



The Smoke of Great Cities

British and American Efforts to Control Air Pollution, 1860–1914

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Coal smoke plagued Great Britain and the United States for well over one hundred years. Cities that relied on soft coal for fuel, including London, Manchester, Glasgow, Chicago, Pittsburgh, St. Louis, and Cincinnati, all suffered through decades of dense air pollution before relief could be found. Although British cities, especially London, suffered longer under a pall of smoke, many U.S. cities experienced remarkably similar environmental problems in the late nineteenth and early twentieth centuries. Concerns about the effect of coal smoke on city residents and the urban environment loomed large in the minds of activists on both sides of the Atlantic. Despite significant differences in economies, governance, and culture, Britons and Americans defined their problems in similar terms. Activists in the two countries engaged in roughly synchronous movements to abate smoke. Sanitarians, physicians, engineers, and lay reformers, particularly from the middle and upper classes, participated in an international discussion of the smoke problem and learned much from each others' attempts to find a solution.¹

Coal smoke posed complex scientific and technical challenges, and it also raised difficult questions about society. Reformers in both nations used smoke as a symbol for broader problems, which in their view could not be solved unless the smoke dissipated. Despite the many similarities in the two countries' responses to coal smoke, significant differences existed. In Britain, some members of the middle and upper classes worried that industrialization and urbanization had gone too far, in the process undermining both Britain's claim to civilization and its own privileged position within it. Smoke became symbolic of disorder and decline. In the United States, the middle class feared that its great and growing economy was not creating a worthy civilization. Smoke symbolized greed and callousness, the sacrifice of beauty and health in the pursuit of profit. As evidence of their shared

Victorian ideals, the upper classes of both nations worried that smoke gravely harmed the lower classes, stunting their moral and physical development. In both nations, smoke became symbolic of a fear of the working class and the increasingly visible urban poor.²

Perhaps the physical nature of the pollution itself gave credence to these grand metaphors. Coal smoke could seem so permanent, so omnipresent. During intense pollution episodes, which all of the cities listed above experienced, residents could only escape the smoke by escaping the city, an option rarely possible for all but the wealthiest urbanites. Smoke's metaphorical meanings too often led reform-minded Britons and Americans to think in terms of civilization rather than coal, the ultimate source of all the smoke. Yet as Peter Brimblecombe observed, "a history of air pollution is almost a history of fuel." In neither country did the movement to abate smoke become a movement to control coal use, and by the outbreak of World War I, neither country had come close to solving the already old pollution problem.³

The Smoke Problem

In both Britain and the United States, when people spoke of smoke they generally meant the dark particulate emissions of fires. The Chicago Association of Commerce, for instance, defined smoke in 1915 as "the visible effluvium or sooty exhalation of anything burning." Indeed, visibility was an important part of the popular definition of smoke and the nuisance it caused. Although persons who complained about smoke rarely bothered to define it precisely, they did generally use adjectives like "dark," "black," and "gloomy" to describe it. This conception was codified in municipal law. Without exception, both American and British anti-smoke laws relied on shade for definition and enforcement. Only dark smoke, as determined on the Ringelmann scale in most cities, constituted a nuisance that required prevention.⁴

This emphasis on visible emissions did not preclude a deeper appreciation of the complexity of combustion's products. The public also frequently complained of noxious gases, which caused significant damage in both nations. In places where smelters and chemical works emitted acidic fumes, residents well understood the ravages of invisible emissions. The Alkali Inspectorate, established in Britain in 1863, initially regulated hydrochloric acid gases emitted in the manufacture of sodium carbonate. Over time, its responsibilities grew to include other industries and pollutants (though not coal smoke). In the United States, however, laws continued to regulate only "dark" smoke, not sulphur or any other emissions. Nonetheless, after the turn of the century, when scientific investigation of smoke became more rigorous and smoke offenders hoped to divert attention from their dark emanations, a greater appreciation of the invisible portion of emissions entered the public dialogue.⁵

Britain and the United States witnessed rapid increases in coal consumption in the nineteenth century, with concomitant increases in smoke. London long had

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the reputation as Britain's smokiest urban area, but rapidly growing industrial cities such as Manchester and Glasgow also vied for the title by the middle of the nineteenth century. In the United States the most dramatic growth in coal consumption occurred after the turn of the twentieth century; in 1908, the U.S. Geological Society estimated that the consumption of the preceding decade had exceeded that of the previous century.⁶ The industrial cities of the Midwest, dependent on dirty bituminous coal, were the first to develop smoke problems after the middle of the nineteenth century, with Pittsburgh, Cleveland, Chicago, Cincinnati, and St. Louis gaining notoriety for dirty air.⁷ Common law, which prevailed in the courts of both nations, allowed victims of pollution to sue perpetrators of smoke nuisances, but complainants could expect relief only if they linked harm to a particular polluter. Civil litigation could stop individual polluters, but this approach was generally reserved for damage caused by smells and noxious vapors easily traced to a single source. The British Parliament periodically passed measures designed to improve air quality, including an 1821 act that prohibited steam engines from emitting smoke in London. Later legislation contained additional anti-smoke provisions, but offenders often escaped conviction and continued to release huge quantities of smoke.⁸ In the United States, the earliest efforts to control smoke tended to concentrate on litigation, although some cities did pass specific anti-smoke legislation. In 1869, Pittsburgh enacted an ordinance forbidding the use of dirty coal in locomotives, and two years later the Cincinnati city council passed an anti-smoke ordinance. These anti-smoke measures went largely unenforced, however, as did those in Britain. In addition, the strict requirements for successful litigation and judicial sympathy for industry limited the effectiveness of civil suits. Any reductions in smoke that did result from anti-smoke laws and litigation were more than offset by increases from rapidly growing populations and industries.⁹

In large cities, the resulting smoke affected nearly everything. Urban air pollution levels were highest during calm weather, when an absence of breezes or rain allowed smoke to accumulate. Temperature inversions, which occurred most frequently in low-lying areas, prevented warm air from rising and trapped smoke near street level. One visitor to Pittsburgh during a temperature inversion in 1868 described the city as "hell with the lid taken off," as he peered through a heavy, shifting blanket of smoke that hid everything but the bare flames of the coke furnaces that surrounded the town. During autumn and winter this smoke often mixed with fog to form an oily vapor, first called *smog* in the frequently afflicted London. In addition to darkening city skies, smoky chimneys deposited a fine layer of soot and sulfuric acid on every surface. "After a few days of dense fogs," one Londoner observed in 1894, "the leaves and blossoms of some plants fall off, the blossoms of others are crimped, [and] others turn black." In addition to harming flowers, trees, and food crops, air pollution disfigured and eroded stone and iron monuments, buildings, and bridges. Of greatest concern to many contemporaries, however, was the effect that smoke had on human health. Respiratory diseases, especially tuberculosis, bronchitis, pneumonia, and asthma, were serious public health problems in late-nineteenth-century Britain and the United States.¹⁰

The complexity of the smoke problem made finding a solution exceedingly difficult. As engineers well understood, incomplete combustion caused all visible emissions, meaning that smoky fires were either too cool or had an insufficient oxygen supply. But understanding the causes of smoke did not make implementing solutions easy. In many cases, poor design of existing equipment made improvements difficult to achieve. This was particularly true in Britain, where most people preferred to burn coal in inefficient open hearths, making domestic fires a major source of pollution. In addition, the great variety of smoke sources—railroad locomotives and steamships, blast furnaces and coke ovens, domestic fires and office building boilers—made deriving and implementing a universal solution impossible. Similarly, wide variations in fuel quality complicated the issue, since some equipment functioned smokelessly with certain coals, but smoked badly with others. The coal markets in most American and British cities contained many different grades of coal, from anthracite, a clean-burning but relatively rare form of coal found in eastern Pennsylvania, southern Wales, and parts of Scotland, to bituminous slack, a cheap, dirty, and widely available grade of fuel.

