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Abstract

The water closet is a modern essential. Cities all over the world seek to provide people with a private restroom that is connected to an underground sewer system. But while water closets are taken for granted, they hinge on a complex technological system that required enormous investments, particularly for underground water pipes and sewers and wastewater disposal. This essay identifies the roots of this global technology in decisions during the second half of the nineteenth century. The first part traces the divergent interests of a broad range of stakeholders. City dwellers, sanitary experts and sewermen, engineers and inventors, state authorities and agriculturalists held different views of wastewater problems that were at odds in significant respects. The second part traces the way how these divergent interests were negotiated, arguing that it was a process of subsequent exclusion rather than negotiation and the gradual development of a compromise. In this way, the rise of the water closet as a self-evident sanitary requirement marks the hegemony of the city in modernity as well as the victory of sanitary and engineering interests at the expense of rural interests. It also turned the water closet into a mode of distinction, as access varied and continues to vary depending on gender and social status.

London was the largest city of the world in the nineteenth century. It was also a hub of the sanitation movement. The environmental consequences of urban life were multiplying rapidly in great cities, and they grew with particularly vigor in the capital of the British Empire. In the summer of 1858, London suffered from an event that entered history books as the Great Stink, when hot weather turned the Thames River into an olfactory abomination.[1] Political effects of singular events are always debatable, but there can be no doubt that London devoted a lot of resources into its sanitary infrastructure. Pipes for fresh water were installed all over the city while sewers sought to bring wastes away from residents, and London's achievements were discussed far beyond the British isles. But did it really make London a clean city? When a British engineer traveled to Japan and analyzed water samples in Tokyo, it seemed poised for a foregone conclusion. While London had been building its water infrastructure for decades, Tokyo used a premodern water system with wooden pipes, and it had a flourishing trade with nightsoils (the Victorian word for human excrements). But when he presented his results to the members of the Asiatic Society of Japan in 1877, British achievements looked like an ambiguous blessing. As shown by the engineer's analyses, Tokyo's water was cleaner than London's.[2]

This result provides an opportunity to reflect on the narratives that have framed our understanding of the modern sanitary revolution. On first glance, it seems like a grandiose success story of Western technology. Cities all over the industrial world sought to bring clean water in from the countryside, and they built underground networks to take care of wastes, and these technologies eventually made their way into urban centers all around the globe. The

1. Cf. Stephen Halliday, The Great Stink of London: Sir Joseph Bazalgette and the Cleansing of the Victorian Capital (Stroud: Sutton Publishing, 1999), pp. 71-76.

2. Susan B. Hanley, Everyday Things in Premodern Japan: The Hidden Legacy of Material Culture (Berkeley: University of California Press, 1997), p. 104n.

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investments into infrastructures that sanitary experts demanded and oversaw made an impression on scholars, whose narratives have situated the sanitary revolution in a context that matched its ambitions. George Rosen's classic *History of Public Health* starts with a chapter on "the origins of public health" that looks at the Indus valley, Egypt's Middle Kingdom, the palace of Knossos on Crete, and the Incas.[3]

History is often written by the winners, and the sanitary revolution is not an exception. It is not just about the enormous financial investments that were waiting to be justified. The elaborate underground structures had their own kind of magic, a networked solution to an intimate problem that took care of problems beyond the public's gaze. Furthermore, there can be little doubt that the networked sanitary city did achieve something: the twentieth-century city in the industrial West was clearly a healthier place than its nineteenth-century predecessor. There is also a lack of alternative role models: no large city of the modern age has shunned the development of centralized water supply and waste removal. Even Japan eventually abandoned nightsoil collection and wooden pipes and went down the standard route, though it bears recognition that the momentum of the old system was enormous. By the end of the Second World War, Japan had only six sewer systems with treatment facilities, and sewers served less than five percent of the total population.[4]

Of course, sanitary networks differ around the globe. Some of them are in public ownership while others operate as private ventures. Some water closets are high-tech solutions (as Japanese readers know very well) while others are merely dignified hole in the ground. Some systems are operating smoothly while others are decaying. But for all this variety, there seems to be a notable convergence on the essentials: a private place for defecation and a systemic solution to waste removal. The water closet is firmly established as the global standard, the hygienic essential that humans either have or strive to have all over the world.

