

Unit title: How Coal Changed Philadelphia: 1820-1865

Abstract: This unit explains how coal and industrialization changed the landscape, institutions, social structure and ideology of antebellum Philadelphia. I focus on five locations in the city: Stop 1 is the Schuylkill Canal with a focus on the transition from a colonial (organic) to an industrial (mineral) economy. Stop 2 is on the textile mills of Manayunk, where coal led to changes in labor, immigration and race. Stop 3 is on the Fairmount Water Works and how its history connects to industrial pollution in the Schuylkill River. Stop 4 is on the Port Richmond Coal Wharves and on the industries fueled by its coal. Stop 5 is about Blockley Almshouse, and here the focus is on attitudes towards the poor, and how institutions of reform connected to industrialization.

Keywords: Coal, industrialization, mineral energy, textile mills, whiteness, nativism, antebellum Philadelphia, ironworking, locomotives, steamships, water pollution, social reform, poverty.

Click this link: <https://www.philageohistory.org/tiles/viewer/?SelectedLayers=Overlay,SMD1860>

The curriculum is built around this map. Take a second to zoom in and out.

There is a slideshow that goes with this unit: [https://docs.google.com/presentation/d/1uOETA-20HV3mrAnKXpc1fOm\\_uglmK0w8VAY5al8csY0/edit?usp=sharing](https://docs.google.com/presentation/d/1uOETA-20HV3mrAnKXpc1fOm_uglmK0w8VAY5al8csY0/edit?usp=sharing)

### Introduction and Overview

In 1820, the Lehigh Canal connected Philadelphia to the rich anthracite fields of the Lehigh Valley. In 1825, the Schuylkill Canal gave the city a second coal highway, this one to the mines of the Schuylkill Valley. By the 1840's, railroads were also serving the city, carrying all cargos and passengers, but mostly countless trainloads of coal. Consumption of coal rose exponentially from 910,000 tons in 1840 to 3,700,000 tons in 1850, to 9,200,000 tons in 1860, to 11,000,000 in 1865.<sup>1</sup> By 1913, consumption reached the staggering sum of 80,000,000 tons per year.<sup>2</sup>

Coal did not just fuel the machines and heat the homes of antebellum Philadelphia. It created a world, touching nearly every aspect of city life. Work, technology, race, immigration, public institutions, transportation, and pollution are just some parts of life that antebellum Philadelphians experienced differently from their ancestors because of coal.

The goal of this curriculum is help students understand the world that coal made. Using an interactive map of the city from 1862,<sup>3</sup> the teacher will walk them through old Philadelphia, stopping at a variety of buildings connected in some way to coal.

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<sup>1</sup> <https://philadelphiaencyclopedia.org/essays/coal/>

<sup>2</sup> Towne, Shari. A River Again: The Story of the Schuylkill River Project. Bristol, PA: Delaware Riverkeeper Network, 2012, p. 17.

<sup>3</sup> <https://www.philageohistory.org/tiles/viewer/?SelectedLayers=Overlay,SMD1860>

There are five stops on this virtual 'tour.' First stop is the Schuylkill Canal, where students learn how wood scarcity in colonial Philadelphia led to a transport infrastructure for anthracite coal, and how boosters taught the city to use this new fuel. Second stop is the textile mills of Manayunk, where students learn how industrialization created a whole new social class, the factory wage earner, and how these new ways of work worsened racial prejudice and xenophobia. Third stop is the Fairmount Water Works, where students learn about the losing struggle between the city and the pollutants released by its industries. Fourth stop is the Port Richmond Coal Wharves, where the goal is for students to understand a wide array of industrial processes fueled by coal, such as iron smelting, soap making, and ship building. The Fifth and final stop is the Blockley Almshouse, where the destitute and the insane sought help, a place that reveals a city unable to comprehend, much less remedy, the social consequences of its industrialization. Although each stop tells a part of a larger picture, teachers are encouraged to leave out stops if the whole tour is too long.

Using the interactive map will be fun for your students. The map is an overlay on a current google map, so kids can drag the 'pegman' and lay it over any section of the map, and see what structures stand there today. One click and the viewer exits the current street view and is back on the old map. Students will be curious about the details of the structures that used to stand there, and for this I provide a google slides presentation (see link above) which matches the five-part structure of the tour. Teachers are encouraged to read a content section, check the accompanying images in the slide show, and then examine the lesson plan for that 'stop'.

Here is a summary of the curriculum, by theme: Stop 1 is historical, on the transition from a colonial (organic) to an industrial (mineral) economy. Stop 2 focuses on labor, immigration and race. Stop 3 is about pollution. Stop 4 is on technology and industrial growth. Stop 5 is about social institutions, community values and mutual aid.

Students in Philadelphia will especially benefit from this curriculum since it will give them a stronger understanding of city geography and history. But kids from other places will also get a lot from the tour. A study of Philadelphia's industrial growth will help kids grasp similar patterns that unfolded in all the main cities of the Atlantic coast, from Baltimore to Boston. Every year, thousands of visitors come to Philadelphia to see Independence Hall and the Liberty Bell, celebrating our Revolution and the republic it created. But Philadelphia is not just the cradle of our democracy. It is the birthplace of America's industrial revolution, and so it is the beginning of all the great achievements and great problems that industrialization caused. Students will finish this curriculum, it is hoped, with a better understanding of the promise and perils of an economy based on abundant carbon energy.

I teach both Science and Social Studies at Alexander Adaire Elementary, a public school in the Fishtown section of Philadelphia. This curriculum was conceived with my 8<sup>th</sup> graders as its target audience, though I believe it will function very well for high school students as well. My students are typical Philadelphia kids, scoring about 20% below the state average in math, reading and science.

## Unit Content

### Stop 1: The Schuylkill Canal

Pennsylvania's rise to industrial might began with an energy crisis. Wood, which had seemed inexhaustibly plentiful to earlier generations of colonists, became scarce and expensive by time of the Revolution. The root cause of this scarcity was the colony's successful expansion and economic diversification.

Religious tolerance combined with light taxation made Pennsylvania the destination of choice for a large share of European immigrants. By 1780, of the 13 colonies only Virginia had a higher population.<sup>4</sup> Philadelphia had long been a busy port, exporting food and forest products to Europe and the Caribbean, but in the mid 18<sup>th</sup> century its economy took its first steps towards industrialization. Ample supplies of wood, which could be burned to make charcoal, led to a growing iron industry in the city. By the time of the Revolution, Pennsylvania had become the colonial leader in iron production.<sup>5</sup>

Population and industrial growth meant increased need for wood, and by the 1760's Philadelphia was pushing the limits of available supply. This was especially true in the winter when frozen waterways prevented the transport of firewood by boat. Persons of means could stock up in the warmer months, if they had the room to store it,<sup>6</sup> but the poor had no such room, nor the money to buy wood even if they had. In the winter they simply froze. In the 1760's, the Quaker community formed a committee to alleviate the sufferings of the poor, providing food, blankets and firewood. But private philanthropy could not solve a problem of this size, and the perennially strapped government of the colony did not even bother to try.

The outbreak of war made wood even scarcer. Supplies of wood had already been strained before the war, but wartime disruptions made matters worse, pushing prices so high that even a comparatively well-off John Adams was moved to complain bitterly to his friend, James Warren. Adams had no trouble paying for food and lodging, but when he tried to buy wood he found himself "lost in an ocean of expence," forced to choose between horse feed, "liquor" and a "spark of light or fire."<sup>7</sup> Wood, noted Adams, cost \$20 per cord, a staggering sum compared to the average annual colonial income at that time.<sup>8</sup> If a man of wealth like Adams fared badly, the situation of the poor must have been dire indeed. In January of 1777, Philadelphian James Tilghman appealed to the Continental Congress, begging them to prevent soldiers from chopping down trees on city commons, trees which had been expressly reserved for relief of the poor. Getting no response, Tilghman spoke to the general in charge of the woodcutters, advising him of the fact that wood from the commons was dedicated to charitable

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<sup>4</sup> <https://web.viu.ca/davies/H320/population.colonies.htm>

<sup>5</sup> Silvester, Steven K. "A Century of Industry in Pennsylvania." *Journal of Mid-Atlantic Studies*, Vol. 22, No. 1. 1955.

<sup>6</sup> A cord is 4x4x8 feet. A typical family would consume about 40 cords per year, half of which was burned in the colder months. To store wood for the winter thus required about 2500 cubic feet of secure storage space.

<https://chrisstevensonauthor.com/2016/01/24/how-much-firewood-did-colonial-americans-use/>

<sup>7</sup> Letter from John Adams to James Warren, quoted in: Foley, Thomas. *An Odious Aristocracy: Energy, Politics and the Roots of Industrial Capitalism in 19<sup>th</sup> Century Pennsylvania*. Unpublished Dissertation submitted to the faculty of Georgetown University, 2019, p. 52.

<sup>8</sup> Lindert, Peter. "American Colonial Incomes." *Economic History Review*, March 2015. Lindert puts the average colonial income at roughly \$278 per year. If a cord of wood cost \$20, the twenty cords a family would need to get through the winter would cost \$400, more than the family could afford even if wood were their only expense.

use. The general responded with dark humor, remarking that “he would give no opposition to the Charity, but that he must have wood cut for the Soldiery.”<sup>9</sup>

The situation grew more dire when the British occupied Philadelphia in October of 1777. With little concern for Philadelphia’s ordinary citizens, much less her desperate poor, British soldiers stripped the woodlots bare, with not even the saplings spared. Since trees take about 20 years to reach maturity, the evacuation of the British in June of 1778 did little to increase wood supply. In the winter of 1778, firewood prices rose so high that the Library Company of Philadelphia had to “limit their borrowing hours to only Wednesdays and Sundays from 2 to 8 in the evening throughout the winter months.” In 1791, with great reluctance, the University of Pennsylvania began to charge a fee for firewood in addition to tuition, an expense that caused a reduction its student body, and in the pay of the teachers who directly depended on student tuitions for their own income.<sup>10</sup>

Outside of the city, farmers avoided wood scarcity by pacing their consumption with the replenishment rate of their woodlots. An acre of forest yielded the 40 cords of wood needed for the year, and since trees took 20 years to grow to maturity, a farmer needed 20 acres for a rotation system to ensure a steady supply. Urban residents had no woodlots to manage, and so were forced to rely upon the market for their supply of wood. The market, however, was constrained by the inherent limits of the organic energy regime.

In an organic energy regime, human societies live within a budget set by the total amount of available solar energy. Most of this energy is stored in biomass through photosynthesis and is then converted into work by combustion, mainly in the metabolic processes of workers or farm animals, but also by the burning of wood to create heat or mechanical power. Some energy enters the ecosystem through falling water or wind, but both count as solar inputs: wind arises from differential heating due to variations in sunlight intensity, while falling water expends energy obtained from solar powered evaporation.

The amount of energy available within an organic regime is limited by time and space. An acre can yield a limited quantity of energy per year. If more energy is desired, production on that acre cannot be accelerated. Rather, one must find and harvest a new acre. Rising demand must therefore be satisfied by spatial expansion, which in turn raises transportation costs. Water transport lowers these costs but cannot solve the problem of getting the resource to and from the water’s edge. Wood was heavy and bulky, hard to load and unload from carts, and taxing to move over rough roads. All this raised its cost, which would double approximately every 3 miles of road transport.<sup>11</sup> Thus, it was not the total amount of wood in the region that constrained Philadelphia’s wood supplies, but rather the difficulty of getting that wood to urban markets at a price that city dwellers could afford.

The organic regime is inherently dispersive. It works against concentrations of population or industries by progressively raising the price of energy as demand increases. Meeting this demand means greater transport costs, and a linear increase in price means a linear decrease in the percentage of the population able to pay it. Philadelphia’s commercial wealth (in the late 18th century it was America’s

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<sup>9</sup> Foley, Thomas. *An Odious Aristocracy: Energy, Politics and the Roots of Industrial Capitalism in 19<sup>th</sup> Century Pennsylvania*. Unpublished Dissertation submitted to the faculty of Georgetown University, 2019, p. 50.

<sup>10</sup> *An Odious Aristocracy*, p. 33-42.

<sup>11</sup> Jones, Christopher. *Routes of Power*. Cambridge: Harvard University Press, 2016, p. 16.

busiest port) allowed many of its citizens to bear these inflationary pressures but in the decades after the Revolution, a moment of crisis had clearly been reached. If the middle and working classes could not stay warm and the forges could not stay lit, the city's population and industries would have to move out.

If the invisible hand of the market could not alleviate scarcity, could government solve the problem? The lessons of English history in the 15th-17th centuries were discouraging. Faced with the same problems of deforestation and population growth, England tried and failed to manage its consumption of wood. Harsh penalties for wood thieves proved to be ineffective deterrents. A steady increase in demand for wood for residential construction, heating, and industrial uses created an irresistible profit motive toward deforestation.<sup>12</sup> By the 17th century, English cities had run out of wood and were choking in the smoke of sulfurous coal, their only alternative fuel. Their houses were being built with waney, crooked timbers that an American carpenter would have thrown on the fire.<sup>13</sup> Wood for its navy and for its iron furnaces (sulfurous coal made iron brittle) had to be imported, at great cost, from the Baltic. The establishment of American colonies opened new sources of wood, giving England temporary relief from wood scarcity. But in the absence of effective resource management, it was inevitable that the colonies would repeat England's self-destructive pattern, and not only cease to meet England's forestry needs, but also their own.

Effective regulation was not an option for Pennsylvania any more than it had been for England. Accustomed to low taxation and deeply suspicious of any state involvement in their affairs, Pennsylvanians would have bitterly resented the application of state power to the management of their forests.<sup>14</sup> Such management would have required new laws, a new bureaucracy, new police, new taxes, and the intrusion of the state into a large economic sector which had never been regulated. It would have smelled like English mercantilism, which it would resemble in its coercive aspects, and Pennsylvanians had just fought a Revolution to escape such compulsion.<sup>15</sup> In these conditions it did not matter that rational forest management would have made everyone better off. It was impossible to achieve within the early Commonwealth's ideological and cultural limits.

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<sup>12</sup> "Great quantities of lumber were required for the construction of the growing number of ships and horse drawn vehicles needed to transport people and goods across water and land. Moreover, although there was some reforestation during the 17th century, more and more forest was being cleared for farms and pastures while smaller areas were being cleared for the growing metallurgical industries and for the expansion of mining, particularly of coal mining. Britain's forests simply could not keep up with the island's demand for wood." Nef, John. "An Early Energy Crisis and its Consequences." Scientific American, Vol. 237, No. 5 (November 1977), pp. 140-151.

