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Domestic Storage Problems and Transitions: Coal in Nineteenth-Century America

Nothing warms a cold, damp room better than anthracite coal. Because of its high carbon content and lack of impurities, anthracite or "stone" coal, as it is sometimes called, produces an intense heat and—as an added bonus for the homeowner—very little soot and smoke. It is no wonder that nineteenth-century Americans in growing cities came to rely on anthracite as an essential heating fuel. Nearly all of the anthracite coal deposits in the United States lay upriver from urban centers such as Philadelphia, and transportation firms, such as the Schuylkill Navigation Company and the Lehigh Coal and Navigation Company, sought to grow markets for mineral coal there in the decades following the War of 1812. As stone coal offered more heat for its weight and better enabled the use of fuel-efficient stoves or fireplace grates, it seemed to be the best solution for the heating-fuel crises that plagued early American cities. Engineers, entrepreneurs, public officials, and even philanthropists enlisted in an effective campaign to promote mineral fuel. Philadelphia served as ground zero for this transformation, but eventually cities such as Boston and New York realized the value of anthracite. By 1860, historian Christopher Jones estimates, about 90 percent of homes in the American North used stoves for heating, and an overwhelming number of those stoves burned anthracite coal for heat.[1]

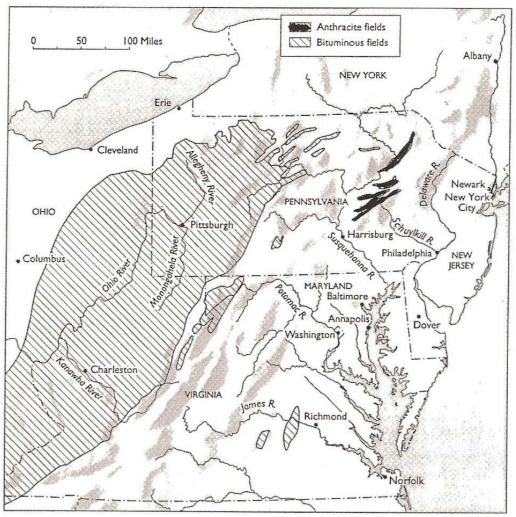

Figure 1:
Map of coalfields in the Eastern US. The dense anthracite fields of Eastern Pennsylvania were in close proximity to the large cities of New York and Philadelphia. Map by author.

1 Christopher Jones, *Routes of Power: Energy and Modern America* (Cambridge, MA: Harvard University Press, 2014), 62.

An Uneven Transition

This transition, however, was far from instantaneous and it depended a great deal on the consumer's ability to invest in it. Affluence also dictated the pace and effectiveness of the conversion from organic to mineral heating fuel for the home. Philadelphia's households of means had the luxury of testing various systems: perhaps installing a fireplace grate in one room, buying a coal stove for another, while retaining a traditional fireplace for burning firewood in yet another. This "hybridization" of home heating sources was common for large urban households, many of which preferred open fireplaces (with their aesthetically pleasing roaring wood fires) in common rooms, while warming functional areas with more efficient coal stoves.[2]

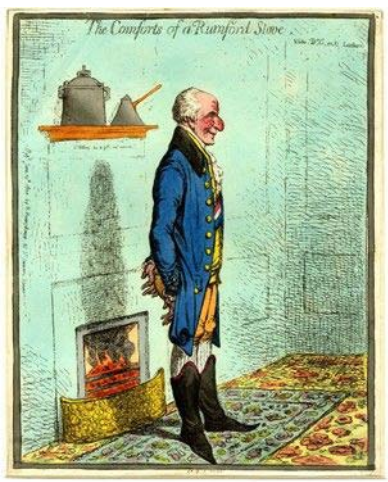

Figure 2: "The Comforts of a Rumford Stove" by James Gillray (1800). Wealthy households retained open fireplaces like this Rumford Stove for aesthetic purposes, but used coal furnaces and stoves to heat their homes more efficiently. Courtesy of the British Museum (CC BY-NC-SA 4.0).