But the global career of the water closet makes it all the more important to inquire about the path that has led world society down this route. While the water closet is largely uncontested in the twenty-first century, it was enormously controversial in the nineteenth century. Even more, it was by all means open whether the public health interests of urban residents would really emerge as the defining interest. The first part of this article seeks to outline the diversity of issues and stakeholders that played a role in the nineteenth century. The second part looks into the way these issues were dealt with. In a nutshell, the argument is that the path towards the water closet was first and foremost about marginalizing or even eliminating competing visions and interests. In the twenty-first century, we are stuck with existing sanitary technology and its inherent demands for better or worse.

I.

The water closet may not look like much in engineering terms, but it took several generations of engineers to turn an idea into a properly functioning reality. It needs a sufficient flow of water to swipe away excrements, but not a deluge that runs a risk of spilling some of the awkward matter out of the bowl. A functioning water closet needs a robust mechanism to start the flow and another mechanism to stop it. Excrements must not block the outlet, and neither must paper and other incidentals that people may choose to flush. The toilet is a place of privacy, and policing users of water closets as to what they dropped into the bowl has rarely been an option. Water closets had to digest whatever people were leaving it with.

The first British patent for a water closet was issued in 1775. Roughly a century later, innovation and tinkering had reached a point of maturity. In *Clean and Decent*, his classic history of the bathroom and the water closet, Lawrence Wright called 1870 "the *annus mirabilis* of the water-closet".[5] In fact, innovation was about two different challenges: first, about finding a technological solution that was working reliably, and second, about finding a way to make this solution ready for mass production, which in turn was crucial for making it affordable to middle-class

3. George Rosen, A History of Public Health. Expanded Edition (Baltimore: Johns Hopkins University Press, 1993 [originally published 1959]), pp. 1-3.

4. Arata Ichikawa, "Japan's Sewerage System," International Journal of Water Resources Development 4 (1988), pp. 35-39; p. 35.

5. Lawrence Wright, Clean and Decent: The Fascinating History of the Bathroom and the Water-Closet (London: Penguin, 2000 [originally published 1960]), p. 201.

and then working-class families. By the late nineteenth century, both challenges were met sufficiently to declare the problem solved in technological terms. People did have to pay for the device, and they had to allocate precious indoor space to set it up, and many families had to contend themselves with a communal toilet, but in engineering terms, a solution was at hand.

Water toilets need a reliable supply of water and a sewer to take care of the waste. Cesspools were an alternative option as on the latter task, but they were easily overwhelmed by the amount of water. It was also a dangerous solution in terms of the water table, a constant worry in a nineteenth century that was in thrall with the miasma theory of disease. In any case, there was a need to develop both supply and waste collection networks, and ideally to develop them in sync. It rarely worked according to the idea. In Baltimore, USA, the municipal government bought a private water company in 1854, and the city launched an aggressive campaign to extend water pipes to urban homes and to build reservoirs to secure clean water. But when it came to wastes, Baltimore was dragging its feet. It was not until after 1900 that the city built a proper sewer system, the last large American city to do so.[6] The vagaries of urban politics determined when and how water pipes and sewers were built, and residents had to contend with the ensuing problems if water closets were deprived of a proper outlet.

Urban supply networks were enormously expensive, and it was an open question who should pay for and operate these systems. German cities typically favored municipal ownership and shouldered enormous investments. Contemporary observers spoke of "municipal socialism".[7] Entrepreneurial London was fonder of private initiative for a while, but it eventually came around to municipal ownership. It had eight companies in the water supply business when they were forced to merge into the Metropolitan Water Board in 1903.[8] St. Petersburg, Russia was quicker in buying private water supply companies, but the city effectively ran them like private corporations after it bought them in 1891. St. Petersburg used revenues from the water network to subsidize the municipal budget, and high fees kept fresh water out of the reach of ordinary citizens.[9] In Mexico City, construction of the Grand Canal, a drainage project for the Valley of Mexico, was a project of the federal government, though president Porfirio Díaz gave the construction job to a British businessman, Weetman Pearson, who completed the Grand Canal two years ahead of schedule. It helped to build a friendship between Díaz and Pearson that produced further contracts for harbor construction, railroads, and oil.[10]

