevention<sup>46</sup>. During this period, the increasing popularity of the flush toilet, alongside the increasing provision of constant water supply to

---

<sup>42</sup> Ibid, 273

<sup>43</sup> Simon Szreter, "The Importance of Social Intervention in Britain's Mortality Decline: A Re-Interpretation of the Role of Public Health," *Social History of Medicine* 1, no. 1 (1988): 1–38, <https://doi.org/10.1093/shm/1.1.1>, 25.

<sup>44</sup> R. A. Easterlin, "How Beneficent Is the Market? A Look at the Modern History of Mortality," *European Review of Economic History* 3, no. 3 (December 1, 1999): 257–94, <https://doi.org/10.1017/s1361491699000131>, 284

<sup>45</sup> Daniel Gallardo-Albarrán, "The Global Sanitary Revolution in Historical Perspective," *Journal of Economic Surveys*, March 21, 2024, <https://doi.org/10.1111/joes.12607>, 15.

<sup>46</sup> A. E. Owen, "15. Records of Commissions of Sewers," *History* 52, no. 174 (February 1967): 35–38, <https://doi.org/10.1111/j.1468-229x.1967.tb01189>, 35

households, resulted in some households illegally connecting private drainage and sewage pipes to public sewage networks, to drain their waste into the River Thames. After 1815, this practice became legally permitted<sup>47</sup>. This presented an advancement away from the popular cesspit system at the time, in which excrement would be funnelled into an enclosed brick enclave below a house and collected by human labour<sup>48</sup>. However, growth in the use of piped drainage to flush waste became increasingly burdensome on the piecemeal mains sewerage constructed by the uncoordinated sewage commission, and the backwash of sewage was common. Meanwhile, bouts of Cholera and Typhoid epidemics in the 1820's increased pressure on the government to address the miasmas caused by sewage backwash owing to the overburdened sewage systems<sup>49</sup>. In 1848 the Metropolitan Sewers Act finally addressed these problems, unifying these sewage commissions into one body and mandated the connection of all homes by drainage to a mains sewer under law<sup>50</sup>.

#### 4. Research Design

In order to understand what characterised patterns of drainage adoption, patterns of drainage adoption are first determined. For this task, the best data on drainage adoption is found in the Westminster Sewage Commission Sewage Registers, constituting two books, one dating from 1812-1822 with 185 entries, and the other dating from 1823-1847 and with 1732 entries<sup>51</sup>.

---

<sup>47</sup> Anne Hardy, *The Epidemic Streets: Infectious Disease and the Rise of Preventive Medicine, 1856-1900* (Oxford: Clarendon Press, 2003), 263

<sup>48</sup> Michelle Allen, "From Cesspool to Sewer: Sanitary Reform and the Rhetoric of Resistance, 1848-1880," *Victorian Literature and Culture* 30, no. 2 (August 27, 2002): 383-402, <https://doi.org/10.1017/s1060150302302018h>, 384

<sup>49</sup> Stephen Halliday, Stephen Halliday, and Adam Hart-Davis, *The Great Stink of London: Sir Joseph Bazalgette and the Cleansing of the Victorian Capital* (Sheltenham, Gloucestershire: The History Press, 2023), 46

<sup>50</sup> *Ibid*, p.48

<sup>51</sup> "Register of New Sewers, 1812-1822" *Westminster and Middlesex Commission of Sewers*, London. From London Metropolitan Archives, Reference code WCS/748. See also, "Register of New Sewers, 1823-1847" *Westminster and Middlesex Commission of Sewers*, London. From London Metropolitan Archives, Reference code WCS/749

These sources record the drainage and private sewerage<sup>52</sup> applications at street level from 1812-1847. Their existence is explained by an 1807 ruling of the Westminster Sewage Commission that ‘any new drain’ had to be connected to the nearest public sewer<sup>53</sup>. Their detail is a fortuitous circumstance, having been bemoaned by their successors in the Metropolitan Commission of Sewers after 1849 as ‘full of unnecessary repetition...overloaded with useless personal accounts’<sup>54</sup>.

The following information was retrieved<sup>55</sup>:

- The situation and description of the sewer
- The date of leave for building the sewer
- The name of the party to whom leave was given to build the sewer

Given the large geographical scope covered by the Westminster Sewage Commission, this study samples four adjoining Inner-London Parishes included in this scope<sup>56</sup>. Differing in size, their defined boundaries nonetheless provide the most accessible and appropriate spatial disaggregation of streets in Inner-London. Parishes in Inner-London have been chosen due to their larger population and number of streets relative to expanding suburban parishes, which allows for a higher number of data points.

---

<sup>52</sup> It is worth briefly noting the difference between private drainage, private sewerage, and mains sewerage. For this analysis, private sewers are interchangeable with private drains, and describe the pipe that connects a property to other drains to a mains sewer, whose construction and maintenance was the responsibility of the Westminster and Middlesex Commission of Sewers.

<sup>53</sup> The National Archives, “The Discovery Service,” Westminster and Middlesex Commission of Sewers | The National Archives, August 12, 2009, <https://discovery.nationalarchives.gov.uk/details/r/609e17c5-1bd1-4ada-8509-c11592d70428>.

<sup>54</sup> “Accountant’s Statement as to Salaries and Charges for Services, 1847” *Metropolitan Commission of Sewers*, 1847. London. From London Metropolitan Archives, collection MCS/476/AA – Printed Reports and Papers – Volume AA

<sup>55</sup> *Westminster Commission of Sewers*, WCS/748, WCS/749

<sup>56</sup> The geographical scope of these sources is large; the Map of Districts drained by the Westminster Sewage Commission in Appendix A shows the Westminster Sewage Commission covered the larger part of Central London and West London.



Figure 2: A visualisation of the data collection method.



*Source:* Westminster and Middlesex Commission of Sewers, WCS/478, WCS749, 1812-1847, and “Langley and Belch’s New Map of London, 1812”

Street indexes of four Inner-London Parishes were then created using Langley and Belch’s New Map of London, 1812<sup>57</sup>. These were matched with their corresponding appearances in the Sewage Registers. Visualised in figure 2, the final data set represents streets in these four parishes, existing by 1812, on which at least one household adopted drainage between 1812-1847.

One precaution considers the accidental inclusion of entries that recorded drainage applications for streets that were yet to be built, or yet to be extended, and which included drainage adoption as part of these pursuits. This pattern was exacerbated after the Metropolitan Buildings Act in 1844, which required all new buildings constructed in London to connect via drainage to a common sewer<sup>58</sup>. To avoid capturing this effect, I have capitalised on an unusual administrative decision taken by the Westminster Sewage Commission to place all intended applications for new housing construction, including streets ‘to be extended’, under an ‘Intended’ title, easily accessed under ‘I’ in the register

<sup>57</sup> Langley and Belch. “Langley and Belch’s New Map of London, 1812”. Langley and Belch, 1812. Accessed at London Picture Archives, Catalogue No: k1262765\_A

<sup>58</sup> The National Archives. “The Discovery Service.” Metropolitan Buildings Office | The National Archives, August 12, 2009. <https://discovery.nationalarchives.gov.uk/details/r/11747702-a2e8-4144-9a17-672772100e08#:~:text=No%20cellar%20or%20underground%20room,provided%20in%20all%20new%20houses>.

Index. Certain streets in the Sewer Registers have been omitted from the dataset for additional reasons<sup>59</sup>.

Table 1 summarises the filtered data. Because multiple private agents often applied for drainage on the same street, there are more application observations than there are streets.

Table 1: Entries for Streets across 4 Parishes in the Westminster Sewage Commission Sewage Registers, 1812-1847.

<i>Parish</i>	Number of Streets	Number of Applications
St George's, Hanover Square	38	91
St James', Westminster	21	41
St Margaret's, Westminster	21	39
St Marylebone	63	155
<b>Total</b>	<b>143</b>	<b>326</b>

*Source:* Westminster and Middlesex Commission of Sewers, WCS/478, WCS749, 1812-1847

On streets with multiple observations, the average drainage application year was taken across the entries, to most closely reflect the incentive for adoption across the whole street.

The most significant limitation of this data set to this study is that it does not account for the level of drainage that existed prior to 1812, records for which had not been found to exist. Therefore, the drainage adoption in this study does not account for the first adopters. Nonetheless, we can compare the early and late adopters *within* the 1812-1847 period, and in so far as the private adoption measured here occurred before its legal mandate in 1848, the dataset is sufficient at capturing the private incentive to adopt drainage earlier than is legally required.

---

<sup>59</sup> The streets in St Margaret's, Westminster which were either part of the Parliamentary Estate or only accessible by members and close affiliates of the British Royal Family have been removed.

#### 4.1 Indicative Findings: Rate of Drainage Adoption

The rate of drainage applications is shown in figure 4 across all four Parishes<sup>60</sup>. The sample sizes for St George's and St Marylebone are large enough to generally reflect the increase in adoption across the entire Register during 1826-1832<sup>61</sup>. This increase is significant because it indicates a substantial private incentive existed as early as the 1820's, predating the often-recalled suggestion that the sanitarian and hygienic movement only picked up momentum in the later decades of the 19<sup>th</sup> century<sup>62</sup>.

Comparing Figure 4 over the 1819-1828 period with the adoption rates of St Marylebone, and to some level in St George's, we observe that in these Parishes drainage adoption began rising more rapidly than the sustained rise observed across the entire Sewer Register dataset after 1819. Analysis in section 3 will attempt to determine what characterised this faster rate of adoption.

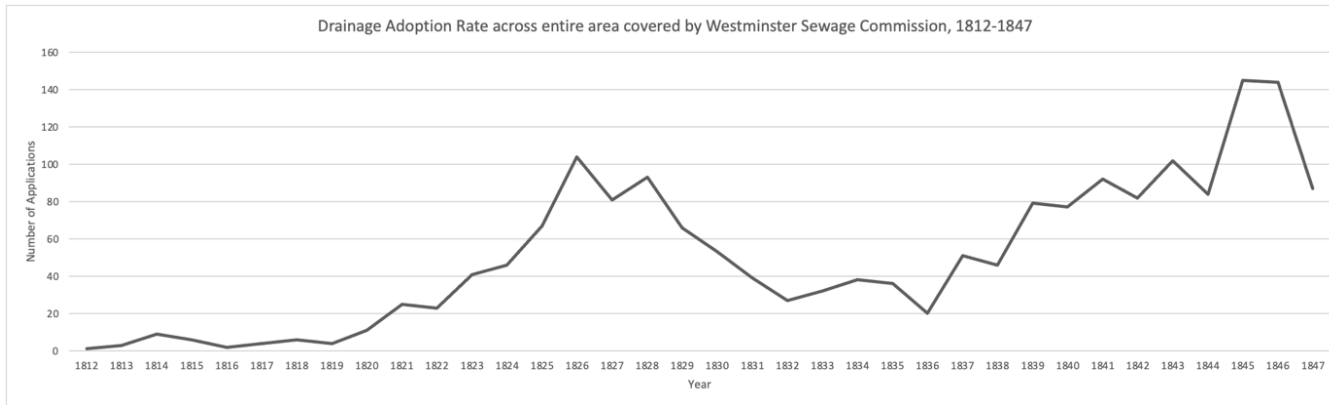
---

<sup>60</sup> Drainage application is used interchangeably with drainage adoption given only applications which resulted in the adoption of drainage have been recorded. See Appendix A:3

<sup>61</sup> It is encouraging that the increase in adoption shown in figure 4 after 1844 is not also observed across the sample of 4 Parishes in figure 3, given this increase likely captured the effects of new building after the 1844 Metropolitan Buildings Act, which required all new buildings constructed in London to connect via drainage to a common sewer. In both graphs, the decline of adoption after 1846-1846 is probably a result of the administrative amalgamation in 1848 of London's Sewage Commissions, Westminster's included, into a single Metropolitan Commission for Sewers<sup>61</sup>, the prior planning of which would have reduced the capacity for these Commissions to process applications.

