KARA MURPHY SCHLICHTING &
MELANIE A. KIECHLE

Invisible Inequalities

Persistent Health Threats in the Urban Built Environment

▼ **KEYWORDS** Urban, inequalities, housing, air, heat

▼ **ABSTRACT** A city's materiality creates health and illness. We both write about air – its movement and its temperature – as it affects human bodies. We offer two topics as case studies, heat and ventilation, and how they exacerbate the effects of each other, to illustrate the long history of seemingly new challenges posed by the novel coronavirus. The environmental inequalities of heat exposure and access to fresh air underscore that cities can only be considered 'low impact' on the environment from a top-down, large-scale approach. In writing about air and heat, we direct attention to the feel and the bodily impacts of unseen but persistent problems in housing. Centuries of building inequalities into the urban environment are coming to bear on our present debates about indoor space, ventilation, and viral spread as cities encounter the COVID-19 crisis.

Introduction

Are air quality and hot weather lethal? Ventilation expert Lewis W. Leeds thought so, writing in 1882 that New Yorkers were "burning to death". Leeds argued that summer heat was deadly in unventilated apartments, especially those situated in the "vicious system of planning" that characterised New York City (Leeds, 1882: 308–309). The *Sanitary Engineer's* editors were sceptical. They published Leeds's letter, but commented that high interior temperatures only contributed to illness or mortality. The editors maintained that dense neighbourhoods and unventilated housing were the greater health threat.

Kara Murphy Schlichting • kara.schlichting@qc.cuny.edu • Queens College, CUNY

Melanie A. Kiechle • mkiechle@vt.edu • Virginia Tech

Journal for the History of Environment and Society, 5 (2020), pp. 159–170.

 DOI 10.1484/J.JHES.5.122472

Air-conditioning and ventilation systems can mitigate stuffy interiors, but do they contribute to ill-health? An expert in airflow and virus circulation recommended that 2020 diners opt for operations with few barriers to air movement that could flush out aerosol viral droplets. An architectural engineer also cautioned the public to consider the flow of air through a space, and the risk of moving into a current of air laden with viral aerosols (Heils, 2020).

These parallel concerns from 1882 and 2020 illustrate that air and heat are invisible environmental challenges that have long occupied public health and architectural experts. Uncertainty about how the novel coronavirus spreads has returned attention to these intangible aspects of the environment. COVID-19 has rendered cities deadly, but not for all urban residents. As was true in the nineteenth century, poor health and high mortality concentrate among racial minorities and the lower classes. Per capita, spring 2020 COVID-19 deaths in New York City concentrated among lowest median incomes and largest household sizes; the outer boroughs, despite having lower density than Manhattan, suffered higher mortality rates (Bassett, 2020; Schwirtz and Cook, 2020). These disparities are unsurprising, since the spatial organisation of American cities segregates both poorer residents and environmental hazards from downtown. While other aspects of urban life have changed dramatically since the nineteenth century, the issue of high mortality rates related to overcrowded households and low environmental services remains relevant – although the geography of risk has shifted to different neighbourhoods.

Environmental inequalities are health problems that have been built into an urban environment over generations. This essay focuses on New York as a built environment, which is how nineteenth-century health reformers approached the city. Both the public health and urban planning professions arose under the sanitary idea that emphasized how environmental features affected health. With the rise of bacteriology at the turn of the twentieth century, public health's primary focus shifted from the built environment to the laboratory microscope, but the environment continues to affect the health of urban residents (Rosen, 2015). Concerns about urban air are not new, but have renewed importance in the context of the COVID-19 pandemic. We use urban environmental history to remind readers of cities' continued health shortcomings. Furthermore, we urge a consideration of cities not in the abstract, as dense congregations of people or as skylines crowded with buildings. Instead, we need to place people in those buildings and understand cities as lived built environments (Owen, 2009; Rybczyski, 2009; Glaeser 2012).

"Here in the city you respire disease"[1]

As early as the 1840s, physicians in the United States and Europe were sounding the alarm about the air of enclosed spaces, especially overcrowded buildings. In

1 'Civic or Rural Life?', *New York Daily Times*, 23 June 1852, p. 2.