But the sanitary interest of urban residents was only one possible view of excrements. Another focused on the nutrients that they contained and how they could be used at a profit in agriculture. German chemist Justus von Liebig became a self-appointed spokesperson for this point of view. Using the world "guano" to designate matter with fertilizer potential, he criticized the cities for not closing the nutrient cycle: "For centuries, we have brought, in the form of meat and produce, the Guano's essentials to the large cities, and we have not brought the Guano back", Liebig declared in his widely read "Chemical Letters".[11] Other experts followed his line of reasoning, and some even put the fertilizer value of human excrements into precise numbers. According to one estimate, the total value of Berlin's feces was precisely 1,693,237 Taler in 1863.[12]

Liebig had a role model that he touted in his writing. It was China, where the conservation of human feces was allegedly standing practice for 3,000 years. Liebig was full of admiration for Chinese conservation routines, even arguing that "in China, everybody knows the value of the excrements that a human being produces in a day,

6. Sherry H. Olson, Baltimore: The Building of an American City (Baltimore: Johns Hopkins University Press, 1980), pp. 136n, 249.

7. Wolfgang R. Krabbe, Die deutsche Stadt im 19. und 20. Jahrhundert: Eine Einführung (Göttingen: Vandenhoeck & Ruprecht, 1989), pp. 121-126.

8. John Broich, London: Water and the Making of the Modern City (Pittsburgh: University of Pittsburgh Press, 2013), p. 143.

9. Clemens Zimmermann, Die Zeit der Metropolen. Urbanisierung und Großstadtentwicklung (Frankfurt: Fischer Taschenbuch-Verlag, 1996), p. 101.

10. Houston Faust Mount II, Oilfield Revolutionary: The Career of Everette Lee DeGoyler (College Station: Texas A&M University Press, 2014), p. 40n.

11. Justus von Liebig, Chemische Briefe (Leipzig and Heidelberg: C. F. Winter, 1865), p. 487.

12. Rita Gudermann, "Die Berliner Abwässer und das Umland 1870-1930)," Noyan Dinçkal, Shahrooz Mohajeri (eds.), Blickwechsel. Beiträge zur Geschichte der Wasserversorgung und Abwässerentsorgung in Berlin und Istanbul (Berlin: Technische Universität Berlin, 2001), pp. 153-169; p. 154.

a week, or a year."[13] Other writers were following Liebig's line of thinking. "No Chinese peasant [...] goes to the town without bringing back, at either end of his bamboo pole, two buckets filled with unmentionable matter", Victor Hugo wrote in his novel *Les Misérables*. According to Hugo, it was "thanks to this human manure that the Chinese earth is as fruitful as in the days of Abraham".[14] Britain's charismatic sanitary reformer, Edwin Chadwick, planned to sell sewage to farmers and even hoped that revenues would be high enough to pay for urban sewer construction.[15]

Stories about nightsoil in East Asia were not completely fictional. Chinese cities had a flourishing trade in nightsoils since the late Ming dynasty. Cities in Japan and India were also in the human fertilizer business, and some recent publications provide insights into the trade.[16] Europe was more fond of sewage farms, where wastewater was used for the irrigation of fields. It was not only attractive in terms of reusing nutrients and redirecting them to the city, as urban markets were prime outlets for crops from sewage farms. It was also a way to reduce pollution of waterways, and an article of 1910 called sewage farms "the best and safest sewage cleaning method."[17] However, it did require space on the outskirts of cities and the ability to buy large tracts of land. Germany's largest city, Berlin, became the largest landowner in the Prussian province of Brandenburg by virtue of its penchant for sewage farms.[18]