<sup>13</sup> Benson, Ted. The Timber Framed Home. The Taunton Press, 1997, p. 9.

<sup>14</sup> Fred Anderson and Andrew Cayton observe a "politically feral quality" in colonial Pennsylvania, a place that "required no military service and levied next to no taxes," which had the effect of rendering its citizens not so much grateful as ungovernable. The Dominion of War. Penguin Books, 2005, p. 79.

<sup>15</sup> "Neither resistance nor rhetoric would have amounted to independence absent the underlying growth of the colonial economy. It was this that prompted the colonists to break free from the restrictions of the Navigation Acts and the laws prohibiting colonial manufactures." Staughton Lynd and David Waldstreicher. "Free Trade, Sovereignty, and Slavery: Toward an Economic Interpretation of American Independence." William and Mary Quarterly, Vol. 68, No. 4 (October 2011), p. 630.

Wood scarcity drove a wave of efficiency improvements in stoves and furnaces, most notably the famous Franklin stove,<sup>16</sup> but none of these improvements could solve the problem of insufficient energy supply. Like England, Pennsylvania would have no choice but to turn to coal. But in the first two decades of the 19<sup>th</sup> century, usage of coal increased at a very slow rate. Transported by ship from Virginia or England, coal was an expensive fuel. This, in addition to the foul, sulfurous fumes it emitted when burned, made it the fuel of necessity rather than preference.

Rich veins of anthracite<sup>17</sup> lay less than a hundred miles from Philadelphia, but there was little interest in using this source of fuel. Early attempts to convince Philadelphians to burn anthracite had not proved promising. In 1820, the first boat load of anthracite floated down the Lehigh River to its juncture with the Delaware, and then docked at the wharves of Philadelphia. So little interest was shown in its cargo that the unfortunate boatmen were forced to break up their craft and sell the lumber to recoup their costs.<sup>18</sup>

By 1860, Philadelphia's annual consumption of anthracite would exceed three million tons per year. By 1913, annual extraction from the anthracite fields (serving Philadelphia and other markets) exceeded eighty million tons per year.<sup>19</sup> What explains this vast change? Three factors had limited the consumption of anthracite: it was hard to burn, hard to get,<sup>20</sup> and no one knew that it offered any advantage over English or Virginian coal. Thus, three changes explain the enormous growth in Philadelphia's use of anthracite. Inventors found new technologies for burning the coal, new transport links (canals) were built to inexpensively move the coal, and boosters were able to convince customers to adopt the new fuel.

No one knows who figured out the secret of how to use anthracite coal. Some sources credit the breakthrough to Jesse Fell, a tavern owner in Wilkes-Barre.<sup>21</sup> Fell may have figured out how to burn anthracite, but he did not apply this knowledge to an industrial process. Josiah White made this crucial step when he showed how to burn anthracite to heat wrought iron for processing into wire. The secret was to create a flow of air through the coal, which meant that the coal could not simply sit on a metal plate and heat a vessel above it. Air had to be drawn from under the coal in order maintain sufficient oxygen for combustion. Anthracite is very low in sulfur, which made it suitable for ironwork, and once ignited, burns at a higher temperature than other coals. White immediately became a convert to the

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<sup>16</sup> Franklin's stove was invented in 1744. But the drive for efficiency improvements persisted and accelerated in the decades after the Revolution. In 1796, the American Philosophical Society offered a \$60 prize for the inventor of a new furnace design that would benefit the poor. Between 1794 and 1815, the U.S. Patent office issued 53 new patents for improved stoves. *An Odious Aristocracy*, p. 59.

<sup>17</sup> Coal is the result of plant decomposition in anoxic environments. Over millions of years, heat and compression slowly concentrate the coal's energy density, and coal is graded according to its degree of concentration. Peat is the least concentrated, followed by lignite, then sub-bituminous, then bituminous, and finally anthracite. Anthracite is the best coal because it provides more thermal energy per unit of mass than any other variety. [https://energyeducation.ca/encyclopedia/Coal\\_formation](https://energyeducation.ca/encyclopedia/Coal_formation)

<sup>18</sup> *Routes of Power*, p. 24.

<sup>19</sup> Towne, Shari. *A River Again: The Story of the Schuylkill River Project*. Bristol, PA: Delaware Riverkeeper Network, 2012, p. 17.

<sup>20</sup> "The reality in the early 19<sup>th</sup> century was that it cost more to ship coal 80 miles overland than it did to ship it 3000 miles from England." *Routes of Power*, p. 28.

<sup>21</sup> *A River Again*, p. 17.

new fuel, estimating that the switch from bituminous to anthracite “cut his production costs by two-thirds, because the higher heat level required only a quarter of the fuel and half the labor.”<sup>22</sup>

White’s iron factories burned down in 1815, but by then he had decided there was more money to be made in transporting coal than in using it to work iron. Rebuffed from participation in Schuylkill Canal, which was already under construction, White turned to a new route to bring anthracite to the city. He would build his own canal, on the Lehigh River instead of the Schuylkill, connecting Mauch Chunk (now Jim Thorpe, PA) with Bethlehem and Easton, and then float his barges the rest of the way to Philadelphia on the Delaware. Eager to keep costs low in a yet unproven market, he did not build a canal with locks. Rather, he would use freshets (reservoirs of water) which could be released to make the Lehigh deep enough for navigation at just those moments when his boats needed to float downstream. Upon reaching Philadelphia, the barges would be broken up and sold for the value of their wood. Workers would put the iron nails from the boats in their pockets, walk back to Mauch Chunk and repeat the process. Finished in 1820 at the low cost of \$200,000 (the Schuylkill Canal, when finally completed five years later, would cost more than \$2,000,000) the canal was immediately profitable.

The Lehigh and the Schuylkill Canals differed in more than price and engineering. The Lehigh was a one-way road, making it more like a pipeline than a canal. It extracted wealth from the site of production, greatly contributing to its environmental degradation, but brought no commerce or wealth back from the city. The Schuylkill, by contrast, had been conceived as part of an organic energy regime. Its system of locks was designed to accommodate two-way traffic. It would bring crops, timber and coal to Philadelphia and load its empty barges with manufactured products to bring back to the hinterland. The Lehigh Canal exemplified the parasitic relation typical of the mineral energy regime. Benefit accrued to the receiver of hydrocarbons, in this case Philadelphia, but not to the site of production. The Schuylkill Canal was mutualistic. Resources would flow to the city, but wealth, goods and population would also flow back to the interior.

The two canals also differed in the way they were financed. The Lehigh Canal was financed by wealthy investors, most from Philadelphia. Because the Schuylkill Canal was imagined more as a public work than a capitalist venture, finance rules had been drafted with the public interest in mind. The Schuylkill Canal Company could not own the businesses (including mines) whose goods it transported, to remove the temptation to give those businesses preferential rates. No investor could own more than twenty shares, and the length of the canal was divided into regions, with each region given the right to purchase a set number of shares. Both canals were created because the state legislature had authorized their parent company’s corporate charters, and these charters were given because the state wanted a canal built but lacked the necessary capital. The rules governing the Schuylkill Canal showed that the state knew the dangers of putting a powerful corporate entity in charge of a vital transport route. These rules aimed to protect against monopoly, foster competition, and ensure that those who needed the canal also had a say in how it was run. They embodied a theory of how republican equality could coexist with capitalism, and an acknowledgement that corporate ambitions inevitably conflict with the public good. The Lehigh Canal charter was granted with no conditions because it was expected to fail, and

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<sup>22</sup> Routes of Power, p. 37.

because the Lehigh valley was a sparsely populated area of little concern to the legislature. If its prospects were brighter, than it too would have been chartered with similar rules.<sup>23</sup>

With the proven viability of anthracite as an industrial and residential fuel and a transport system able to deliver the coal cheaply, all that remained was to convince Philadelphians to make the switch. White again led the way, keeping an open house where his wife was always willing to demonstrate the correct combustion technique. Philanthropic organizations saw anthracite as way to save the poor from freezing winters. One such organization, The Fuel Savings Society, contracted with iron workers to build cheap stoves that could provide the proper draft. Churches also proved to be a valuable early market. In fierce competition for congregants, a church that could provide a warm room for a Sunday service would gain advantage. First Presbyterian Church at 7<sup>th</sup> and Washington Square (demolished 1939) installed six new coal burning stoves. St. Stephen's Episcopal, at 10<sup>th</sup> and Ludlow (just below Market St.) raised the ante, placing a large furnace in its basement that would keep the church warm with no smell and the stoker kept well out of sight.<sup>24</sup>

The industrial market for anthracite also grew rapidly. Use of charcoal for working iron fell precipitously, and soon "the entire anthracite region and the areas adjacent thereto in terms of carriage of coal by canal were blossoming with the new type furnaces."<sup>25</sup> In 1825, the Phoenix Nail Works achieved the first successful use of anthracite in a steam engine. By 1838, Philadelphia led the nation in the construction and use of these new machines. Industries requiring large amounts of heat—bleaching, dying, papermaking, distilling, glass works, sugar refineries, foundries—flocked to Philadelphia to take advantage of the new fuel. Consumption of anthracite rose exponentially: 35,000 tons in 1825, 175,000 tons in 1830 and 500,000 tons by 1835. As consumption rose, economies of scale lowered the per unit cost. The wholesale price of a ton of Lehigh coal dropped from \$6.50 in 1830 to \$5.50 in 1840 to \$4.50 in 1850.<sup>26</sup> Thanks to its canals, the ingenuity of its inventors, and the persuasiveness of its salesmen, all of which played a part in freeing the city from its dependence on wood, Philadelphia began its transformation from a mid-sized commercial port city to industrial giant.<sup>27</sup>

## Stop 2: The Textile Mills of Manayunk

Visitors to today's Manayunk neighborhood in Northwestern Philadelphia will see abundant evidence of its industrial past. Many of the expensive bars and boutiques of Main St. are housed in massive, multi-storied structures with rubble-built masonry walls, an expensive and time-consuming method of construction. Why were these structures built, and why are they crowded along the banks of the Schuylkill Canal?

The Canal was dammed at its Philadelphia terminus, providing a fall of 26 feet to the Schuylkill River. Water at this elevation could provide mechanical power to machinery. By the 1820's, methods for

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<sup>23</sup> Routes of Power, p. 37-46.

<sup>24</sup> An Odious Aristocracy, p. 77.

<sup>25</sup> "A Century of Industry in Pennsylvania," p. 53.

<sup>26</sup> Routes of Power, p. 49, 61.

<sup>27</sup> Population growth is one indicator of this change. In 1790, Philadelphia had less than 30,000 residents. By 1830, there were more than 80,000 and by 1860, more than half a million.

[https://en.wikipedia.org/wiki/Demographics\\_of\\_Philadelphia](https://en.wikipedia.org/wiki/Demographics_of_Philadelphia)

using water-power to run textile machines had been well developed by the textile industry of New England, particularly in Providence, RI and in Lowell, MA. Philadelphia's capitalists saw that New England's methods could be brought to the banks of the Schuylkill Canal. By 1840, eight mammoth textile mills had been built, with an aggregate production far higher than that of Lowell or Providence, making Philadelphia the leading textile producer in the nation.<sup>28</sup>

In 1820, there were about 1,100 textile workers in Philadelphia, although this number does not include many "outwork" workers, who labored on textile work in their homes rather than in a mill.<sup>29</sup> By 1827, the number rose to 4,500, and by 1850 there were 326 firms employing over 12,000 workers,<sup>30</sup> most concentrated in Manayunk, although Kensington also had several mills.

Coal, in these early decades, was not used to power the textile machines. That would happen in the 1850's and 60's, as mills expanded production and needed more power than canal water could supply. But even in the early decades, coal was a necessary ingredient of industrial growth. Mills were integrated facilities for the production of cotton cloth, with separate areas for carding the cotton, spinning it into yarn, dyeing the yarn, and weaving the yarn into cloth. Coal-fired boilers were crucial for the dyeing process. Coal also provided heat for drying the colored yarn. Most importantly, coal was burned for heat, to keep the factory warm enough to work in, and to warm the homes of the workers who lived on the steep hillsides near the mills.

Philadelphia's mills were able to out-compete the mills of Lowell in part because they had excellent port facilities and were so much closer to the South, which lowered their transport costs for raw cotton. Lowell was about 40 miles inland, but Philadelphia was a port city, so raw cotton could travel by ship to wharves that were only a mile or so from the factory doors. But a second, equally important reason was that Philadelphia's labor force was abundant and cheap. Lowell, by contrast, had to build dormitories and mess halls for the young, single women it employed, and because there were never enough hands to work the machines, it also had to pay these women well. Philadelphia's mills needed no amenities and could pay low wages because there were so many immigrants pouring into the city, desperate for work of any kind.<sup>31</sup> These workers could not have settled, however, if they were not able to heat their homes with coal. Cheap, abundant coal enabled a concentration of cheap labor near the mills, and it was this cheap labor that gave Philadelphia's industrial products a competitive advantage in price.<sup>32</sup>

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<sup>28</sup> Shelton, Cynthia Jane. The Mills of Manayunk. Baltimore: Johns Hopkins Univ. Press, 1986.

<sup>29</sup> Lan, Derek. The Sounds of these Mills May be Heard at All Hours: Textile Manufacturing Work and Reform in Philadelphia County, 1788-1854. Unpublished dissertation submitted to the faculty of Binghamton University, 2017, p. 10.

<sup>30</sup> The Sounds of these Mills May be Heard at All Hours, p, 34.

<sup>31</sup> "A key to understanding the early industrial history of Philadelphia is the city's position as an immigrant port, a status not shared by New England's seaports. By 1820, Irish and English handloom weavers and mule spinners had turned Philadelphia into the major center of fine yarn and cloth production. Thereafter, immigrant women and children, disembarking in growing numbers in the 1820s, filled the demand for water-powered machine attendants in the mechanized cotton factories of Manayunk, Philadelphia's counterpart to Lowell." Shelton, Cynthia. "The Role of Labor in Early Industrialization: Philadelphia, 1787-1837." Journal of the Early Republic, 1984, Vol. 4, No. 4, pp. 365-394.