New York City, physician and public health advocate John Hoskins Griscom, Jr. published *The Uses and Abuses of Air* and urged close attention to the aerial impacts of the built environment. Like his contemporaries, Griscom used medical topography to read the natural environment of Manhattan for healthfulness. Given the island's geographic location, geologic structure, temperate climate, and natural amenities such as the fast-flowing Hudson and East Rivers that could carry wastes away, physicians and urban boosters agreed that New York was in an ideal environment for human health (Griscom, 1845: 4; New York Association for Improving the Condition of the Poor, 1853: 4; Smith, 1911: 17–18). As Brooklyn native Walt Whitman summarised prevailing knowledge, coastal breezes created "favorable health-chances", with one glaring exception: "If only the suffocating crowding of some of Manhattan's tenement houses could be broken up" (Whitman, 1892). This environmental-health logic held firm throughout the century; rising mortality rates were evidence of problems in the built environment.

Griscom identified two problems in the built environment: buildings blocked air flow, and walls separated interior air from outdoor air. Manhattan Island's location near the ocean yet slightly inland meant constant sea breezes flowed across plants, carrying oxygen into the city. This should have supplied city residents with plenty of fresh air, but closely constructed buildings inhibited airflow across the island. Particularly concerning were *culs-de-sac*, where closely constructed buildings blocked winds and dangerous gases accumulated instead of oxygen (Griscom, 1850: 8–47; New York State Senate, 1859: 31; Citizens' Association of New York, 1865: lxxv–lxxviii, 56–58).

In talking about oxygen, dangerous gases, and stagnant air, Griscom and other physicians applied the newest research on respiration to the built environment. Chemists and physicians focused on the gaseous components of the air, now that they understood that bodies required oxygen but exhaled carbon dioxide, a gas that was poison to breathe. In stagnant air, the normal act of breathing depleted the air of oxygen and loaded it with carbon dioxide. This meant that bodies needed breezes to convey oxygen, and specialists began calculating the volume of air that spaces needed for inhabitants' healthful breathing. Griscom turned to ventilation expert David Boswell Reid, who had documented that an adult needed ten cubic feet of air per minute for perfect health. As Griscom applied this figure to New York, he found that most of his patients' homes lacked the air that their bodies required (Griscom, 1850: 66–68, 167–168; Griscom 1845: 10–11; Reid, 1844).

Ventilation was both the problem of and the solution to the built environment. Reid noted that defective ventilation was "too often the forerunner of plagues and pestilence in former times, and associated, even at present, with an immense loss of life". Yet many ventilation problems could be easily addressed, Reid argued, by opening windows, managing fires and other heat sources, and constructing flues to create through currents of air that conveyed oxygen and dispersed concentrations of carbon dioxide. Public health documents and domestic advice manuals reprinted Reid's guidelines, but readers unevenly implemented his methods (Reid, 1844: x–xi; Reid, 1858).

Although property owners had control over the built environment and thus the ability to improve household ventilation, relatively few owned their living space. Middle- and upper-class women could implement the ventilation techniques they read in Catharine Beecher's *Treatise on Domestic Economy*, but the majority of those about whom Griscom worried were poor laborers who could only afford to rent poorly ventilated tenement rooms, some of them in cellars (Beecher, 1841). Griscom argued that renters were not to blame for the "foul air" and "suffocating vapor" that made them ill. Landlords had the means to improve ventilation, but they rarely had the motivation to make aerial improvements (Griscom 1845: 8–9).

Griscom knew that the built environment could improve health because cities had constructed costly waterworks in his lifetime. Griscom urged city governments to provide fresh air much as they had provided fresh water, a refrain that public health reformers took up in cities across the United States. Reformers advocated widening streets, courts, and alleys, as well as building public squares, parks, and gymnasiums to break up the built environment and provide fresh air. They also demonstrated ventilation in model homes and demanded "discreet but firm legislation" that would mandate ventilation through stipulating, for example, the size and number of windows and fireplaces (Bell, 1860: 107–112, 165–166).

New York's government tried to legislate for improved air quality and health. However, property owners met the letter rather than the intent of a series of Tenement House Acts that were passed between 1867 and 1901. These building regulations stipulated room size, windows for access to outdoor air and light, and even the proportion of the lot that buildings could occupy. However, builders innovated to meet both the new regulations and property owners' desire to maximize rentable living space, resulting most infamously in the 'dumbbell tenement' in the 1880s. When built side by side, dumbbell tenements created narrow air shafts that provided scant air and light to interior apartments. Instead of improving living conditions, property owners constructed the known health threat of poor ventilation into the built environment (Plunz, 2016; Lubove, 1962).