However, one should not only look at the goals that the various approaches served. Sanitary networks were not just about technology but also about working people. A quarter-century ago, Donald Reid published an acclaimed book about *Paris Sewers and Sewermen* that drew attention to this human dimension of the sanitary revolution. Around 1900, almost 1,000 men worked in the underground canals that collected the dirty waters of Paris, and whether it was a good job was subject to contemporary studies. Statistics indicate that about one-third of these men had died after ten years on the job.[19]

Sewermen have traditionally stood in the shadow of the experts that designed and built the sanitary infrastructure. Engineers and public health experts were involved in framing ideas and turning them into a material reality, though their role was often ambiguous on the ground. A particularly glaring example was Edwin Chadwick, whose name became famous beyond the British Isles. He ran the General Board of Health from 1848 to 1854, but his tenure was marked by a dramatic dispute over the merits of brick versus pipe sewers that did him little good.[20] The quagmires of London politics did the rest. Parliament passed the Public Health Act of 1848 and created the General Board of Health, but the City of London, always eager to underline its peculiar constitutional status, passed its own Sewers Act and insisted on jurisdiction over its own underground. It was a "Chadwickian tragicomedy", as the medical historian Roy Porter has argued, and Porter felt that "the politicking surrounding Chadwick perhaps hindered metropolitan sanitary reform."[21]

Of course, one must not exaggerate the problems and contestations that sanitary reformers were facing. The job description was already challenging enough. First, building an underground infrastructure in densely populated areas was always an endeavor fraught with conflicts. Landowners and shopkeepers would inevitably question plans because they created expenses and hassles, and nobody likes a construction site at one's doorstep. Furthermore, we must not forget that the nature of disease remained contested throughout the nineteenth century. It was only towards the end of the century that the famous dispute between miasma theorists and contagionists came to a conclusion. In practical terms, this meant that any sanitary design stood on shaky ground in cognitive terms: it was impossible to

13. Liebig, Chemische Briefe, p. 501.

14. Victor Hugo, Les Misérables. Translated and with an Introduction by Norman Denny (London: Penguin, 1982), p. 1061.

15. Nicholas Goddard, "'A Mine of Wealth'? The Victorians and the Agricultural Value of Sewage," Journal of Historical Geography 22 (1996), pp. 274-290; p. 275.

16. Yong Xue, "'Treasure Nightsoil As If It Were Gold:' Economic and Ecological Links between Urban and Rural Areas in Late Imperial Jiangnan," Late Imperial China 26 (2005), pp. 41-71; Dean T. Ferguson, "Nightsoil and the 'Great Divergence': Human Waste, the Urban Economy, and Economic Productivity, 1500-1900," Journal of Global History 9 (2014), pp. 379-402.

17. Rudolf Hauptner, "Herstellung und Betrieb von Rieselfeldern," Technische Blätter 42 (1910): 141-51; p. 141.

18. Gudermann, "Die Berliner Abwässer," p. 158.

19. Donald Reid, Paris Sewers and Sewermen: Realities and Representations (Cambridge, Mass.: Harvard University Press, 1993), p. 154n.

20. Cf. Christopher Hamlin, "Edwin Chadwick and the Engineers, 1842-1854: Systems and Antisystems in the Pipe-and-Brick Sewers War," Technology and Culture 33 (1992), pp. 680-709.

21. Roy Porter, London. A Social History (London: Hamish Hamilton, 1994), p. 262.

know whether it contained widespread diseases if nobody knew for sure what diseases were. We are surely beyond the point where sanitary reformers were celebrated in heroic narratives, but in light of the challenge, it seems wise to meet them with a measure of respect.

Historians of the water closet should also note that access to the water closet has emerged as a political hotbed in the twenty-first century. I am not talking about the penchant for gender-neutral toilets that has recently emerged as a discussion point in liberal circles. I am talking about the Global South, where denial of access has emerged as a critical cause. In the Indian general election of 2014, Narenda Modi pledged to "build toilets first and temples later".[22] It seems to have struck a nerve, for Modi became prime minister in 2014. Access to toilets is a particularly critical issue for women, who are otherwise compelled to relieve themselves outside at night, which makes them vulnerable to sexual assault.[23]

The issue has received recognition at the highest level. The General Assembly of the United Nations passed a resolution on "sanitation for all" in 2013. It urged member states "to end open defecation" and created World Toilet Day (November 19).[24] This current concern may serve as a reminder to look more closely at the fate of those who historically lacked access to toilets. What happened to people, and specifically to women who were urinating or defecating in gardens, fields, or forests? It seems advisable to put more emphasis on their vulnerability and their sense of fear when they were conducting their intimate business. But at the same time, we need to acknowledge that there is a long way from a sense of vulnerability to a prominent role in the political arena.