During the late nineteenth and early twentieth centuries, Britain experienced enormous economic and geopolitical competition from abroad and increasing class conflict at home. Depressed trade, combined with foreign industrial and imperial competition, led many Britons to feel pessimistic about their country's future. Using imagery familiar to all who had experienced a smoke-filled fog, one writer referred to the economy as clouded by a "gloom of uncertainty." To some, coal smoke might once have been an acceptable price to pay for Britain's unrivaled industrial supremacy. But as other nations eroded Britain's lead in the late nineteenth century, many people began to associate smoke not with national pre-eminence, but with national decline, physical degeneration, and social disorder.¹¹

Britain's relative decline in the late nineteenth century owed much to the United States' continuing rapid industrialization. Historians have argued that the dramatic changes associated with urbanization, increasing immigration from eastern and southern Europe, the closing of the Western frontier, repeated and intensifying panics and recessions, and uncertain and troubled labor relations in the new industrial economy all combined to cause an American psychic crisis in the 1890s. But the stunning economic growth of the last decades of the century made the United States the world's largest economy and greatly expanded the middle class. It was with an assumption of future prosperity and growth that this middle class, often in cooperation with the more established upper class, undertook extensive reforms in governance and society in the following decades that were designed to make American cities more healthful, beautiful, and moral places to live. As Samuel Hays argues, many of those who supported reform were optimistic, thinking not of impending crisis, but of the application of science in the name of national progress. If Americans experienced a psychic crisis in the late nineteenth century, it was of a different nature than the British crisis, for the upper classes of the two nations were in very different moods.¹²

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Britain in the 1880s

Concerns about Britain's depressed economy in the 1880s overlapped with fears of political and social disturbances, and smoke-filled air provided an apt symbol for people's inability to see what lay ahead. A contemporary article summed up 1879 as "a year of continuous gloom. Cheerless weather, bad trade, social discomfort, [and] unforeseen political disasters, have made up the staple of experience in the United Kingdom, with only here and there a bright interval to relieve it." The metaphorical darkness of the time was matched by the literal state of the atmosphere. December 1879 was London's foggiest month on record; on some days the fog was so dense that carriage traffic became impossible, and pedestrians had to grope blindly along the edges of buildings. After additional fogs covered London during the remainder of the winter, the Registrar General, responsible for compiling statistics of births and deaths, reported that mortality in London had risen 220 percent during the fogs, causing the premature deaths of about three thousand people.¹³

Two prominent reformers soon began independent efforts to combat the smoke problem. Ernest Hart, the editor of the *British Medical Journal* and the chair of the National Health Society, urged his organization to take action. The society, a quintessentially Victorian assemblage of upper-class men and women that focused on instilling "sanitary knowledge" in the working class, responded quickly to Hart's suggestion. Independent of Hart, the housing and open-spaces advocate Octavia Hill began work on the smoke issue through the Kyrle Society. This organization aimed to improve the lives of poor city residents by bringing nature and art into the slums. When Hart and Hill learned of each other's interest in attacking the smoke nuisance, they persuaded their respective societies to form a joint Fog and Smoke Committee. Despite the two groups' differences, they shared a common concern that coal smoke damaged the environment, human health, and morality. From the beginning, the committee viewed smoke's detrimental effects on health and the environment as significantly interrelated.¹⁴

Members of the Smoke Abatement Committee, as it soon became known, believed that open spaces and growing plants were not simply pleasing to look at, but were also important sources of fresh air. The idea that the natural world exerted an important influence on health had long existed, but it gained particular prominence among urban reformers during the late nineteenth century in Britain and the United States. So widespread was the view that vegetation was vital to health that many writers referred to parks as "the lungs of London," just as many New Yorkers had come to call Central and Prospect Parks the lungs of their city. Park land was increasingly needed, reformers contended, because rapid urban expansion was pushing the countryside ever further from the hearts of cities, diminishing the likelihood that breezes would bring in unpolluted air.¹⁵

Like most educated Victorians, smoke-abatement activists believed that an ability to appreciate nature and art was essential to what it meant to be a civilized person. As working-class political and economic power increased during the late nineteenth century, apologists for the elite complained that "the masses" lacked

the respectable values and cultured sensibilities required for responsible citizenship.¹⁶ Many believed that sustained educational efforts were needed to accomplish this goal and that air pollution interfered with its realization. W. R. E. Coles, a prominent smoke-abatement advocate, argued in 1883 that a “darkened and polluted atmosphere” caused a decline in the “tastes and moral tone” of those surrounded by it and suggested that air pollution might have negative consequences for social order.¹⁷

The Smoke Abatement Committee decided to publicize their cause by sponsoring an exhibition of smoke-prevention technology, which opened in November 1881. Containing more than 230 exhibitors, the exhibition was divided into two sections, industrial and domestic. Instead of accepting manufacturers’ claims about the smoke-preventing properties of their stoves, grates, and boilers, the exhibition subjected them to impartial and scientific trial. Thirteen thousand people visited the exhibition in its first week; by the time it closed, 116,000 people had seen it. The exhibition attracted a great deal of attention from other cities faced with a smoke problem. The Manchester and Salford Noxious Vapours Abatement Association was so impressed that it asked for permission to put on the exhibition in England’s industrial Northwest, where it opened in the spring of 1882.¹⁸

After the exhibitions ended, the Smoke Abatement Committee reconstituted itself on a more permanent basis as the National Smoke Abatement Institution. But many of the participants soon became discouraged at the seemingly intractable nature of the smoke problem and turned their attention to other issues. Those who remained found themselves divided over how to proceed. Some believed that the group had devoted too much attention to education and not enough to legislative reform.¹⁹ Despite the call for greater state intervention, many activists were strongly committed to achieving improvement through voluntary efforts instead of through government pressure. The public health expert Douglas Galton expressed such *laissez-faire* principles unequivocally in an 1880 address before the Sanitary Institute. “Real practical progress” in reducing smoke, he insisted, “can only be secured by the exertions of the individual members of the community.”²⁰

By the middle of the 1880s, the National Smoke Abatement Institution had lost much of its early enthusiasm. The group continued to promote the use of “smokeless” grates and gas, but its hopes of rapid improvements in air quality were disappointed. It called on the government to appoint a Royal Commission to investigate the smoke problem, but these efforts collapsed when the Home Secretary rejected the proposal. In 1884, disenchanted with the group’s failure to achieve meaningful progress through education alone, Lord Stratheden and Campbell introduced a far-reaching bill that would have regulated smoke from all new dwellings in London. A majority of MPs blocked the bill, but they proved less successful in keeping London’s smoke-filled air from entering parliament. Despite the installation of filters in the ventilation system, smoke continued to enter. Reporting on the failure of this technological fix, the *Lancet* observed that politicians might finally realize that “if they determine to legislate in a clear atmosphere, they must provide for the prevention of fog in the whole of London, as well as in the legislative chamber itself.”²¹

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The United States in the 1890s

The London fogs of 1879–1880 made news in the United States, as did the heavy fogs of subsequent winters. Reporting from London in early February 1880, a *New York Times* correspondent wrote that the British capital had experienced virtually “a week of night” as a result of unremitting fogs: “[A] curtain of cloud, thick with the smoke of coal fires, has been drawn over London. . . . [T]he fog has pervaded all society . . . it has poisoned some of our citizens to death . . . it has set pedestrians crying aloud in the streets lest they should be run over, and they have not always cried successfully.”²² The sensationalistic tone of this article may have helped promote an American fascination with London’s extreme pollution, a fascination which persisted throughout the era. In 1889, the *New York Times* reported on “Pea-Soup Fog in London,” using a common metaphor that described not only the thickness of the moisture, but also its yellowish tinge. The newspaper noted that “New-York’s Worst Fog Does Not Approach It.”²³

Many Americans followed with interest Britain’s smoke problem and the efforts to solve it. Secretary of State James G. Blaine asked the U.S. embassy in London to find “some suitable person” to visit the smoke prevention exhibition and report back to his office. The effort, he noted, would benefit the citizens of Cincinnati, Pittsburgh, and other cities that burned bituminous coal. In other words, the State Department understood the growing importance of smoke abatement in American cities and the relative expertise of British engineers and inventors in combating the problem. Yet many Americans looked to London not just as another smoke-afflicted city with lessons to give, but also as the world’s metropolis. London’s failure to control its smoke could represent a failure of Anglo civilization. Equally, London’s persistent smog could signal the insignificance of smoke abatement to world status. “We of Chicago hope to rival London as a great center of civilization,” wrote an engineer in 1906. “If London finds it possible to endure the smoke, we can undoubtedly do the same.” Americans on both sides of the abatement issue, then, looked to Britain for guidance.²⁴

Americans did not need to look across the Atlantic to find growing smoke clouds, however. The United States witnessed increasing concern for polluted air in the 1880s, but it saw little organized effort to control smoke. Americans did not create an organization even vaguely resembling the National Smoke Abatement Institution, and not until the first years of the 1890s did Americans begin a serious attack on smoke. Although several cities had passed anti-smoke ordinances before the 1890s, and although urban residents had long sought relief from offensive smokestacks through nuisance abatement laws and the court system, not until that decade did Americans create an organized movement that treated smoke as a citywide problem. Pittsburgh, St. Louis, Cleveland, and Chicago all witnessed the beginning of concerted anti-smoke activism between 1890 and 1893. Activists in these cities redefined smoke, attempting to remove its somewhat positive image as a symbol of progress. According to these reformers, smoke was dirty, unhealthful, ugly, evil, and wasteful.²⁵

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Taken together, the efforts in these four cities reveal a changing perception of the urban atmosphere in America's industrial centers. As in Britain, American middle-class anti-smoke activists were steeped in Victorian ideals which related cleanliness, health, aesthetics, and morality. To be orderly, healthful, and moral, a city also had to be clean and beautiful. With the booming economy of the first years of the 1890s, the expanding middle class began to demand more of their prosperous cities. Chicago's former chief health officer, Andrew Young, summarized this attitude: "It is only by the strict regard of the rules of cleanliness and healthfulness that we are enabled to keep ourselves and surroundings in a condition befitting the common sense of enlightened humanity and civilization. Our atmosphere is no exception to the general rule."²⁹

This reform fervor resulted in new anti-smoke legislation in several cities. These laws proved largely ineffective, however, and judges often declared them unconstitutional. Moreover, many anti-smoke organizations of the early 1890s could not survive the depression following the panic of 1893. In some cities the laws and the organizations remained intact through the economic downturn, but with little effect.³⁰