<sup>32</sup> "A growing population of urban poor women and children provided a reserve pool of cheap unskilled labor that encouraged textile capitalists like Ripka and Borie to mechanize." The Mills of Manayunk, p. 59. One cause of this

So many textile mills sprang up in Philadelphia that people started calling the city the “Manchester of America,” a reference to the principal textile manufacturing city in England. This analogy was strained because working conditions in Manchester were horrible but in Philadelphia, they were far worse. Britain’s Factory Regulation Act of 1833 established a maximum ten-hour day, prohibited the employment of children under ten, and required the installation of ventilation, to clear the factory of airborne cotton lint, and guards on the gearing, to protect workers from injury by the machines. Philadelphia had none of these rules. Lint, dust and fibers filled the air, causing many workers to suffer from lung ailments. Workers were paid a daily wage, which encouraged mill owners to lengthen the working day, often to more than twelve hours. Children did heavy work, such as carrying sixteen-pound boxes of bobbins up four stories for their twelve-hour shifts. Often, they would fall asleep from exhaustion and be injured in the machines. For all workers, being fifteen minutes late meant the loss of one-quarter of the day’s wages. Two days’ wages were lost for each day absent without reason. Owners always held back two weeks’ wages, which were forfeited if one quit without permission.<sup>33</sup> A downturn in the market led to instant dismissal of unneeded workers, often without the wages they had earned.

The desire for profit only partly explains why mill owners imposed these dehumanizing conditions. These owners did not think of themselves as exploitative or rapacious. In their eyes, their mills performed a vital moral function by schooling the idle poor in the norms of industry. Factory labor taught the poor the discipline of working hard for their wages, a habit which helped the owners, the nation, and the workers themselves.

This attitude was not new. Massachusetts statutes in 1662 and 1692 provided for the public whipping and imprisonment of any unemployed person “fit and able to work.” Ben Franklin took a typically hard line, observing that “the best way of doing good to the poor is not making them easy in poverty, but leading or driving them out of it.” Because there was a perennial labor shortage nearly everywhere in America in the 17<sup>th</sup> and 18<sup>th</sup> century, most people believed that anyone who did not work did not want to. Poverty, it seemed to them, was not the product of misfortune, but of vice. The poor were “lazy, immoral and anti-social, and (with some obvious exceptions such as the blind and widowed), basically a criminal class.”<sup>34</sup>

In the eyes of the mill owners and of most native-born Americans, no one was in more in need of this industrial discipline than the Irish. The Irish were by far the largest and poorest class of immigrants in the city, and because they often arrived destitute, they were also the largest consumer of charitable services.<sup>35</sup> As a group, they were seen as a burdensome drain on city resources, prone to

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labor superabundance was an 18<sup>th</sup> century technological breakthrough in thread production. Richard Arkwright’s water frame (1769) “virtually eliminated the livelihood of the female hand spinner throughout Britain before the end of the century. This spurred immigration from Britain and Ireland to the United States. In the last two decades of the eighteenth century, approximately 5000 passengers per year from the Ulster textile area came to the middle Atlantic ports, the chief of which was Philadelphia.” Perrow, Charles. Organizing America : Wealth, Power, and the Origins of Corporate Capitalism. Princeton: Princeton University Press, 2005, p. 35.

<sup>33</sup> The Mills of Manayunk, p. 73.

<sup>34</sup> Betten, Neil. “American Attitudes Toward the Poor: A Historical Overview.” Current History, Vol. 65, No. 383, 1973, pp. 1-5.

<sup>35</sup> For example, records of Blockley Hall Almshouse show that of all destitute women seeking obstetric help, two thirds were Irish. Higgins, Catherine. Out of Mind: The Institutionalized Insane in 19<sup>th</sup> Century Philadelphia. Unpublished dissertation, Bryn Mawr College, Graduate School of Social Work and Social Research, 1986.

alcoholism and out of wedlock births, and of dubious loyalty because of their Catholicism. These attitudes only worsened as Irish immigration rose meteorically in the wake of the potato famine of the 1840's. Protestants, including the mill owners, were "convinced by the combined efforts of anti-Catholic journalists, politicians, clergy, and laity that they were about to be wiped out by an inundation of Catholicism."<sup>36</sup> In this atmosphere of suspicion and loathing, mill owners would have seen harsh treatment of their Irish workers as appropriate and necessary.

A further factor which worsened the treatment of workers was the transition to mechanization. When mills started using water to power their machines, they were able to fire the skilled, male workers who had run the mule spinners (the 'mule' is a manually powered machine for spinning thread into yarn). This achieved considerable savings in labor costs. By the mid-1830s a female worker could operate a throstle spinning frame that turned out one and a half times the amount of yarn as the standard male spinner. She labored for \$2.25 per week compared to the male spinner who earned \$6.50.<sup>37</sup> Mechanization, in other words, was a big step downwards for the poor, since it put thousands of male breadwinners out of work. These unemployed men responded with a spate of arsons and machine breaking in a hopeless attempt to hold back the tide of mechanization. This only contributed to the public perception that the Irish were dangerous, anti-social elements, a feeling that was strengthened when people saw the new, female labor force go on strike or agitate for better wages and conditions.

This intense public hostility towards the Irish led some members of the upper classes to speak out on their behalf. Matthew Carey, a successful and wealthy Irish-American publisher, tried to explain why the Irish should be seen with more sympathy. In the turgid prose of someone who is himself desperate to be respected, Carey explained that the working class was not monolithic: "This class is susceptible of two great subdivisions—those who are so well paid for their labors, as to be able to save enough to commence business on a small scale on their own account. With this fortunate description, which is numerous and respectable, I have no concern at present. My object is to consider the case of those whose services are so inadequately remunerated, owing to the excess of labor beyond the demand for it, that they can barely support themselves while in good health and fully employed; and, of course, when sick or unemployed, must perish, unless relieved by charitable individuals, benevolent societies, or the guardians of the poor."<sup>38</sup> Carey makes two important points here. First, he notes that there is an "excess of labor" which not only drives down wages, but renders many unable to work, even if they want to. Second, there is no real possibility that lower tier workers, such as the unskilled women and children who tended the textile machines, would gain industrious habits and rise in social class. Social mobility is possible for skilled, well-paid workers, such as the native-born, male mechanics who built and repaired the machines, but for the mass of unskilled, female workers, labor in the mills barely provided subsistence.

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<sup>36</sup> Geffen, Elizabeth M. "Violence in Philadelphia in the 1840's and 1850's." Journal of Mid-Atlantic Studies, 1969, Vol. 36, No. 4, 1969.

<sup>37</sup> Shelton, Cynthia. "The Role of Labor in Early Industrialization: Philadelphia, 1787-1837." Journal of the Early Republic, Vol. 4, No. 4, 1984.

<sup>38</sup> Carey, Matthew. "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" (1833). <https://digitalcommons.unl.edu/etas/11/>

Carey's plea seems to have fallen on deaf ears. Skilled, native-born male workers saw themselves as a class apart from the unskilled Irish. Many skilled trades organized and unionized in the 1840's and 1850's, but specifically excluded women, foreign-born, unskilled and black workers. The United American Mechanics, founded in Philadelphia in 1844, was a typical example, providing a unified voice for native born skilled workers, and ferocious hostility towards everyone else.<sup>39</sup>

Anti-Catholic, anti-Irish violence occurred regularly. In 1844, for example, a large crowd of Nativists marched to the Kensington neighborhood of Philadelphia, which was full of Irish textile workers, and held a rally for the American Republican Party with fiery speeches that were anti-immigrant and anti-Catholic.<sup>40</sup> The Irish Catholics of Kensington responded to these provocations with violence, forcing the Nativist speakers from their podiums and tearing down their platforms. Nativists responded with overwhelming force, burning dozens of Irish homes and destroying two Catholic churches. John B. Berry, a witness to the riots, saw "a large number of Irish Catholics and others, who were so ruthlessly thrust from their homes during the riots of Tuesday and Wednesday, encamped in Camac's Woods and other places, some two or three miles north of the city...They were without food, except what chance or charity threw in their way."

If Nativists resented the Irish, the Irish were in turn antagonistic to their rivals at the bottom of Philadelphia's laboring world, African-Americans. In 1834 and 1842, Philadelphia was the scene of bloody race riots, where the victims were Black and the perpetrators largely Irish.<sup>41</sup> Job competition was one factor behind this violence, since Irish and Black workers often did the same dirty, low paid jobs, such as dredging ship channels, domestic and restaurant work, or shoveling coal. But it is important to note that Black workers were never allowed to labor in the mills. This would have been seen as insufferably demeaning to the mill's white workers. Anti-black violence, suggests David Roediger, should be understood as an assertion of whiteness by Irish workers.<sup>42</sup> Exclusion of black workers was not merely the expression of mill owners' racism. It served a purpose, giving white workers, no matter how badly exploited, a sense that they were still part of the ruling class. Wage labor, which seemed distressingly like slave labor in many respects, was differentiated from it by means of race. The right to earn wages through factory work became a badge of whiteness, a way to feel better about one's lot in life, no matter how bleak, because it was still so much better than the marginal roles to which Black workers were confined.

The decades before the Civil War, notes Roediger, were a time of increasing racial hostility in the North. By 1805, Blacks were excluded from Christmas and Independence Day celebrations, where in earlier years their presence had been tolerated. When Pennsylvania reformed its state constitution in 1838, what had previously been an informal racial caste system became codified and explicit. Blacks

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<sup>39</sup> [https://en.wikipedia.org/wiki/Order\\_of\\_United\\_American\\_Mechanics](https://en.wikipedia.org/wiki/Order_of_United_American_Mechanics). A bonus 'stop' on the 1860 interactive map is the American Mechanics Cemetery, in the 21<sup>st</sup> ward, at the corner of 22<sup>nd</sup> and Diamond.

<sup>40</sup> [https://hsp.org/sites/default/files/legacy\\_files/migrated/studentreadingriotsinthecityofbrotherlylove.pdf](https://hsp.org/sites/default/files/legacy_files/migrated/studentreadingriotsinthecityofbrotherlylove.pdf)

<sup>41</sup> "The participation of the Irish is reflected in the arrest of rioters with names like McLaughlin, Lynch, Cavanaugh and M'Kearnan... The low economic and social status of many of the rioters provides a key to what appears to have been one of the riot's major causes. It was precisely this type of person who was forced to compete for employment with the equally depressed Negro, and the ensuing rivalries generated tensions and bitterness." Runcie, John. "Hunting the Nigs in Philadelphia: The Race Riots of 1834." *Pennsylvania History: A Journal of Mid-Atlantic Studies*, 1972, Vol. 39, No. 2, p. 196.

<sup>42</sup> Roediger, David. *The Wages of Whiteness*. New York: Verso Books, 1991, ch. 7.

were now barred by law from voting, serving on a jury, or joining the state militia. Why, asks Roediger, does Northern racism in these decades get so much worse? His answer is that racism played a key role in the growth of Northern industrial capitalism. An impediment to that growth was the reluctance of white labor to accept the grueling regime of work in the mills. Once that work became a sign of whiteness, it led not only to increased racism, but to a greater tendency among white workers to accept their lives as wage laborers.<sup>43</sup>

Like a prism that separates light into its separate wavelengths, coal and the industrial changes that coal brought about divided Philadelphia's workers into a society of mutually antagonistic classes. Nativists hated immigrants, skilled labor despised unskilled, and all white workers grew in their racism towards Blacks. Add religious and political differences (Irish were loyal Democrats, nativists tended to be Whigs), and the result was a badly fragmented working class. This fragmentation distinguishes American labor from European, where racial and religious homogeneity aided attempts at collective action. Here, divisions between different groups of workers impeded coordination and kept labor prices very low. This, in turn, accelerated industrialization and capital growth, further increasing the consumption of coal. The example of Manayunk's textile mills shows that coal created a way of work and a system of values and identities among the workers, and that these two effects were mutually reinforcing. Industrialization, nativism, and racism grew from coal as many branches from a single trunk.

### Stop 3: The Fairmount Water Works

Float down the Schuylkill from Manayunk to the rowing basin, look to your left, and you will see the elegant buildings of Boathouse Row, where Philadelphia's universities and private rowing clubs store their shells. The southern limit of the rowing basin is a long, diagonal dam, which today appears to have no other function than to create a recreational area for boating. But if recreation were the only goal, why build this long, diagonal structure, instead of the shortest span from bank to bank?

On the east bank, the dam terminates at a large, neo-classical building with white stone columns and porticos, the Fairmount Water Works. Today the Water Works houses the Philadelphia Water Department's education center and a space for catered events, but one senses that the scale and magnificence of the building exceeds its current role. The building and the dam raise the same questions: why was it built, what function did it formerly serve, and why does it no longer perform its original task? The answers to these questions form another part of the story of Philadelphia and its relationship to coal.

The history of the Water Works begins before the advent of coal, in a booming colonial city that was facing two, simultaneous impediments to growth, an energy crisis brought on by a shortage of wood, and an environmental crisis caused by pollution in the city's wells. In the 1630's Dutch navigators had been awed by the profusion of wildlife in the Delaware estuary, with its huge populations of otter, beaver and waterfowl, and vast schools of sturgeon and shad. By the 1730's, the otter and beaver were gone, and city residents like Ben Franklin could taste that their drinking water was getting progressively

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<sup>43</sup> Roediger writes: "Whiteness was a way in which white workers responded to a fear of dependency on wage labor and to the necessities of capitalist work discipline...This logic had particular attraction for Irish-American immigrant workers, even as the whiteness of these very workers was under dispute." Wages of Whiteness, p. 14.

worse. In his Gazette, Franklin complained about the many tanneries and breweries built along the banks of Dock Creek,<sup>44</sup> noting that “the creek was choked with hair, horns, guts and skins and that the fish swimming in the creek soon floated belly up.”<sup>45</sup> Animal excrement lay everywhere, waiting for a rainstorm to be washed into the river. Privies were sometimes built right over a creek or brook, and some were dug into the ground, where their contents would overflow or leach into waterways and wells.<sup>46</sup> The result was a city choking on its own filth, with foul tasting water and malodorous air. The Yellow Fever outbreak of 1793, wrongly attributed to ‘miasmas’ brought on by environmental contamination (in fact, it was a virus spread by mosquito bites) provided the final catalyst to action. The city would build a new water system, piping water from the relatively pristine Schuylkill to the densely settled areas next to the Delaware.

In 1801, Benjamin Latrobe built the city’s first water system. One steam engine (located at the intersection of 24<sup>th</sup> and Chestnut) pulled water from the Schuylkill and pumped it to a second station, located on the current site of City Hall. From there, a second steam engine would push the water through wooden pipes to free, public hydrants and to the homes of better-off citizens who could afford a subscription fee. The system’s fatal flaw was its dependence on the two steam engines, both of which had to work if water were to flow. Steam engine technology was new, and the machines constantly broke down.

A second attempt was made in 1815. A much larger pumping station was built at the foot of Faire Mount (Fairmount) with two engines, either of which could keep water flowing if the other broke down. A massive, 3 million gallon reservoir was dug at the top of Faire Mount<sup>47</sup>, from which the water would flow by gravity through the wooden pipes built for the earlier, 1801 system. Although this new system improved over its predecessor, it, too suffered from problems. Wooden pipes were leaky and prone to break, and their right-angled connections decreased water velocity and pressure. Iron pipes solved this problem, but a much bigger issue still faced the system. The steam engines ran on wood (at this point, the coal canals had not yet opened) and wood was ruinously expensive.