"The bigger [cities] are…the more intolerable they become in July and August…"[2]

Among the next generation of reformers who strove to improve the built environment for public health, architect and housing reformer Edward T. Potter stands out for his attention to heat threats. As he read the built environment, Potter lamented that narrow city streets and dense blocks made it "impossible to have a current of air through tenements, to cool them in summer or to air

2 'Urbanus Redux', *Harper's Weekly*, 3 September 1892, p. 843.

them at any time". Housing and public health reformers still agreed that good ventilation, which both cooled interior temperatures and circulated fresh air, was key to health in the city (Potter, 1877; Ralph, 1889).

The inflexibility of urban form and the lack of climate-sensitive design created the seasonal environmental challenge of intense heat. July and August average around 80°F in New York, and humidity exacerbates the feel of high temperatures. By the late-nineteenth century New York's buildings and layout led to the absorption and storage of incoming solar radiation – a meteorological effect known as the urban heat island. Unlike rural and suburban environs, which lose the day's heat overnight, the urban core absorbs more heat and cools at a slower rate. Due to the urban heat island, the densest districts nearest the center of a city's mass became reservoirs of heat. By the late nineteenth century, the city subjected residents to higher temperatures with few accessible reliefs (Yow, 2007; Mills 2008; Klein-Rosenthal and Raven, 2017).

Potter's focus on cooling currents of air through buildings represented nineteenth-century climate control. In New York, thermo-ventilation required large, south-facing windows that captured prevailing southerly breezes. The "fortunate dweller on Murray Hill", the wealthy neighbourhood where the Astors lived, could arrange "his windows so as to catch the faintest breeze", but the lower classes could not move their windows to catch a breeze. Instead, tenement residents sought out cooling breezes when indoor temperatures crept too high. On hot summer nights, fire escapes, stoops, and roofs were their only recourse: "every fire-escape platform held its group of those willing to forfeit sleep if they might here obtain a breath of cooler air". Moving outside provided little relief, however, as tenement dwellers merely exchanged the "sweat box" of their apartment for the stored heat of the roof, which radiated back into the air and their bodies after the sun set (Anonymous, 1882; Anonymous, 1883).

When nineteenth-century urbanites worried about the impact of hot weather, they recognised that summer health threats spread unevenly across the city. In the 1870s, physician Stephen Smith observed that deaths peaked during the hottest months in the densest districts. During an 1896 heat wave, the city's coroner identified the health threat of heat stored in the dense cityscape (Anonymous, 1896). Reporting on the same heat wave, a *Harper's Weekly* journalist declared "As usual in such times, the heat worked havoc with the poor. It literally swept them into graves by the hundreds" (Matthews, 1896). Traumatic heat was a regular part of summer, but mortality resulted from poverty and the built environment: compared to city-wide seasonal death rates, summer had disproportionately high health consequences for residents who overheated in tenement districts (Smith, 1899: 433–434).

Heat created four categories of summertime health threats: infectious disease outbreaks, accidents due to attempts to cool off, excessive heat exposure, and the general effect of hot weather on vulnerable populations – the old, young, and those with pre-existing conditions. Lewis W. Leeds, the ventilation expert who railed of New Yorkers "burning to death", blamed 13,427 deaths on summer heat between 1866 and 1875. "I have long maintained that the

excessive heat was the most fatal of all causes, for the destruction of human life in New York City", he wrote. "But on recently mentioning this belief to a prominent sanitarian, he said, 'Oh, no; it is not the heat at all; the Board of Health reports show that it is the diarrhea". Leeds disagreed, as he understood that heat increased gastrointestinal morbidity and mortality (Leeds, 1882). The Board of Health obfuscated the threat of heat by focusing on more tangible and easily controllable aspects of the environment, namely water and food supply. Heat exposure illustrated a web of inequality. New Yorkers knew summertime health diverged along the lines of class and ethnicity, social density and geography – and these categories were indivisible.