II.

If we summarize the range of opinions and perspectives, there is no way to deny that the water closet brought widely different people together. The previous list includes physicians and engineers, sewer workers and company directors, men and women, urbanites and farmers. It also brought starkly divergent ideas about the key challenge into play. We see those who focused on technological matters, those who cared about public health hazards, those who cared about privacy and public decency and those who cared about the nutrients that wastewater held. In fact, it is tempting to speculate whether there was a major group in nineteenth-century societies that did *not* have a stake in the water closet. The one communality was that no group showed a strong interest in all the various aspects of the water closet. People favored certain perspectives over others, and policy outcomes reflected the balance of power in contemporary society.

The industrializing nations of the nineteenth century were divided societies with multiple frontlines. There were gaps between factory owners and workers, urban and rural residents, men and women, sometimes supplemented by gaps between different religions and races. One of the most rigid barriers was about gender: nineteenth-century politics was overwhelmingly male. Most women lacked the right to vote or another legitimate reason to intervene in political matters, and prevailing understandings of women's roles confined them to the domestic sphere. In short, the anxieties of defecating women were not a political issue or even a discussion point. The sanitary world was a masculine world for better or worse, though disputes over public restrooms served as a reminder that building and maintaining water closets was not a gender-neutral affair.[25]

The significance of workers is more difficult to specify across the board. The bourgeoisie held a powerful place in the political arena of many cities – certainly stronger on the municipal level than in national politics, where landed elites held greater sway – but the sanitary sewer won majorities even in the United States, where the electorate in-

22. "Build Toilets First and Temples Later, Nareda Modi Says," available at http://timesofindia.indiatimes.com/india/Build-toilets-first-and-temples-later-Narendra-Modi-says/articleshow/23422631.cms (last retrieved December 13, 2017).

23. Cf. Ayona Datta, "Another Rape? The Persistence of Public/Private Divides in Sexual Violence Debates in India," Dialogues in Human Geography 6 (2016), pp. 173-177.

24. United Nations General Assembly Resolution 67/291, adopted on July 24, 2013.

25. Cf. Annabel Cooper et al., "Rooms of Their Own: Public Toilets and Gendered Citizens in a New Zealand City, 1860-1940," Gender, Place and Culture 7 (2000), pp. 417-433; Clara H. Greed, "Public Toilet Provision for Women in Britain: An Investigation of Discrimination Against Urination," Women's Studies International Forum 18 (1995), pp. 573-584.

cluded large numbers of workers and poor immigrants. “Municipal socialism” smacked of revolutionary politics, but most city governments saw things in pragmatic terms: the goal was to solve a pressing urban problem rather than fight proxy class warfare. As we have seen, cities diverged on the question of municipal versus private ownership, and cities like London shifted course at some point when they bought up existing businesses, but the politics was often muddled. In France, liberal Bordeaux decided to take the trash collection business in municipal hands in 1889 whereas Socialist governments in Lyon and Saint-Etienne felt more comfortable with private initiative.[26]

It is beyond debate that wealthy bourgeois urbanites were quicker to embrace the water closet than the working class. In many cities, and particularly those outside Western and Central Europe, water supplies and sewer construction was openly discriminatory in that poorer quarters were served only reluctantly or not at all. However, there was also a countervailing trend: bringing the benefits of sanitation to the poor was seen as a way to tame the workers’ revolutionary instincts. Some authors actually said as much: one of the leading authors of German cultural despair, Julius Langbehn, noted in his widely read *Rembrandt als Erzieher* that Germany might have fewer socialists with more bathrooms.[27] Quite a few cities built accordingly. In Berlin, essentially a working-class city in the late nineteenth century, the number of households with access to a water closet stood at 81 percent in 1890 and at 97 percent in 1900.[28] Needless to say, the reality behind the numbers was another matter, and many working-class families shared their restrooms with neighbors. But giving workers access to flowing water and sewers was obviously a priority in the German capital. Berlin was notorious for its gap between bourgeois and working-class quarters, and there was no way to supply most of the city’s proletariat without a targeted effort to do so.