The solution was to use power from the river itself to pump water from ground level up to the reservoir at the top of Faire Mount. In 1821, workers broke ground on a dam which cut at an angle across the river, to direct the flowing current into a mill race. Since the mill race had a much smaller cross-sectional area than the river’s natural channel, the water’s velocity greatly increased. This spun the water wheels, which drove the pumps that pushed water up to the reservoir. The system was a great success, and for a few decades Philadelphia had a water system that was the envy of the world.

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<sup>44</sup> Today, the creek is covered by a cobblestone road, Dock Street. Press an ear to the cobbles and sometimes you can hear the water running underneath.

<sup>45</sup> Kaufmann, Gerald. “The Delaware River Revival: Four Centuries of Water Quality Change from Henry Hudson to JFK.” *Pennsylvania History: A Journal of Mid-Atlantic Studies*, Vol. 77, No. 4, 2010.

<sup>46</sup> In his 1798 report on the feasibility of a water works for Philadelphia, Benjamin Latrobe noted that wells and privies were sunk into the same layer of permeable gravel. “The perfect permeability of this stratum is evident from the connection of the wells with each other, and with the sinks and privies, from whence arises the extreme unpleasantness of the water in the crowded parts of the city.” Quoted on the website <http://www.phillyh2o.org/canvas/canvas02.htm>. This site offers an excellent history of water use in Philadelphia, from the colonial era to the present.

<sup>47</sup> Currently, the Art Museum of Philadelphia sits on this spot.

By the 1840's, however, the quality of the water in the Schuylkill had begun to decline. Everyone knew that industrial and human waste had fouled the water in the Delaware, and to prevent the Schuylkill from meeting a similar fate, the city started buying land upstream of the Water Works.<sup>48</sup> The problem was that industrial growth was accelerating all along the Schuylkill, from Manayunk to Pottstown, because of the Schuylkill Canal and the cheap, abundant coal it provided. There was no way that the city could do anything to forestall this growth. Much of it was outside city borders and thus beyond political control. Even in the parts of the river it could control, the city faced a dilemma. It could either have industries and the wealth and jobs that industries brought, or it could have clean water, but it could not have both.

The severity of the problem can be seen in Dana Barber's survey of 1885.<sup>49</sup> Granted, this survey shows a much worse scale of pollution than antebellum Philadelphians faced, but the types and sources of pollution are mostly the same. Textile mills produced dye wastes with hydrochloric acid, sulfuric acid, caustic soda and a wide range of metallic compounds. Preparing fabric always involved washing, which required huge amounts of lye. Gas works produced benzene.<sup>50</sup> Paper mills used chlorine of lime in enormous quantities. All these industrial wastes, and many more, went straight into the river. Organic wastes were a whole other category of contaminants, with thousands of privies, slaughterhouses, breweries, tanneries, and transport animals making their daily contribution of pollutants to the river.

A final category of pollutants came from the mining and processing of coal. Before coal can be burned, it must be cleaned. Slate and other rock material must be removed, large chunks must be broken down to burnable size, and smaller bits of coal (culm) must be removed. Any piece smaller than 7/8" was considered a waste product and discarded, forming huge piles near the breaker rooms, which gradually washed down into nearby waterways. This sediment killed vegetation on the banks of whatever waterway it contaminated, causing erosion and adding to the water's turbidity. So much culm flowed into the river that by 1900, its depth was measured at between six and eight feet at Schuylkill Haven. By 1940, the Philadelphia Water Department estimated that at least thirty million cubic yards of culm had been deposited in the river's bed, choking its flow, spreading its floodplain, and diminishing its ability to flush out industrial and organic pollutants.<sup>51</sup> In 1860 there was not so much culm in the riverbeds, but there must have been a large and continual flow of coal solutes in the water, slowly adding to the accumulating total on the bottom. No measurements of dissolved solids were taken, but we know that in 1940 there were about 3,500 ppm of coal dust in the Schuylkill's waters. More than 500 ppm of any solid, including those far less toxic than coal, is considered unhealthy.

Acid mine discharge was, and remains, a further source of water pollution from coal mining. Coal mining in 19<sup>th</sup> century was by the 'room and pillar' method, where a room was opened to the coal

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<sup>48</sup> Eventually these city-owned properties would become Fairmount Park.

<sup>49</sup> Barber, Dana. Report of a Sanitary Survey of the Schuylkill Valley, 1885. I am using a spreadsheet of his findings prepared by Ellen Schultz, who directs PWD's education center at the Fairmount Water Works.

<sup>50</sup> This liquid hydrocarbon is produced as a byproduct of the manufacture of coal gas. In this process, coal is heated until it releases gaseous methane. This 'city gas' was pumped to the houses of wealthy Philadelphians for use as a home illuminant. The benzene, it seems, had no purpose and was dumped, along with a host of other toxic byproducts, including bitumen, sulfur, tar and heavy metal. See Jarrige, Francois. The Contamination of the Earth: A History of Industrial Pollutions. Cambridge: MIT Press, 2020, p. 94.

<sup>51</sup> Towne, Chari. A River Again, The Story of the Schuylkill River Project. Bristol: Delaware Riverkeeper Network, 2012.

face with a central pillar of coal left untouched to support the roof. As miners moved to new coal faces, their old rooms filled with water. This water leached sulfur from the exposed rock face, which became sulfuric acid. This acid in turn pulled metals like mercury, arsenic and cadmium from the rock, creating a highly toxic mix of acid and heavy metals. As rain flowed down into disused rooms, it washed this poisonous fluid into local streams, and from there, into the river. Even now, after decades of attempts to halt the flow of this discharge, hundreds of AMD sources still drain from mine pools into the Schuylkill River.<sup>52</sup>

Gauging the health consequences of this tainted water is difficult. It seems that the only form of mortality which Philadelphians attributed to water was deaths due to infectious disease. Typhoid and cholera, both waterborne diseases which follow the fecal-oral transmission route, killed around 27,000 people between 1860 and 1900, and for every person killed, dozens were sickened.<sup>53</sup> One can only imagine how many others were killed by pathogens or industrial poisons in this notoriously foul smelling and tasting water, but had their deaths ascribed to other causes.

For decades the city kept pumping drinking water with the Fairmount works because they lacked any viable alternative. Manayunk was identified as a principal polluter, and in 1883 the city built a sewer which captured Manayunk's wastes and deposited them at a point downstream of the Fairmount Works. But many businesses refused to connect to this sewer, nor was this a real solution, even if there had been full compliance. Norristown, Phoenixville, and Pottstown were all industrializing and adding pollutants to the river upstream. Acid mine discharge and culm could not be avoided, since they were deposited near the Schuylkill's headwaters, far upstream from the city. Finally, in the early decades of the 20<sup>th</sup> century, sand filtration was accepted as the only way to provide the city with clean drinking water. Since there was no room at the Fairmount site for sand filters, the Fairmount Works could not be converted to the new process. The Fairmount Water Works closed for good in 1909.

The sad tale of the Fairmount Water Works raises the question of how its death by pollution was ever allowed to occur. How is it possible that clean water, a basic necessity for every human life, was sacrificed for the sake of economic growth? The reasoning in an 1878 case, *Pennsylvania Coal Company v. Sanderson*, may illuminate the thinking of the time. Sanderson's farm had been ruined by acid discharge from a nearby mine. Sanderson's suit for damages was denied, however, because the court ruled that acid discharge was an inevitable byproduct of mining coal, and the mining of coal was too important to be stopped. "The exigencies of the great industrial interest," wrote the court, "must be kept standing in view. For slight inconvenience or occasional annoyances, they ought not to be held responsible."<sup>54</sup> This decision would be cited in legions of future pollution cases, always in defense of the polluters, but it would be wrong to dismiss it as a mere pretext. The Sanderson case reflected a widely accepted understanding that even if industrialization carried an awful environmental price, its benefits outweighed its costs. Tainted water, like the smoky, foul air that Philadelphians had to breathe, was the inevitable price of progress.

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<sup>52</sup> Cravotta, Charles et al. "Surface Water and Groundwater in an Extensively Mined Watershed, Upper Schuylkill River, PA." *Hydrological Processes*, vol. 28, 2014.

<sup>53</sup> <http://www.phillyh2o.org/canvas/canvas06.htm>

<sup>54</sup> Casner, Nicholas. "Polluter vs. Polluter: The Pennsylvania Railroad and the Manufacturing of Pollution Policies in the 1920's." *Journal of Policy History*, Vol. 11, No. 2, 1999, p. 185.

Perhaps, then, the root cause of the death of the Fairmount Works was not pollution, but a certain conception of social evolution in which a rise in living standards and material prosperity was the paramount goal, to which all other human interests were subordinate. Andrew Carnegie gave a clear expression of this view in 1889, writing: “Today the world obtains commodities of excellent quality at prices which even the generation preceding this would have deemed incredible... The poor enjoy what the rich could not before afford. What were the luxuries have become the necessities of life. The laborer has now more comforts than the landlord had a few generations ago. The farmer has more luxuries than the landlord had, and is more richly clad and better housed.”<sup>55</sup>

It seems obvious—though our society seems no more aware of this than Carnegie was—that it is unethical to sacrifice the health of millions for “luxuries and comforts,” particularly when the benefits of this sacrifice were not so widely distributed as Carnegie suggests. Increased prosperity for some came at a cost to future generations who would suffer from, and eventually have to clean up the environmental wreckage left by their ancestors. Well off citizens could remove themselves to cleaner, healthier places, (like Carnegie’s castle in Scotland) but for the great mass of Philadelphia’s working class, their ‘progress’ would be a life lived in a sacrifice zone, one of harsh toil cut short by the poisonous air and water they had no choice but to consume. Gone were the pristine waters that had so moved the early Dutch navigators; gone were the rivers in which ordinary people could swim and fish; gone was the air and water that could support a healthy human life. The shuttered Water Works, like Sanderson’s poisoned farm, could be seen as an inevitable casualty of social growth, but also as a symptom of social devolution.

#### Stop 4: Port Richmond Coal Wharves

Most kids who grow up in Philadelphia’s river wards (Fishtown, Kensington and Port Richmond) know about Graffiti Pier. There is something wild and dangerous about the place, which is private property, but easily accessible to trespassers. There is no safety equipment, no signs, and no effort to remove the needles and broken glass scattered among the thick concrete pillars under the wharf. Every inch of the pillars is covered with graffiti, making this place a work of public art to some, to others, a monument to urban decay. Someone has set footholds into a large tree that abuts the pillars, which lets the adventurous climb on top of the pier. From there, one can gaze over the side to the Delaware River, thirty odd feet below, or look up or down river, where many other disused piers can be seen, all covered with vegetation, all relics of a vanished age.<sup>56</sup>

What few people in the neighborhood know is that Graffiti Pier used to be called the Port Richmond Coal Wharves (later, the Port Richmond Marine Terminal). As a major node for the distribution of coal, the Coal Wharves were connected to thousands of Philadelphia riverfront industries that relied upon it for energy. What were these industries and how did they operate? How did coal make their manufacturing processes possible? Who worked in these factories, and how did they view themselves, as workers and as citizens?

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<sup>55</sup> <https://www.swarthmore.edu/SocSci/rbannis1/AIH19th/Carnegie.html>

<sup>56</sup> Philadelphia Magazine wrote nice article on the pier in 2015.

<https://www.phillymag.com/news/2015/11/08/graffiti-pier-philadelphia/>

To uncover this lost era, one must conjure a “cacophony of steam engines, whirling lathes, pounding forges, clattering looms, smoke, sweat and strain,” looking past the “bewigged gentlemen debating the birth of a nation” to a city that proudly claimed the title of Workshop of the World.<sup>57</sup> In place of our lightly used river, imagine 257 busy wharves, bustling with steam and sail driven ships, served by three major railroad systems. Imagine thousands of tons of finished goods—textiles, machine tools, locomotives, ship engines, rolled iron products, street cars, armored plate, refined sugar, hand tools—leaving the port while thousands of tons of raw materials—iron, coal, wool, cotton, chemicals, and wood—flowed in. Picture hundreds of thousands of industrial workers, many unskilled and barely subsistent, many skilled and prosperous, proud homeowners rooted to the city and to their neighborhoods. Hanging over it all, a thick cloud of coal smoke, not something to be lamented, but a sign that here were the jobs and wealth that industrial production brings.

If the city can be imagined as a vast body, the Port Richmond Coal Wharves was one of its stomachs, feeding energy into homes and industries all along the Delaware waterfront. The first pier was built in 1842. By 1876, there were 21 wharves totaling 15,000 feet in length. These wharves were the Philadelphia terminus of the Reading Railroad. Coal trains started their journey in Pottstown, where feeder lines from the mines converged. From there, trains traveled to Philadelphia on the west bank of the Schuylkill River, just across from the canal.<sup>58</sup> Loaded trains arrived at the Coal Wharves and decoupled from their locomotives, which then picked up a string of empty coal cars for the return trip to Pottstown. The full coal cars would be stored if a vessel were not docked and waiting, but when a ship was ready, they were pulled by a cable to an elevated platform. There they were tipped, so the coal would fall by gravity into the open holds of a transport steamer, six of which were owned by the Reading itself. In 1860, of a total regional coal output of 9,200,000 tons, 2,500,000 tons would pass through the Richmond terminal.<sup>59</sup> Most of it was for export, some was sold in the neighborhood, and some traveled down the waterfront line, moving by means of Richmond St. to Delaware Ave. (now, Columbus Blvd.).

A large amount of coal went to local glassworks. Two major works were a few hundred yards south of the Coal Wharves, the Flint Glassworks and the famous Dyottville Glassworks. Glassworks created products which sold directly to consumers (tableware, mostly) but also products that were used in other industries, such as glass bottles for breweries and ampules for the booming patent medicine trade.<sup>60</sup> Glass production required huge amounts of heat. The primary ingredient is sand, silicon dioxide (SiO<sub>2</sub>), which is mixed with sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>) to lower the melt temperature, and calcium oxide (CaO) which helps to make the glass waterproof. These ingredients melt and form a homogenous mixture at about 2700F. After careful stirring to remove the bubbles, a glassblower can stick a tube into mass of melted glass, blowing a bottle or any other desired shape. Once shaped, the glass cooks in the annealing oven, which increases its durability. The melting and annealing process are energy intensive, but the proximity of the Coal Wharves meant that the glassworks had all the coal they would need.