The city's very fabric exacerbated the challenge of heat and air circulation. Summer heat, Potter maintained through the 1870s, '80s, and '90s, required a new residential design sensitive to local climate. Maintaining thermal comfort in New York depended primarily on natural ventilation and, ideally, architectural devices designed to create airflows through enclosed spaces. Potter suggested all apartments should have "a through and through current of air at any time by setting open the doors between the rooms and opening the windows. For the windows look out in opposite directions, so that the winds blow right through" (Potter, 1902a: 5). On an even larger structural scale, Potter advocated nothing less than a ninety degree rotation of the city grid, so that its streets opened south, not west, to take advantage of prevailing winds. Only then would local climatic conditions ameliorate summer heat inside tenements. He also counselled the city to break up its grid and lay out smaller lots. Potter's ideas earned recognition and praise in the 1890s at the Congress of Architects at Chicago, the New York Tenement Exposition, and the 1893 Chicago Columbian Exposition, where he won a medal for his model tenement design. Nevertheless, his re-imagined cityscape of "sunways" and "airways" required far too great a rearranging of the urban fabric for practical application (Potter, 1902b). Instead, New Yorkers sweated and suffered for another forty years until the post-war era and the introduction of residential air conditioning. Contemporary New Yorkers have inherited a built environment that exposes them to long-standing air inequalities. These have renewed danger in the COVID-19 pandemic.

"Man's own breath is his greatest enemy"

When Lewis W. Leeds captioned his *Lectures on Ventilation* with this phrase, the "enemy" was carbon dioxide concentrating in unventilated rooms (Leeds, 1869). Today, Leeds's sentiment looms large as public health experts and communities worldwide grapple with novel coronavirus transmission. In recent months, stories about respiration have addressed questions such as how long exhaled droplets containing the virus hang in the air and how far heavy breathing during exercise or speaking expel droplets from an individual body. Evidence that suggests COVID-19 can travel via aerosols mounted in Summer

2020, prompting renewed attention to airspace and ventilation (Tufekci, 2020; Allen and Marr, 2020). Nineteenth-century airspace calculations have re-emerged in concerns about how heating, ventilation, and air conditioning (HVAC) systems create currents of air and may disperse exhaled virus through enclosed spaces. Ventilation is of paramount importance as churches and schools, businesses and stores reopen their buildings during the pandemic (Heil, 2020; Khamsi, 2020).

Summer renewed concerns about urban density and the thermal discomfort wrought by the urban heat island in the era of COVID-19. New technologies such as air conditioning have not overcome economic determinants of environmental comfort and health. Much as nineteenth-century New Yorkers could only improve ventilation if they owned buildings, only New Yorkers who are able to afford air conditioning can afford to remain cool, and socially distanced, in climate-controlled spaces. Heat exposure remains a social-environmental inequality; fewer than half of city residents in public housing reported air-conditioning in their apartments at the start of the twenty-first century. For those who live without climate control, the city usually opens cooling centres during heat waves, but social distancing complicated these programs in Summer 2020 (Culliton, 2020). Facing the combined threat of COVID-19 and summer heat, Mayor Bill de Blasio promised more than 74,000 free air-conditioners for elderly and low-income New Yorkers, communities vulnerable to heat-related mortality. Shoring up private cooling, however, does not address the urban heat island. In fact, the by-product energy of air-conditioning adds to the city's overheated microclimate. The decision to partially close parks and pools from viral transmission fears and budget concerns, despite the important role these play in providing relief, means overheated air was a particularly urgent environmental challenge in 2020 (Schuerman, 2019; New York (City), 2007; Lee, 2020; Schlichting and Benepe, 2020).

Epidemics have underscored environmental inequalities in the past, but reforms have been narrowly focused and insufficient. Cholera epidemics of the nineteenth century, for example, led American municipalities to build public water supply systems and expand street cleaning, but not to address insanitary living conditions holistically (Rosenberg, 1987). Optimistic proclamations abound across this history, such as New York's Metropolitan Board of Health's declaration that "The problem of health in a crowded city can be solved only by the joint intelligence of the physician, the architect, and the sanitary engineer. Hercules must cleanse, and Hygeia will guard the Metropolis" (New York (State), 1866). The board's confidence belied the limited powers reformers would wield against the environmental inequalities related to air and heat. Questions about airborne pathogens and heat-related morbidity and mortality continued to arise and remained unresolved. Marginalised New Yorkers, the poor and working classes who live in overcrowded and unsanitary housing, many of them immigrants, continue to face the greatest environmental health risks. Only the geography of urban inequalities has

changed, shifting from Manhattan's tenement districts to the outer boroughs as a result of gentrification in the twentieth and twenty-first centuries. The economic and racial inequalities embedded in New York City's physical – and social – fabric continue to have public health ramifications (Bassett, 2020; Anonymous, 2020; Citizens Housing & Planning Council, 2020).