But the vast majority of Philadelphia's working poor could not repeat this pattern of fuel consumption. Comfort was not the main concern; keeping warm during the winter was more an issue of survival for them. Whereas wealthy Philadelphians might measure their weekly consumption of heating fuel in dollars, one contemporary estimated that the average seamstress in Philadelphia budgeted only about 15 cents a week in 1833. More importantly, less affluent consumers often lacked the cash and storage space to "lay up" their fuel, so they tended to purchase it in small amounts: by the half-bushel or even less. "If poor people could only realize what an advantage it would be to purchase coal in the summer, and their summer goods in winter, availing themselves of the seasons when they are selling cheap," one 1856 proscriptive short story opined, "they certainly would, I think, make greater efforts to do so."[3] But all the realization in the world could not provide space in which to store coal over a long winter season; nor could it provide the ready cash to purchase four or five tons of coal at one time. Both economic and

2 Frederick M. Binder, "Anthracite Enters the American Home," *Pennsylvania Magazine of History and Biography* 82 (1958): 82–99.
3 Emma Carra, "Laying in the Winter's Coal," *Ballou's Dollar Monthly Magazine*, 4 July 1956.

spatial restrictions therefore delayed the implementation of mineral fuels in all urban hearths, even as coal clearly represented the future of home heating by the time of the Civil War.[4]

The Challenge of Providing Heat on Demand

Coal-storage methods in America's anthracite-burning cities remained imperfect. Some urban residents dug "coal holes" in the street for storage. In 1855, however, city officials in Boston considered coal holes a nuisance, as they tended to collect pedestrians as well as mineral fuel. An 1863 ordinance in Boston required them to be covered "with a 'substantial iron plate,'" and the legislated maximum depth of 11 feet suggests this was no idle threat to passers-by. Other methods made coal holes look sophisticated. In 1877 New York's *Saward's Coal Trade Journal* criticized "the ordinary custom of dumping the coal upon the sidewalk" as a "most unhandy and unclean arrangement."[5] In order to remedy this problem, the editors recommended that coal be delivered in two-hundred-pound bags (of which ten would make a ton), which they said would be cleaner. In London, coal was already being delivered in one-hundred-pound bags to poorer customers. Spatial concerns about the storage of mineral fuel reinforced the division between affluent and poor consumers; the former could still afford roomy coal cellars or coal holes in which they stored fuel, while the latter depended upon smaller purchases, usually secured on unfavorable terms.[6]

Spatial constraints frustrated the equitable use of anthracite coal in American cities. An 1870 study of working-class households found that an average Boston model tenement house had 20 compartments for wood or coal fuel in the basement, but that most other buildings lacked adequate space for their renters to store heating fuel. Inspectors from the Massachusetts Bureau of Labor Statistics reported that coal was kept in closets, cupboards, or under the stairs—all of these locations suggest that only a small amount of coal could be stored. One worker told inspectors that only "one in ten can

4 Mathew Carey, *An Appeal to the Wealthy of the Land, Ladies as Well as Gentlemen, on the Character, Conduct, Situation, and Prospects of Those Whose Sole Dependence for Subsistence Is on the Labour of their Hands* (Philadelphia, PA: L. Johnson, 1833); Carra, "Laying in the Winter's Coal," 21.

5 *Saward's Coal Trade Journal* 13, no. 2, (January 1877).

6 City of Boston, *Ordered That the Chief of Police Be Directed to Notify All Owners or Occupants of Coal Holes* (Boston, MA: 1855), n.p.; City of Boston, *Rules and Regulations in Relation to Coal-Holes, Vaults, &c. Under the Sidewalks* (Boston, MA: 1863) n.p.; *Saward's Trade Journal.*

put in a winter's [worth of] coal"[7] ahead of the season. Moreover, once Boston's harbor froze up, dealers demanded payment in advance. Poor consumers there bought coal by the "peck," an informal measure of about 20 pounds. Unlike the more economical practice of purchasing coal by the ton once per season, small-scale purchase drove the price up for those who could least afford it. A Massachusetts survey of 1870 estimated that coal secured in this fashion cost about 18 dollars a ton—about a fourfold increase in the price charged for larger purchases. Despite moves to reform urban housing in postwar decades, the improvement of heating systems found only rare mention. More often than not, renters were left to decide whether to use a stove, grate, or fireplace, and where they could purchase and store their fuel. As late as 1889, Boston's city code ruled that every tenement building "shall have adequate chimneys running through every floor, with an open fireplace or grate, or place for a stove," along with the facilities to collect noncombustible waste.[8]

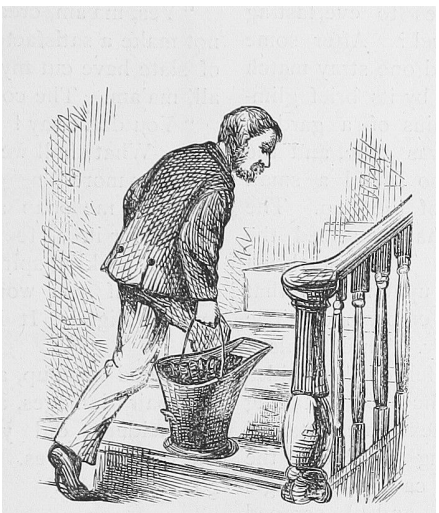

Figure 3: Affluent households could lay in a season's supply of coal in a basement and then use coal hods to provide fuel. Poorer residents stored their fuel wherever they could, or used it at the same time as purchase. Source: Charles Barnard, "From Hod to Mine. In Seven Lifts," *American Homes Magazine*, 1874.