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<sup>57</sup> <https://www.workshopoftheworld.com/overview/overview.html>

<sup>58</sup> The Reading bought the canal in 1870, which it then abandoned and allowed to decay, eliminating it as a rival carrier of anthracite. Treese, Loretta. *Railroads of Pennsylvania*. Mechanicsburg: Stackpole Books, 2003, p. 91.

<sup>59</sup> <https://philadelphiaencyclopedia.org/essays/coal/>. See also

[http://www.readingrailroad.org/rdg\\_indus\\_coal.shtml](http://www.readingrailroad.org/rdg_indus_coal.shtml)

<sup>60</sup> Dr. Jayne’s Family Medicines made an enormous fortune in this business, building a huge 10 story building at 2<sup>nd</sup> and Chestnut (since demolished).

Go a bit further down river, and one finds a soap works at the corner of Shackamaxon and Delaware Blvd. Soap in the 19<sup>th</sup> century was made by combining a rendered animal fat with lye. Lye (sodium hydroxide, NaOH) was obtained by allowing water to drip through the ashes of wood fires. Salt could be added for hard soap or omitted for soft soap, or a fragrance like oil of peppermint to make the soap smell nice. The production process required heat to cook the fat and lye mixture, so soap works also needed an ample supply of coal.<sup>61</sup>

Just South of the Coal Wharves stood the I.P. Morris Iron Foundry, one of dozens on the waterfront. The iron industry was foundational for a wide variety of manufacturing processes that depended on wrought iron as their basic material. Steel, which would replace wrought iron in the decades after the Civil War, was not widely used in the antebellum period. But what was wrought iron, and how was it made?

The first step in making wrought iron is to smelt pig iron from iron ore. Iron ore is one of several natural rock formations containing iron. Hematite ( $\text{Fe}_2\text{O}_3$ ), for example, was abundant and easy to mine, but the problem of how to separate the iron from its oxides was not an easy one to solve. If coal was used in the blast furnace, the iron would become contaminated with sulfur (present even in anthracite, though to a lesser extent than in bituminous coal) which made it brittle and useless. The breakthrough came in 1839 when David Thomas of the Lehigh Crane Iron Company smelted iron using anthracite as his only fuel.<sup>62</sup>

Before smelting, Thomas purified his coal into coke. Coke is the result of cooking coal in an airtight chamber which allows distilled gases to escape. This process removes any impurities in coal, including the sulfur, leaving it nearly pure carbon. In the blast furnace, limestone, coke and hematite are stacked in alternating layers. The tuyere blows hot air (rich in  $\text{O}_2$ ) upward through the coke, bonding oxygen to carbon to make carbon monoxide (CO). Carbon monoxide is a powerful reducing agent, which allows it to pull oxygen out of the hematite ore. Bonding this extra oxygen produces  $\text{CO}_2$ , which vents out of the top of the furnace. Stripped of its oxygen, the resulting  $\text{Fe}_2$  is mostly elemental iron, which falls to a pool at the bottom of the furnace.<sup>63</sup> Limestone bonds to any impurities as slag, which sits on top of the molten iron. Open a tap, and the molten iron flows into a set of molds. Since this image reminded iron workers of a pig suckling its young, a block of smelted iron became known as a pig.

Pig iron is what we now call cast iron. Its high carbon content (about 5%) makes it non-malleable and fairly brittle, so it is not suited for most industrial applications. However, from pig iron it is possible to produce wrought iron, which is malleable. If pig iron is melted and stirred, with some slag added to provide a structural lattice in the finished iron, oxygen in the air will bond to carbon in the pig iron, outgassing as  $\text{CO}_2$ .<sup>64</sup> As the iron loses carbon, its melting point rises, making the iron thicken, a moment that 'puddlers' (the workmen who performed this process) called 'coming to nature.' When the puddle or ball of decarbonized iron comes to nature, it adheres to the stirring rod, and is lifted from the crucible

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<sup>61</sup> <https://americanhistory.si.edu/blog/2011/06/suds-up-how-to-make-soap-19th-century-style.html>

<sup>62</sup> Durfee, William. "The Development of American Industries Since Columbus." *Popular Science Monthly*, Vol. 38, 1891.

<sup>63</sup> A very clear explanation of the chemistry of the blast furnace: [https://www.youtube.com/watch?v=UjBrZCNvt\\_s](https://www.youtube.com/watch?v=UjBrZCNvt_s)

<sup>64</sup> Note that this is a slow, laborious way of achieving the same result that the Bessemer process achieves quickly, the removal of carbon from pig iron by oxygenation.

and worked (wrought) with a hammer. The resulting block, now called bar iron, is now ready for further industrial use.

Bar iron can be cooled, shipped and reheated at another mill for processing with machine tools. After reheating in a reverberatory furnace, the bar can be reduced to the desired shape using lathes, presses, or files. The machinist can in this way create the rods, shafts, cranks, cylinders, pistons, and any other parts that are needed for steam engines or steam driven machines. If the bar needs to be elongated rather than reduced, it can be rolled between two heavy wheels, with each pass reducing the width of the bar by about a quarter inch. The first iron railroad rails were nothing but long squares of bar iron, rolled to the desired dimensions, with countersunk screws driven through the top to fix the rail to the tie.<sup>65</sup> In 1844, the T-rail shape was adopted, offering easier connection to the tie and a longer wearing surface. Bar iron could also be shaved into slices with a shearing machine. The resulting slices could be sheared again into any desired size, such as little pieces for spikes or nails, or long, thin slices to be rolled into barrel hoops. One important product was boiler plate. A boiler plate started as a thick slice sheared off the bar, which was then reduced by rolling to the desired thickness, providing 1" plates to make boilers for steam engines, or 3"-5" plates for armored warships, or thinner plates for non-pressurized compartments like stoves or fireboxes.

The most important wrought iron machine was the steam engine, because with this engine one could drive innumerable other machines, such as a rotating saw blade for cutting wood, a power loom for weaving cloth, a propeller shaft to drive a ship, or a set of wheels to move a locomotive. The steam engine can be powered by any fuel, but by the 1850's it was usually anthracite coal.<sup>66</sup> Coal was burned in a firebox, and its hot exhaust gases flowed through tubes that ran through the boiler. This heated the water in the boiler, turning it into steam. From the boiler, a channel or 'inlet' allowed steam to collect on one side of a piston, driving it forward. Once the piston was fully forward, a valve switched the flow of steam to the other side of the piston, driving it backwards. This is the 'double action' steam engine, in contrast to the 'single action' of Newcomen's original model, in which the piston was only driven in one direction. The piston was connected to a rotating crank, which imparted torque to an axle, driving a saw, locomotive, steamship, loom, or any other shaft-powered machine.<sup>67</sup>

Philadelphia quickly became a world leader in the production and refinement of steam engines. The Franklin Institute (founded 1824) made an important contribution to this growth, acting as a liaison between researchers and industrialists. In its current incarnation, the Institute's main purpose is public education. In the decades before the Civil War, however, it was more like an industrial think tank, a place for mechanics to share and learn from one another. This mission was evident in its name, The Franklin Institute for the Promotion of the Mechanic Arts, and in the pages of its Journal, a large portion of which was dedicated to mechanical engineering.<sup>68</sup>

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<sup>65</sup>Swank, James. "The Manufacture of Iron and Steel Rails in Western Pennsylvania." The Pennsylvania Magazine of History and Biography, Vol. 28, No. 1, 1904.

<sup>66</sup>Fisher, Charles E. "The Steam Locomotives of the Pennsylvania Railroad System." The Railway and Locomotive Historical Society Bulletin, No. 89, 1953.

<sup>67</sup>A short, clear video on how a steam engine works: <https://www.youtube.com/watch?v=lmw8L5p7mOk>

<sup>68</sup><https://philadelphiaencyclopedia.org/essays/franklin-institute/#related-readings>. See also: Sinclair, Bruce. Philadelphia's Philosopher Mechanics. A History of the Franklin Institute, 1824- 1865. Baltimore: Johns Hopkins University Press, 1974.

Excellence in iron working and steam engine technology gave Philadelphia a commanding position in the construction of locomotives and steamships. The Baldwin Locomotive Works and its neighbor the Norris Locomotive Works occupied a vast complex from Broad St. to 18<sup>th</sup>, between Spring Garden and Callowhill. Most American locomotives in the steam era would be built at one of these two plants. The Baldwin plant alone produced more than seventy thousand locomotives, an amazing feat given the size and complexity of these massive machines.<sup>69</sup>

Use the 1860 map to look up and down the Delaware waterfront, and one striking feature is the number of steamship lines that operated from their own docks. There are lines to Baltimore and New York, to Charleston and to Boston, and of course, many connections to New Jersey.<sup>70</sup> Many of these lines used ships built upriver, at the Port Richmond shipyard of William Cramp (for some reason, not shown on the 1860 map, but just south of the Coal Wharves). Cramp built ships for every cargo, and many warships, but as was the case with the railroads, the principal cargo for Philadelphia-based steamers was coal.

If one machine encapsulated the sophistication of Philadelphia's manufacturers, it was the ironclad steamer U.S.S. New Ironsides, launched in 1862. The contract to build the ship, for the then enormous sum of \$780,000, was awarded to Merrick and Sons (on the 1860 map at Washington Ave. and 5<sup>th</sup> St.). Merrick would build the engines, but subcontracted the hull to Cramp, a clear indication that the power plant was seen as the more important engineering task.<sup>71</sup> Unlike the more famous U.S.S. Monitor, which was an innovative but unsuccessful design,<sup>72</sup> the New Ironsides was durable (she suffered no casualties, despite nearly constant action until the end of the war), seaworthy, and, threw a very heavy broadside with her sixteen Dahlgren 11 inch guns. She was powered by four boilers, each 17x11 feet, each fed by six coal furnaces. These boilers powered two enormous steam engines, each with two 50" diameter pistons, which turned a 10" propeller shaft, spinning a single, 12' brass propeller. When the improvised ironclad C.S.S Virginia (Merrimack) rampaged through the blockading squadron at Hampton Roads, it seemed that iron plating had nullified Northern naval dominance and that Southern cotton would again flow to European ports. As ships like the New Ironsides rolled off the stocks, it became apparent that the blockade would remain. Both sides grasped the technology of ironclad warships, but only the North had the skilled manpower to turn this knowledge into a working fleet.

Who were these urban workmen whose skills were so foundational to Northern victory? How did they see themselves, and how did this perception affect their political activity? Their identity was in part built on gender and race. The mechanic was a white man, with no exceptions, because skilled industrial work was not a pathway open to anyone else. But within this privileged class, a new way of work had created a new set of political perceptions, and it was these perceptions that found expression in the dominant political party of the 1850's, the Republicans. "The driving force of the Republican party," writes Alexander Saxton, "was never simply anti-slavery or westwards expansion. The driving

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<sup>69</sup> <https://www.baldwinparkphilly.org/baldwin-locomotive-works>

<sup>70</sup> The Delair Bridge, built in 1895, was the first to connect Philadelphia to New Jersey.

<sup>71</sup> Roberts, William H. "The Neglected Ironclad: A Design and Constructional Analysis of the U.S.S. New Ironsides." *Warship International*, Vol. 26, No. 2, 1989.

<sup>72</sup> The Monitor's rotating turret was revolutionary but unreliable, and she had only two guns. Worse, she had a very low freeboard, which led to her sinking in moderate seas off Cape Hatteras in late 1862.

force was industrialization.”<sup>73</sup> The culmination of this process, Saxton says, was “a nation state totally and unopposedly controlled by an industrial, capitalist class,” but if this is so it raises a question: how did the highly oppositional culture of workers vs. owners one saw in the mills of Manayunk transform into one in which workers saw their interests as identical with those of the owners?

For decades, Southern writers had dismissed the Northern way of work as a form of white slavery. Southern ideologues like George Fitzhugh saw the industrial North as a cannibalistic society, one in which poor whites had a nominal freedom but were in fact condemned to wage slavery in miserable, unhealthy factories.<sup>74</sup> In the 1830’s and 40’s, this critique resonated with the immigrant communities of Northern cities like Philadelphia, whose grim, powerless lives in the textile mills did resemble slavery in some respects. It was these communities that gave the Democratic Party its foothold in the cities of the North. Southern planters and poor, Irish workers found common ground in their distaste for the Whigs who ran the factories, many of whom had no qualms about expressing their ferocious Nativism, even while they exploited immigrant labor in their mills.

As industrial capitalism matured in the North, the Southern critique gradually lost its appeal. A skilled industrial worker, of the sort that built the New Ironsides, had nothing to fear from unskilled, immigrant labor. Here is a passage on the boiler makers of the Norris Locomotive Works: “In testing boiler plates, one of the first processes they pass through is a testing with the hammer...to make it almost certain that any flaw or other imperfection would be discovered. Some of the principal hands in the boiler shop have been employed there twenty years. Scarcely a rivet is headed, except under the supervision of a master workman: that these regulations are carried out in the most minute workings of the shop, will at once explain the causes of admitted excellence of the boiler work from this establishment.”<sup>75</sup> Granted, this is a piece of corporate self-promotion. But it shows that skilled labor had a secure, valued place, and this opened new political possibilities. In stark contrast to the Nativist Whigs, the Republicans would welcome immigrants and espouse a Homestead Act to see them settled in the West, where they could create new markets for Northern goods and mineral energy. This broadened the appeal of the Republican Party to urban, immigrant communities, severing part of this key constituency from the Democrats.

Long gone were the preindustrial, native-born workers that had been displaced by immigrant labor in the first wave of mechanization, as the mule spinners of Manayunk were replaced by Irish women and children. The skilled worker of the 1850’s found his skills in high demand, giving him the power to choose his employer and negotiate his conditions of work. The ability to own productive property, always a key barometer of freedom, was increasingly within the grasp of these highly paid workers.<sup>76</sup> They could own their homes or use their wages to start their own firms, which many did. Upward mobility came from good pay, which depended on the prosperity of the corporations they worked for. A full quarter of the work force at a firm like Norris were apprentices, making the factory an engine of social mobility. No wonder, then, that these workers increasingly saw the wellbeing of their capitalist employers as coincident with their own. The viability of the Democratic Party in the North had

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<sup>73</sup> Saxton, Alexander. The Rise and Fall of the White Republic. London: Verso Books, 1990, p. 247.

<sup>74</sup> Faust, Drew Gilpin. The Ideology of Slavery. Baton Rouge: Louisiana State University, 1981, p. 274.

<sup>75</sup> White, John H. “Once the Greatest of Builders: The Norris Locomotive Works.” Railroad History, No. 150, 1984.