Britain at the Turn of the Century

In the mid-1890s, the Smithsonian Institution published a series of essays concerning the relationship between air and human life. Two of the essays came from individuals prominent in the British smoke abatement movement. Julius B. Cohen, a chemistry professor from the industrial city of Leeds who would later belong to the executive committee of the Smoke Abatement League of Great Britain, sought to prove that sustained exposure to air pollution caused serious health problems. Rollo Russell, a prolific writer on smoke and the son of a former prime minister, suggested that air pollution provoked intemperance and social unrest among urban workers. "The air being deprived of its exhilarating powers," he wrote, encouraged city residents to "seek stimulants in food and drink, and go to mischievous excess in the consumption of animal flesh and alcohol . . . Most children born and bred in the crowded parts of towns are sickly, pale, feeble, unnaturally sharp and wizened."³¹

The Cohen and Russell articles appeared as the culmination of the Smithsonian's Hodgkins Fund competition. Endowed by a large bequest in 1891 from Thomas George Hodgkins, an English-born businessman, the competition aimed to promote the study of the atmosphere. It attracted over two hundred papers and stimulated greater attention to smoke among scientists, helping activists on both sides of the Atlantic make the case that smoke was a serious health problem. The Cohen and Russell essays in particular encouraged American readers to think of air pollution in distinctly British terms, wrapping the issue within fears of and for the urban masses.³²

Like America's middle-class Victorian reformers, many Britons considered smoke not simply an inconvenient nuisance, but rather part of a web of problems that threatened their nation's social, economic, and imperial future. Some feared that

environmental degradation undermined the sustainability of city life by damaging the air, food, and health of residents.³³ Writing in 1887, Lord Reginald Brabazon, the twelfth Earl of Meath, warned that if such trends continued, Britain would eventually suffer on the battlefield. These concerns intensified as a result of Britain's difficulties in South Africa during the second Boer War (1899–1902), in which it experienced a series of costly and unexpected defeats. To make the situation worse, Britain's system of voluntary recruitment was severely strained when a large proportion of the men who volunteered for enlistment failed their army physical exams. To Sheffield's smoke inspector, William Nicholson, the reason for this "physical degeneracy" was "directly traceable to the constant inspiration of impure air."³⁴

Concerns about the military consequences of physical deterioration were connected to fears about its effect on Britain's ability to compete economically. Rejecting arguments that a period of low profits and increasing foreign competition was no time to advocate stricter enforcement of anti-smoke laws, William Bousfield asserted in 1882 that "there is but one way of maintaining our industrial ascendancy, and that is by the excellence and the artistic beauty of our manufactures." Bousfield insisted that the design and quality of manufactured goods deteriorated in an environment of "gloom and ugliness," and maintained that the smoke that had "arisen in the creation of our trade . . . must be removed if we are to preserve it."³⁵

Smoke, often described as unconsumed coal, struck many as visible evidence that the nation was "wasting in the most irresponsible manner" its most precious natural resource. If Britain used up its supplies, other countries could charge high prices for their coal and force Britain into a state of dependency. In 1907, John W. Graham, who went on to chair the Smoke Abatement League, predicted that as Britain's coal supplies dwindled, its industrial base would collapse:

When our coal has gone the manufacturing and mercantile part of the greatness of England and all that depends upon it will have gone too. London will live by running hotels in which Americans can spend their holidays, and as a centre of culture and fashion; in Lancashire and Yorkshire sheep will wander over the ruined heaps of former towns; Manchester and Leeds will be visited chiefly for their Art Galleries and Libraries, their impoverished Universities and interesting old Town Halls, doubtless cleaned at last.³⁶

In December 1898, Brabazon chaired a meeting of prominent individuals who wanted to resume the fight against smoke. The organization they formed, the Coal Smoke Abatement Society, adopted a strategy quite different from that of the National Smoke Abatement Institution of the 1880s. Instead of directing its efforts toward education and persuasion, this new group focused on insuring greater enforcement of anti-smoke laws. Its president, Sir William Blake Richmond, explained that local officials were often "averse to convicting themselves or their friends; and a kindly and amiable transfer of good-will went on between our local governors, their friends, and inspectors. Inspectors did not see the smoke, and denied, therefore, that it existed."³⁷

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Local sanitary authorities held primary responsibility for enforcing the law against smoke, but if they failed to do so, higher levels of government were supposed to intercede. For the vestries of London, this body was the London County Council; elsewhere in England, the Local Government Board had this responsibility. One of the society's first projects was to put pressure on the London County Council to indict polluters when vestry authorities would not act. As a result of these efforts, the society claimed that the number of smoke nuisances within the immediate metropolitan area had fallen from 187 cases in 1900 to only 15 in 1908. Leaders of the society complained, however, that much of the smoke obscuring London's skies came from factories situated outside the council's jurisdiction. The society repeatedly asked the Local Government Board to take action, but the board invariably ignored its requests. Frustrated with this inattention, activists hoped to extend the authority of the London County Council so that it could deal with smoke from neighboring districts. The government declined to give the board this power, but it did grant another of the group's requests: in 1904, the Foreign Office asked British ambassadors stationed in Washington, D.C., and several European capitals to furnish information about how other industrialized countries regulated smoke. The ensuing report, presented to Parliament in 1905, focused particular attention on the United States; it even included a copy of the legal notice that Chicago's chief smoke inspector issued to violators of the city's smoke ordinance.³⁸

The United States in the 1900s

If British anti-smoke organizations hoped to learn something from a study of American ordinances, American reformers hoped to learn from British organizations. In the spring of 1905, Dr. Charles Reed, Cincinnati's noted surgeon and gynecologist, used what he had learned from his travels in Europe, particularly Britain, to develop a strategy for a smoke abatement movement in the United States. While in Manchester, Reed had become familiar with that city's Smoke Abatement League. He quickly saw the value of such an organization and brought the idea home with him to Cincinnati. In an address on the smoke problem delivered before that city's Woman's Club, an exclusive organization of 150 prominent citizens, Reed proposed that the women of Cincinnati initiate a smoke abatement league, and indeed, that they attempt to create some national anti-smoke organization, no doubt to be modeled on Britain's Coal Smoke Abatement Society.³⁹

In his address, Reed made clear that he understood his audience's particular interest in smoke abatement. Noting that women were martyrs to the growing smoke problem, he charged that "the extra drudgery in housekeeping imposed upon women is never taken into account by the company whose factories fill the air with soot that filters alike into the parlor and bed-room." Moving beyond the issue of cleanliness, Reed also emphasized the health aspects of air pollution, relating smoke to tuberculosis, catarrh, and other respiratory diseases. No doubt, many of the club members well understood the implications of the city's dense smoke. For nearly a year, the club's Civics Department had studied the smoke problem, observing offensive stacks, gathering information concerning effective

abatement equipment, and inviting Reed to speak before the larger organization on the issue.⁴⁰

After Reed's presentation and a subsequent address by Dr. Julia Carpenter, another Cincinnati physician long engaged with the smoke issue, the women drew up a plan of action. In 1906, Carpenter, Reed, and several members of the Woman's Club joined other middle-class reformers in forming the Smoke Abatement League. Over the next few years the league grew into a powerful force in the city; with a membership list that resembled a "who's who" of Cincinnati, the league had more than enough political clout to influence public policy. The organization lobbied city government for more effective enforcement of its anti-smoke ordinance. More important, the league hired a superintendent to conduct his own investigations and make citizen's arrests of smoke offenders. Twice over the next four years, league superintendents would move into the city's chief smoke inspector position. Through the league, its superintendent, and its connections in municipal government, middle-class reformers guided the city's anti-smoke movement. As with the earlier anti-smoke efforts in the United States, the movement focused on the health, cleanliness, aesthetic, and moral implications of smoke, and the city battled smoke through a small office within the Health Department.⁴¹

Cincinnati was not the only American city to experience a revival in anti-smoke activism in the early 1900s. Just three days after Reed delivered his influential 1905 address in Cincinnati, the *New York Times* reported on the efforts of Charles T. Barney in New York City. Barney, a real estate agent, hoped to spark an effective anti-smoke movement in his city through the organization of a smoke abatement league, just as Reed had done in Cincinnati. Over the next two years that organization, the Anti-Smoke League, led a crusade against the smoke cloud developing over Manhattan. Under pressure from the organization, the Board of Health revised an old ordinance which required the use of a "smoke consumer." The city launched dozens of cases against smoke offenders in the early months of 1906, with members of the league notifying Health Department officials of offending stacks so that the city might initiate legal proceedings. More important, once cases reached trial, the league located witnesses to the offending stacks who testified that the smoke caused them annoyance.⁴²

The assistance of the Anti-Smoke League made a significant difference in the city's effectiveness and apparently had some effect on the clarity of the air. A New York publication, *Medical Record*, indicated that the league and the city had made progress in the summer of 1906. "This method of frequent daily arrests," the magazine wrote, "has had its effect, and there are now few chimneys giving forth black smoke." In New York, as in Cincinnati, the organization of a single-issue interest group kept the smoke problem before the public and forced municipal action.⁴³

Britain, 1905–1910

Britain's pressure groups also kept the smoke problem before the people, and despite their nation's dependence on coal, they often worked toward new fuel solu-