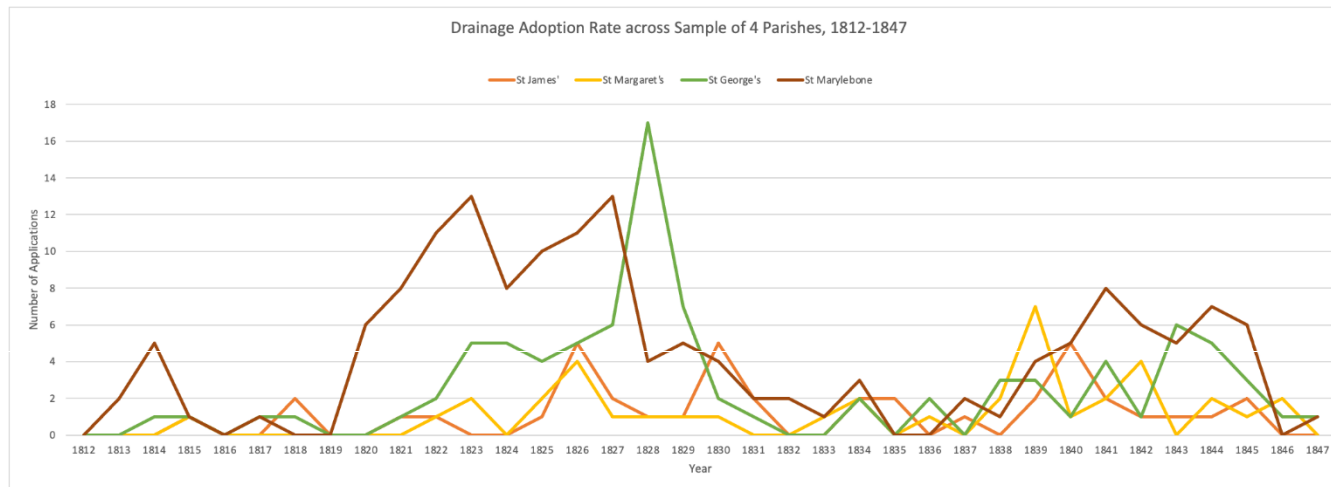
<sup>62</sup> Joel Mokyr, *The Gifts of Athena: Historical Origins of the Knowledge Economy* (Princeton: Princeton University Press, 2005), 181

**Figure 3: Drainage Adoption Rate across the Entire Sewage Registers, 1812-1847**



*Source: Westminster and Middlesex Commission of Sewers, WCS/478, WCS749, 1812-1847*

**Figure 4: Drainage Adoption Rate Across Sample of 4 Parishes, 1812-1847.**



*Source: Westminster and Middlesex Commission of Sewers, WCS/478, WCS749, 1812-1847*

Interestingly, the increase in applications after 1836 correlates with the instance of epidemic diseases related to sanitary provision; Typhus became epidemic across London in both 1826-1827 and 1831-1832<sup>63</sup>, whilst epidemic cholera reached London in February 1832<sup>64</sup>. Considering the understanding cholera was spread by the presence of foul waste odour, this increase correlates with Mokyr's projection that drainage adoption would react not only to income, but also to changes in learning and knowledge diffusion. It is believable that the sentiment displayed in an 1849 report in Westminster detailing the "public attention having been so much directed to the drainage of Westminster Abbey Precincts in consequence of the outbreak there of alarming fever" may have also explained increases in adoption after 1836<sup>65</sup>.

#### 4.2 Indicative Findings: Spatial Aspects of Drainage Adoption

The spatial distribution of drainage application records was then mapped across all four Parishes<sup>66</sup>. Streets on which drainage applications were received have been marked in four iterations, categorised by the average year in which a drainage application was received on a given street during the period 1812-1847<sup>67</sup>:

1812-1820:	Green
1821-1829:	Yellow
1830-1838:	Orange
1839-1847:	Red

---

<sup>63</sup> Anne Hardy, "Urban Famine or Urban Crisis? Typhus in the Victorian City," *Medical History* 32, no. 4 (October 1988): 401–25, <https://doi.org/10.1017/s0025727300048523>, 418

<sup>64</sup> Joseph H. Tien et al., "Herald Waves of Cholera in Nineteenth Century London," *Journal of The Royal Society Interface* 8, no. 58 (December 2010): 756–60, <https://doi.org/10.1098/rsif.2010.0494>, 756

<sup>65</sup> Thomas Lovick, "Metropolitan Commission of Sewers report on the drainage of the Westminster Abbey Precincts" *Metropolitan Commission of Sewers*, 1849. From London Metropolitan Archives, collection MCS/477/B49

<sup>66</sup> Langley and Belch. "Langley and Belch's New Map of London, 1812". Langley and Belch, 1812. Accessed at London Picture Archives, Catalogue No: k1262765\_A

<sup>67</sup> Whilst the markings are not wholly historically accurate in that very rarely were applications made to lay drainage for a whole street, the entire street has been marked both for visual convenience and because the drainage application books do not contain house numberings.

Intuitive observation indicates there is little correlation between the drainage adoption years of streets and their geographic proximity. Whilst this rejects the suggestion made by sanitary economics literature that adoption clustered around wealthier areas due to the incentives of suppliers to favour wealthier areas<sup>68</sup>, it also echoes the proliferation of decreasing social class separation in this period<sup>69</sup>, together supporting the suggestion that demand factors characterised drainage adoption during these years.

Figure 5: Spatial Adoption of Drainage across 4 Parishes, 1812-1847



Clockwise, starting top left: St Marylebone; St George's, Hanover Square; St Margaret's, Westminster; St James', Westminster.

**Source:** “Langley and Belch’s New Map of London, 1812”, and Westminster and Middlesex Commission of Sewers, WCS/478, WCS749, 1812-1847. Note that whilst this figure includes the majority of streets in the sample, it excludes the eleven of those that either shared a name with another street in the Parish, and three of those which the area of the map did not cover

<sup>68</sup> Jane Nabunnyax Jane Nabunnyax Mulumba et al., “Striking the Balance: What Is the Role of the Public Sector in Sanitation as a Service and as a Business?,” *Waterlines* 33, no. 3 (July 1, 2014): 195–210, <https://doi.org/10.3362/1756-3488.2014.021>, 200 See also, Peter Ward, *The Clean Body: A Modern History* (Montreal: McGill-Queen’s University Press, 2019), 41

<sup>69</sup> Matthew Sangster, “Transformation and Specialization in London and Its Topography,” *Journal of Victorian Culture* 22, no. 3 (May 24, 2017): 317–28, <https://doi.org/10.1080/13555502.2017.1329971>, 319

Where subtle patterns of spatial adoption are observed in the sample, they corroborate with architectural histories detailing the socio-economic occupancy structure of Victorian London, and therefore support indications of a relationship between income and adoption year. The adoption year observations of the area around Grosvenor Square in the Parish of St George's Hanover Square, for instance, uphold Olsen's findings that the wealthiest residents occupied squares and principal streets, the middle classes clustering around adjacent and smaller streets, and the poor and domestic servants occupied back courts and mews houses<sup>70</sup>.

## **5 Socio-economic characteristics of Drainage adoption**

Following the hypothesis that the demand for early drainage adoption was characterised by an inverse relationship between income and average adoption year, we observe the relationship between the average drainage adoption year per street from 1812-1847 and the average number of servants per household on the same street in 1841.<sup>71</sup> After analysing these results in chapter 5.2 occupational data is used to qualitatively characterise distinctive groups within this dataset more closely.

### 5.1 Research Design

All streets in the sample are matched to their respective entries in the 1841 census. From these streets, blocks of flats were removed from the dataset before a random sample of 5 houses was taken to ensure that houses were selected across the geographical distribution of the street, to account for the emphasis in the literature that often a range of social and income classes lived along the same street<sup>72</sup>.

---

<sup>70</sup> Donald J Olsen, "Victorian London: Specialization, Segregation, and Privacy." *Victorian Studies* 17, no. 3 (1974): 265–78. <http://www.jstor.org/stable/3826665> , 271

<sup>71</sup> Note again that adoption is used interchangeably with applications, given only successful applications have been recorded in this dataset. Application date has been used instead of the date the building work was completed, given this data is missing for several streets with successful applications.

<sup>72</sup> Donald J Olsen, "Victorian London: Specialization, Segregation, and Privacy." *Victorian Studies* 17, no. 3 (1974): 265–78. <http://www.jstor.org/stable/3826665> , 271



The following data was recorded for the sampled houses:

- Number of Households in a House
- Total number of occupants (minus domestic servants)
- Occupation of the head of each household
- Number of Domestic Servants in a house

Table 2 summarises the principal data points used in this analysis:

Table 2: Descriptive Data for Socioeconomic characterisation.

Parish	Number of Streets (WCS Register and 1841 Census)	Number of Houses Sampled (1841 Census)	Number of Households in Sample (1841 Census)
St George's, Hanover Square	38	185	328
St James', Westminster	21	105	179
St Margaret's, Westminster	21	105	208
St Marylebone	63	315	804
<b>Total</b>	<b>143</b>	<b>715</b>	<b>1519</b>

**Source:** Westminster and Middlesex Commission of Sewers, WCS/478, WCS749, 1812-1847, and 1841 England, Wales and Scotland Census

The unconventional decision to proxy income with average servant numbers diverges from the common preference of socioeconomic studies for occupational indicators and so warrants explanation<sup>73</sup>. The occupational data in the 1841 census is not appropriate for this analysis due to the catholic use of the occupational term ‘independent’, which in simply referring to “Men, or widows, or single women having no profession or calling, but living on their own means”<sup>74</sup>, was therefore listed frequently across the entire population sample, warranting any occupational indicator of income insufficient. A second point explains that the average levels of income in the four Parishes concerned were much higher than those across the entirety of London. Largely a result of the

<sup>73</sup> Michael B. Katz, “Occupational Classification in History,” *Journal of Interdisciplinary History* 3, no. 1 (1972): 63-88 <https://doi.org/10.2307/202462>, 63

<sup>74</sup> *P.P.*, 1843, XXII, “Abstract of the Answers and Returns: Enumeration Abstract”, p. 3n.



speculative building on the aristocratic Estates of Grosvenor in Mayfair, Portman in Regent's Park, and the Duke of Bedford's, alongside the restriction these areas placed on non-residential traffic<sup>75</sup>, the greater part of the 5,544 elites listed in 1800 as living in London lived within these four parishes.<sup>76</sup> At such a calibre of income and wealth, the number of servants per house is more sensitive to variance in income than occupational title, particularly given many of these aristocratic households had no 'occupation', *per se*.

Whilst the 1841 census was chosen as it was the first 'modern' census to record exact address, occupation and household information, and therefore is the richest source base to identify who received drainage across this period, it is necessary to address how appropriately the 1841 population represents those living on these streets throughout the 1812-1847 period. Whilst this measure is far from accurate, fears that certain demographic changes during 1812-1847 may have created large distortions in the relative wealth between streets are allayed by evidence attesting to the relatively stable socioeconomic characteristics of Victorian London's affluent communities during these years<sup>77</sup>.

## 5.2 Results

First, an attempt was made to observe the relationship between early drainage adoption and the average number of domestic servants working within a household, as a proxy for income. Figure 5 shows the results for the entire sample, and Figure 6 shows the results disaggregated for each Parish.