<sup>76</sup> Foner, Eric. Free Soil, Free Labor, Free Men: The Ideology of the Republican Party Before the Civil War. Oxford: Oxford University Press, 1995, p. xxi.

always depended on antagonism between workers and owners. As industrial production grew more sophisticated, this antagonism diminished, enabling a powerful, new alliance between labor and capital. It was this alliance that the Republican party represented. When disunion removed Southern legislators from Congress, a raft of pro-industry laws quickly passed. The Morrill Tariff of 1861 raised rates to 20 percent on average. Funding for three transcontinental railroads was enacted. The Morrill Land Grant Act (1862) established agricultural and mechanical colleges. The Homestead act (1862) provided 160 acres in western territories free to anyone who settled on it for five years and declared their intention to become a citizen. These initiatives won support for the Republicans among farmers and immigrants, making their base far broader than the Whigs. These were foundational changes whose effects would last for decades, and the origin of these changes was the new way of work that industrialization had made possible. The anthracite revolution, which had led to industrialization, may therefore be seen as the first term in a sequence that led to Civil War and national transformation.

War would benefit Philadelphia despite its enormous cost in blood. It would strengthen and extend an economic regime in which cities like Philadelphia occupied a privileged place. Philadelphia's dominance in 19<sup>th</sup> century manufacturing, which rose to new heights in the decades after the war, flowed from the positive reinforcement loops of industrial production and coal. Coal allowed the production of iron, and with iron, Philadelphia could build ships and locomotives, which would not only consume enormous amounts of coal themselves, but also transport it, creating new markets for coal and for the machines that coal could feed. Wherever the railroads or steamships reached, one could build an energy intensive factory like a brickworks, paper mill or glassworks, or buy a steam engine to run a sawmill, rolling mill, or textile factory, sure in the knowledge that the factory would be well supplied with energy. By the end of the antebellum era, Philadelphia had established itself as a central node in a vast network of land and seaborne transport, as a principal supplier of energy, and as a major manufacturer. This threefold dominance, in transportation, manufacturing, and energy, allowed the city in its next five decades to double in population and then double again, fully earning the name it gave itself, the Workshop of the World.

#### Stop 5: The Blockley Almshouse

On the west bank of the Schuylkill River, just south of the University of Pennsylvania, there is a thick cluster of medical buildings, including the Children's Hospital of Philadelphia (CHOP), The Perelman Center for Advanced Medicine, and the VA Hospital of Philadelphia. Go back to 1860, and the land was still dedicated to medicine. On top of a grassy knoll, surrounded by pleasant, wooded acres, stood a large neo-classical building called the Philadelphia General Hospital at Blockley, although nobody called it that. To the residents of Philadelphia, it was Blockley Almshouse, and it was not a place you wanted to be.

Much as today's public nursing homes function as all purpose receptacles for our society's cast-offs—the sick, the dying, the disabled, the superannuated, the mentally ill, the addicted—all united by their poverty and their lack of options to go anywhere else, Blockley was a place of last resort for Philadelphia's poor. Its very name, observed a doctor who worked there, had "a certain sinister meaning attached, on account of the maladministration in all departments, and the general misery and

wretchedness that became a part of the lives of all who passed within its gates.”<sup>77</sup> Dr. J. Chalmers Da Costa, at one time Blockley’s physician-in-chief, said of Blockley: “Within these gray walls we find all sorts of physical and mental diseases, and also a multitude of those social maladies that degrade manhood, undermine national strength and threaten civilization itself. Here is drunkenness; here is pauperism; here is illegitimacy; here is madness; here are the eternal priestesses of prostitution who sacrifice for the sins of man; here is crime in all its protean aspects, and here is vice in all its monstrous forms.”<sup>78</sup>

These scathing comments raise a host of questions. Why was the management of the place so bad? Who were its residents, and why were they there? How did the rest of Philadelphia’s society see it, and how did these attitudes contribute to its being run so poorly?

The story of Blockley begins with the best of intentions. In 1834, reform-minded citizens, inspired by calls to social reform that were common during the 2<sup>nd</sup> Great Awakening, decided that the city’s small almshouse at 10<sup>th</sup> and Pine St. could no longer meet the needs of the growing city. They envisioned a complex so large that it would serve indefinitely. The main part of the almshouse would have accommodations for 1,250 paupers,<sup>79</sup> clerks, students, and other necessary staff. The second building would be the House of Employment. This building would be big enough to hold workshops and accommodate up to 500 people, each in separate rooms. A wall tall enough to prevent escape would also surround the facility. The third building would be the hospital. This building would be large enough to hold 600 patients with an additional 100 cells for the insane. This building would also have a wall surrounding it, tall enough to prevent escape.<sup>80</sup>

Why so many walls? The walls are clues that here was an institution not so much dedicated to care as to reform. Reform involves a transformation of personality, a conversion of a sinner into a responsible person, and it is not necessarily a process that the patient wants to undergo. By being destitute and asking for help, the ‘inmate’<sup>81</sup> confesses to being a prisoner of his or her own moral vices. Whether the problem was ‘bastardy’ (women were held responsible for promiscuously producing bastards) or alcoholism (seen as mainly a male vice) or destitution (seen as improvidence or laziness, shared by both sexes) inmates at Blockley were not seen as unfortunate victims of circumstances beyond their control, but rather as sinners in the grip of vices that they themselves had chosen to indulge. They were, therefore, morally reprehensible, and if society chose to impose coercive conditions, doing so was both necessary and deserved.

Primary sources of the era fairly drip with disdain towards these undeserving poor. The presence of paupers is, “without a doubt, a serious injury to real estate, and must become increasingly objectionable to the community.” Paupers, says this author, should be confined in an “almshouse in the

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<sup>77</sup> Bliss, Arthur Ames, M.D. Blockley Days; Memories and Impressions of a Resident Physician, 1883-1884. Printed for private distribution, 1916, p. 8-9.

<sup>78</sup> <https://collaborativehistory.gse.upenn.edu/stories/blockley-almshouse>

<sup>79</sup> A pauper is a poor person who receives government assistance. In 19<sup>th</sup> century America, the word seems to have had a derogatory implication; a pauper is someone who could work but chooses not to.

<sup>80</sup> Higgins, Catherine Ruth. Out of Mind: The Institutionalized Insane in 19<sup>th</sup> Century Philadelphia. Unpublished dissertation: Bryn Mawr College, Graduate School of Social Work and Social Research, 1986.

<sup>81</sup> Patient is our preferred word. They called residents of Blockley ‘inmates’, which is probably a more accurate term, given that the residents would be confined as a condition of being helped.

neighborhood of the House of Correction, and as a large proportion of those who ultimately end their days in pauperism are from the dissolute and criminal classes, the two institutions might be neighbors without harm to either.”<sup>82</sup> Another contemporary author laments the rising number of street beggars: “This revolting and corrupting nuisance seems to be rather on the increase in Philadelphia, notwithstanding the means of relief through benevolent associations are multiplied... We live in days when few are disposed to say “to beg I am ashamed.” Begging seems to have become a regular calling and is classed among the professions... The ingenuity displayed by our professional beggars is often remarkable. Children are sometimes employed as agents in accomplishing these purposes. The other day we saw a little boy sitting on the steps and crying bitterly. We asked what was the matter. “I have lost my mother’s money, sir.” A day or two after we saw the same little boy, not far from the first spot, weeping just as bitterly. “What is the matter,” we asked. “I have lost my mother’s money.” Truly, it is sad to think that we live in days when wolves are to be found even in lamb’s clothing.”<sup>83</sup> It does not seem to have occurred to this author that a child beggar, even one using a ruse to increase his earnings, was probably in desperate circumstances and not a ‘professional’ at all. What explains this profound myopia towards a fact that seems so obvious, that poverty can be a product of bad choices, but can also happen to people who have done nothing wrong?

Neil Betten<sup>84</sup> suggests that the harsh attitudes of antebellum Philadelphians toward the poor flowed from industrialization. Industrialization created wealth for the social elite, who were able to isolate themselves from the poor. Poverty, for them, became an abstraction rather than a matter for community concern, because the poor were not in their communities. The poor lived in dark and dangerous neighborhoods where ‘good’ people did not go, and if you saw one in your neighborhood, it was a nuisance, a trespasser whose presence posed a ‘serious injury to real estate.’ Industrialization also created plenty of jobs, so it seemed to many that unemployment must therefore be a matter of choice. This attitude ignored the possibility that a reasonable person might prefer poverty to a life of unskilled wage labor, given the harsh conditions at the mills, and that unemployment might not be a matter of choice, given the enormous number of immigrants arriving in the city, desperate for any kind of work, and the various other factors (age, injury, sickness) that might prevent a person from being able to work. Industrialization might also have a psychological connection to a disdain for the poor. If you are worried about your own ability to conform to industrial discipline, despising the poor might be a form of projection, a way to hate the parts of yourself you are struggling to control. Hatred towards the poor thus stands in the same relation to industrial discipline as hatred towards Black Americans stood in relation to a controlled sexuality.<sup>85</sup> In both cases the despised class represented an internal struggle against a repressed wish.

No matter what caused such hatred of the poor, its result was an archipelago of utterly unsympathetic institutions whose purpose was to extirpate vice and instill industrial discipline. Blockley was but one of many. Penitentiaries (like Eastern State, opened in 1829) ‘reformed’ the refractory poor

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<sup>82</sup> No author cited. *Friend’s Intelligencer*, Philadelphia. Vol. 39, issue 50, 1883.

<sup>83</sup> No author cited. *Pennsylvania Journal of Prison Discipline and Philanthropy*, Philadelphia, Vol. 6, Issue 1, 1851.

<sup>84</sup> Betten, Neil. “American Attitudes Towards the Poor: A Historical Overview.” *Current History*, Vol. 65, no. 383, 1973.

<sup>85</sup> Alexander Saxton suggests that Black Minstrelsy reveals a Pandora’s box of repressed wishes that white audiences could shun by projecting on to a Black ‘other’: intemperance, laziness, homosexuality, cowardice, etc. *Rise and Fall of the White Republic*, ch. 7. London: Verso Books, 1990.

by making them work, often at tasks that had been obviated by industrialization, such as hand weaving or hand-carved, crude furniture making. Immigrants disembarking at the Washington Ave. docks were directed to the aptly named House of Industry (founded, 1846),<sup>86</sup> where they, too, were taught to work as unskilled labor. Children had their own special hell, the spectacularly misnamed House of Refuge (founded 1826, located just south of Girard College), where they would be lashed, starved and placed in solitary confinement to get more work out of them.<sup>87</sup> These abuses were not secret. In 1876, an investigation revealed all of what had gone on there, but none of the practices were deemed abusive.

Antebellum Philadelphia was a culture in which poverty was despised and punished, and this suggests that Blockley was not an aberration, nor a result of mismanagement, but a place whose horrors were typical and there by design. Disdain for the poor gave rise to a perverse system of incentives for Blockley's directors. They would not be judged by the quality of the care they provided, but rather by the number of destitute they could convince to leave. The more unbearable the conditions, the fewer the inmates, and the less the public would have to spend on upkeep.

One cost conscious decision was to mix the genuinely insane with everyone else, including the tubercular, venereal, fevered, blind, orphaned, old or merely poor. Blockley did not so much have rooms as borders; the periphery was secured with locked doors, but within those doors there was no segregation (except by race) and little supervision. Because the facility was overcrowded, there were no private rooms, and large numbers of patients slept on the floors of main halls, ensuring that no one would get a peaceful night's sleep. There was a single, metal coal fired furnace in the center of the room, around which the inmates huddled and where they were frequently burned. 'Nurses' were not real nurses, just female inmates forced to do the work of nurses to save on costs. They were seen with utter contempt by the professional staff, as shown in these observations by a visiting physician: "These (pauper nurses) are persons whose companions are the most abandoned, whose haunts are the most degraded, and whose lives are about equally spent between the Almshouse and the prison. They are detained against their will, they work reluctantly, they are insensible to praise, and have no fear of punishment. They perform no labor which they can avoid and do nothing right that is easier to do wrong. When required to lay hands on a patient, they do it in a most provoking manner."<sup>88</sup> One can only imagine these disgruntled women handling their charges with as much solicitude as they would show to a sack of coal. Occasional scandals would erupt, revealing a litany of abuses: drinking on the job, sexual abuse of female patients, selling inmate-made goods for private gain, selling medicine and other publicly purchased goods for private gain, and selling corpses of inmates to medical students. The one constant for all inmates was constant labor. All 'able bodied' were expected to work, a broad category that included the very old (40% of the workers were over sixty) and the insane, who were made to work the treadmill if they were too far gone for anything else.

One thing the staff were diligent about was keeping out anyone who might report the chaos inside the almshouse. Occasional large-scale disasters, however, made this impossible. In 1864, "thirty or forty" inmates were killed when sloppy work on a new furnace in the basement resulted in the collapse of the upper floors.<sup>89</sup> In 1885, a fire swept through the main hall, incinerating dozens of

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<sup>86</sup> Torn down, but formerly at 7<sup>th</sup> and Catherine St. in Bella Vista.

<sup>87</sup> <https://philadelphiaencyclopedia.org/essays/house-of-refuge/>

<sup>88</sup> *Out of Mind*, p. 73.

<sup>89</sup> No author cited. "Fearful Disaster in Philadelphia." *New York Times*, July 21, 1864.

inmates, most of whom could not be identified after the fire was put out.<sup>90</sup> These events could not be kept out of the news and resulted in brief moments of reform. But once the news cycle moved on to other topics, the customary corruption and abuse would return. The simple fact was that the public was more concerned about the idle poor taking advantage of public relief than they were about whether those poor were cared for properly. A chaotic, abusive hospital, with no supervision, no treatment for the insane, and very few paid staff, was a very cheap hospital to run, and even cheaper if the conditions drove patients to leave. Directors who created these conditions would be praised; ones who did not would be let go.

Black Philadelphians were over-represented at Blockley. Although they were about 10% of Philadelphia's population, they were 17% of the inmates. They were rigidly segregated from all other inmates, with their own medical and surgical wards and a separate cellar for punishment. During the day they were confined to the attic, which was cold and drafty during winter and brutally hot in the summer. Foreign born whites, overwhelmingly Irish, made up 57% of the inmates, native born whites the remaining 16%.<sup>91</sup> Here was data that could have supported an obvious conclusion, that membership in a privileged caste, not the possession of superior virtue, seemed to count the most in determining whether one would avoid destitution. But the data was read in another way, as confirming what everyone already suspected, that Black and Irish people were childlike and improvident, and it was this that led them to poverty. Numbers that, for us, reveal a racist and nativist system, for antebellum Philadelphians were numbers that justified that very system.