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tions. The Coal Smoke Abatement Society received frequent assistance from the *Lancet*, which provided ample and favorable coverage in its pages and helped the group evaluate the claims of smoke-preventing fireplaces. Inspired by this group's success, reformers in Manchester hired their own smoke inspector, who "worked on the lines on which the inspector of the London Coal Smoke [Abatement] Society has worked so successfully for the last ten years." Like Cincinnati's Smoke Abatement League and New York's Anti-Smoke League, the inspectors hired by the society and the Manchester group provided evidence to aid in prosecution and ensure strict enforcement of the law. In Manchester, activists linked these efforts toward better enforcement with education, combining a program about the benefits of clean air with the promotion of gas cooking and heating appliances.⁴⁴

Despite achieving some notable successes, many reformers recognized that a purely local approach had serious shortcomings. Jurisdictional boundaries meant that local governments lacked the authority to take action against sources of smoke that lay outside city limits. In many cases, however, local authorities failed to act even when they clearly had the power to do so. Smoky factories were sometimes owned by the very officials whose duty it was to enforce smoke laws. More commonly, officials feared that stringent application of the law would drive away industries and jobs. As Sheffield's smoke inspector explained in 1905, until environmental standards were enforced uniformly throughout the country, polluting factory owners would continue threatening to relocate whenever local authorities tried to make them reduce their smoke output. Fred Scott, secretary of the Manchester Smoke Abatement League, similarly argued that uniform standards and unbiased enforcement were sorely needed.⁴⁵

The late nineteenth and early twentieth centuries in Britain were a period of increasing governmental involvement in many matters previously left to private initiative, such as education, housing, and health insurance. Adapting to this changing political context, many anti-smoke activists came to believe that the health effects of air pollution justified greater state action. Giving voice to this shift, one reformer argued that an "individual who is one of a community . . . must not do that which will produce ill effects on the health and comfort of the community."⁴⁶ The reformer John W. Graham noted in 1907 that health remained worse in cities than in the countryside, even though people in urban areas generally had higher wages, superior nutrition, and better sanitation than rural residents. "The atmosphere is largely responsible for the difference," he wrote, adding that "the atmosphere is made what it is by smoke." Everyone had a right to pure air, and the state had a compelling interest in protecting it, even if this meant fines for individual householders.⁴⁷ Two decades earlier, such arguments had been rejected as extreme, even by many people involved in the smoke-abatement movement, but a growing number now agreed with them.

In 1909, smoke activists from Glasgow, Sheffield, Manchester, and other industrial cities formed an organization to coordinate their efforts. Called the Smoke Abatement League of Great Britain, the group sent a deputation of municipal officials to meet with the president of the Local Government Board in 1910. They argued that the only way to solve the smoke problem was through more active

government involvement. William B. Smith, the acting president of the Glasgow and West of Scotland branch of the league, repeated a common refrain among reformers, namely that each locality “could only take action with regard to works within its own area, whilst it often happened that there were works just beyond the city or borough which poured out smoke continually, yet no action could be taken.”⁴⁸

International Cooperation, 1910–1914

In the fall of 1911, Richard B. Mellon provided funding to the University of Pittsburgh’s Department of Industrial Research for a comprehensive study of smoke. The investigation focused on Pittsburgh’s smoke problem, but with implications for smoky cities everywhere. It covered all aspects of the issue: smoke’s effects on the economy, physical health, mental health, vegetation, weather, and building materials, as well as its engineering causes. The Mellon Investigation was the most extensive and thorough study of the smoke problem yet undertaken in the United States, and its reports, issued in a series of nine bulletins in 1913 and 1914, set the standard for the professional investigation of the problem.⁴⁹ The institute gathered twenty-seven specialists for the study, including seven physicians, five architects, four engineers, and two chemists. The two most active participants, economist John O’Connor and chemist and chief fellow Raymond Benner, published extensively in the years during the study, making certain that the investigation would be widely known.⁵⁰

The Mellon Investigation largely involved a review of existing knowledge of smoke and its effects. Most of the bulletins, then, offered valuable collections of information, but not necessarily new understanding of the various aspects of the problem. This was not the case in two very important areas of research, however: engineering and health. The engineering researchers conducted a soot-fall study in Pittsburgh, modeling their collection on a similar London study conducted in 1912. The investigators found that Pittsburgh’s annual average soot-fall per square mile was 1,031 tons, more than four times London’s 248 tons. More significantly, the engineers conducted a survey of 152 stationary coal-burning plants in Pittsburgh. The study categorized the plants by means of stoking, hand-fired, chain-grate stoker, underfed stoker, and so forth, and then compared the emissions from each of these types. Fifty percent of the hand-fired plants were in violation of the smoke ordinance, while underfed and side-fed stokers performed admirably, with negligible violations. The bulletin concluded that the abundance of cheap fuel (Pittsburgh sat atop a 112-trillion-ton coal field) contributed to the lack of interest in efficient firing of boilers, particularly with automatic stokers. “One cannot read the report,” *Power* editorialized, “without again being reminded that plenty of available cheap fuel is sometimes an evil as well as a blessing to a large city, for as long as it is cheap, gross negligence and resulting smoke accompany its use.”⁵¹

The Mellon study’s ninth bulletin contained original research concerning smoke’s effects on health. Here Dr. Samuel Haythorn published his research on the effect of carbon deposition in the lungs on tuberculosis and pneumonia.

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Haythorn conducted experiments using a guinea pig and a white rabbit (just one of each). From his research, Haythorn concluded that smoke adversely affected the lung tissues of pneumonia patients, a conclusion which amplified the findings of German physician Louis Ascher. In 1906, Ascher had compiled mortality statistics that indicated a link between acute pulmonary disease and residence in smoky districts, and his work received considerable international attention. Now, Haythorn's work provided histological support for Ascher's broad epidemiological study.⁵²

Although the Mellon study ostensibly focused on Pittsburgh's smoke problem, O'Connor and the other investigators collected information from all over Europe and the United States. As the investigation neared completion, the bulletins found an international market. O'Connor himself communicated with several British activists and officials, including Lawrence Chubb, who for many years served as secretary of both the Commons Preservation Society and the Coal Smoke Abatement Society. O'Connor also collected information from Britain, including a reprint of Rollo Russell's 1899 lecture, "London Fog and Smoke," and pamphlets from the Glasgow Smoke Abatement Exhibition of 1912 and the International Smoke Abatement Exhibition and Conference held in London the same year.⁵³

Benner represented the Mellon Investigation at the latter meeting, giving those in attendance a detailed preview of the study then under way. Benner was one of sixteen delegates from outside Britain. Several American cities sent representatives and speakers, including C. W. A. Veditz from the University of Pittsburgh and Thomas E. Donnelly of Chicago. Donnelly, the chairman of Chicago's Smoke Abatement Commission, discussed at length the administrative aspects of his city's anti-smoke movement. Donnelly claimed that Chicago's educational approach had achieved remarkable success, perhaps reducing the city's total smoke by one-third and reducing the emissions of certain stacks by much more.⁵⁴

The presentations delivered by Donnelly and Benner revealed the significant changes in the public conception and municipal regulation of smoke that had occurred over the previous decade. States had given cities the authority to regulate emissions, and many urban residents had come to assume that municipal governments had the obligation to improve air quality. These new expectations led to evermore complicated anti-smoke ordinances, often modeled after the Chicago law. The new generation of laws generally required smoke inspectors to have engineering experience and to pass a civil service exam, an important step toward professionalizing the smoke abatement effort. The laws also conferred upon inspectors the right to enter all premises emitting dense smoke, with the goal of allowing inspectors to instruct operators in better techniques or to determine what structural improvements proprietors needed to make.⁵⁵

The new laws, combined with the greater emphasis on study and education, indicated the arrival of a new phase in the anti-smoke effort. The old Victorian ideals connecting health, beauty, and cleanliness to the morality of urban residents began to lose their luster, and a nation infatuated with progress and efficiency began to search for more scientific justifications for the abatement of smoke. With engineers at the forefront of the anti-smoke effort in the early 1910s, the

national discussion of the smoke problem naturally turned toward efficiency issues. Certainly, the health, cleanliness, and aesthetic implications of smoke never disappeared from the movement, and the middle-class women's organizations that were so instrumental in sparking activism did not lose interest in the issue. Indeed, in some cities, including St. Louis and Cleveland, women's groups organized important anti-smoke crusades in the 1920s. Yet, while some women may not have lost their enthusiasm for reform, they did lose much of their influence. As cities turned toward a technological solution to the air pollution problem, the issue of economic waste, both for consumers of coal and victims of soot, gained in salience, and engineers eclipsed women as the voices of reform. The grand metaphors of smoke as the bane of civilization, as the manifestation of evil, no longer seemed appropriate.⁵⁶

British speakers at the conference shared their American counterparts' concern that smoke was inefficient, uneconomical, and unnecessary. William Nicholson, the chief smoke inspector for the steelmaking city of Sheffield, told attendees that science offered a solution that would benefit both the users of coal and the wider community by reducing the amount of fuel consumed and the amount of smoke produced. Stressing cooperation between employers, employees, and government, Nicholson argued that modern equipment, "scientific feeding" of industrial furnaces, and inspectors who possessed technical expertise in smoke prevention would together solve the smoke problem. Education should be used to show factory owners that they would save money by investing in modern technology and by teaching stokers how to burn coal more efficiently.⁵⁷