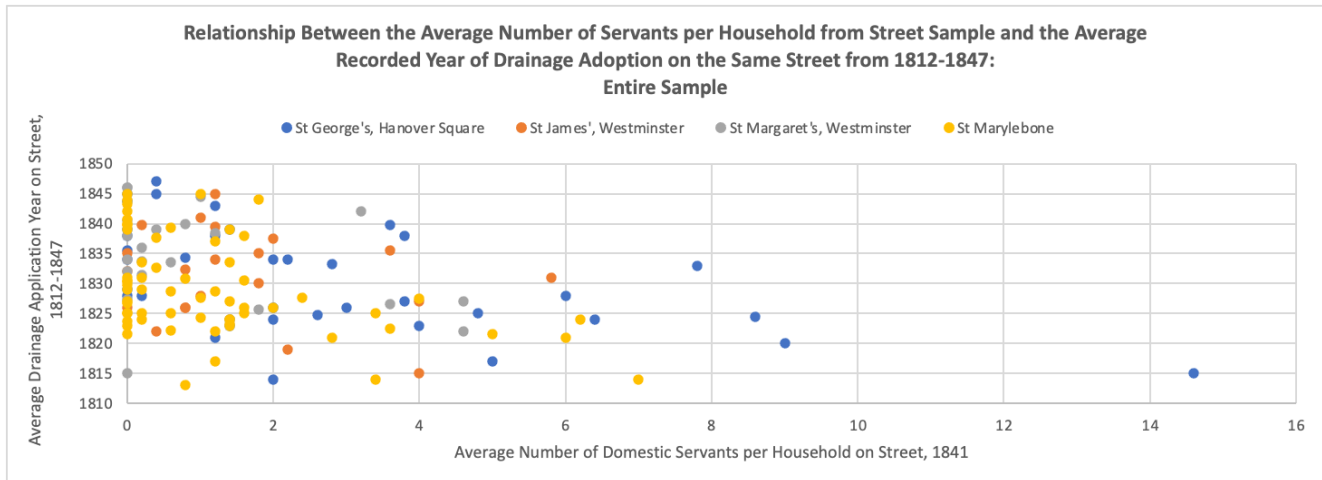
---

<sup>75</sup> P. J. Atkins, "The Spatial Configuration of Class Solidarity in London's West End 1792–1939," *Urban History* 17 (May 1990): 36–65, <https://doi.org/10.1017/s0963926800014346>, 38

<sup>76</sup> "Boyle's Fashionable Court and Country Guide and Town Visiting Directory: Corrected for January 1921: Containing Street and Alphabetical Arrangements of the Names and Places of Abode in Town and Country of the Nobility and Gentry ..., Inns of Court, Etc" (London: Court Guide Office, 1921).

<sup>77</sup> Garrett Ziegler, "The City of London, Real and Unreal," *Victorian Studies* 49, no. 3 (April 2007): 431–56, <https://doi.org/10.2979/vic.2007.49.3.431>, 439

Figure 1: relationship between the Average number of servants per household from street sample and the average year of drainage adoption on the same street, from 1812-1847.



Source: Westminster and Middlesex Commission of Sewers, WCS/478, WCS749, 1812-1847, and 1841 England, Wales and Scotland Census

Intuitive visual analysis of Figure 5 shows that to a large extent, the observed relationship between domestic servant averages in 1841 and the average year of drainage application from 1812-1847 reflects the distribution of domestic servant numbers across the four Parishes. The graph displays a weak and inconclusive correlation between average application year and average servant number, rejecting the hypothesis that across the sample, early drainage adoption was characterised by an inverse relationship between income and adoption year. In spite of this, Figure 5 explains that at the highest levels of servant numbers, the range of average drainage application year is smaller than those streets in the middle and lower end of the servant distribution. Of the streets in the sample who had a household average of at least four servants, 89.4% of them had adopted drainage between the years 1812- 1830, the year in which Hardy suggests flush-toilets became popularised among the middle-class<sup>78</sup>. Of the 108 streets whose households averaged 2 or less servants, only 45% had an average

<sup>78</sup> Anne Hardy, *The Epidemic Streets: Infectious Disease and the Rise of Preventive Medicine, 1856-1900* (Oxford: Clarendon Press, 2003), 157

drainage application year before 1830. Parish-level results in Figure 6 explain that the samples in St George's and St Marylebone drive this finding.

Despite the weakness of this correlation, this relationship is worth characterising more closely, particularly in light of the fact we do not know the levels of drainage prior to 1812. Towards this, Figure 7 records the average drainage adoption year for each percentile grouped according to the average number of servants per household on a street<sup>79</sup>.

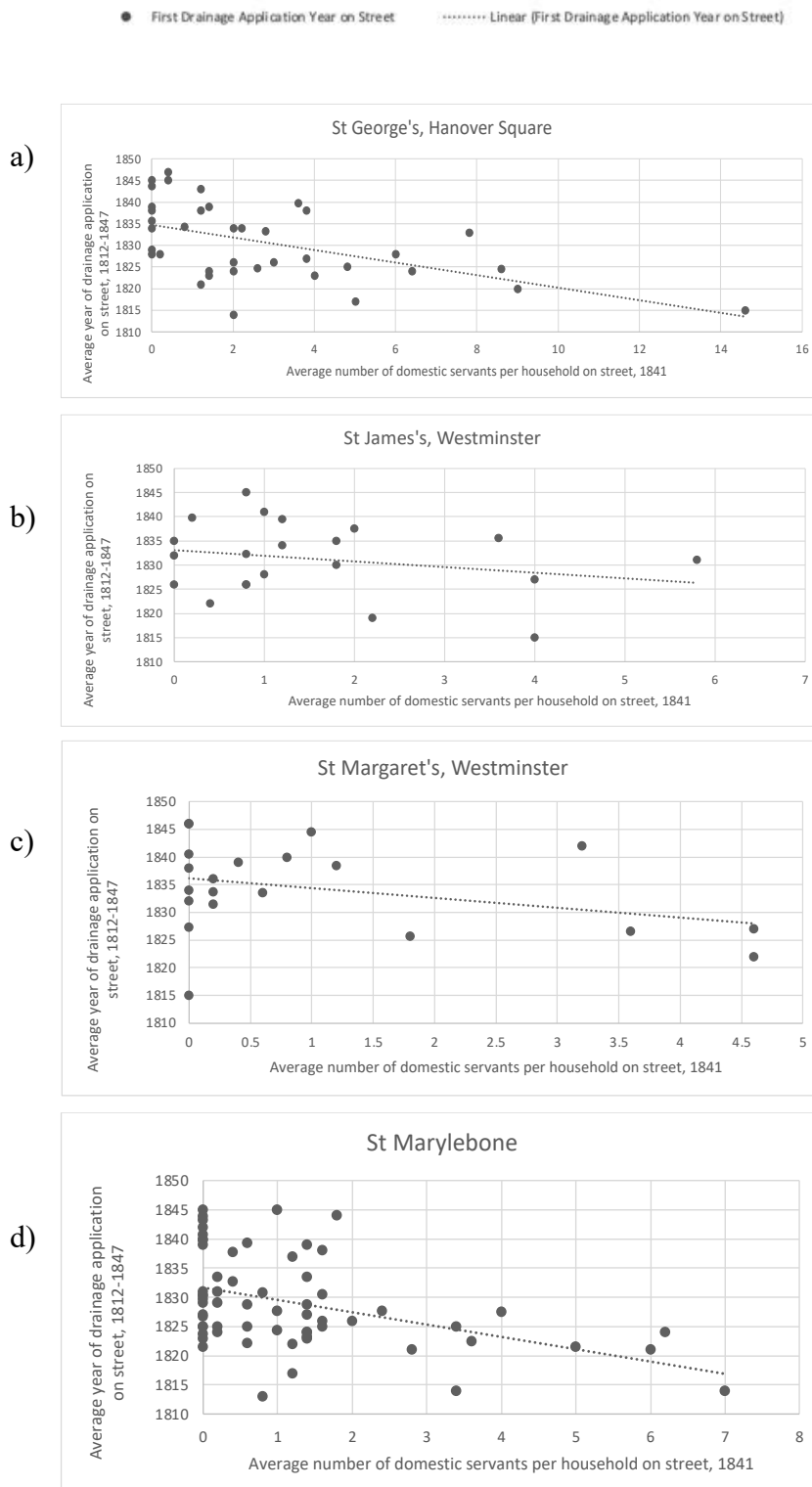
Figure 7 consolidates the wealthiest cohort, explaining that those in the top 10% of income as proxied by servants adopted drainage, on average, 8.4 years earlier than the rest of the sample, and 5 years before those in the top 10-20% of average servant numbers. This lends some support to the understanding that at the highest level of society, drainage adoption occurred earlier on average than among poorer members of the distribution. The large increase in average adoption year between the 50<sup>th</sup> and 60<sup>th</sup> percentile groups is most likely a representation of the pattern shown in figure 5 that below the level of around 2 servants, the range of adoption year is very wide.

Unexpectedly, the lowest 3 percentiles, representing the cohort with average servant numbers of 0-0.2, have an earlier average adoption year of up to 1.57 years earlier than the 40<sup>th</sup> and 50<sup>th</sup> percentile groups. This directly opposes the hypothesis that as adoption year will be earlier among richer streets within the sample. Therefore, these two distinctive cohorts that characterise adoption amongst the very poorest and very richest streets are classified more closely in the next sections.

---

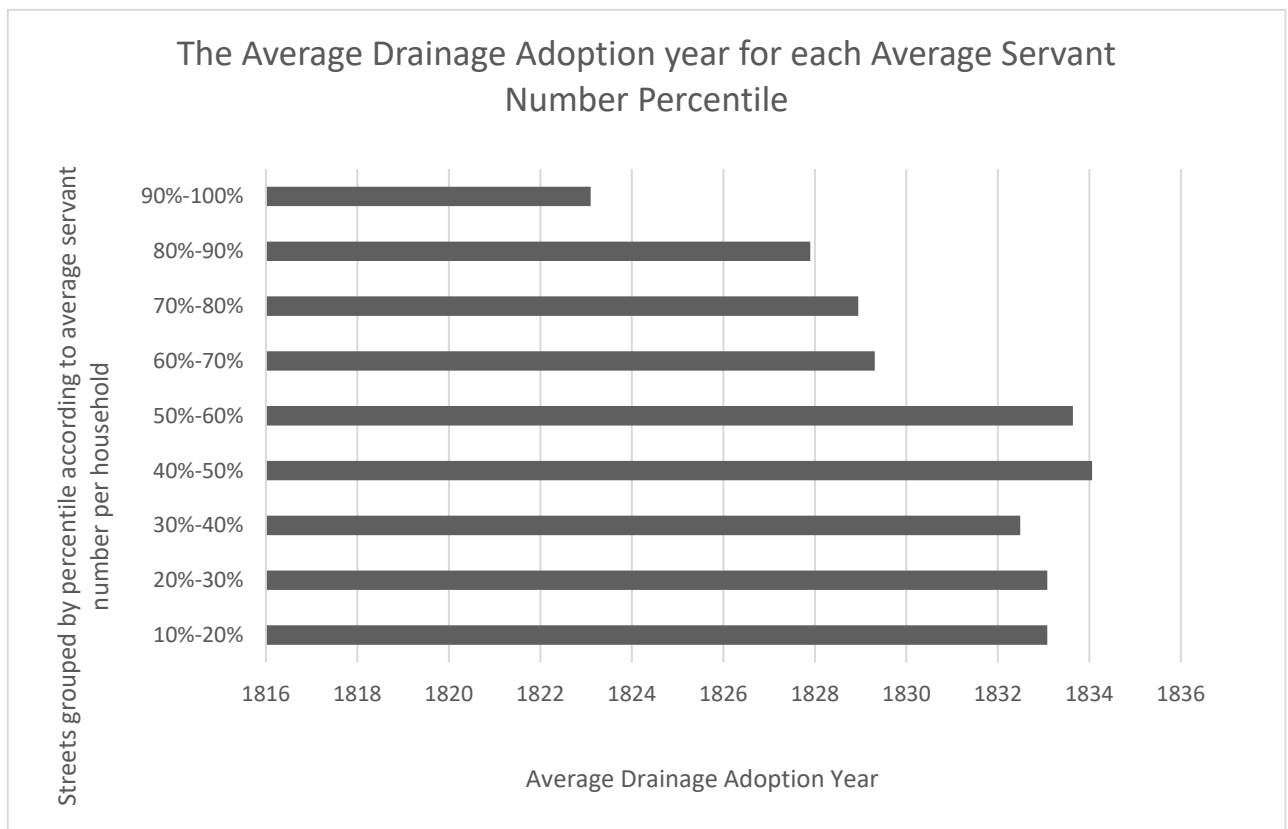
<sup>79</sup> Note that the data points used to record the averages for the 10%-20% and 20% to 30% groups are the same, as the average servant number across these was 0

**Figure 6: Relationship between the Average Number of Servants per Household from Street Sample and the Average Recorded Year of Drainage Adoption on the Same Street from 1812-1847: Parish Level**



**Source:** Westminster and Middlesex Commission of Sewers, WCS/478, WCS749, 1812-1847, and 1841 England, Wales and Scotland Census

**Figure 7: Average Drainage Adoption year for each percentile grouped by average servant numbers.**



Source: Westminster and Middlesex Commission of Sewers, WCS/478, WCS749, 1812-1847, and 1841 England, Wales and Scotland Census

### 5.3 Characterising the Wealthiest Adopters

Figure 7 explained that whilst income as proxied by servant numbers had a weak effect on drainage adoption year across the 1812-1847 period, the top percentile of streets by way of servants had an average adoption year 8.4 years earlier than the rest of the sample. Whilst one explanation might be that the fixed capital costs of drainage were very high, and could only be afforded at the highest level of income, this is unlikely given sources that explain the relatively incremental pricing of drainage costs which varied by length<sup>80</sup>.