What role did Blockley play within the social system that coal, or more directly, industrialization, had brought about? It makes little sense to say that Blockley, and the reform archipelago of which it was a part, offered care to those who could not care for themselves. The brutal indifference of these institutions towards their inmates shows that anything we would call care was neither attempted nor achieved. Reform also seems a somewhat overgenerous description, although this is certainly how Philadelphians of the time would have explained their purpose. To reform something is to improve it and remedy its flaws, but most residents at Blockley were not there because of a character flaw. They were old, sick, hurt, or insane, and most were members of marginalized groups that stood little chance of success even if they were sound in body and mind. Nor were residents 'improved,' unless improvement is measured by the number of people who flee from a regimen of coercion, neglect, and hard labor. So, reform may have been the nominal purpose of places like Blockley, but it certainly was not their real one.

Calling these institutions an industry seems to strike closer to their actual function. Every aspect of the way they worked was determined by the desire to reduce costs. Inmates were coerced into work that did not give them in marketable skills, but rather produced simple goods that earned revenue for their host institutions. Directors were hired and fired according to how much money they could save the taxpayers. Even in death, the bodies of the poor were commodities to be sold for medical research.

But places like Blockley did not turn a profit. They might cost the taxpayers more or less money, depending on the way they were run, but they were never self-sustaining. What, then, distinguished the reform industry from other industries of the era? What did they do for society that justified their costs?

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<sup>90</sup> No author cited. "The Blockley Asylum Disaster." *New York Times*, Feb. 16, 1885.

<sup>91</sup> *Out of Mind*, p. 101.

Catherine Higgins suggests that the real purpose of places like Blockley was to segregate those who could not or would not fit into the social system that industrial capitalism had created. They were places where the destitute could simply disappear, and by disappearing, cease to remind society of its own moral flaws. On the streets, the destitute were living indictments of a social system whose racism, nativism, competitiveness, and individualism inevitably created victims. They were mute testaments to the hypocrisy of a culture that prided itself on its Christian piety but was largely indifferent to the ethic of communal sharing and mutual aid that Christ had preached. Warehoused in places like Blockley, the destitute would cease to proclaim these contradictions. Disdain towards poverty as a species of criminality, the myth that most beggars practiced deception so they could live easy lives, offered a similar kind of psychological relief. If the destitute were victims of misfortune, it would generate a moral responsibility to render aid. If they were criminals, however, there would be no such duty, and one could see them off to hells like Blockley, secure in the knowledge that they were getting what they deserved. It seems, then, that the real purpose of the reform industry was to protect society from any challenge to its moral complacency. Like a lubricant that allowed a machine to work without destructive friction between its parts, the reform archipelago let antebellum Philadelphia forget that its embrace of industrial capitalism came at a terrible human cost.

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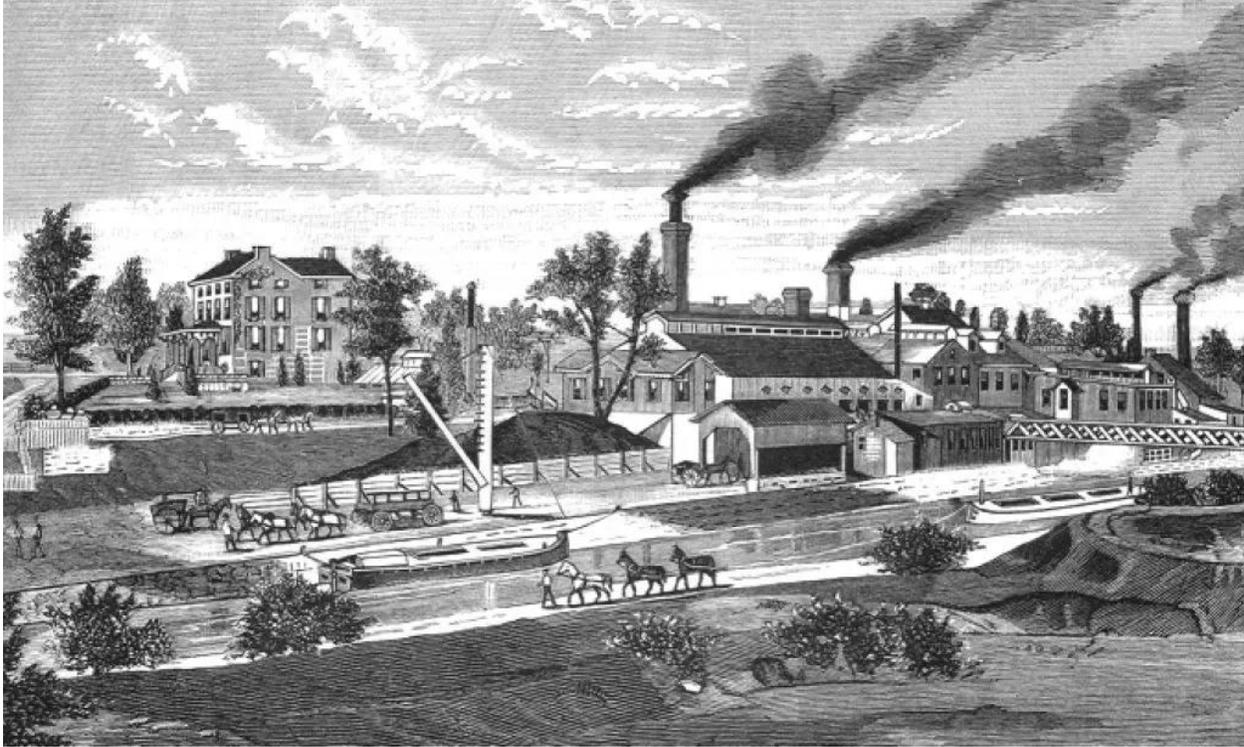
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### Lesson Plans

#### **Lesson 1: Stop 1, The Schuylkill Canal**

**On the map:** scroll to Manayunk, in the city's northwestern corner, or just follow the Schuylkill upstream.

- a. **analyze an image:**



Have students answer these questions:

--what moves the boats up and down the canal? (Teams of donkeys)

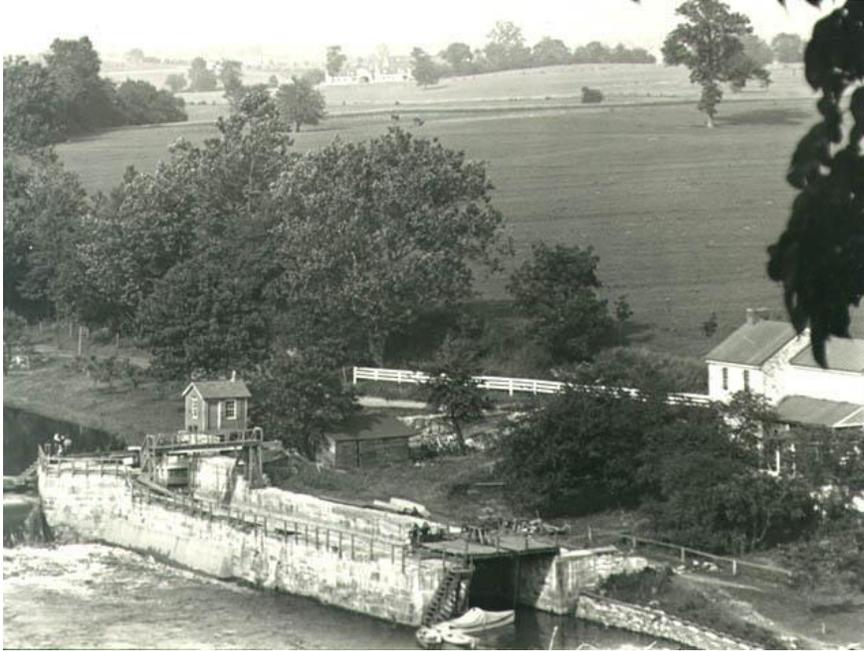
--what is piled up next to the factory in the middle of the picture? (coal)

--what is the big, triangle shaped machine on the bank of the canal? (a hoist, with a pulley at the top of the pole which gave the user leverage for lifting loads into or out of the barges)

--did people live far away from factories, like they do today? (no, a residence is in the background, right next to the factory)

--how did people move loads when they could not use the canal? (horse drawn wagons are shown in the picture. Be sure kids grasp that there were no cars or trucks in those days. Human and animal muscle were thus key parts of the transport chain)

**b. students describe how a lock on a canal works**



Motivate this lesson by asking: it's easy for a barge to float downstream, but how do you move it upstream? Donkeys and horses cannot pull against the river current, so how do the barges move?

Students can watch this simple video on how locks work:

<https://www.youtube.com/watch?v=B1glm1oU9Oo>

Have students write a paragraph where they lay out the sequence of events involved in lifting or lowering a barge. Be sure they grasp how the river does the work of lifting.

### c. Life on the canal, as seen through primary source texts

**Miners Journal of August 6, 1853, Schuylkill Haven, PA**

**Last Monday was another total loss to the coal trade so far as Schuylkill Haven was concerned. All the boatmen carrying coal to the New York market were on a "strike" in anticipation of the rise in towage through the Raritan Canal. Not a pound of coal was shipped from Saturday through Tuesday morning. On Tuesday morning, however, the shippers "knocked under" as the phrase goes, consequently all hands have gone to work again. Five cents increase on the ton was all that they demanded. There was very little done on the Saturday previous making a loss of nearly two days to the trade.**

--What does this passage tell you about the power of canal boatmen at that time? How did the boatmen force the shippers to 'knock under' (give up), and give them a pay increase? What would be the consequences for the city and its industries if the traffic in coal were stopped?

**Miners Journal of September 23, 1865**

**On Monday morning last about three o'clock, as the boat, Virginia, owned by the Schuylkill Navigation Company and commanded by Captain Smith of Reading, was passing through the guard locks at Landingville, this county, four Irishmen boarded the boat, two seating themselves at the bow of the boat and two at the stern. As the boat was passing up the dam, the men gathered around the captain and demanded his money. The captain replied that he had but seven dollars and that they could have that. The robbers were dissatisfied and one of the ruffians named Owen Mullen struck the captain on the head with a billyclub and threw him on the hatchway. The captain's son, a small boy, who had loaded a gun by his father's direction, came up the cabin steps, and placing the gun near Mullen's head, fired the contents through the head of the robber, killing him instantly. Mullen lived on "the Flat" in Schuylkill Haven and was known to be a desperate character. Every good citizen will feel a sense of relief that such a scoundrel as Mullen has been disposed of and earnestly hope that other wretches in this county, when caught in crime, may be sent the same road as quickly.**

--Why do you think the robbers are identified as Irish? Why not just say 'four men' and leave out their ethnicity? What does this choice in language (as well as other details in the description) tell you about attitudes towards the Irish at that time?<sup>92</sup>

**d. Math skills: Using slide 6, help students grasp the efficiency gains of canal transport, compared to wagons**

**A wagon can carry 1 ton of goods. The driver must be paid \$1 per day, and the horses eat about 25 cents worth of food per day. The wagon can go about 12 miles in average day (they don't move very quickly!). A barge carries 250 tons of coal. It has a crew of two men, and both get \$1 per day. It also moves about 12 miles per day. The donkey team that pulls the barge eats 25 cents worth of food per day.**

--What is the unit rate for each method of transport (the cost per mile of moving a ton of coal by wagon, vs. the cost per mile of moving it by barge)?

## **Lesson 2: Stop 2, The Textile Mills of Manayunk**

**On the map:** Adjacent to the Schuylkill Canal

### **a. Making Fabric**

Have students look at fabric under a microscope and record their observations. Let them make guesses about how the fabric was made.

Watch this video on fabric weaving: <https://www.youtube.com/watch?v=TyhDkd8labs>

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<sup>92</sup> These primaries and others, along with a very detailed explanation of how the canal works, may be found here: <http://schuylkillhavenhistory.com/CANAL.html>

This video shows modern machines, but the principles are the same. Using the terms warp, weft and shuttle, students should write a few sentences explaining the process of making fabric.

**b. Stages of the textile manufacturing process**

These steps are out of order:

Carding: Using wire brushes to straighten and clean the cotton fibers. Carding gets all the fibers lined up in the same direction.

Dyeing: Finished fabric is dyed and dried, then rolled up into bolts (rolls of about 15 yards in length)

Weaving: Two sets of yarn strings (the warp) are stretched across a frame. One set rises, the other falls, then the first falls, and the second one rises. The process repeats. Each time the sets of strings switch position, a shuttle is passed between them, leaving a string of yarn that is perpendicular to the strings of the warp. Over time, the familiar ‘over under’ pattern of the fabric begins to emerge.

Spinning: the straightened fibers must be stretched and wound tightly around one another. The result is a yarn ready to be woven into fabric.

Packaging: the finished fabric is rolled into bolts, which are usually about 15 yards long. Packed into boxes, the bolts are ready for shipment to a retail fabric store.

Place the five steps in their proper order:

- 1.
- 2.
- 3.
- 4.
- 5.

**c. Imagine you are a mill owner, thinking about what kind of workers to hire. Make a chart, showing the advantages and disadvantages of each type.**

Worker	Advantages to hiring	Disadvantages to hiring
Skilled Male		
Unskilled Female		
Unskilled Child		

**d. Respond to primary sources**

**1833 Statement of Protest by the “Working People of Manayunk”**

**We must work thirteen hours per day of hard labor, at an unhealthy employment, where we never feel a refreshing breeze to cool us, overheated and suffocated as we are, and where we never behold the sun but through a window, and an atmosphere thick with the dust and small particles of cotton, which we are constantly inhaling to the destruction of our health, our appetite and our strength. Often we do feel ourselves so weak as to be scarcely able to perform our work, because we are forced to labor through the long and sultry days of summer.**

--What are the complaints of the textile workers that you see in this passage?

**The Know Nothing Platform of 1855:**

**I call upon every reader to inquire, as to his own precinct, who are the paupers supported by public taxes in that precinct? His answer will be, Roman Catholic foreigners. Who are the vagrants who fill the jails of the district? The Roman Catholic Foreigners. Who are the peace breakers, rioters and murderers? The Roman Catholic foreigners. Who are the venders of liquid damnation, under the name of whiskey and lager beer? Still the Roman Catholic foreigners.**

--What are some of the stereotypes about the Irish that you see in this passage?

**Appeal of 40,000 citizens, Threatened with Disenfranchisement, 1834**

**We appeal to you from the decision of the " Reform Convention," which has stripped us of a right peaceably enjoyed during forty -seven years under the Constitution of this commonwealth. We honor Pennsylvania and her noble institutions too much to part with our birthright, as her free citizens, without a struggle. To all her citizens the right of suffrage is valuable but surely there are none who can so ill afford to spare it as ourselves...**

**When a distinct class of the community, already sufficiently the objects of prejudice, are wholly, and forever, disfranchised and excluded, to the remotest posterity, from the possibility of a voice in regard to the laws under which they are to live — it is the same thing as if their abode were transferred to the dominions of the Russian Autocrat, or of the Grand Turk. They have lost their check upon oppression, they are thrown upon the mercy of a despotic majority.**

--How does Philadelphia’s black community argue that they should not be stripped of their right to vote?