As has always been true of heating homes with coal, the solution to negotiating the system was spatial: large stores of coal purchased cheaply in warm summer months could last throughout the winter. This might seem obvious—of course the wealthy were able to negotiate consumer markets with more ease—but consider the ways in which home-heating markets were shaped by these spatial limitations. Although coal dealers suffered the immediate brunt of consumer anger, they really only represented one component of an immensely complex energy delivery system that linked far-flung mining communities via rail and canal to urban distribution centers. Any disruption in this network could have dire effects on millions of Americans, many of whom lacked the capacity to store energy for more than a few days at a time. This "just in time" en-

7 *Report of the Massachusetts Bureau of Statistics of Labor* (Boston, MA: Wright & Potter, 1870).
8 *Massachusetts Bureau of Statistics*, 173, 176, 179, 246, 272; Associated Charities of Boston, *Laws Applying to Tenements in the City of Boston* (Boston, MA: Associated Charities of Boston, 1889), 9.

ergy flow kept wholesale prices low and discouraged oligopolistic positions in energy markets by creating a national system of energy production; if one coal region went "offline," another could make up the difference in supply. But this network could not adapt when fuel consumption swelled at the same time that labor troubles simultaneously hit the bituminous and anthracite fields. Pennsylvania alone witnessed more than eight hundred strikes in its coal fields from 1881 to 1886.[9]

Famines, Strikes, and Energy Flows

The rise of a particularly urban phenomenon in the era of labor unrest in the coalfields—the "coal famine"—reflected the vulnerabilities of this national network of fuel production in serving urban populations. In February 1871, a series of labor disputes panicked New Yorkers; 1.5 million residents had an estimated two-week supply of coal on hand in their city. "At the very season of the year when Winter sheds it icy coat, and the chill, damp winds and mists of Spring succeed—just when we need the artificial heat to temper the unfriendly atmosphere of wind and storm," *The New York Times* reported, "we are threatened with this kind of famine." When more labor troubles threatened the flow of coal in April 1875, panicked consumers rushed to the "bucket and scuttle" trade of the "small-fry groceries." In the process, they paid outrageously high prices for small parcels of coal, or simply did without. These occurrences played out across Gilded-Age America, and although most strikes were short lived, the dreadful prospects of an energy crisis never quite abated.[10]

The problem of how to provide heat on demand was not really solved until the gradual implementation of electric and gas heaters over the half century following the Second World War. There were problems, of course, with this new system of burning fossil fuels for heat; but generally, the networked city of the twentieth century solved the nineteenth-century issue of coal storage, at least in areas where natural gas or electricity could replace stoves. These networks grew in both size and scale, slowly replacing the need for coal cellars and regular fuel deliveries in the decades following the First

9 Andrew Arnold, *Fueling the Gilded Age: Railroads, Miners, and Disorder in the Pennsylvania Coal Country* (New York: New York University Press, 2014), 87; Sam H. Schurr and Bruce C. Netschert, *Energy in the American Economy, 1850–1975: An Economic Study of Its History and Prospects* (Baltimore, MD: Johns Hopkins University Press, 1960), 36–37.

10 *The New York Times*, 25 February 1871; The New York Times, 1 May 1875.

World War. Although early adopters of natural-gas heating drew upon local reserves, the completion of interstate pipelines such as the Second World War's Big Inch and Little Big Inch—each stretching over one thousand miles to link the gas fields of Texas and Oklahoma to the East Coast—mirrored the expanded, national system of coal distribution, even as natural gas or heating oil offered a more cost-effective solution to home heating. In fact, Philadelphia, the same city that benefited the most from the production and consumption of anthracite coal in the nineteenth century, became dependent upon natural gas piped in from the American Southwest in order to heat its homes in the 1950s.[11]

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Why is the story of nineteenth-century energy storage significant? It forces us to think about the wider implications of an energy transition and provides an object lesson for how a small-scale problem—the spatial limitations of urban housing—could create vulnerabilities in a national system of energy distribution. Today's home-heating networks provoke different anxieties. Now, we worry more about the impacts of burning coal on global climate change, the environmental impact of natural-gas pipelines, and the continued reliance upon fossil fuels in keeping us warm during the winter. Just as in the original transition to mineral fuel, making the break to a new regime will prove difficult. In 2015, for example, Tesla's CEO Elon Musk promoted one potential solution with a system of wall-mounted lithium-ion batteries, called the Tesla Powerwall, to take individual homes off the grid and allow them to be self-sufficient providers of energy. Like the "boosters" of anthracite coal in the Early American Republic, Musk engaged in some criticism of the current energy regime. "It sucks, exactly," Musk has said of fossil fuel emissions and climate change. "I think we, collectively, should do something about this," he added, "for us and a lot of other creatures." Rebilling itself as an "energy innovation company" rather than an automotive one, Tesla hopes to replace the networked home with an energy-independent one.[12]

11 Nicholas Wainwright, *History of the Philadelphia Electric Company* (Philadelphia, PA: Philadelphia Electric Company, 1961), 320.