Did the natural setting of cities make a difference? By and large, cities were remarkably effective in isolating urban residents from their environmental settings. Even desert cities followed the general path. Some of them could afford it. Los Angeles famously brought in water from Owens Valley, a place more than 200 miles to the north of the Southern Californian metropolis, and the engineering achievement along with the political shenanigans entered movie history in the form of Roman Polanski’s *Chinatown*.[29] Others could ill afford water closets and embraced them nonetheless. In Saint-Louis, the capital of Senegal in the nineteenth century, French colonialists insisted on the familiar amenities in spite of a long dry season and built a reservoir to keep water closets operational in the absence of rain. But the dam broke in the 1860s, and Saint-Louis subsequently suffered from both a yellow fever epidemic and a cholera epidemic.[30]

But Los Angeles and Saint-Louis made their choices under the impression of sanitary role models elsewhere, and it is tempting to speculate whether these role models built on a temperate climate without a dry season. Maybe the sanitary revolution would have taken a different turn if it had not had its epicenter in Central and Northwestern Europe, where rain was a common occurrence throughout the year? More specifically, would sewers have emerged as the technology of choice if European engineers had worked in a different climate? Rainfall was a functional necessity for sewer systems, as it helped to swipe away underground leftovers with a force that daily water consumption cannot quite match. Counterfactual history has always an air of speculation, but it is quite possible that dry toilet solutions would have fared better if the pioneering cities had grown in a different climate. As it stands, we can observe that climatic variation played out mostly at the end of the pipe, as arid conditions encouraged the agricultural use of wastewater. Martin Melosi, whose *Sanitary City* stands as a defining work on U.S. urban environmental

26. William B. Cohen, Urban Government and the Rise of the French City: Five Municipalities in the Nineteenth Century (Basingstoke: Macmillan, 1998), p. 253n.

27. Anonymous [August Julius Langbehn], Rembrandt als Erzieher: Von einem Deutschen (Leipzig: Hirschfeld, 1925 [originally published 1890]) p. 312.

28. Shahrooz Mohajeri, 100 Jahre Berliner Wasserversorgung und Abwasserentsorgung 1840-1940 (Stuttgart: Steiner, 2005), p. 142n.

29. William Deverell, Tim Sitton, Water and Los Angeles: A Tale of Three Rivers, 1900-1941 (Oakland: University of California Press, 2017), pp. 12-14.

30. Cf. Kalala J. Ngalamulume, “Coping with Disease in the French Empire: The Provision of Waterworks in Saint-Louis-du-Senegal, 1860-1914,” Petri S. Juuti, Tapio S. Katko, Heikki S. Vuorinen (eds.), Environmental History of Water: Global Views on Community Water Supply and Sanitation (London: IWA Publishing, 2007), pp. 147-163.

history, has noted that sewage farms were particularly popular in the American West.[31]

Unlike what Liebig was hoping for in the nineteenth century, reuse of nutrients is a second-rate issue in the arid American West. In a region where farming depends greatly on irrigation, sewage is simply another way to gain precious water. Other regions of the world were not terribly excited about recycling nutrients from sewage either, and in the twenty-first century, the reuse rate of human excrements in agriculture or aquaculture stands at a paltry ten percent.[32] Needless to say, that average hides some significant fluctuations. Israel is the world leader: it recycled 86 percent of its wastewater in 2015, and recycled effluents constitute more than half the irrigation water on the country's 130,000 hectares of agricultural land.[33] But statistics is an ambiguous marker of success, as one of Israel's leading environmentalists, Alon Tal, has argued that recycling sewage "is much more problematic than its advocates may have realized. Extensive wastewater reuse should be seen as a temporary exigency and a transition stage in a country's agricultural evolution."[34]