Other British representatives at the 1912 conference agreed with Nicholson that education could reduce the smoke problem, but many felt that persuasion and enlightened self-interest would not eliminate it. Notable improvements had occurred in some places, but many towns and cities remained full of smoke. Some factory owners seemed content to burn coal wastefully rather than invest in less polluting equipment, safe in the knowledge that fines, if levied, would be modest. Private smoke inspectors, hired by anti-smoke groups, could be used to prompt local authorities into action, but the latter often failed to act because they feared that offending industries would simply move away. To establish uniform and comprehensive standards across the country, immune to local pressure and modification, many felt that smoke inspection should become a responsibility of the national government.⁵⁸

In contrast to Nicholson's characterization of the smoke problem as predominantly industrial, and a matter of science and engineering, others viewed it as predominantly domestic, the result of poor public policy. William B. Smith, who, in addition to leading a local branch of the Smoke Abatement League of Great Britain, was the chairman of Glasgow Corporation's Air Purification Sub-Committee, asserted that industry accounted for only a quarter of the city's smoke. The remainder came from fireplaces and stoves in hotels, restaurants, offices, and private houses. In contrast to industry, where new equipment and improved stoking could reduce smoke emissions, little could be done to reduce the amount of smoke from coal in open fireplaces.⁵⁹

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The occasion of the 1912 international conference on smoke abatement provided opportunities for participants from both the U.S. and Britain to bolster their claims that the smoke problem required greater attention from their respective governments.⁶⁰ If smoke was an appropriate subject for an international meeting, it seemed natural to compare one country's progress in reducing smoke against another's. By linking clean air with efficient production and healthy citizens, activists implied that smoke abatement provided visible proof of a nation's capacity to succeed in a world where the ability to compete both industrially and militarily appeared essential to its survival.

Conclusion

British and American activists attacked coal smoke in remarkably similar ways. Smoke's pervasive and invasive unpleasantness allowed people in both countries to use it as a symbol for much greater problems in society. The nature of the pollution problem, bolstered by communication between the two nations, also forced the movements against smoke to evolve in very similar ways. Both nations turned to engineers to find solutions to the technical aspects of smoke pollution. Neither country witnessed the development of a significant movement to control the use of coal, and both nations continued to suffer from polluted air. In 1913, William Smith traveled from Glasgow to Pittsburgh to attend the International Association for the Prevention of Smoke, a North American organization of smoke abatement engineers and officials. In a speech to the group, Smith discussed Europe's smoke problem and the state of efforts to reduce it. With obvious disappointment, not with Smith but with Pittsburgh itself, the *Gazette Times* editorialized that "William B. Smith, described as a noted expert on air purification, said nothing that has not been said before." The newspaper noted that Pittsburghers had all the information they needed to act and lamented that most citizens remained complacent about the smoke problem. "Yes, smoke is a bad thing," the paper concluded. "None—not even a Glasgonian—knows it better than a Pittsburgher."⁶¹

In the spring of 1914, after years of pressure by smoke abatement groups, the British government finally appointed a committee to consider whether additional legislation was needed to reduce the smoke problem. Despite its auspicious beginnings—the committee included several prominent advocates of cleaner air, such as Rollo Russell and Julius B. Cohen—other events soon interrupted its work. As the head of the Smoke Abatement League ruefully observed in December 1914, the "outbreak of war has caused the committee to suspend its sittings while hostilities continue."⁶² Many scientists, including Cohen, turned their attention to military projects. Because of concerns about aerial bombardment of British cities, smoky air actually became a useful defensive measure for the duration of World War I. Two and a half years later, the United States entered the war, a development that significantly reduced its smoke-abatement efforts as well. Although most U.S. cities witnessed dramatic decreases in air quality as the nation prepared for

war, municipalities generally ceased enforcement of anti-smoke laws. In spite of the fact that coal shortages turned public attention to conservation, municipal officials assumed that anti-smoke enforcement would only impede the production and transportation of goods, an unacceptable prospect during the war emergency.⁶³

Pressure to reduce air pollution would resurface in both Britain and the U.S. with the coming of peace, but the war permanently reshaped public attitudes toward smoke. The symbolic significance accorded to smoke had begun to wane in the decade prior to the outbreak of the war as engineers displaced lay reformers' authority to speak out about air pollution. The war significantly accelerated this trend by dwarfing relatively abstract concerns about industrialism's compatibility with civilization and whether cities could be healthy places to live with much more tangible concerns. Whether one believed that the war was a life-and-death struggle to defend democracy or a senseless act of collective self-destruction, the horrific reality of warfare robbed smoke of the symbolic weight it had earlier possessed. Experts in the U.S. and Britain continued to pursue research and compare approaches, but smoke had become almost entirely a technical question. During the decades that followed, air pollution would be discussed by engineers, but largely ignored by the wider public.⁶⁴

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Notes

1. The phrase “smoke of great cities” occurred frequently during the late nineteenth and early twentieth centuries in both countries. Adam W. Rome recently argued that Britain and the United States experienced very different movements to improve air quality, with British landed gentry leading a rural campaign against industrial “noxious vapors,” and the American urban middle class engaging in a crusade against the smoke problem in cities. While Rome rightly notes that the British paid much greater attention to pollution in rural areas than did Americans, he exaggerates the rural character of British attempts to reduce air pollution and implies that urban anti-smoke efforts were largely confined to the U.S. See “Coming to Terms with Pollution: The Language of Environmental Reform, 1865–1915,” *Environmental History* 1 (1996): 6–28.
2. For a discussion of cultural connections between the U.S. and Britain in this period, see David D. Hall, “The Victorian Connection,” and Daniel Walker Howe, “Victorian Culture in America,” in *Victorian America*, ed. D. W. Howe (Philadelphia: University of Pennsylvania Press, 1976), esp. 3–26, 81–94.

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3. Peter Brimblecombe, "Attitudes and Responses Towards Air Pollution in Medieval England," *Journal of the Air Pollution Control Association* 26 (1976): 941–45, esp. 941. See also Peter Brimblecombe, *The Big Smoke: A History of Air Pollution in London Since Medieval Times* (London: Methuen, 1987).
4. In addition to visibility, the popular definition also assumed the preventability of smoke. In other words, not all emissions from fires constituted smoke, only the unnecessarily dark emissions. The Sanitary Act of 1866 required London's police to bring charges against factory owners whose chimneys emitted black smoke, but many polluters escaped fines by arguing that, although their smoke was indeed dark, it was not actually black. Even when the authorities punished polluters, the resulting fines were extremely small, often no more than half a pound sterling. Chicago Association of Commerce, *Smoke Abatement and Electrification of Railway Terminals in Chicago* (Chicago: n.p., 1915), 28–29; Lucius H. Cannon, *Smoke Abatement: A Study of the Police Power as Embodied in Laws, Ordinances, and Court Decisions* (St. Louis: St. Louis Public Library, 1924); and Joseph Hurst, *English Law Relating to the Emission of Smoke from Chimneys* (London: Coal Smoke Abatement Society, n.d.), Box 7, Archives of the National Society for Clean Air and Environmental Protection, Brighton, England [hereafter NSCA].
5. A. E. Dingle, "The Monster Nuisance of All': Landowners, Alkali Manufacturers, and Air Pollution, 1828–64," *Economic History Review*, 2d ser., 35 (1982): 529–48; Roy M. MacLeod, "The Alkali Acts Administration, 1863–84: The Emergence of the Civil Scientist," *Victorian Studies* 9 (1965): 83–112; Richard Hawes, "The Control of Alkali Pollution in St. Helens, 1862–1890," *Environment and History* 1 (1995): 159–71; Donald MacMillan, "A History of the Struggle to Abate Air Pollution from Copper Smelters of the Far West, 1885–1933" (Ph.D. diss., University of Montana, 1973); and Chicago Association of Commerce, *Smoke Abatement*, 29. On the development of nuisance law, see Horace Gay Wood, *A Practical Treatise on the Law of Nuisances in Their Various Forms* (Albany, N.Y.: John D. Parsons Jr., 1875); and Joel Franklin Brenner, "Nuisance Law and the Industrial Revolution," *Journal of Legal Studies* 3 (1974): 403–33.
6. Coal consumption in London increased roughly fivefold between 1829 and 1879, rising to over ten million tons per year. B. R. Mitchell, *British Historical Statistics* (Cambridge: Cambridge University Press, 1988), 245. For U.S. coal consumption figures from 1850 through 1920, see Sam H. Schurr and Bruce C. Netschert, *Energy in the American Economy, 1850–1975* (Baltimore: Johns Hopkins University Press, 1960), 508. On the importance of coal to the American energy market, see Martin Melosi, *Coping With Abundance: Energy and Environment in Industrial America* (Philadelphia: Temple University Press, 1985).
7. For early reports of smoke in American cities, see James Parton, "Pittsburgh," *Atlantic Monthly*, January 1868, 17–28, esp. 18; and *Cleveland Daily Leader*, 7 May 1869, 26 October 1871.
8. British acts containing anti-smoke provisions included 1 & 2 Geo. IV c. 41, 16 & 17 Vict. c. 128, 29 & 30 Vict. c. 90, and 38 & 39 Vict. c. 55. But legislation did nothing to restrict smoke from household sources until passage of the Clean Air Act in 1956. See Eric Ashby and Mary Anderson, *The Politics of Clean Air*, Monographs on Science, Technology, and Society (Oxford: Clarendon Press, 1981), esp. 4–6, 17; Howard A. Scarrow, "The Impact of British Domestic Air Pollution Legislation," *British Journal of Political Science* 2 (1972): 261–82; and B. W. Clapp, *An Environmental History of Britain Since the Industrial Revolution* (London and New York: Longman, 1994), esp. 13–69.