Epidemics are not driven by urban crowding writ large, but by the conditions in private households. Nineteenth-century urban reformers differentiated between the concentration of built structures and population and congestion. The latter meant "the overloading of land … indicative of conditions of population"and insanitary, unsafe, and uncomfortable living (New York (City) Commission on Congestion of Population, 1911: 4; Duffy, 1974). Crowded homes, in the past and present, are not created by the people who inhabit them, but result from centuries of manipulating the environment for economic efficiency and real estate profit rather than for health. We need to understand how airflow, heat, and viruses have been built into urban space – these are intangible aspects of the built environment that affect lives differently by class and by race (Burrows and Wallace, 1999: 785; Blackmar, 1995). The difficulties in mitigating COVID-19 are a reminder that cities still await urban planning and public health to, in unison, address the health disparities and class inequalities of the urban environment.

Further Reading

Urban environmental history has not adequately addressed air or heat as urban problems. Although the subfield has grown considerably since its emergence in the late twentieth century, much of its emphasis has been on physical aspects of the urban environment such as parks, pollution, and waterways. The following literature offers an introduction to air and health as environmental issues in the field.

Ackermann, M. E. (2002) *Cool Comfort: America's Romance with Air-Conditioning*, Washington (D.C.).

Banhan, R. (1984) *The Architecture of the Well-Tempered Environment*, Chicago.

Cooper, G. (1998) *Air-Conditioning America: Engineers and the Controlled Environment*, Baltimore.

Freund, D. (2012) *American Sunshine: Diseases of Darkness and the Quest for Natural Light*, Chicago.

Hauser, J. (2017) *By Degree: A History of Heat in the Subtropical American South*, unpublished doctoral thesis, Mississippi State University, Starkville.

Kiechle, M. A. (2017) *Smell Detectives: An Olfactory History of Nineteenth-Century Urban America*, Seattle.

Klinenberg, E. (2003) *Heat Wave: A Social Autopsy of Disaster in Chicago*, Chicago.

Mitman, G. (2007) *Breathing Space: How Allergies Shape Our Lives and Landscapes*, New Haven.

Murphy, M. (2006) *Sick Building Syndrome and the Problem of Uncertainty: Environmental Politics, Technoscience, and Women Workers*, Durham.
Platt, H. L. (2005) *Shock Cities: The Environmental Transformation and Reform of Manchester and Chicago*, Chicago.
Sellers, C. C. (2012) *Crabgrass Crucible: Suburban Nature and the Rise of Environmentalism in Twentieth-Century America*, Chapel Hill.
Stradling, D. (1999) *Smokestacks and Progressives: Environmentalists, Engineers, and Air Quality in America, 1881–1951*, Baltimore.
Sze, J. (2006) *Noxious New York: The Racial Politics of Urban Health and Environmental Justice*, Cambridge.

Bibliography

Allen, J. G. and Marr, L. C. (2020) 'Recognizing and controlling airborne transmission of SARS-CoV-2 in indoor environments', *Indoor Air*, 30, 4, pp. 557–558.
Anonymous (1882) 'The Recent "Hot Term"', *Frank Leslie's Illustrated Newspaper*, 12 August 1882, p. 390.
Anonymous (1883) 'Midsummer Nights Among City Tenements', *Harper's Weekly*, 30 June 1883, p. 410.
Anonymous (1896) 'The Hospitals Overtaxed', *The New York Times*, 12 August 1896.
Anonymous (2020) 'New York City Coronavirus Map and Case Count', *The New York Times*, https://www.nytimes.com/interactive/2020/nyregion/new-york-city-coronavirus-cases.html.
Bassett, M. T. (2020) 'Just Because You Can Afford to Leave the City Doesn't Mean You Should', *The New York Times*, 15 May 2020, https://www.nytimes.com/2020/05/15/opinion/sunday/coronavirus-cities-density.html.
Beecher, C. E. (1841) *A Treatise on Domestic Economy, for the Use of Young Ladies at Home, and at School*, Boston.
Bell, J. (1860) *Report on the Importance and Economy of Sanitary Measures to Cities*, New York.
Blackmar, E. (1995) 'Accountability for Public Health: Regulating the Housing Market in Nineteenth-Century New York City', in: Rosner, D. (ed.), *Hives of Sickness: Public Health and Epidemics in New York City*, New Brunswick, pp. 42–64.
Burrows, E.G., and Wallace M. (1999) *Gotham: A History of New York City to 1898*, New York.
Citizens Housing & Planning Council (2020) 'Density & COVID-19 in New York City', https://chpcny.org/density-and-COVID-19/.
Citizens' Association of New York (1865) *Report of the Council of Hygiene and Public Health of the Citizens' Association of New York Upon the Sanitary Condition of the City*, New York.
Cullito, K. (2020) 'Cooling Centers Open, Despite Coronavirus Concerns, as NYC Enters Hottest Weeks of Summer', *NY1*, 9 July 2020, https://www.ny1.