<sup>80</sup> “Register of Contracts and Plans” *Metropolitan Commission of Sewers*, 1849. From London Metropolitan Archives, reference MBW/2837.

Therefore, this group may have shared additional characteristics that better explain the extremity of the deviation their earlier adoption year shows from the pattern identified in figure 7. Remembering the indications provided by Allen towards the understanding that drainage, and the technologies its adoption proxied, were a ‘trend’ among the wealthiest members of society<sup>81</sup>, we might identify potential clustering of this cohort around certain social networks through occupational analysis. Certainly, Mokyr identifies that drainage adoption may have had peer effects on its consumption by those in similar social networks, as he suggests major diffusion processes were triggered by the increasingly keen interest in science and engineering among the rising industrial culture of British elite during this period<sup>82</sup>.

Figure 8 adapts the Booth/Armstrong Classification model<sup>83</sup> by including ranks for Nobility and titled occupants and those whose occupations were marked as ‘Politician’ or ‘Diplomat’<sup>84</sup>, to compare the occupational characteristics of those in the top servant percentile against those across the three percentile groups below them.

---

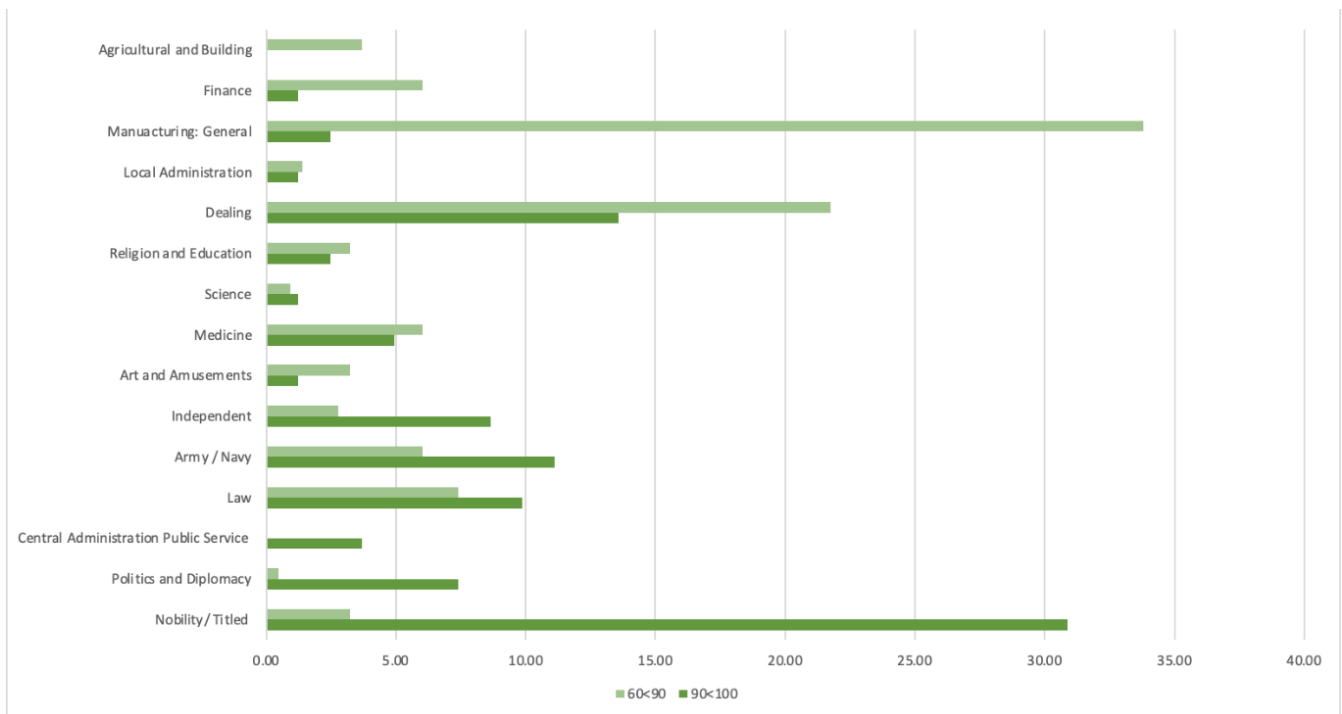
<sup>81</sup> Michelle Allen, “From Cesspool to Sewer: Sanitary Reform and the Rhetoric of Resistance, 1848–1880,” *Victorian Literature and Culture* 30, no. 2 (August 27, 2002): 383–402, <https://doi.org/10.1017/s1060150302302018h>, 386.

<sup>82</sup> Joel Mokyr, *The Gifts of Athena: Historical Origins of the Knowledge Economy* (Princeton: Princeton University Press, 2005), 182

<sup>83</sup> Charles Booth, "On Occupations of the People of the United Kingdom, 1808-81," *Journal of the Royal Statistical Society*, XLIX (1886), 314-4

<sup>84</sup> Note that due to an 1841 census data issue that assigned general terms to the population, measuring occupational rank alongside adoption year across the whole sample would not be appropriate; the term ‘builder’, for instance, could be assigned both to a casual labourer and a managerial role that generated high levels of income

**Figure 8: A comparison of the occupational characteristics between the 90th and 60th-80th average servant number percentile**



**Source:** 1841 England, Scotland and Wales Census

The most striking indication from Figure 8 is that 27.62% more of the proportion of the 90<sup>th</sup> percentile is made-up from the nobility and titled classes. There is also a significantly higher proportion of politicians, diplomats, and ‘Independent’ classes. ‘Independent’ people, classified by the census as ‘Men, or widows, or single women having no profession or calling, but living on their own means, may be inserted as *independent*<sup>85</sup>, at this level of average servant number were typically widowed or unmarried female aristocracy or retired, high-income professionals. Conversely, the occupational make-up of the 60<sup>th</sup>, 70<sup>th</sup> and 80<sup>th</sup> percentile group is predominantly explained by manufacturing and dealing employment, and a range of scientific, medical, and religious occupations of similar proportion to the 90<sup>th</sup> percentile. To the extent these findings corroborate with indications that there was a strong connection between the adoption of drainage and the circulation patterns of best-practice ideas, this analysis

<sup>85</sup> P.P., 1843, XXII, *Abstract of the Answers and Returns: Enumeration Abstract*, p. 3n.

supports the suggestion that at the highest levels of income as proxied by servant numbers, knowledge transfer and the understanding drainage was a 'trend' likely characterised the earlier average adoption year relative to the rest of the sample.

#### 5.4 Characterising the Poorest Adopters

Of equal interest from Figure 7 was the earlier adoption year of the lowest 40% of the cohort than those streets in the 40%-60% percentile groups. This opposes the hypothesis that the wealthier a household, the earlier they adopted drainage; factors other than income must explain their early adoption. The most obvious possibility is that those receiving drainage at the lowest end of the income distribution were not the people paying for it. Certainly, cross-referencing this cohort with street entries in the Sewage Registers confirmed none of these households paid for the drainage which their streets received<sup>86</sup>. This is significant because it indicates that a redistributive function was facilitated by the private market, regardless of the incentive, that resulted in an earlier average adoption year amongst the poorer households than those in the middle of the income distribution.

Towards explaining these incentives, two possibilities are identified. The first is the suggestion by social histories that it was common practice for wealthy households to house their service staff in mews houses or courts<sup>87</sup>. Given the cost of sewerage was priced by length<sup>88</sup>, this implies an increased incentive from homeowners to adopt drainage for domestic service staff living in close proximity to the families they served. Therefore, Table 3 observes the proportion of the 10<sup>th</sup> to 30<sup>th</sup> percentile groups who worked in domestic service, showing results both

---

<sup>86</sup> *Westminster Commission of Sewers*, WCS/748, WCS/749

<sup>87</sup> Kathryn Wilkins, "'The Most Exclusive Village in the World': The Utilization of Space by the Victorian Aristocracy during the London Season," *Urban History Review* 40, no. 1 (September 2011): 5–16, <https://doi.org/10.7202/1006402ar>, 12

<sup>88</sup> Register of Contracts and Plans" *Metropolitan Commission of Sewers*, 1849. From London Metropolitan Archives, reference MBW/2837.



for those whose jobs were titled ‘servant’ in the census records and these same results but including additional occupations that indicated domestic service.<sup>89</sup>

Table 3: Comparison of the Occupational Characteristics between the 10<sup>th</sup> to 30<sup>th</sup> average servant number percentiles (Column 1) and the 50<sup>th</sup> and 60<sup>th</sup> percentiles (Column 2)

	Streets with average servant numbers in the 10 <sup>th</sup> , 20 <sup>th</sup> and 30 <sup>th</sup> Percentiles	Streets with average servant numbers in the 40 <sup>th</sup> and 50 <sup>th</sup> Percentiles
<u>No of Occupational Servants in Sample</u>	77	6
Total Number of Occupation Observations	464	142
Proportion of Sample Population who were Servants (%)	<b>16.59%</b>	<b>4.22%</b>
<u>No of Occupational Domestic Service Staff in Sample</u>	129	18
Total Number of Occupation Observations	464	142
Proportion of Sample Population who worked in domestic service (%)	<b>27.80%</b>	<b>12.67%</b>

*Source:* Westminster and Middlesex Commission of Sewers, WCS/478, WCS749, 1812-1847, and 1841 England, Wales and Scotland Census

It explains that at 27%, over twice the proportion of the 1841 population observed in the streets among the lowest 3 percentiles worked in domestic service than the same population observed in the streets within the 40<sup>th</sup> and 50<sup>th</sup> percentiles. Additionally, this same relationship is observed for the proportion of the population described as “Servants”, who represented almost four times the population of the lowest 3 percentile groups than for those in the 40<sup>th</sup> and 50<sup>th</sup> percentiles.

---

<sup>89</sup> Particularly, this group includes those working in the Mews houses and Stables in jobs adjunct to the popularised use of horse and carriage by wealthy households: stablemen, coachmen, and grooms, for a few.

There are some issues with this analysis<sup>90</sup>. To a large extent, the higher portion of those employed in domestic service in the 10<sup>th</sup> to 30<sup>th</sup> percentiles may just reflect the lower income levels amongst this group. Due to this, qualitative analysis of the drainage applicants for these streets can better explain this phenomenon as a characteristic of early drainage adoption<sup>91</sup>.

In some instances, the incentive for drainage adoption of Mews houses did come from wealthy families themselves. In 1829, an E.Mitchell of Chapel Street, Grosvenor place, successfully applied for the construction of a 150ft long, 2ft, 6-inch-wide sewer on Chapel Mews<sup>92</sup>. Or in 1828, when a G.Green of Little Chester Street paid for 140 feet of 2ft, 6-inch sewer on Chester Mews. Examples of this behaviour persist later into the period, such as in 1839, when a J.Higgs of Davies Street applied for 90 ft of 2ft, 6-inch sewer on both Davies Street and Davies Mews<sup>93</sup>. This adoption phenomenon can be explained as an externality of the best-practise knowledge acquirement of the wealthiest households in the distribution.

The bulk of analysis, however, found that the payees of drainage for the poorest streets were members of elite society who lived nearby. Sir Richard Sutton Baronet of Margaret Street, Cleveland Square, “considered one of the most wealthy men in the country” by the People’s Paper upon his death in 1855<sup>94</sup>, paid for the drainage of Russel Court, Cleveland Street in 1826<sup>95</sup>. Similarly, Lady Frances J Scott, the daughter of Lord John Scott, the Lord High Chancellor of

---

<sup>90</sup> Firstly, the number of those listed in the census data as ‘servants’ may be overstated, given some of the ‘servants’ who did not live-in the homes of their employer may have been women who worked in the home of their kin, whom the remuneration sometimes labelled as ‘domestic servants’ – local population studies. org

<sup>91</sup> The individual observations drawn out below do not discriminate between adoption dates across the 1812-1847 period; it is not appropriate to only investigate those adopting drainage on poor streets earlier in the period as this may limit understanding of the interactions that explained early adoption.