9. Augustus A. Straub, "Some Engineering Phases of Pittsburgh's Smoke Problem," *Mellon Institute Smoke Investigation Bulletin No. 8* (Pittsburgh: University of Pittsburgh, 1914), 12. See also Robert Dale Grinder, "From Insurgency to Efficiency: The Smoke Abatement Campaign in Pittsburgh Before World War I," *Western Pennsylvania Historical Magazine* 61 (1978): 187–202; *Proceedings of the Tenth Annual Convention of the International Association for the Prevention of Smoke* (Cincinnati: n.p., 1915), 36; and Richard Macrory, "The Legal Control of Pollution," in *Pollution: Causes, Effects, and Control*, 2d ed., ed. Roy M. Harrison (Cambridge: Royal Society of Chemistry, 1990), 287–88.
10. Rollo Russell, *London Fogs* (London: Edward Stanford, 1880), 6; Parton, "Pittsburgh," 21; Eric Stuart Bruce, "Town Fogs: Their Amelioration and Prevention," *Dublin Review* 114 (1894): 132–34, esp. 138; *Cleveland Press*, 6 January 1905; and R. C. Benner, "Papers on the Effect of Smoke on Building Materials," *Mellon Institute Smoke Investigation Bulletin No. 6* (Pittsburgh: University of Pittsburgh, 1913). On smoke's health effects, see "Advantages of Fogs," *Lancet*, 25 June 1892, 1433; Oskar Klotz and William Charles White, eds., "Papers on the Influence of Smoke on Health," *Mellon Institute Smoke Investigation Bulletin No. 9* (Pittsburgh: University of Pittsburgh, 1914); G. Melvyn Howe, *Man, Environment, and Disease in Britain: A Medical Geography of Britain Through the Ages* (New York: Harper and Row; Newton Abbot: David and Charles, 1972), esp. 192; and Anthony S. Wohl, *Endangered Lives: Public Health in Victorian Britain* (Cambridge, Mass.: Harvard University Press, 1983), 205–32. The word *smog* appears to have been coined in 1905 by Dr. H. A. Des Voeux, the honorary treasurer of the Coal Smoke Abatement Society. See *Oxford English Dictionary*, 2d ed., s.v. "smog."
11. See T. E. C. Leslie, "The Known and the Unknown in the Economic World," *Fortnightly Review* 31 (1879): 934–49, esp. 934; and Lancet Analytical Sanitary Commission, "Report on Perfect Combustion and Smoke Prevention," *Lancet*, 21 March 1891, 682–85, esp. 682.
12. Samuel Hays makes this argument specifically about conservationists. Unfortunately, Hays's paradigm-setting work on progressive environmental activism all but ignores urban reform. Hays grounds conservationism in the Western concern for water reclamation and fails to suggest implications of scientific management of resources for urban environments. See Hays, *Conservation and the Gospel of Efficiency: The Progressive Conservation Movement, 1890–1920* (Cambridge, Mass.: Harvard University Press, 1959). See also Robert H. Wiebe, *The Search for Order, 1877–1920* (New York: Hill and Wang, 1967); Richard Hofstadter, *The Age of Reform: From Bryan to F.D.R.* (New York: Alfred A. Knopf, 1955); and Martin Melosi, ed., *Pollution and Reform in American Cities, 1870–1930* (Austin: University of Texas Press, 1980).
13. *Illustrated London News*, 3 January 1880, 2; R. C. Mossman, "The Non-Instrumental Meteorology of London, 1713–1896," *Quarterly Journal of the Royal Meteorological Society* 23 (1897): 287–304, esp. 290; and W. C., "A London Fog," *Chambers's Journal*, 4 December 1880, 769.
14. Hart's group also worked to raise money to "pay for a few weeks' country air for the little children of our overcrowded London courts." National Health Society, *Seventh Annual Report* (1880), British Library, 3, 13. On the Fog and Smoke Committee's early activities, see "Smoke-Abatement Exhibition," *Nature* 25 (8 December 1881): 121–22; and W. F. Pollock, "Smoke Prevention," *Nineteenth Century* 9 (1881): 473–90, esp. 483.

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15. Robert Martin, "Sanitary Progress and Its Obstacles in Manchester," paper presented on 14 April 1875, *Transactions of the Manchester Statistical Society* (Session 1874–1875): 87–98, esp. 93; J. Milner Fothergill, *The Town Dweller: His Needs and His Wants*, intro. B. W. Richardson (1889), reprinted in Lynn Hollen Lees and Andrew Lees, eds., *The Rise of Urban Britain: A Collection of Thirty-five Important Titles Documenting This Major Transformation and the Responses to It* (New York and London: Garland Publishing, 1985), 31; Louis C. Parkes, "The Air and Water of London: Are They Deteriorating?" *Transactions of the Sanitary Institute of Great Britain* 13 (1892): 59–69, esp. 62. On the American use of "lungs of the city," see David Schuyler, *The New Urban Landscape* (Baltimore: Johns Hopkins University Press, 1986), 59–60. On British concerns about the effects of the natural environment on health, see Christopher Hamlin, "Providence and Putrefaction: Victorian Sanitarians and the Natural Theology of Health and Disease," *Victorian Studies* 28 (1985): 381–411; H. L. Malchow, "Public Gardens and Social Action in Late Victorian London," *Victorian Studies* 29 (1985): 97–124; and John Ranlett, "'Checking Nature's Deseccration': Late-Victorian Environmental Organization," *Victorian Studies* 26 (1983): 197–222.
16. For a discussion of links between environmental and social order, see Roger Cooter, "The Power of the Body: The Early Nineteenth Century," in *Natural Order: Historical Studies of Scientific Culture*, ed. Barry Barnes and Steven Shapin (Beverly Hills and London: Sage, 1979), 73–92; and Bill Luckin, *Pollution and Control: A Social History of the Thames in the Nineteenth Century* (Bristol: Adam Hilger, 1986), esp. 20–30.
17. Coles, "Smoke Abatement," 336.
18. "The Smoke Abatement Exhibition," *Nature* 25 (5 January 1882): 219–21; *Times* (London), 9 December 1881; John Ranlett, "The Smoke Abatement Exhibition of 1881," *History Today* 31 (November 1981): 10–13; and P. A. Ryan, "Public Health and Voluntary Effort in Nineteenth Century Manchester, with Particular Reference to the Manchester and Salford Sanitary Association," (master's thesis, University of Manchester, [1974]).
19. *Report of the Smoke Abatement Committee, 1882* (London: Smith Elder and Co., 1883), 143; and W. C., "London Fog," 770–71.
20. Galton was president of the Sanitary Institute of Great Britain in 1882. Douglas Galton, "On Some Preventible Causes of Impurity in London Air," paper presented to the Sanitary Institute, 8 July 1880, British Library, 6.
21. National Smoke Abatement Institution, *Smoke Abatement*, 13; "The Fog in Parliament," *Lancet*, 5 January 1889, 35; Ashby and Anderson, *Politics of Clean Air*, 60–63.
22. "Life and Talk in London: Political, Social, and Literary Affairs," *New York Times*, 16 February 1880.
23. *New York Times*, 29 December 1889; see also 3 January 1892.
24. U.S. Senate, *Report from the Secretary of State, and its Accompanying Papers, Concerning the Smoke Abatement Exhibition Which was Held at South Kensington, London, Last Winter*, 47th Cong., 1st sess., 1882, Ex. Doc. 183, 1–5; *Journal of the Western Society of Engineers* 11 (1906): 731. The British also expressed interest in the American effort to follow British activities. To emphasize the importance of the work in which they were engaged, the National Smoke Abatement Institution's 1884 report boasted that "the United States Government, who sent a special Commissioner to the Smoke Abatement Exhibition, and printed his report as a State document, have recently applied for additional copies of the reports and publications of the Institution." National Smoke Abatement Institution, *Smoke Abatement: Report of Council*, 16 July 1884, British Library, 10.