com/nyc/all-boroughs/news/2020/07/09/cooling-centers-open--despite-coronavirus-concerns--as-nyc-enters-hottest-weeks-of-summer-.

Duffy, J. (1974) *A History of Public Health in New York City, 1866–1966*, New York.

Glaeser, E. (2012) *Triumph of the City: How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier*, New York.

Griscom, J. H. (1845) *The sanitary condition of the laboring population of New York with suggestions for its improvement*, New York.

Griscom, J. H. (1850) *The Uses and Abuses of Air: Showing Its Influence in Sustaining Life, and Producing Disease, with Remarks on the Ventilation of Houses*, New York.

Heil, E. (2020) 'As restaurants reopen, here's what you should know about air conditioning, air flow and the coronavirus', *The Washington Post*, 28 May 2020, https://www.washingtonpost.com/news/voraciously/wp/2020/05/28/as-restaurants-reopen-heres-what-you-should-know-about-air-conditioning-air-flow-and-the-coronavirus/.

Khamsi, R. (2020) 'They Say Coronavirus Isn't Airborne – but it's Definitely Borne by Air', *Wired*, 14 March 2020, https://www.wired.com/story/they-say-coronavirus-isnt-airborne-but-its-definitely-borne-by-air/.

Klein-Rosenthal, J., and Raven, J. (2017) 'Urban Heat And Urban Design – An Opportunity to Transform in New York City', *The Sallan Foundation*, https://www.sallan.org/Snapshot/2017/07/urban_heat_and_urban_design_an_opportunity_to_transform_in_nyc.php#.XIqJskRKjUI.

Lee, R. (2020) 'City's "Summer Heat Plan" Includes Free A/C Units, Generator Stockpile', *NY1*, 17 May 2020, https://www.ny1.com/nyc/all-boroughs/news/2020/05/15/mayor-de-blasio-daily-coronavirus-update-summer-heat-preparations.

Leeds, L. W. (1882) 'Heat, House Plumbing, and Mortality', *Sanitary Engineer*, 14 September 1882, pp. 308–309.

Leeds, L.W. (1869) *Lectures on Ventilation: Being a Course Delivered at the Franklin Institute, of Philadelphia, during the Winter of 1866–1867*, New York.

Lubove, R. (1962) *The Progressives and the Slums: Tenement House Reform in New York City, 1890–1917*, Pittsburgh.

Matthews, F. (1896) 'August's Heat Plague', *Harper's Weekly*, 29 August 1896, p. 850.

Mills, G. (2008) 'Luke Howard and *The Climate of London*', *Weather*, 63, 6, pp. 153–157.

New York (City) (2007) 'Adults Reporting Air Conditioning in the Home', *Environment & Health Data Portal New York City government*, http://a816-dohbesp.nyc.gov/IndicatorPublic/VisualizationData.aspx?id=2104,719b87,107, Summarize.

New York (City) Commission on Congestion of Population (1911) *Report of the New York City Commission on Congestion of Population. Transmitted to the Mayor and the Board of Aldermen, February 28, 1911*, New York.

New York (State) (1867) *Annual Report of the Metropolitan Board of Health 1866*, Albany.

New York Association for Improving the Condition of the Poor (1853) *First Report of a Committee on the Sanitary Condition of the Laboring Classes in the City of New York, with Remedial Suggestions*, New York.