Tal made his remark against the background of salinity problems and undesirable chemical elements and pathogens in the wastewater. Even Israel, a state that is among the world leaders when it comes to the technology of water use and irrigation, is struggling to turn sewage farming into a sustainable industry. It might be tempting to take this outcome as a retrospective justification of the world's low interest in sewage recycling, but that would miss a crucial point: today's wastewater is different from nineteenth-century wastewater. Whereas today's sewage includes a broad range of chemicals that mass consumption has bestowed on affluent societies, human excrements were the prevailing type of waste in nineteenth-century sewers. Decisions on infrastructures were made in an age where changes in the composition of sewage were still beyond the horizon.

Sanitary policy is best understood as the outcome of a struggle between city and countryside. In physical terms, sanitation was about the flow of matter into and out of cities. Reservoirs collected clean water at a distance from urban areas, and pipelines brought it into urban perimeters. After water did its job in toilet bowls or other places of urban consumption, it left cities for treatment or deposition on the outskirts. The nineteenth century was a century of urbanization, and migration was overwhelmingly from the countryside to the cities, which were the rising centers of economic power. That shaped debates and outcomes. The construction of sewers and water supply networks mirrored the supremacy of urban concerns, with rural and specifically agricultural views as a mere afterthought.

It is important to recognize that there was no technological rationale that made a choice between urban and rural views inevitable. From an engineering point of view, it was entirely possible to build with both perspectives in mind. But that would have required two parties that saw eye to eye with each other, and that was rarely the case. For example, the rural faction suffered from a significant delay in the creation of institutional expertise. The German Society for Agriculture (*Deutsche Landwirtschafts-Gesellschaft*, or *DLG*) set up a "committee on urban wastes" (*Sonderausschuß für Abfallstoffe*) as late as 1891, more than a decade after the German Public Health Association (*Deutscher Verein für öffentliche Gesundheitspflege*), the leading gathering point of sanitary experts in Germany, had de facto closed the book on alternatives to the combined sewer system.[35] The agricultural experts had missed the boat, and their attempt to reopen the debate went nowhere. The committee on urban wastes sputtered on for a decade and a half until the DLG had seen enough. Looking back at expenses of more than 100,000 Marks, the association's journal noted with regret that "the work has not produced, from the viewpoint of agriculture, a positive result."[36]

Sewage farms could work, but only if one moved beyond Liebig's grandiose visions and engaged with a lot

31. Martin V. Melosi, The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present (Baltimore: Johns Hopkins Press, 2000), p. 167.

32. Dana Cordell, Jan-Olof Drangert, Stuart White, "The Story of Phosphorus: Global Food Security and Food for Thought," Global Environmental Change 19 (2009), pp. 292-305; p. 296.

33. Alon Tal, "Rethinking the sustainability of Israel's irrigation practices in the Drylands," Water Research 90 (2016), pp. 387-394; p. 388n.

34. Ibid., p. 393.

35. Jürgen Büschenfeld, Flüsse und Kloaken. Umweltfragen im Zeitalter der Industrialisierung (1870-1918) (Stuttgart: Klett-Cotta, 1997), p. 58.

36. Mitteilungen der Deutschen Landwirtschafts-Gesellschaft 21 (1906), p. 190.

of muddy details. Recycling sewage called for specific methods of soil preparation. Irrigation had to take place when plants did need nutrients, notwithstanding the fact that wastewater flowed continuously year-round. The sewage farm in Freiburg in southwest Germany used only half of its land for farm production – 268.73 hectares, to be precise – and flooded the rest when there was no field around that needed a boost of nutrients.[37] And then there was the issue of who owned the land, a crucial question for rural societies everywhere and yet one that many cities were rather insensitive about: municipal authorities wanted to have control over their wastewater outlet, and that was often synonymous with land ownerships. It was perhaps no coincidence that the sewage farm in Dortmund, one of the most successful in Germany, had a significant share of land that was privately owned.[38]