25. For a fuller discussion of the smoke abatement movement in the United States, see David Stradling, *Smokestacks and Progressives: Environmentalists, Engineers, and Air Quality, 1881–1951* (Baltimore: Johns Hopkins University Press, forthcoming). See also the groundbreaking essays of Joel A. Tarr, now collected in one volume, *The Search for the Ultimate Sink: Urban Pollution in Historical Perspective* (Akron, Ohio: University of Akron Press, 1996); and Joel A. Tarr and Carl A. Zimring, “The Struggle for Smoke Control in St. Louis,” in *Common Fields: An Environmental History of St. Louis*, ed. Andrew Hurley (St. Louis: Missouri Historical Society Press, 1997), 199–220.
26. *Proceedings of the Engineers’ Society of Western Pennsylvania* 8 (1892): 31, 44–46. See also Grinder, “From Insurgency to Efficiency.”
27. “Smoke Prevention: Report of the Special Committee on Prevention of Smoke, Presented to Engineers’ Club of St. Louis,” *Journal of the Association of Engineering Societies* 11 (1892): 322–23; “To Stop the Smoke,” *St. Louis Post-Dispatch*, 22 January 1893; Cannon, *Smoke Abatement*, 212.
28. *Industrial World* 41, pt. 2 (1907): 860–61 [indicated as X and XI in the volume]; Elroy McKendree Avery, *A History of Cleveland and its Environs*, vol. 1 (Chicago: Lewis Publishing Company, 1918), 467. Quotation is from an undated and untitled speech which begins, “My Dear Friends,” and probably dates from 1897 or 1898. Charles Fayette Olney Papers, Oberlin College Archives. Some Chicago residents also crusaded against coal smoke largely on aesthetic grounds, but with a narrow goal. In 1891, several civic-minded business elites formed the Society for the Prevention of Smoke and began a campaign designed to protect the White City of the World’s Fair from Chicago’s dense smoke and soot, and not coincidentally, to protect their investments in the fair. The Society lasted only until 1893, just long enough to see the White City become the model for the clean, planned, healthful city of the future. See Christine Meisner Rosen, “Businessmen Against Pollution in Late Nineteenth Century Chicago,” *Business History Review* 69 (1995): 351–97; William F. M. Goss, *Smoke Abatement and Electrification of Railway Terminals in Chicago* (Chicago: Chicago Association of Commerce, 1915), 82–96; and Charles Zueblin, “‘The White City’ and After,” *Chautauquan* 38 (1903): 373–84.
29. Historians have called the linkage between environment and character “positive environmentalism.” See Paul Boyer, *Urban Masses and Moral Order in America* (Cambridge, Mass.: Harvard University Press, 1978), 220–51; and Stanley Schultz, *Constructing Urban Culture* (Philadelphia: Temple University Press, 1989), 112–14. See also R. Dale Grinder, “The Battle for Clean Air: The Smoke Problem in Post-Civil War America,” in Melosi, *Pollution and Reform*, 83–103, esp. 86; and “The Smoke Nuisance,” *Sanitary News* 18 (1891): 129.
30. In 1894, the Minneapolis Improvement League, a small group of middle-class women, began a crusade against smoke in their city. The city council unanimously passed a smoke ordinance the following year, but court challenges prevented prosecution of the law. By the time the state supreme court declared the law constitutional, city officials had apparently lost interest in the cause. More effective action in Minneapolis would wait more than a decade, just as it would in dozens of other American cities. Mrs. David F. Simpson to John O’Connor, [1916?], Smoke Activities Committee Manuscripts, Series 1, Folder 21, University of Pittsburgh.
31. Julius B. Cohen, “The Air of Towns,” in *Annual Report of the Board of Regents of the Smithsonian Institution, 1895* (Washington, D.C.: GPO, 1896), 349–87, esp. 351; and Rollo Russell, “The Atmosphere in Relation to Human Life and Health,” in *Annual*

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- Report of the Board of Regents of the Smithsonian Institution, 1895* (Washington, D.C.: GPO, 1896), 203–348, esp. 290–93.
32. George Brown Goode, ed., *The Smithsonian Institution, 1846–1896: The History of Its First Half Century* (Washington, D.C.: [Smithsonian Institution], 1897), 241–45, 623–26; Helen Waldo Burnside, “The Hodgkins Fund of the Smithsonian Institution,” *Smithsonian Miscellaneous Collections* 45 (1903): 168–74; *Times* (London), 26 April 1893.
 33. J. Milner Fothergill stated this case in blunt terms in 1889, declaring that “town life is seen to have a malignant and sinister effect upon the physique.” Fothergill described inhabitants of cities as “a doomed race” whose descendants would scarcely survive beyond a few generations without “infusions of new blood” from the countryside. Fothergill, *Town Dweller*, 4, 16–17. Another article warned that if a dense fog lasted for a week without interruption, food might be unable to reach the metropolis and a famine of “unutterable misery” would result. “The Reign of Darkness,” *Spectator* 62 (19 January 1889): 85–86.
 34. Reginald Brabazon, “Decay of Bodily Strength in Towns,” *Nineteenth Century* 21 (1887): 673–676. Over one-third of the military recruits who volunteered between 1893 and 1902 failed their induction physical exams. See Wohl, *Endangered Lives*, 332; George F. Shee, “The Deterioration in the National Physique,” *Nineteenth Century* 53 (1903): 797–805, esp. 797; and William Nicholson, *Smoke Abatement: A Manual for the Use of Manufacturers, Inspectors, Medical Officers of Health, Engineers, and Others* (London: Charles Griffin and Co., 1905), 2. On turn-of-the-century concerns linking biological and national decline, see Bernard Semmel, *Imperialism and Social Reform: English Social-Imperial Thought, 1895–1914* (Cambridge, Mass.: Harvard University Press, 1960); G. R. Searle, *The Quest for National Efficiency: A Study in British Politics and Political Thought, 1899–1914* (Oxford: Basil Blackwell, 1971); Bentley B. Gilbert, “Health and Politics: The British Physical Deterioration Report of 1904,” *Bulletin of the History of Medicine* 39 (1965): 143–53; Dorothy Porter, “‘Enemies of the Race’: Biologism, Environmentalism, and Public Health in Edwardian England,” *Victorian Studies* 34 (1991): 159–78; and F. H. A. Aalen, “Lord Meath, City Improvement, and Social Imperialism,” *Planning Perspectives* 4 (1989): 127–52.
 35. Brabazon, “Decay,” 676; William Bousfield, “Smoke in the Manufacturing Districts,” *Art Journal* (1882): 9–10.
 36. L. Sohncke, “The Problem of the Exhaustion of Coal,” *Open Court* 4 (1890): 2389–92, esp. 2391. Despite occasional warnings that Britain’s coal reserves would soon be exhausted, conservation remained a minor concern for most advocates of smoke prevention until after the turn of the century. As the Lancet Analytical Sanitary Commission put it in 1892, the nation’s known supply of coal “is practically as abundant as ever it was, and there is no reason to fear that our resources are likely to fail for years yet to come.” See their “Second Report on Perfect Combustion and Smoke Prevention,” *Lancet*, 5 March 1892, 548–50, esp. 548.
 37. Coal Smoke Abatement Society, *Minutes of a Meeting for the Purpose of Forming a Smoke Abatement Society*, 5 December 1898, NSCA; William Blake Richmond, “The Black City: London Fog and Smoking Chimneys,” *Pall Mall Magazine*, April 1903, 462–73, esp. 463.
 38. Lawrence W. Chubb, “Smoke Abatement,” paper presented to the Institute of Sanitary Engineers, 22 January 1912 (London: Coal Smoke Abatement Society, [1912]), Box 5, NSCA, 9; H. A. Des Voeux, “Ten Years’ Work of Smoke Abatement in London,” [1909], Box 6, NSCA, 3–6; Coal Smoke Abatement Society, *Minute Book* 3, 4 March 1904, 38,