New York State Senate (1859) *Mr Ely's Report on the Sanitary Condition of the City of New York*, Albany.
Owen, D. (2009) *Green Metropolis: Why Living Smaller, Living Closer, and Driving Less are the Keys to Sustainability*, New York.
Plunz, R. (2016) *A History of Housing in New York City*, New York.
Ralph, J. (1896) 'A Hot Night in New York', *Harper's Weekly* 17 August 1889, pp. 667–668.
Reid, D. B. (1844) *Illustrations of the Theory and Practice of Ventilation, with Remarks on Warming, Exclusive Lighting, and the Communication of Sound*, London.
Reid, D. B. (1858) *Ventilation in American Dwellings; with a Series of Diagrams, Presenting Examples in Different Classes of Habitations*, New York.
Rosen, G. (2015) *A History of Public Health*, Baltimore.
Rosenberg, C. E. (1987) *The Cholera Years: The United States in 1832, 1849, and 1866*, Chicago.
Rybczyski, W. (2009) 'The Case for Green Cities', *The Atlantic*, https://www.theatlantic.com/magazine/archive/2009/10/the-green-case-for-cities/307661/.
Schlichting, K. M., and Benepe A. (2020) 'New York City Doesn't Have to Suffer This Summer', *The New York Times*, 25 May 2020, https://www.nytimes.com/2020/05/25/opinion/new-york-summer-coronavirus.html.
Schuerman, M. (2017) 'One Small Step to Keep Public Housing Cool', *WNYC News*, 17 June 2019, https://www.wnyc.org/story/small-step-keep-elderly-cool-public-housing-seniors/.
Schwirtz, M., and Cook, L. R. (2020) 'These N.Y.C. Neighborhoods Have the Highest Rates of Virus Deaths', *The New York Times*, 18 May 2020, https://www.nytimes.com/2020/05/18/nyregion/coronavirus-deaths-nyc.html.
Smith, S. (1899) 'Vegetation a Remedy for the Summer Heat of Cities', *Appletons' Popular Science Monthly*, 54, pp. 433–450.
Smith, S. (1911) *The City that Was*, New York.
Tufekci, Z. (2020) 'We Need to Talk About Ventilation', *The Atlantic*, 30 July 2020, https://www.theatlantic.com/health/archive/2020/07/why-arent-we-talking-more-about-airborne-transmission/614737/?utm_source=share&utm_campaign=share.
Whitman, W. (1892) 'Hot Weather in New York', in: *Complete Prose Works*, Philadelphia, pp. 186–187, https://whitmanarchive.org/published/other/CompleteProse.html#leaf096v1.
Yow, D. M. (2007) 'Urban Heat Islands: Observations, Impacts, and Adaptation', *Geography Compass*, 1, 6, pp. 1227–1251.

Unpublished Sources

Patricia D. Klingenstein Library at the New York Historical Society, Folder 76, Box 1, MS3132 Blatchford, Potter, and Delano Family Papers, Potter (E. T.) "Concentrated Residence Studies… ca 1902", "Tenement Houses. Ideas for Their Construction. From the *NY Tribune*, Dec. 3d 1866", 1866.

Patricia D. Klingenstein Library at the New York Historical Society, Folder 76, Box 1, MS3132 Blatchford, Potter, and Delano Family Papers, Potter (E. T.) "Concentrated Residence Studies … ca 1902", "New York Tenement Houses" (Feb. 22, 1877), 4, 1877.

Patricia D. Klingenstein Library at the New York Historical Society, Folder 76, Box 1, MS3132 Blatchford, Potter, and Delano Family Papers, Potter (E. T.) "Concentrated Residence Studies … ca 1902", Appendix to Papers Illustrating a Study of Concentrated Residence, 1902a.

Patricia D. Klingenstein Library at the New York Historical Society, Folder 76, Box 1, MS3132 Blatchford, Potter, and Delano Family Papers, Potter (E. T.) "Concentrated Residence Studies … ca 1902", "Preparatory Note", 1902b.

About the Authors

Kara Murphy Schlichting is an assistant professor of history at Queens College of the City University of New York. She is the author of *New York Recentered: Building the Metropolis from the Shore* (2019). Her current research examines the urban-environmental history of weather in New York City before the advent of climate control technology.

Melanie A. Kiechle is an associate professor of history at Virginia Tech, and author of *Smell Detectives: An Olfactory History of Nineteenth-Century Urban America* (2017). She researches and teaches at the intersections of science, medicine, lay experience, and the urban environment in the nineteenth century.