<sup>92</sup> *Westminster Commission of Sewers*, WCS/748, WCS/749, no.462

<sup>93</sup> *Westminster Commission of Sewers*, WCS/748, WCS/749, no. 903

<sup>94</sup> “The People’s Paper” Saturday, November 7<sup>th</sup>, 1855 p.7

<sup>95</sup> *Westminster Commission of Sewers*, WCS/748, WCS/749, no.199

Great Britain between 1801-1827, lived at Palace Yard, St Margaret's<sup>96</sup>, and paid for 115 ft of 3ft sewer for Princes Row in 1842<sup>97</sup>. In many instances, this connection involved Mews houses. George Harrison, an English barrister and previous Auditor of the Treasury<sup>98</sup>, paid for the drainage of 100ft of Woodstock Mews in 1827<sup>99</sup>, as E.P Littleton Esquire did for the 63ft of 2', 6" sewerage laid on Chesterfield Mews in 1828<sup>100</sup>. In an interesting connection that may be simply a coincidence of name, Abel Smith, listed in the 1841 London Gazette as an Esquire of Woodhall-Park in the County of Hertford<sup>101</sup>, paid for 120 feet of 2ft, 6" sewer on Hertford Mews in 1838<sup>102</sup>. It may have been the case then that Abel Smith owned the land on which Hertford Mews was built; whilst this information has not been obtained, we can look to an example from the same Parish for indication of whether this phenomenon occurred. On Gloucester Mews, John Clay Boutall, a Surgeon of Grosvenor Square<sup>103</sup>, paid for the drainage of Gloucester Mews<sup>104</sup>. We might understand Gloucester Mews to have been part of his estate, given upon his death multiple properties were listed in the Daily Herald as parts of his Estate: he owned homes on North Row, Park Lane, Oxford Street, and Bruton Mews<sup>105</sup>.

Whilst the incentive behind this phenomenon is not clear, some evidence from this analysis found a philanthropic incentive towards drainage adoption for the poorest households. There is evidence of initiative taken by charities; some households living in Palmer's village in 1836 had 125 feet of private sewer paid for to replace the pre-existing open sewer, paid for by the Trustees of Palmer's

---

<sup>96</sup> "Sally Rackham - Family Tree," Sally Rackham - family tree - Person Page, accessed February 10, 2024, <https://www.dublor.co.uk/g0/p33.htm>

<sup>97</sup> *Westminster Commission of Sewers*, WCS/748, WCS/749, no.843

<sup>98</sup> J. R. Torrance, "Sir George Harrison and the Growth of Bureaucracy in the Early Nineteenth Century," *The English Historical Review* LXXXIII, no. CCCXXVI (1968): 52–88, <https://doi.org/10.1093/ehr/lxxxiii.cccxxvi.52> 54

<sup>99</sup> *Westminster Commission of Sewers*, WCS/748, WCS/749, no.309

<sup>100</sup> *Westminster Commission of Sewers*, WCS/748, WCS/749, no.329

<sup>101</sup> "London Gazette" July 16<sup>th</sup>, 1841. P.4

<sup>102</sup> *Westminster Commission of Sewers*, WCS/748, WCS/749, no.841

<sup>103</sup> *Westminster Commission of Sewers*, WCS/748, WCS/749, no 970

<sup>104</sup> "Westminster Rate Books" Westminster, 1841.

<sup>105</sup> "The Morning Herald", February 28<sup>th</sup>, 1839. P.1

Charity<sup>106</sup>, a philanthropic initiative that provided alms-houses for 12 widows and ex-householders<sup>107</sup> and a school for 20 boys<sup>108</sup>. The 1841 census returns corroborate with these indications of poverty; an average of 3.4 households occupied each house, one of which contained 27 occupants spread over 4 households. A more dilute connection between philanthropic initiative and drainage adoption across the poorest streets considers wealthy individuals who were associated with charitable endeavour. Walpole Eyre Esquire, who paid for a substantial 1800 feet of drainage in the St John's Wood Estate of St Marylebone<sup>109</sup>, was a known philanthropist: In an 1847 edition of the Morning Herald Newspaper<sup>110</sup>, he is listed as a Trustee of the St Marylebone Benevolent Society. That he lived at 22 Bryanston Square, which had an average drainage adoption year of 1814 and an average servant number of 7, elucidates the personal involvement those early, wealthy adopters had to the carriage of adoption among the poorest households, often with benevolent incentive.

As productive as these findings are for displaying a redistributive function facilitated by the private market for drainage, that these findings cannot indicate whether this adoption was supplemented by improved toilet or water supply technologies highlights the limitations of this study for extending conclusions towards the implications adoption patterns had for unequal health outcomes. Any identification of 'redistribution' should be applied cautiously to the context of 19<sup>th</sup> century London. It is useful therefore to mitigate these findings with recognition both of the huge variety in the quality and cleanliness of toilet-technology available during this period<sup>111</sup>, and secondly the understanding that in general, sanitary conditions and drainage provision were

---

<sup>106</sup> *Westminster Commission of Sewers*, WCS/748, WCS/749, no 732

<sup>107</sup> "London Lives 1690 to 1800," Background - Parish Relief - London Lives, accessed May 20, 2024, <https://www.londonlives.org/static/ParishRelief.jsp>.

<sup>108</sup> Stephen Fisk, "Abandoned Communities - Palmer's Village," Palmer's village, accessed February 20, 2024, <http://www.abandonedcommunities.co.uk/palmer's%20village.html>.

<sup>109</sup> *Westminster Commission of Sewers*, WCS/748, WCS/749, no 30

<sup>110</sup> The Morning Herald", 5<sup>th</sup> January 1847. P.1

<sup>111</sup> Anne Hardy, *The Epidemic Streets: Infectious Disease and the Rise of Preventive Medicine, 1856-1900* (Oxford: Clarendon Press, 2003), 162

deplorable amongst most poor households until the state sewerage system became consolidated in the 1860's<sup>112</sup>.

### 5.5 Characterising Drainage Adoption by Sanitary Incentive

The adoption characteristics of drainage identified thus far have assumed those adopting it understood it as a health-enhancing good. To the extent that any connection made between evidence of early drainage adoption patterns and evidence of an early private sanitary incentive is dependent on this assumption being correct, this section contributes a brief investigation towards analysing this assumption without marshalling the facts.

Evidence from a Metropolitan Sewage Commission survey<sup>113</sup> inquiring into household opinions on sewage operations indicates that by 1849, the benefits of these infrastructures towards cleanliness, disease prevention, and public health had dissipated to the middle-class streets in the distribution. Whilst this is not sufficient in providing direct evidence for a sanitary incentive among the upper class as early as 1812, it certainly supports Mokyr's prediction that knowledge on best-practise technologies filtered vertically down across the first half of the century, and therefore indicates the presence of the opinions evidenced below among the upper classes earlier in the period<sup>114</sup>. Mr Rolfe, for example, a chemist from Gloucester Street in Regent's Park, explains that "‘good’ and ‘clean’ sewerage enhances the value of a neighbourhood considerably, both in a medical and lucrative point of view"<sup>115</sup>, whilst both Mr Morris and Mr Phillips, chemists at separate addresses on Tottenham Court Road, explained in 1849 improved sewerage adoption 'will prove highly beneficial to public health'<sup>116</sup>. These

---

<sup>112</sup> G Cook, "Construction of London's Victorian Sewers: The Vital Role of Joseph Bazalgette," *Postgraduate Medical Journal* 77, no. 914 (December 1, 2001): 802–4, <https://doi.org/10.1136/pgmj.77.914.802>, 802.

<sup>113</sup> Thomas Lovick, "Report on Flushing Operations", Metropolitan Commission of Sewers, 1849. Found in London Metropolitan Archives, reference code MCS/477/011. Appendix A and B

<sup>114</sup> Whilst this does not directly acquire information as to the opinions of those adopting drainage in the area covered between 1812 and 1849 on the adoption of that drainage, the source records the opinions of those on streets who did adopt drainage between 1812-1847 on the sanitary benefits of later drainage operations after 1848.

<sup>115</sup> Lovick, *Report on Flushing Operations*, p.8

<sup>116</sup> Lovick, *Report on Flushing Operations*, p.9

represent three opinions of the twenty-three medical men living in the four Parishes analysed who expounded the benefits of sewers to either cleanliness or public health. The survey indicates it was not only medical men, however, but equally occupants of other professions, who by 1849 understood the benefits drainage brought to not just their household, but the greater public. Mr Wells of Gray's Inn Road explained 'I consider the public health myself, and I make no doubt but that the plan of flushing is very preferable to the old one'<sup>117</sup>. Or consider Mr Willis, of Tottenham Court Road, who highlights the preferability of flushed sewage over open gully drainage: 'I am myself one of the directors of the poor, and if I can at any time stop the men from allowing the sweeping of slush from the roads down the gullies, I immediately stop them'<sup>118</sup>.

For some this approach may not provide a sufficient indicator of the understanding among the wealthiest and earliest drainage adopters that this was a health-enhancing good. Therefore, another approach can be taken by placing the knowledge that drainage adoption for the poorest streets was often provided by wealthy elites alongside evidence for the later involvement of this section of society in public sewerage initiatives. It would be a notable coincidence if, of the 16 Head Commissioners for the Metropolitan Commission of Sewers in 1854<sup>119</sup>, all of whom were Esquires or Baronets, none of the 8 of these who lived in the area covered previously by the 4 inner-London Parishes bore any connection to the group of societal elites who adopted drainage during 1812-1848.

Chapter 5.3 also suggested the possibility that knowledge transfers among occupants of streets within the highest percentiles of income may have influenced the dissipation of sanitary incentive among these groups. Indications of communication of sanitary matters within these surveys can certainly be found, for instance with Mr Bandwell of Great Queen Street, Westminster, who

---

<sup>117</sup> Lovick, *Report on Flushing Operations*, p.22

<sup>118</sup> Lovick, *Report on Flushing Operations*, p.48

<sup>119</sup> "Names of Commissioners" Metropolitan Commission of Sewers, 1854. Found at London Metropolitan Archives, reference code MCS/478/C23 p.1

assured he ‘is quite sure the inhabitants of the neighbourhood are of the same opinion [as to the benefits of flushing], having expressed themselves quite pleased’<sup>120</sup>. As did Mr Kirby of Marylebone High Street – ‘all his neighbours express themselves perfectly satisfied’<sup>121</sup>.

Together, these pieces of evidence provide support that the adoption patterns found in chapters 5.2, 5.3 and 5.4 were characterised by a sanitary motivation. Of particular significance is the evidence that those among the highest income percentile of the distribution both had sanitary incentives and were involved in the adoption of drainage amongst the poorest streets in the distribution. The understanding that occupational analysis has provided of their tight social networks, coupled with evidence that members of this social class were also at the fore of later Sewage Commissions, reinforces the role that an incentive for sanitary dissipation amongst this group played in characterising adoption patterns throughout these years.

## **6 Discussion and Conclusions**

This study of early drainage adoption hypothesised that there was a sanitary incentive encouraging its uptake, but that the provision of these technologies by the private market generated patterns of adoption that were socioeconomically unequal.

Indicative findings in chapters 4.1 and 4.2, and qualitative analysis in chapters 5.4 and 5.5 explains there was a substantial amount of drainage adoption in the four Parishes studied, which increased across the period, and was primarily a sanitary incentive.

Even before any discussion towards the inequalities that this adoption displayed, this finding alone is significant in the contribution it makes to thickening those

---

<sup>120</sup> Lovick, *Report on Flushing Operations*, p.41

<sup>121</sup> *Ibid.*

arguments promoted by Mokyr which advocate for the inclusion of private incentives within the narrative of English Sanitarian impulse in the 19<sup>th</sup> Century.