It was perhaps unsurprising that the prevailing interests of cities were always first and foremost about inexpensive supply and removal. But state authorities, whose territory typically comprised both city and country, had more holistic views, and sometimes they would jump into action and act as a counterweight to urban interests. In 1877, Prussia issued a landmark decree that compelled urban sanitation projects to include sewage treatment.[39] But that determined stance withered away in a maze of concessions and compromises in subsequent years, and when Martin Strell published a comprehensive textbook on urban water technology in 1955, "agricultural use of urban wastewater" stood at the very end of the volume and claimed a grand total of eight pages in a book of some 350 pages.[40] The city had won, and there was a monument to that victory in every house and apartment: the water closet.

III.

In the nineteenth century, urban water projects were also a spectacle. When mountain spring water from the Alps arrived in Vienna in 1873, a large crowd gathered around a fountain, with Kaiser Franz Joseph as the guest of honor, and witnessed water shooting 60 meters into the air.[41] Paris had its spectacle underground, as the city began to allow visitors into the sewers during the world's fair of 1867.[42] Given the enormous investments that urban governments shouldered in the quest for the sanitary city, a sense of pride and celebrations were perhaps only too natural, but they distracted from the full range of actors. Engineers and sanitary reformers built water pipes and sewers, but so did urban residents by virtue of their routine visits to the bathroom and agriculturalists outside the city by never challenging the political hegemony of urban interests effectively. As an assemblage of technology and power, everyday use and rural acceptance, the urban water systems of the industrialized world persist for more than a century, and people enjoy the privacy on a water closet all around the world.

But will this be the end of history, sanitation-style? In 2017, Thames Water publicized a spectacular blockage in a London sewer. A huge congealed mass of fat and sanitary items had accumulated below the streets of Whitechapel, stretching for 250 meters and weighing an estimated 130 tons.[43] Workers struggled to dismantle the "monster" (a verbal quote from Thames Water's head of waste networks), and one can safely assume that they were grumbling more than once about the ignorance of urbanites who disposed the material without so much as a thought about the sanitary world underground. In fact, Thames Water likely publicized the fatberg in order to enhance public understanding of sewers and their needs, but they would be well advised not to hope for too much: London sewers suffer

37. Siegfried Schirrmeister, Das Rieselfeld der Stadt Freiburg i. B. (Schmölln: Böckel, 1937), p. 22.

38. Wilhelm Herzog, Die Rieselfeldkulturen der Stadt Dortmund. Kulturgeographische Auswirkungen städtischer Abwasserwirtschaft (Arbeiten zur Rheinischen Landeskunde 11, Bonn: Geographisches Institut der Universität, 1956), p. 52.

39. Büschenfeld, Flüsse, p. 59.

40. Martin Strell, Wasser und Abwasser, Reinhaltung der Gewässer (Munich: R. Oldenbourg, 1955), pp. 324-337.

41. Gerhard Meißl, "Gebirgswasser in Wien: Die Wasserversorgung der Großstadt im 19. und 20. Jahrhundert," Karl Brunner, Petra Schneider (eds.), Umwelt Stadt: Geschichte des Natur- und Lebensraumes Wien (Vienna: Böhlau, 2005), pp. 195-203; p. 198.

42. Reid, Paris Sewers, p. 39.

43. Matthew Taylor, "'Total Monster': Fatberg Blocks London Sewage System," available at https://www.theguardian.com/environment/2017/sep/12/total-monster-concrete-fatberg-blocks-london-sewage-system (last retrieved December 13, 2017).

from roughly five blockages per hour on average.[44] Most Londoners will likely stick to their routines, confident about the privacy behind the bathroom door, the sewers' proven ability to swallow everything somehow, and the absence of a serious challenge to the water closet anywhere on the globe. In other words, urbanites will continue to stick to the winning formula that earned them their right to a toilet in the nineteenth century: they will ignore all other stakeholders. And they will likely get away with it.

44. Sam Francis, "Five Blockages an Hour in London Sewers," available at http://www.bbc.co.uk/news/uk-england-london-41485867 (last retrieved December 13, 2017).