12 Benjamin Hulac, "Tesla's Elon Musk Unveils Solar Batteries for Homes and Small Businesses," *ClimateWire*, 1 May 2015, https://www.scientificamerican.com/article/tesla-s-elon-musk-unveils-solar-batteries-for-homes-and-small-businesses/.

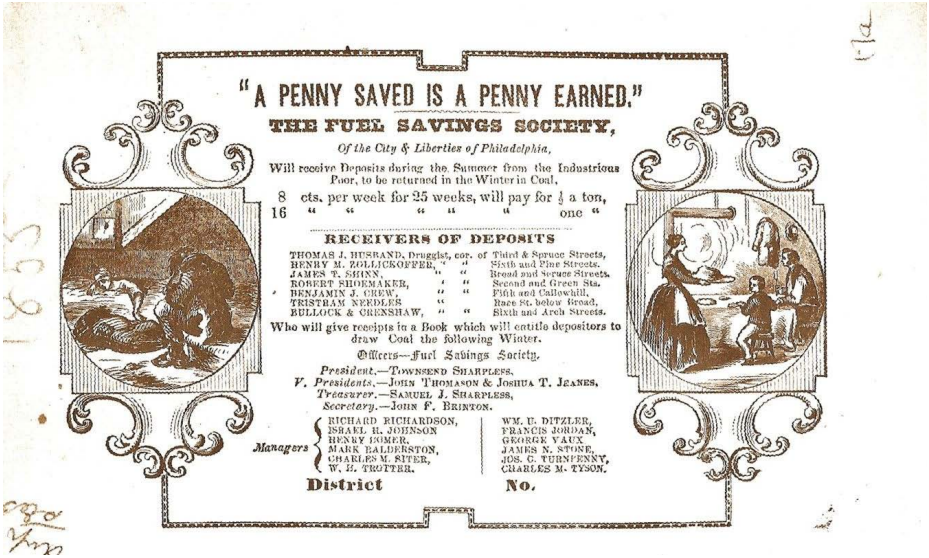

Figure 4: Philadelphians attempted to remedy fuel disparities through charitable institutions. This frontispiece of the 1855 Annual Report of the Fuel Savings Society highlights the gap in home heating between poor and affluent households. Courtesy of the Library Company of Philadelphia.

If the historical experience of home heating teaches us anything, though, it is that energy transitions among consumers is a sticky, uneven process. Cultural preferences for open fireplaces, imperfect knowledge about anthracite coal ignition, and early disruptions in the trade all delayed the implementation of a coal-stove regime in early American cities. Once anthracite was king in home-heating markets, the challenges of fuel storage ensured that its reign benefited only wealthy consumers. Put simply, the process of replacing one household technological system with another—even with the straightforward task of warming air—can take decades to accomplish. And once in place, there is no guarantee that the new system will not bring unique problems of its own. What will be the lithium battery's version of ash and soot, storage space problems, or "coal famines"? Only time will tell.

Even today, the difficulties of household energy transitions are apparent. A crisis in Australia offers an example of this, where political and economic factors have complicated that nation's plan to wean itself off coal-fired electric plants. One might think that this is the moment for Tesla to demonstrate the value of its battery-powered substitute. But while batteries offer a fast solution to the immediate problem, coal is still cheaper in Australia than either natural gas or renewable energy forms, such as wind or solar power. Consumer resistance to higher utility bills, as well as the politician's

allergic reaction to promoting them, have derailed Tesla's plan to provoke revolutionary change. "Forging enough common ground with the various stakeholders will be the main obstacle," columnist Clyde Russell argued of Tesla's plan, "but more than anything else, Australia is showing how difficult it is to end the age of coal." The story of the United States over the course of the nineteenth century demonstrates not only how difficult it was to usher in that age, but also the unintended consequences of its arrival.[13]

Further Reading

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13 Clyde Russell, "Why Elon Musk's Offer of Tesla Batteries Won't Solve Australia's Power Problems," *Reuters*, 14 March 2017, http://fortune.com/2017/03/14/elon-musk-tesla-batteries-australia/.