Turning now to the hypothesis that drainage adoption across 1812-1847 was characterised by an inverse relationship between income and adoption year. The weak and inconclusive correlation between average adoption year and average servant number - as a proxy for income - rejected this hypothesis. However, two distinctive findings were analysed in sections 5.3 and 5.4, which mitigate this rejection. These are the findings that firstly, at the top percentile of the income distribution, average adoption year was 8.4 years earlier than any other percentile group, indicating income may have had implications for relative adoption year at the highest levels of society. And secondly, that one reason for the weakness of the correlation was the wide range in average adoption year across the lower end of the income distribution, which in large part was explained by an unexpected pattern of adoption that existed outside the household consumption model. Therefore, a rejection of our hypothesis, which rested on Mokyr's model of household behaviour, cannot necessarily equate to a rejection that this model might predict inequalities in health consumption *per se*, but instead explains its failure to extend a substantial explanation to early drainage adoption, which was characterised by alternative methods of consumption.

Towards understanding the earlier adoption year of the highest income streets, findings in Chapter 5.3 that nearly a third of the highest average servant number percentile were members of the aristocracy, and almost 40% engaged in legal careers or government military, political, and administrative pursuit, offer the suggestion that supplementary to income, social networks and concentrated knowledge diffusion likely influenced the early adoption of drainage amongst this group. This finding extends support for Mokyr's argument that the 'learning effect' brought changes in household adoption behaviour to the context of early drainage adoption and its appending innovations amongst the top income



groups. It also echoes Allen's understanding that drainage may have been a trend amongst these groups.

However, an additional suggestion for the role knowledge networks played in characterising adoption outside of Mokyr's household model is supported by the unexpected finding in chapter 5.4 that this social group was equally engaged in providing the financial capital for drainage adoption on streets amongst the lowest end of the income distribution. In some cases, this phenomenon was characterised as an externality generated by the learning and acquisition of best-practise knowledge undergone by the wealthiest adopting households.

Remember, for instance, the E.Mitchell of Chapel Street, Grosvenor place, who successfully applied for the construction of a 150ft long, 2ft, 6-inch-wide sewer on Chapel Mews. In the majority studied, however, remunerators were members of high society, often living within the same Parish of the streets for which they provided the capital for drainage. Together, these results lend strong initial support for the role that, after conditions of income are met, knowledge-networks played in characterising adoption, both exacerbating its occupational patterns at the highest echelons of society, and equally in encouraging the increased application of best-practice knowledge towards the diffusion of drainage systems amongst the lower class across the period.

The importance of the finding that drainage adoption amongst the lowest income groups was characterised as an incentive of the highest income groups should not be understated, particularly in light of the earlier average drainage adoption year shared amongst the lowest three average servant number percentiles relative to those in the middle of the distribution. As a basic fact, this finding highlights that part of early drainage adoption was characterised by a redistributive function, and therefore disturbs the literature expounding the failures of the private market to provide equitable sanitary technologies<sup>122</sup>. More

---

<sup>122</sup> Simon Szreter, "The Importance of Social Intervention in Britain's Mortality Decline: A Re-Interpretation of the Role of Public Health," *Social History of Medicine* 1, no. 1 (1988): 1–38, <https://doi.org/10.1093/shm/1.1.1>, 25.

specifically, it pushes against the existing perception promoted by historians of the sanitary revolution that there were no efforts to provide sanitation for the poor before the emergence of public intervention<sup>123</sup>. Nonetheless, the experience of these four Parishes is extremely localised; in so far as the high proportion of political, social, and business elites living within these Parishes is extremely unique, this study recognises the dangers of applying any conclusions from such an isolated study of a local economy to the wider London context<sup>124</sup>.

Deserving extended discussion under this unique context, however, is the contribution these findings on early drainage adoption characteristics make to clarifying the role that private sanitary incentive under the market mechanism before 1848 had towards later public-health reform. This also reaches an important discussion about the role of the market in providing sanitary technologies.

As referenced in the literature review, the expounded failures of the market to contribute to English mortality decline - which have discouraged serious investigation into the characteristics of early sanitary commodity markets<sup>125</sup>- have led to the expansion of an alternative literature arguing that instead of the market, it was the diffusion of political and social movements which advocated for a sanitary reform in both public and private domains, that then caused mortality decline<sup>126</sup>.

---

<sup>123</sup> E. P. Hennock, "The Urban Sanitary Movement in England and Germany, 1838–1914: A Comparison," *Continuity and Change* 15, no. 2 (September 2000): 269–96, <https://doi.org/10.1017/s0268416099003550>, 270. See also James Webb, *The Guts of the Matter: A Global History of Human Waste and Infectious Intestinal Disease* (Cambridge: Cambridge University Press, 2019), 65, and Anne Hardy, *The Epidemic Streets: Infectious Disease and the Rise of Preventive Medicine, 1856-1900* (Oxford: Clarendon Press, 2003), 4

<sup>124</sup> Daniel Gallardo-Albarrán, "The Global Sanitary Revolution in Historical Perspective," *Journal of Economic Surveys*, March 21, 2024, <https://doi.org/10.1111/joes.12607>, 15.

<sup>125</sup> R. A. Easterlin, "How Beneficent Is the Market? A Look at the Modern History of Mortality," *European Review of Economic History* 3, no. 3 (December 1, 1999): 257–94, <https://doi.org/10.1017/s1361491699000131>. In this, he argues that market forces cannot explain English mortality decline, because of the externalities and information failures they created.

<sup>126</sup> For examples, see Simon Szreter, "The Importance of Social Intervention in Britain's Mortality Decline: A Re-Interpretation of the Role of Public Health," *Social History of Medicine* 1, no. 1 (1988): 1–38, <https://doi.org/10.1093/shm/1.1.1>, 25. See also, Knut Ringen, "Edwin Chadwick, the Market Ideology, and Sanitary Reform: On the Nature of the 19th-Century Public

What gets lost between this bipolar literature attempting to explain mortality decline, then, is an appreciation for the possibility that perhaps the experience of market provision was an important event in encouraging the initial impetus for sanitary movements in private, and eventually public spheres. This embraces the context of private drainage and sewerage provision before 1848.

Therefore, the extended discussion point which follows tentatively suggests, and without making any unfounded claims, that in so far as the drainage market encouraged a knowledge acquisition and drainage adoption process amongst the political, social, and business elites of society, it may have also provided a useful impetus for their emergence within sanitary-reform culture, and the eventual introduction of state-provided and mandated drainage after 1847.

In this way, the uneven socio-economic characteristics of drainage and private sewer adoption are not best explained by the inability of the private market to supply these technologies equitably, but instead are more productively understood as a process whose successful conclusion was the mandated responsibility of local government provision after 1848.

The disproportionate concentration of business, political and social elites, many of whom were likely sanitary-inclined, and some philanthropically so, who were involved in adopting and paying for private sewerage across 1812-1847 would have produced a learning process amongst this group, the product of which was an increasing appreciation for the public-good character of these drained technologies. Qualitative analysis has certainly supplemented evidence of this groups' drainage adoption incentive for poorer streets with indications of their awareness of the benefits drainage bought for 'public health'. Meanwhile, more powerful evidence remembers the eight of the sixteen Metropolitan Sewage Commission Board in 1854 who lived in the area within these four Parishes, and whose opinions on the inefficiencies of the private market for providing sanitary

---

Health Movement," *International Journal of Health Services* 9, no. 1 (January 1979): 107–20, <https://doi.org/10.2190/lr4g-x2nk-9363-f1ec>, 118.

services by 1854 are reflected in their 1854 statement on the condition of Sewerage in Marylebone. They think it “remarkable, considering how intimately connected the subjects of house drainage, sewerage, and the supply of water are, that these matters should have been kept so long separate...their separation is the chief cause of the evils that have ensued”<sup>127</sup>. Such evils the report means as disease and illness “which entail so much suffering upon all classes, and particularly upon the poor”<sup>128</sup>. This exhibits Tremolet’s indication that preceding the state provision of sanitary services is often a process of realisation that the successful implementation of one technology requires the universal provision of other infrastructures<sup>129</sup>.

Following indications of this learning, we might interpret the ‘social networks’, which for Mokyr would have informed knowledge transfer and drainage adoption at household level, as the same networks which, in facilitating a nexus between early adopters who were among the wealthiest business, social, and political elites in London society, nurtured an emerging understanding that drainage should best be provided by the market. Turning our attention to the changes this may have caused in the political economy of public health in the nineteenth-century that receives so much interest in the literature<sup>130</sup>, we might infer the understanding that once consumers are aware of the public benefits of drainage and sewage infrastructures, they will demand a shift in the provision of these goods away from the commodity market and towards the political market<sup>131</sup>. Given the high number of political occupations listed in the 90<sup>th</sup> servant number percentile, alongside the indications that many members of nobility were

---

<sup>127</sup> John Phillips, John Roe, and Henry Austin. “Report by John Roe, John Roe Phillips and Henry Austin on Ventilation of Sewers”, Metropolitan Commission of Sewers, 1848. Found in London Metropolitan Archives. Reference number MCS/476/AA. P.5

<sup>128</sup> Ibid, 3

<sup>129</sup> Sophie Trémolet Sophie Trémolet, “Sanitation Economics: Understanding Why Sanitation Markets Fail and How They Can Improve,” *Waterlines* 32, no. 4 (October 1, 2013): 273–85, <https://doi.org/10.3362/1756-3488.2013.029>, 273

<sup>130</sup> For a summary of the literature, see 1. R Millward, “The Political Economy of Urban Utilities,” essay, in *The Cambridge Urban History of Britain*, vol. 3 (Cambridge: Cambridge University Press, 2000).

<sup>131</sup> Joel Mokyr, *The Gifts of Athena: Historical Origins of the Knowledge Economy* (Princeton: Princeton University Press, 2005), 178

frontmen of political reform, it is entirely within reason to suggest that a portion of the occupants on the streets examined in this project would have been involved in this process of demand, or at the least made a contribution to the body of knowledge that increased among this group from 1812-1847 and contributed to their understanding as to the necessity of state provision. Perhaps another manifestation of this process was the gradual integration of drainage adoption into legislation. Consider for instance the Metropolitan Building Act which emerged four years prior to the Metropolitan Sewers Act.

In a broader sense, then, and as far as this paper set out to characterise early drainage adoption between 1812-1847, the evidence provided attesting to the involvement and intention of elite society as a primary characteristic of drainage adoption from 1812-1847, points towards the most convincing conclusion that this experience was characterised by a process of increased ‘learning’ amongst this group as to the sanitary and public-health benefits of drainage across the period.

This understanding not only informed their earlier household adoption relative to the rest of the sample, testament to Mokyr’s model of household behaviour, but equally translated into a process of redistribution, seen in the diffusion of drainage renumerated by this class amongst streets at the lower ends of the distribution.

In this way, the importance of state-involvement within London’s story of sewerage provision has been overstated to the extent an unmeasured portion of its eventual political agency was the legacy of a social class involved in drainage adoption within the private commodity market as early as forty years prior. This is not to say this process was the primary or largest informant of sanitary reform culture<sup>132</sup>, nor to suggest for a moment that drainage amongst the poorest

---

<sup>132</sup> For a brilliant description of the other forces which initiated public improvement, and in particular the role of sanitary reformers at the front of the Public Health Movement, see Knut Ringen, “Edwin Chadwick, the Market Ideology, and Sanitary Reform: On the Nature of the 19th-Century Public Health Movement,” *International Journal of Health Services* 9, no. 1

households was not deplorable<sup>133</sup>. Instead, this analysis makes the case for more research on the individual figures in this study who were involved in the diffusion of drainage technologies to streets across the income distribution. It also makes the case for more research into the adoption characteristics amongst the middle of the income distribution; whilst this study has drawn out the striking relationship between the top and bottom members of the distribution to provide indications of a sanitary impulse, it has not identified the experience of intermediary members of the population as a distinctive ‘group’ of early adopters.

---

(January 1979): 107–20, <https://doi.org/10.2190/lr4g-x2nk-9363-f1ec>, and Ruth Gladys Hodgkinson, *Public Health in the Victorian Age: Debates on the Issue from 19th Century Critical Journals* (Farnborough: Gregg international, 1973).

<sup>133</sup> Anne Hardy, *The Epidemic Streets: Infectious Disease and the Rise of Preventive Medicine, 1856-1900* (Oxford: Clarendon Press, 2003), 4



## Appendix

Image A.1: Map of area drained by the Westminster Sewage Commission from 1812-1847.