- and 20 May 1904, 86, NSCA; Great Britain, Parliamentary Papers (PP), 1905, Cd. 2347, lxxxv, *Reports on the Laws in Force in Certain Foreign Countries in Regard to the Emission of Smoke from Chimneys*.
39. Charles A. L. Reed, "An Address on the Smoke Problem," paper presented to the Woman's Club of Cincinnati, 24 April 1905, Cincinnati Historical Society. Reed enjoyed national recognition among physicians, serving as president of the American Medical Association and, at the time of his address to the Woman's Club, the chairman of the legislative committee of the A.M.A. Summaries of Reed's speech appeared twice in the organizations's official journal. See *Journal of the American Medical Association* 44 (1905): 1619–20, and 49 (1907): 813. For a brief biography of Reed, see Rev. Charles Goss, *Cincinnati: The Queen City, 1788–1912*, vol. 3 (Cincinnati: S. J. Clarke Publishing Company, 1912), 662–66.
 40. Reed, "Address on the Smoke Problem," 1–4; The Woman's Club of Cincinnati, "Reports of the Department of Civics, 1895–1906," 186, 188; and Woman's Club, "Minutes of the Executive Board, 1902–," 130–31, 136. The Woman's Club's records are held in private in the club's library. See David Stradling, "To Breathe Pure Air: Cincinnati's Smoke Abatement Crusade, 1904–1916," *Queen City Heritage* 55 (1997): 3–18.
 41. Charles Reed, "The Smoke Campaign in Cincinnati," remarks made before the National Association of Stationary Engineers, 10 July 1906; and Smoke Abatement League of Cincinnati, "History of the Anti-Smoke Movement in Cincinnati, Ohio," (The Health Exposition, 1921), both located at the Cincinnati Historical Society.
 42. *New York Times*, 27 April 1905, 5 September 1905; 6 March 1905; 8 March 1905; 15 March 1905; 4 May 1906; 17 May 1906. See also *Industrial World* 41, pt. 2 (1907): 855–57 [indicated as V–VII in the volume].
 43. *Medical Record* 70 (1906): 420.
 44. The league's president was the mayor of Manchester, and among its vice-presidents were the mayor of Salford, the bishop of Manchester, two members of the House of Lords, the editor of the *Manchester Guardian*, and the philanthropist Thomas Coglan Horsfall. See Smoke Abatement League of Great Britain: Manchester & District Branch, *Annual Report* (1913), NSCA, 1, 4–6; Diane Joan Buxton, "The Decline of Air Pollution in Manchester, 1880–1985: A Reinterpretation" (master's thesis, University of Manchester, 1993); and Michael Harrison, "Thomas Coglan Horsfall and 'the Example of Germany,'" *Planning Perspectives* 6 (1991): 297–314, esp. 300.
 45. Fred Scott, "The Administration of the Law Relating to Smoke," [1899?], Box 5, NSCA, 4; and Nicholson, *Smoke Abatement*, 6. On Scott's enormous influence on air pollution reform, see "Mr. Fred Scott," *Manchester Faces and Places* 5 (1893–94): 86–88.
 46. William Charles Popplewell, *The Prevention of Smoke, Combined with the Economical Combustion of Fuel* (London: Scott, Greenwood, and Co., 1901), xviii.
 47. John W. Graham, *The Destruction of Daylight: A Study in the Smoke Problem* (London: George Allen, 1907), 2–3, 55–56.
 48. Smoke Abatement League of Great Britain, *First Annual Report* (1909–1910), Box 5, NSCA, 4; William B. Smith, "The Abatement of Smoke on Two Continents: A British View," *Industrial World* 48 (1914): 15–16.
 49. The Department of Industrial Research soon bore Mellon's name. In 1928, the Mellon Institute separated from the University of Pittsburgh and continued to conduct research in close affiliation with industry. For a good early history of the Mellon Institute, see John W. Servos, "Changing Partners: The Mellon Institute, Private Industry, and the Federal Patron," *Technology and Culture* 35 (1994): 221–57.

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50. *Mellon Institute of Industrial Research Smoke Investigation, Bulletins 1–9* (Pittsburgh, 1913–1914). Together, Benner and O'Connor's works appeared in at least ten different periodicals, including *Science*, *National Municipal Review*, *American City*, *American Architect*, and *Scientific American*. British clean air advocates praised the project and hoped that a similarly comprehensive investigation might be undertaken in their country. See Smoke Abatement League of Great Britain, *Third Annual Report* (1912), C22, Box 5, NSCA, 6–8; and John B. C. Kershaw, "Smoke Abatement in Europe and America," *Nature* 93 (19 March 1914): 69–70.
51. *Pittsburgh Post*, 8 September 1912; A. A. Straub, "Some Engineering Phases of Pittsburgh's Smoke Problem," *Mellon Institute Smoke Investigation Bulletin No. 8* (Pittsburgh: University of Pittsburgh, 1914), 24–25, 85–180; and *Power* 40 (1914): 349.
52. Oskar Klotz and William Charles White, eds., "Papers on the Influence of Smoke on Health." A wide variety of publications carried Ascher's findings, including the *Engineering News* in the United States and the *Journal of the Royal Sanitary Institute* in Britain. See *Engineering News* 58 (1907): 434–35; and *Journal of the Royal Sanitary Institute* 28 (1907): 88–93.
53. Correspondence between Lawrence Chubb and John O'Connor, January–February 1915, Series 1, Folder 2, Mellon Smoke Investigation Activities Manuscripts, University of Pittsburgh Library. O'Connor and Raymond Benner also corresponded with Peter Fyfe, Chief Sanitary Inspector of Glasgow, and John B. Kershaw of Liverpool. See Series 1, Folder 22. For O'Connor's collection of British publications, see Series 4, Folder 4.
54. R. C. Benner, "Smoke Abatement in Pittsburgh," 81–83, and Thomas E. Donnelly, "Smoke Abatement in Chicago," 51–58, in Coal Smoke Abatement Society, *Papers Read at the Smoke Abatement Conferences, March 26, 27 & 28, 1912* ([London]: Coal Smoke Abatement Society, [1912]); "The Smoke Abatement Conference," *Power* 35 (1912): 617–19; and Harold Platt, "Invisible Gases: Smoke, Gender, and the Redefinition of Environmental Policy in Chicago, 1900–1920," *Planning Perspectives* 10 (1995): 67–97.
55. For example, see the Milwaukee ordinance of 1914. Bureau of Smoke Suppression, City of Milwaukee, "Smoke Suppression Ordinances" (1914), Milwaukee Municipal Reference Library, 3–9. Cannon, *Smoke Abatement*, contains the ordinances from dozens of cities, most of them from a slightly later period.
56. Tarr and Zimring, "Struggle for Smoke Control," 204–9.
57. William Nicholson, "Smoke Abatement from the Inspector's Point of View," in Coal Smoke Abatement Society, *Papers Read at the Smoke Abatement Conferences, March 26, 27, & 28, 1912* (London: Coal Smoke Abatement Society, 1912), 76–80. On the search for technological solutions to the smoke problem, see Carlos Flick, "The Movement for Smoke Abatement in 19th-Century Britain," *Technology and Culture* 21 (1980): 29–50. For examples of the growing emphasis on coal conservation after 1900, see Arthur John Martin, "Coal Conservation, Power Transmission, and Smoke Prevention," paper presented on 28 March 1906, *Journal of the Society of Arts* 54 (1906): 531–53; Graham, *Destruction of Daylight*, 134–35; and John W. Cobb, "Coal Conservation," *Edinburgh Review* 229 (1919): 39–61.
58. John B. C. Kershaw, "Notes on Recent Progress in the Campaign Against Black Smoke in this Country," in Coal Smoke Abatement Society, *Papers Read at the Smoke Abatement Conferences, March 26, 27 & 28, 1912* ([London]: Coal Smoke Abatement Society, [1912]), 68–75.

59. William B. Smith, "Should the Domestic Smoke Nuisance Be Any Longer Tolerated?" in Coal Smoke Abatement Society, *Papers Read at the Smoke Abatement Conferences, March 26, 27 & 28, 1912* ([London]: Coal Smoke Abatement Society, [1912]), 62–67. Many municipalities discouraged people from adopting cleaner sources of energy by using gas and electricity revenues to "relieve the rates." On the practice of using gas profits to reduce local taxes, see Robert Millward, "The Market Behaviour of Local Utilities in Pre-World War I Britain: The Case of Gas," *Economic History Review* 44 (1991): 102–27.
60. A bill introduced to parliament in 1913 would have given regional and national governmental bodies greater authority to regulate smoke when local authorities failed to act. In London, enforcement would have become the direct responsibility of the London County Council; elsewhere the Local Government Board would have gained power "to set up local smoke abatement authorities" as needed. As had happened with many previous attempts to strengthen smoke enforcement, this bill failed to win enough support to become law. Great Britain, PP, 1913 (136) v, *A Bill to Provide for the Abatement of Smoke*.
61. *Pittsburgh Gazette Times*, 10 September 1913; 13 September 1913.
62. *Nature* 93 (14 May 1914): 274; and Smoke Abatement League of Great Britain, *Fourth Report (1913-1914)*, Box 5, NSCA, 6. The British government's smoke committee reconvened after the war. In a 1920 report, it concluded that the bulk of Britain's smoke came from domestic rather than industrial sources and suggested requiring smokeless heating system in all future government-sponsored housing projects. Reflecting a strong faith that technology would solve the smoke problem, the committee concluded by urging the government to "encourage the co-ordination and extension of research into domestic heating generally." Great Britain, PP, 1920, Cmd. 755, xxv, *Interim Report of the Committee on Smoke and Noxious Vapours Abatement*.
63. Osborn Monnett, "Smoke Abatement," *Bureau of Mines Technical Paper* 273 (1923): 1. See also Philadelphia *Annual Reports* (1917), 1: 299, and (1918), 1:283, Philadelphia Public Library; and "Pittsburgh Smoke Regulation in 1918," *Power* 49 (1919): 469.
64. World War I forged strong new connections between government and science in both countries. In Britain, the Department of Scientific and Industrial Research, itself a product of the war, continued this linkage into peacetime. Its Fuel Research Board quickly emerged as a dominant sponsor of research into coal smoke and clearinghouse for information on the subject. Its findings appeared in a series of technical papers during the 1920s. See, for example, Margaret White Fishenden, *The Efficiency of Low Temperature Coke in Domestic Appliances* (London: HMSO, 1921); and Roy M. MacLeod and E. Kay Andrews, "The Origins of the D.S.I.R.: Reflections on Ideas and Men, 1915–1916," *Public Administration* 48 (1970): 23–48. In 1924, an internal document from the British Medical Association's Public Health Committee noted that the Smoke Abatement League had been "completely shattered by the activities of the war" and had not resumed meeting until 1923. Minute 14, 22 October 1924, SA/BMA/F.39, Contemporary Medical Archives Centre, Wellcome Institute for the History of Medicine, London.