*Source: Westminster Sewage Commission, 1817*

Image A.2: Map of London in 1812.



*Source: Langley and Belch, 1812.*

**Table A.3: Street Index with Average Servant Number and Adoption Year, 1812-1847.**

Parish	Street	Av. Servant no.	Av. Adoption Year
<i>St George's</i>	Arlington	8.6	1824.5
<i>St George's</i>	Black Lion Lane	0.8	1834.3
<i>St George's</i>	Bolton	3.8	1827
<i>St George's</i>	Brook	2.6	1824.7
<i>St George's</i>	Brook Little	3.8	1838
<i>St George's</i>	Brook Mews	0	1843.7
<i>St George's</i>	Carpenter	2	1826
<i>St George's</i>	Chapel Mews	0	1829
<i>St George's</i>	Chapel St	2	1814
<i>St George's</i>	Charles Street	3.6	1839.8
<i>St George's</i>	Chester st	5	1817
<i>St George's</i>	Chesterfield Mews	0.2	1828
<i>St George's</i>	Chesterfield Street	6	1828
<i>St George's</i>	Davies	1.4	1839
<i>St George's</i>	Davies Mews	0	1839
<i>St George's</i>	Dean	4	1823
<i>St George's</i>	Duke St	1.2	1821
<i>St George's</i>	George st	4.8	1825
<i>St George's</i>	Grosvenor Mews	0.4	1847
<i>St George's</i>	Grosvenor Square	14.6	1815
<i>St George's</i>	Grosvenor Street	7.8	1833
<i>St George's</i>	Hart	1.4	1823
<i>St George's</i>	Hereford Street	6.4	1824
<i>St George's</i>	Hertford Mews	0	1838
<i>St George's</i>	Hill Street	9	1820
<i>St George's</i>	Knightsbridge Green	0.4	1845
<i>St George's</i>	Knightsbridge	2.8	1833.3
<i>St George's</i>	Maddox Little	1.2	1843
<i>St George's</i>	Market st	0	1834
<i>St George's</i>	Park	2	1824
<i>St George's</i>	Swallow	3	1826
<i>St George's</i>	Shepherds	1.4	1824
<i>St George's</i>	South	2	1834
<i>St George's</i>	Union	0	1835.6
<i>St George's</i>	Vine street	2.2	1834
<i>St George's</i>	Weaver's court	0	1845
<i>St George's</i>	Wood Street	1.2	1838
<i>St George's</i>	Woodstock mews	0	1828
<i>St James</i>	Berwick Street	0.8	1832.3
<i>St James</i>	Church Passage	1.2	1834
<i>St James</i>	Cleveland Street	0.8	1826
<i>St James</i>	Conduit Mews	1.2	1845
<i>St James</i>	Conduit Street	3.6	1835.6
<i>St James</i>	Crown Street	0.2	1839.7
<i>St James</i>	Duke st	1.8	1835
<i>St James</i>	Haymarket	2.2	1819
<i>St James</i>	King St	1	1828
<i>St James</i>	Marshall Sr	0.8	1826
<i>St James</i>	Oxford Street	2	1837.5
<i>St James</i>	Pall Mall	1.8	1830
<i>St James</i>	Park	5.8	1831
<i>St James</i>	Princes little	0	1832
<i>St James</i>	Rupert	4	1815
<i>St James</i>	St James	4	1827
<i>St James</i>	Stable Yard	0	1826
<i>St James</i>	Wardour St	1	1841
<i>St James</i>	Warwick St	1.2	1839.5
<i>St James</i>	Wells Mews	0	1835
<i>St James</i>	West Street	0.4	1822
<i>St Margaret's</i>	Abingdon Little	0.4	1839
<i>St Margaret's</i>	Bennett	0	1815
<i>St Margaret's</i>	Bloomberg	0	1827.3
<i>St Margaret's</i>	Bowling	0	1846
<i>St Margaret's</i>	Bowling Green Place	0.2	1833.7
<i>St Margaret's</i>	Brewer st	3.6	1826.5
<i>St Margaret's</i>	Coburg Row	0	1838
<i>St Margaret's</i>	Dean's Yard	3.2	1842
<i>St Margaret's</i>	Duke st	4.6	1827
<i>St Margaret's</i>	Francis Place	0	1846
<i>St Margaret's</i>	Grosvenor Place	0.8	1840
<i>St Margaret's</i>	Horseferry Road	0.6	1833.6
<i>St Margaret's</i>	James Street	0.2	1831.5
<i>St Margaret's</i>	Palmer's Village	0.2	1836
<i>St Margaret's</i>	Princes Row	0	1840.5
<i>St Margaret's</i>	Queen st Little	1	1844.5
<i>St Margaret's</i>	Queen Street	4.6	1822
<i>St Margaret's</i>	Rochester Row	0	1832
<i>St Margaret's</i>	St James st	0	1834
<i>St Margaret's</i>	Vauxhall Bridge Rd	1.8	1825.7
<i>St Margaret's</i>	William	1.2	1838.4
<i>St Marylebone</i>	Edgware Road	0.6	1822.2
<i>St Marylebone</i>	Barrow Hill	0	1843.3
<i>St Marylebone</i>	Bell Street	0	1831
<i>St Marylebone</i>	Berkeley Street	5	1821.5
<i>St Marylebone</i>	Blandford street	1.8	1844
<i>St Marylebone</i>	Blandford street	3.4	1825
<i>St Marylebone</i>	Blandford Terrace	1.6	1825
<i>St Marylebone</i>	Bryanston Square	7	1814
<i>St Marylebone</i>	Castle	0.4	1837.7
<i>St Marylebone</i>	Chandos	1.4	1824
<i>St Marylebone</i>	Chapel Place	2.4	1827.7
<i>St Marylebone</i>	Charles	0.6	1839.3
<i>St Marylebone</i>	Charles Little	0	1843.8
<i>St Marylebone</i>	Church Mews	0	1839
<i>St Marylebone</i>	Church St Little	0	1830.3
<i>St Marylebone</i>	Circus Road	0.8	1830.8
<i>St Marylebone</i>	Devonshire	0	1823.7
<i>St Marylebone</i>	Devonshire Place	0.2	1824
<i>St Marylebone</i>	Dorset	1.4	1823.3
<i>St Marylebone</i>	Dudley Court	0	1842
<i>St Marylebone</i>	Earl Street, West	0	1821.5
<i>St Marylebone</i>	East John Street	1.4	1823
<i>St Marylebone</i>	Edward Street	0	1825
<i>St Marylebone</i>	George (Upper)	1.4	1827
<i>St Marylebone</i>	Gloucester Mews	0	1839.7
<i>St Marylebone</i>	Gloucester place	2.8	1821
<i>St Marylebone</i>	Gloucester street	3.6	1822.5
<i>St Marylebone</i>	Grove St Little	1.4	1824
<i>St Marylebone</i>	Hamilton Terrace	4	1827.5
<i>St Marylebone</i>	Harley street	6	1821
<i>St Marylebone</i>	Harrow Street	0	1825
<i>St Marylebone</i>	Hays Place	0.6	1828.75
<i>St Marylebone</i>	Henrietta Street	0.6	1825
<i>St Marylebone</i>	High	1.4	1839
<i>St Marylebone</i>	James little	0	1840
<i>St Marylebone</i>	James mews	0	1845
<i>St Marylebone</i>	John	0	1830.4
<i>St Marylebone</i>	King	1.6	1830.5
<i>St Marylebone</i>	Linton Place	0.2	1825
<i>St Marylebone</i>	Lisson Grove	0.8	1813
<i>St Marylebone</i>	Margaret St	1.6	1838
<i>St Marylebone</i>	New Church St	1	1824.3
<i>St Marylebone</i>	Paradise Street	1	1845
<i>St Marylebone</i>	Portman Place	1.2	1837
<i>St Marylebone</i>	Princes	1.4	1833.5
<i>St Marylebone</i>	Quebec (Great)	1	1827.7
<i>St Marylebone</i>	Quebec (New)	0.4	1832.7
<i>St Marylebone</i>	Queen	0.2	1833.5
<i>St Marylebone</i>	Queen Anne	6.2	1824
<i>St Marylebone</i>	Riding House	0	1823
<i>St Marylebone</i>	Seymour Place	1.2	1817
<i>St Marylebone</i>	Seymour st Upper	3.4	1814
<i>St Marylebone</i>	Spring	0	1829.7
<i>St Marylebone</i>	Spring mews	0	1840.7
<i>St Marylebone</i>	Stephens Street	1.2	1822
<i>St Marylebone</i>	Titchfield Terrace	1.6	1826
<i>St Marylebone</i>	Titchfield, Great	2	1826
<i>St Marylebone</i>	Tudor Place	0	1829
<i>St Marylebone</i>	Virgil Place	0.2	1829
<i>St Marylebone</i>	Wells Street	0.2	1831
<i>St Marylebone</i>	William	0	1826.7
<i>St Marylebone</i>	Woodstock Mews	0	1827
<i>St Marylebone</i>	York Place, Upper	1.4	1828.7

**Source:** WCS Registers, 1812-1822, 1823-1847; 1841 Census



## Bibliography

### Core Primary Sources

- “Register of New Sewers, 1812-1822” *Westminster and Middlesex Commission of Sewers*, London. From London Metropolitan Archives, Reference code WCS/748.
- “Register of New Sewers, 1823-1847” *Westminster and Middlesex Commission of Sewers*, London. From London Metropolitan Archives, Reference code WCS/749
- The National Archives of the UK (TNA), “1841 Census of England, Scotland and Wales”, 1841
- Langley and Belch. “Langley and Belch’s New Map of London, 1812”. (Langley and Belch, 1812). Accessed at London Picture Archives, Catalogue No: k1262765\_A

### Additional Primary Sources

- “Accountant’s Statement as to Salaries and Charges for Services, 1847” *Metropolitan Commission of Sewers*, 1847. London. From London Metropolitan Archives, collection MCS/476/AA – Printed Reports and Papers – Volume AA
- Lovick, Thomas, “Report on Flushing Operations”, *Metropolitan Commission of Sewers*, 1849. Found in London Metropolitan Archives, reference code MCS/477/011.
- Lovick, Thomas. “Metropolitan Commission of Sewers report on the drainage of the Westminster Abbey Precincts” Metropolitan Commission of Sewers, 1849. From London Metropolitan Archives, collection MCS/477/B49
- “Map of districts drained by watercourses discharging into the River Thames” *Westminster Sewage Commission* 1817. Accessed at London Metropolitan Archives, REF: WCS/PR/006
- “Names of Commissioners” *Metropolitan Commission of Sewers*, 1854. Found at London Metropolitan Archives, reference code MCS/478/C23 p.1
- P.P., 1843, XXII, Abstract of the Answers and Returns: Enumeration Abstract, p. 3n.
- “Register of Contracts and Plans” *Metropolitan Commission of Sewers*, 1849. From London Metropolitan Archives, reference MBW/2837.
- “Westminster Rate Books” *Westminster*, 1841.
- “Sally Rackham - Family Tree.” Sally Rackham - family tree - Person Page. Accessed May 20, 2024. <https://www.dublur.co.uk/g0/p33.htm>.
- “The Morning Herald”, 5<sup>th</sup> January 1847
- “The Morning Herald”, 28<sup>th</sup> February 1839
- “London Gazette” 16<sup>th</sup> July 1841
- “The People’s Paper” 7<sup>th</sup> November 1855

## Secondary Sources

- Allen, Michelle. "From Cesspool to Sewer: Sanitary Reform and the Rhetoric of Resistance, 1848–1880." *Victorian Literature and Culture* 30, no. 2 (August 27, 2002): 383–402. <https://doi.org/10.1017/s1060150302302018h>.
- Alsan, Marcella, and Claudia Goldin. "Watersheds in Child Mortality: The Role of Effective Water and Sewerage Infrastructure, 1880–1920." *Journal of Political Economy* 127, no. 2 (April 2019): 586–638. <https://doi.org/10.1086/700766>.
- Antman, Francisca M. "For Want of a Cup: The Rise of Tea in England and the Impact of Water Quality on Mortality." *Review of Economics and Statistics* 105, no. 6 (November 2023): 1352–65. [https://doi.org/10.1162/rest\\_a\\_01158](https://doi.org/10.1162/rest_a_01158).
- Atkins, P. J. "The Spatial Configuration of Class Solidarity in London's West End 1792–1939." *Urban History* 17 (May 1990): 36–65. <https://doi.org/10.1017/s0963926800014346>.
- Beach, Brian, and W. Walker Hanlon. "Coal Smoke and Mortality in an Early Industrial Economy." *The Economic Journal* 128, no. 615 (November 18, 2017): 2652–75. <https://doi.org/10.1111/eoj.12522>.
- Booth, Charles. "On Occupations of the People of the United Kingdom, 1808-81," *Journal of the Royal Statistical Society*, XLIX (1886), 314-4
- Boyle's fashionable court and Country Guide and town visiting directory: Corrected for January 1921: Containing street and alphabetical arrangements of the names and places of abode in town and country of the nobility and gentry ..., Inns of Court, etc.* London: Court Guide Office, 1921.
- Chadwick, Edwin, and M. W. Flinn. *Report on the sanitary conditions of the labouring population of Great Britain by Edwin Chadwick, 1842. edited with an introduction by M.W. Flinn.* Edinburgh: Edinburgh University Press, 1965.
- Clark, Clare. *The great stink.* Orlando, FL: Harcourt, 2006.
- Cook, G. "Construction of London's Victorian Sewers: The Vital Role of Joseph Bazalgette." *Postgraduate Medical Journal* 77, no. 914 (December 1, 2001): 802–4. <https://doi.org/10.1136/pgmj.77.914.802>.
- Costa, Dora, and Richard Steckel. *Long-term trends in health, welfare, and economic growth in the United States*, November 1995. <https://doi.org/10.3386/h0076>.
- Davenport, Romola Jane, Max Satchell, and Leigh Matthew Shaw-Taylor. "Cholera as a 'Sanitary Test' of British Cities, 1831–1866." *The History of the Family* 24, no. 2 (November 3, 2018): 404–38. <https://doi.org/10.1080/1081602x.2018.1525755>.
- De Giorgi, Giacomo, Anders Frederiksen, and Luigi Pistaferri. "Consumption Network Effects." *The Review of Economic Studies* 87, no. 1 (May 6, 2019): 130–63. <https://doi.org/10.1093/restud/rdz026>.
- De Rocha, Angela, Carl Christensen, and Newton Paim. "Characteristics of Innovative Firms in the Brazilian Computer Industry." Essay. In *Journal of Product Innovation Management* 7, 2nd ed., 7:123–34. PDMA, 1990.
- Deaton, Angus. "What Does the Empirical Evidence Tell Us about the Injustice of Health Inequalities?" *Inequalities in Health*, October 18, 2013, 263–81. <https://doi.org/10.1093/acprof:oso/9780199931392.003.0018>.

- Easterlin, R. A. "How Beneficent Is the Market? A Look at the Modern History of Mortality." *European Review of Economic History* 3, no. 3 (December 1, 1999): 257–94. <https://doi.org/10.1017/s1361491699000131>.
- Easterlin, Richard A. "Industrial Revolution and Mortality Revolution." *Journal of Evolutionary Economics* 5, no. 4 (December 1995): 393–408. <https://doi.org/10.1007/bf01194368>.
- Farrow, S C. "McKeown Reassessed." *BMJ* 294, no. 6588 (June 27, 1987): 1631–32. <https://doi.org/10.1136/bmj.294.6588.1631>.
- Fisk, Stephen. "Abandoned Communities - Palmer's Village." Palmer's village. Accessed February 20, 2024. <http://www.abandonedcommunities.co.uk/palmer's%20village.html>.
- Fraser, Derek. *Power and authority in the Victorian City*. Oxford: Blackwell, 1979.
- Gagnon, Julien, and Sanjeev Goyal. "Networks, Markets, and Inequality." *American Economic Review* 107, no. 1 (January 1, 2017): 1–30. <https://doi.org/10.1257/aer.20150635>.
- Gallardo-Albarrán, Daniel. "The Global Sanitary Revolution in Historical Perspective." *Journal of Economic Surveys*, March 21, 2024. <https://doi.org/10.1111/joes.12607>.
- Halliday, Stephen, Stephen Halliday, and Adam Hart-Davis. *The Great Stink of London: Sir Joseph Bazalgette and the cleansing of the Victorian capital*. Sheltenham, Gloucestershire: The History Press, 2023.
- Hardy, Anne. *The epidemic streets: Infectious disease and the rise of Preventive Medicine, 1856-1900*. Oxford: Clarendon Press, 2003.
- Hardy, Anne. "Urban Famine or Urban Crisis? Typhus in the Victorian City." *Medical History* 32, no. 4 (October 1988): 401–25. <https://doi.org/10.1017/s0025727300048523>.
- Henock, E. P. "The Urban Sanitary Movement in England and Germany, 1838–1914: A Comparison." *Continuity and Change* 15, no. 2 (September 2000): 269–96. <https://doi.org/10.1017/s0268416099003550>.
- Hodgkinson, Ruth Gladys. *Public health in the victorian age: Debates on the issue from 19th century critical journals*. Farnborough (GB): Gregg international publ, 1973.
- Jane Nabunnyax Mulumba, Jane Nabunnyax, Cristophe Nothomb Cristophe Nothomb, Alana Potter Alana Potter, and Marielle Snel Marielle Snel. "Striking the Balance: What Is the Role of the Public Sector in Sanitation as a Service and as a Business?" *Waterlines* 33, no. 3 (July 1, 2014): 195–210. <https://doi.org/10.3362/1756-3488.2014.021>.
- Jenkins, Simon. *Landlords to London: The story of a capital and its growth*. London: Faber & Faber, 2012.
- Johansson, Sheila Ryan. "Food for Thought: Rhetoric and Reality in Modern Mortality History." *Historical Methods: A Journal of Quantitative and Interdisciplinary History* 27, no. 3 (July 1994): 101–25. <https://doi.org/10.1080/01615440.1994.10594227>.
- Katz, Michael B. "Occupational Classification in History." *Journal of Interdisciplinary History* 3, no. 1 (1972): 63. <https://doi.org/10.2307/202462>.
- Livi Bacci, Massimo. *A Concise History of World Population*. Cambridge: Blackwell, 1989.

- “London Lives 1690 to 1800.” Background - Parish Relief - London Lives. Accessed May 20, 2024. <https://www.londonlives.org/static/ParishRelief.jsp>.
- McKeown, Thomas, and R. Record. “Reasons for the Decline of Mortality in England and Wales during the Nineteenth Century.” *Population Studies* 16, no. 2 (November 1962): 94–122. <https://doi.org/10.2307/2173119>.
- McKeown, Thomas. *The Modern Rise of Population*. London: E. Arnold, 1976.
- Millward, R. “The Political Economy of Urban Utilities.” Essay. In *The Cambridge Urban History of Britain* 3, Vol. 3. Cambridge: Cambridge University Press, 2000.
- Mitchell, Brian. *European Historical Statistics* (London: Macmillan, 1975)
- Mokyr, Joel. “Technological Progress and the Decline of European Mortality.” *American Economic Review*, 2, Papers and Proceedings, no. 83 (1993): 324–30.
- Mokyr, Joel. *The gifts of Athena: Historical Origins of the Knowledge Economy*. Princeton: Princeton University Press, 2005.
- The National Archives. “The Discovery Service.” Metropolitan Buildings Office | The National Archives, August 12, 2009. <https://discovery.nationalarchives.gov.uk/details/r/11747702-a2e8-4144-9a17-672772100e08#:~:text=No%20cellar%20or%20underground%20room,provided%20in%20all%20new%20houses>.
- The National Archives. “The Discovery Service.” Westminster And Middlesex Commission Of Sewers | The National Archives, August 12, 2009. <https://discovery.nationalarchives.gov.uk/details/r/609e17c5-1bd1-4ada-8509-c11592d70428>.
- Owen, A. E. “15. Records of Commissions of Sewers.” *History* 52, no. 174 (February 1967): 35–38. <https://doi.org/10.1111/j.1468-229x.1967.tb01189.x>.
- Poulton, G. A. *Managing voluntary organizations*. Chichester West Sussex: Wiley, 1988.
- Ringen, Knut. “Edwin Chadwick, the Market Ideology, and Sanitary Reform: On the Nature of the 19th-Century Public Health Movement.” *International Journal of Health Services* 9, no. 1 (January 1979): 107–20. <https://doi.org/10.2190/lr4g-x2nk-9363-f1ec>.
- Sangster, Matthew. “Transformation and Specialization in London and Its Topography.” *Journal of Victorian Culture* 22, no. 3 (May 24, 2017): 317–28. <https://doi.org/10.1080/13555502.2017.1329971>.
- Szreter, Simon, and Graham Mooney. “Urbanization, Mortality, and the Standard of Living Debate: New Estimates of the Expectation of Life at Birth in nineteenth-Century British Cities.” *The Economic History Review* 51, no. 1 (February 1998): 84–112. <https://doi.org/10.1111/1468-0289.00084>.
- Szreter, Simon. “Economic Growth, Disruption, Deprivation, Disease, and Death: On the Importance of the Politics of Public Health for Development.” *Population and Development Review* 23, no. 4 (December 1997): 693–728. <https://doi.org/10.2307/2137377>.
- Szreter, Simon. “The Importance of Social Intervention in Britain’s Mortality Decline: A Re-Interpretation of the Role of Public Health.” *Social History of Medicine* 1, no. 1 (1988): 1–38. <https://doi.org/10.1093/shm/1.1.1>.

- Thorsheim, Peter. *Inventing pollution coal, smoke, and culture in Britain since 1800*. Athens, OH: Ohio University Press, 2018.
- Tien, Joseph H., Hendrik N. Poinar, David N. Fisman, and David J. Earn. "Herald Waves of Cholera in Nineteenth Century London." *Journal of The Royal Society Interface* 8, no. 58 (December 2010): 756–60. <https://doi.org/10.1098/rsif.2010.0494>.
- Torrance, J. R. "Sir George Harrison and the Growth of Bureaucracy in the Early Nineteenth Century." *The English Historical Review* LXXXIII, no. CCCXXVI (1968): 52–88. <https://doi.org/10.1093/ehr/lxxxiii.cccxxvi.52>.
- Trainor, Richard. "Urban Elites in Victorian Britain." *Urban History* 12 (May 1985): 1–17. <https://doi.org/10.1017/s0963926800007458>.
- Trémolet, S. "Sanitation Economics: Understanding Why Sanitation Markets Fail and How They Can Improve." *Waterlines* 32, no. 4 (October 1, 2013): 273–85. <https://doi.org/10.3362/1756-3488.2013.029>.
- Ward, W. Peter. *The clean body: A modern history*. Montreal: McGill-Queen's University Press, 2019.
- Webb, James. *The Guts of the Matter: A Global History of Human Waste and Infectious Intestinal Disease*. Cambridge: Cambridge University Press, 2019.
- Wilkins, Kathryn. "The Most Exclusive Village in the World': The Utilization of Space by the Victorian Aristocracy during the London Season." *Urban History Review* 40, no. 1 (September 2011): 5–16. <https://doi.org/10.7202/1006402ar>.
- Wilson, David C. "The Strategic Challenges of Cooperation and Competition in British Voluntary Organizations: Toward the next Century." *Nonprofit Management and Leadership* 2, no. 3 (March 1992): 239–54. <https://doi.org/10.1002/nml.4130020304>.
- Wilson, J. "Innovation in Organization: Notes towards a Theory." Essay. In *Approaches to Organizational Design*, edited by J Thompson, 193–218. Pittsburgh: University of Pittsburgh Press, 1966.
- Wrigley, Julia, William Lazonick, and Bernard Elbaum. "Technical Education and Industry in the Nineteenth Century." Essay. In *The Decline of the British Economy*, 162–88. Oxford: Clarendon Press, n.d.
- Ziegler, Garrett. "The City of London, Real and Unreal." *Victorian Studies* 49, no. 3 (April 2007): 431–56. <https://doi.org/10.2979/vic.2007.49.3.431>.