**Lesson 3, Stop 3: The Fairmount Water Works**

**a. Primary source: Medical Examiner’s Report on the Cholera Epidemic of 1844**

**“To stop the spread of disease, “barrels of pitch were burned in the enclosure to create an upward current of air. Fires were kindled in the wards and the windows thrown open in order to thoroughly**

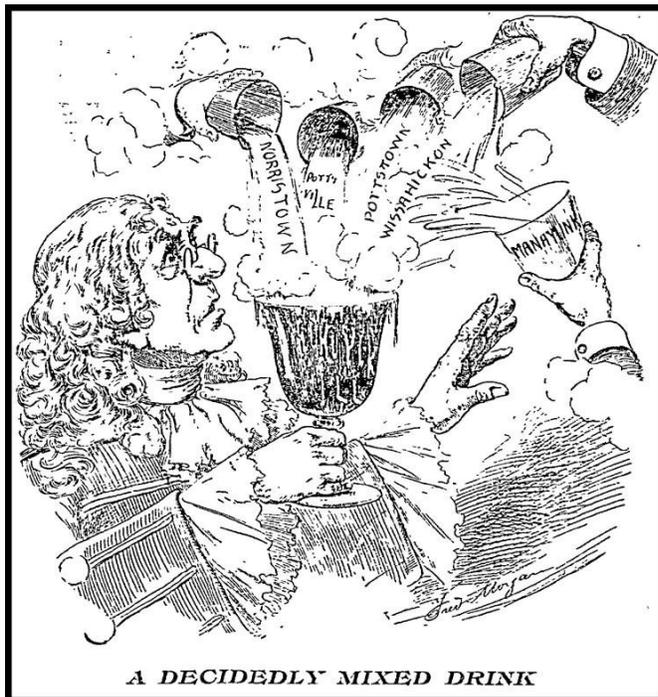
ventilate the house... The medical board also suggested that such persons as were physically able to leave the Almshouse should be allowed to depart, and be induced to do so by the offer of a weekly stipend... There were several thunderstorms during the epidemic, and after that a remarkably violent thundergust on the 14<sup>th</sup> of July, and the number of cases increased for some time."

--watch this video on cholera and how it spreads: <https://www.youtube.com/watch?v=iG1VNSCsP5Q>

Do the doctors of 1844 understand how cholera works? Why or why not? What assumptions do they make about how the disease is spread?

--why would thunderstorms and rain increase the number of people who suffered from cholera?

**b. A cartoon on water in the Schuylkill:**



--what is the artist trying to communicate with this cartoon? Who is its intended audience?

**c. A dispute over building a sewer on the Schuylkill**

Primary 1: From the industries who would have to pay for the new sewer:

**No artificial drainage (a sewer) can ever be efficiently substituted for the natural bed of the Schuylkill River. From the drainage of the vast cemeteries on its banks, from the gutters of city streets, and the canal boats constantly passing along the river, there is a vastly greater amount of filthy animal matter thrown in the river than from all the operations of manufacturing establishments.**

**Whilst on the other hand it has been suggested, to secure for the use of the Fairmount Water Works an ample supply of unquestionably pure water, by laying a large, iron pipe from the Flat Rock Dam to Fairmount.**<sup>93</sup>

--Who do the manufacturers blame for pollution in the Schuylkill?

--What is their proposed solution, instead of building a sewer? Do you think this pipe would solve the problem? (Hint: think about cartoon you looked at above).

Primary 2: A response to the manufacturers' memorial

**"The proposal to build an iron pipe is manifestly absurd. If less than one hundred factories find it impossible to construct drains great enough to carry off their own refuse, how utterly impossible will it be for the city to carry a sufficient supply of water through a single iron pipe? The fact is, the people have the best right to the river, because they are in the majority, because they were there before the factories were thought of, and because the Almighty placed the stream there as a source of water supply, not as a sewer."**<sup>94</sup>

--how does this author argue against the manufacturers' memorial?

#### **d. Physics of water flow**

The dam above the Fairmount works is designed to channel the flow of the Schuylkill through a narrow passage. This increases the velocity of the water, and thus the amount of kinetic energy available for transformation into the mechanical work of pumping that water to a greater height.

Look at this simulation from phet: <https://phet.colorado.edu/en/simulations/fluid-pressure-and-flow>

Study the equation of continuity

$$a_1 \cdot v_1 = a_2 \cdot v_2$$

Take a cross section of pipe, measure its area and the speed of the water at that cross section. Call this  $a_1$  and  $v_1$ . Now take a second cross section, measure its area and the speed of the water at that cross section. Call this  $a_2$  and  $v_2$ . According to the equation of continuity,  $a_1$  times  $v_1$  equals  $a_2$  times  $v_2$

--How does this equation explain why the Fairmount dam increases the velocity of the Schuylkill?

### **Lesson 4, Stop 4: The Port Richmond Coal Wharves**

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<sup>93</sup> Memorial to the Senate and House of Representatives of Pennsylvania, Feb. 13, 1868. Note: this document is part of a lesson on the Fairmount Water Works water curriculum.

<sup>94</sup> Letter to the Sunday Ledger and Transcript, Philadelphia, March 29, 1868.

- a. **Chemistry of hydrocarbon combustion: Goals: explain the reactants and products of hydrocarbon combustion. Balance equations for the combustion of methane and propane. Define acid rain, connect acid rain to coal combustion. If molecular modeling kits are available, use them in this lesson.**

1. Watch this video: <https://www.youtube.com/watch?v=cRnpKjHpFyg>

--What are the reactants of methane combustion?

--What are the products of methane combustion?

--Methane combustion releases heat. Is this also a product?

--write a balanced equation for the combustion of methane

2. Watch this video: <https://www.youtube.com/watch?v=1gzhNed3bbQ>

--same tasks as above, this time using propane as a reactant.

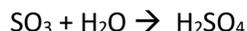
--How does the combustion of hydrocarbons connect to global warming?

--Respond to this statement: "19<sup>th</sup> century Philadelphians received benefits from the combustion of hydrocarbons, but the price for that combustion is being paid by 21<sup>st</sup> century Philadelphians." Is this statement true or false? Explain.

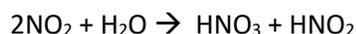
3. Watch this video: <https://www.youtube.com/watch?v=Nf8cuvl62Vc>

--Model the reactions that produce acid rain:

#### **Sulfuric Acid**



#### **Nitric Acid**



Connect these processes to the sulfur and nitrates released in coal combustion (note: emphasize that coal is not a pure hydrocarbon like methane or propane. It is a mixture of many compounds, including molecules containing mercury, sulfur, nitrogen, cadmium, and other metals).

- b. **Transforming coal into mechanical energy: Goals: explain how steam engines work, how they create torque to spin drive wheels and propellers, making powered transportation possible.**

1. Watch this video showing a transparent steam engine:  
<https://www.youtube.com/watch?v=73txXT21aZU>

--have students explain what they are seeing in this video. What could you power using this machine (if you were to scale it up).

2. Now watch this slightly more detailed explanation of a steam engine:  
<https://www.youtube.com/watch?v=Imw8L5p7mOk>

--define terms: inlet, boiler, piston, sliding valve, crank, axle, torque, flywheel, connecting rod

--explain how this engine could power a locomotive or a ship.

--for about \$30, you can purchase a kit to build a working steam engine, that will also run on any source of compressed air (no heat needed). Building this kit will deepen student understanding of how the steam era worked: <https://abong-inc.myshopify.com/products/wooden-steam-engine-kit>

3. Watch this 'tour' of a cutaway locomotive: <https://www.youtube.com/watch?v=g8LrAsL4oH0>

--have students draw a numbered diagram of this locomotive. Their drawing should include: firebox, exhaust tubes, boiler, steam dome, separator, pistons, rods.

4. Watch this video showing how steam spins a propeller shaft:

<https://www.youtube.com/watch?v=K9dw8CnV2U8>

--Discuss the physics of propulsion using Newton's 3<sup>rd</sup> law (pushing against water creates as much forward force on the ship as backward force on the water).

--Discuss the concept of net force by noting the contribution of each piston to the net force on the shaft.

--Discuss the concept of torque

#### **c. Deepen the connection of steam transport to basic Newtonian physics: friction, force, acceleration, velocity**

--Use this excellent simulation to model force and acceleration:

[https://phet.colorado.edu/sims/html/forces-and-motion-basics/latest/forces-and-motion-basics\\_en.html](https://phet.colorado.edu/sims/html/forces-and-motion-basics/latest/forces-and-motion-basics_en.html)

Start with friction set to zero so students can focus on the relation between force, mass, acceleration, and velocity. Use the 'pushing man' as a proxy for the locomotive, the objects he pushes are proxies for the cargo cars of the train.

--Now raise the friction setting so friction is greater than zero. Calculate the new net force on the load (cargo cars), explaining that friction is a force pushing in the opposite direction as the pushing man (locomotive). With new net force, calculate the coefficient of friction (what percent of force is 'lost' as a result of kinetic friction?)

#### **d. Connect combustion of coal to heat-intensive industries: glass making, soap making**

--list the reactants and products involved in making glass. Then do the same for soap.

--create balanced chemical equations showing how these products are produced.

--review the physics of molecular bonds and how heat is used to break those bonds (intramolecular force diminishes with distance between atoms, distance between atoms increases with heat).

#### **e. Connect combustion of coal to iron smelting**

--list the reactants and products involved in iron smelting

--draw a cutaway of a blast furnace, with explanations of the functions of each part

--narrate the production of pig iron using a 'hot blast' (hot, forced air), coke, hematite ore

**f. Turning iron into a durable, malleable form: wrought iron**

--discuss the process of turning pig iron into wrought iron

--connect to the Bessemer process: explain how 'puddling' iron and the Bessemer process achieve similar results (removing carbon from pig iron). Explain what steel is, and let students list some of the applications of steel that they see in their daily lives (cars, steel framed buildings, elevators, etc.)

**g. Primary sources connected to skilled labor and the emergence of the Republican party:**

1. From the Republican Party platform of 1860:

**"While providing revenue for the support of the general government by duties upon imports, sound policy requires such an adjustment of these imports as to encourage the development of the industrial interests of the whole country; and we commend that policy of national exchanges, which secures to the workingmen liberal wages, to agriculture remunerative prices, to mechanics and manufacturers an adequate reward for their skill, labor, and enterprise, and to the nation commercial prosperity and independence."**

--What proposals do you see here that will directly benefit industrial workers? (Hint: tariffs, wage controls).

2. Excerpt from George Fitzhugh: *Cannibals All, or Slaves Without Masters*:

**"The White Slave Trade is more exacting and fraudulent (in fact, though not in intention) than Black Slavery, but we also say that it is more cruel, in leaving the laborer to take care of himself and family out of the pittance (small, inadequate wages) which capital (factory owners) have allowed him to retain. When the day's labor is ended, he is free, but is overburdened with the cares of family and household, which make his freedom an empty and delusive mockery."**

--How does Fitzhugh argue that the white factory worker of the North is a kind of slave?

3. Excerpt from a primary source description of workers at the Norris Locomotive Factory, Philadelphia:

**"Some of the principal hands have been employed there twenty years, and even among rival craftsmen, the superiority of one or two of them is universally acknowledged. Scarcely a rivet is headed, except under the supervision of the master workman: that these regulations are carried out in the most minute workings of the shop, will at once explain the causes of admitted excellence of the boiler work from this establishment."**

--Do you think the master craftsmen described in this passage would agree with Fitzhugh when he calls them white slaves? Why or why not?

--Do you think these master craftsmen would be forced to accept the 'pittance' the factory owners chose to give him, or could they find work at another shop for better wages?

4. Excerpt from a secondary source on race and skilled labor, by Eric Foner

**“Black workers could take little pride in Philadelphia’s reputation as a pioneer trade-union center, for although they were members of the city’s labor force, they were rigidly excluded from all of its trade unions. *The National Trades Union*, official organ of the labor body bearing the same name, and published in Philadelphia, explained in 1835 that Negroes could not belong to unions of white workers since they were inherently inferior to whites, and were actually employers’ tools to hinder the growth of unions and keep white workers oppressed. The short-lived Industrial Congress – a national organization of reformers and workingmen – did admit Negro delegates to an 1851 convention, but the Mechanics’ Assembly of Philadelphia was so resentful of the admission of Blacks that it voted to sever all ties with the Industrial Congress.”<sup>95</sup>**

--Why were Black workers excluded from skilled labor unions?

--Wikipedia defines systemic (or institutional) racism as: “a form of racism that is embedded in the laws and regulations of a society or an organization. It manifests as discrimination in areas such as criminal justice, employment, housing, health care, education, and political representation.” Do you see systemic racism in the way that Black workers were treated by white labor unions?

### **Lesson 5, Stop 5: Blockley Almshouse**

#### **a. Primary source from 1851 on street begging:**

**“This revolting and corrupting nuisance seems to be rather on the increase in Philadelphia, notwithstanding the means of relief through benevolent associations are multiplied... We live in days when few are disposed to say “to beg I am ashamed.” Begging seems to have become a regular calling and is classed among the professions... The ingenuity displayed by our professional beggars is often remarkable. Children are sometimes employed as agents in accomplishing these purposes. The other day we saw a little boy sitting on the steps and crying bitterly. We asked what was the matter. “I have lost my mother’s money, sir.” A day or two after we saw the same little boy, not far from the first spot, weeping just as bitterly. “What is the matter,” we asked. “I have lost my mother’s money.” Truly, it is sad to think that we live in days when wolves are to be found even in lamb’s clothing.”**

Watch this video on Fox News about Jason Greenslate, who is supposedly a ‘typical’ recipient of public aid: <https://www.youtube.com/watch?v=Nd7AFicELHY>

--Compare the video from Fox News and the excerpt from 1851. Do they have a similar purpose? What conclusion are they urging their audiences to accept? Look up a logical fallacy called ‘hasty generalization’. Are both pieces committing this fallacy? Explain.

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<sup>95</sup> <http://paheritage.wpengine.com/article/blacks-labor-movement-pennsylvania-beginnings/>

**b. Amusing lunatics: A primary from 1861**

**“There is in Blockley Almshouse a singular individual who goes under the name of Jesus Christ... His auburn hair flows down upon his shoulders, his beard and mustache give him a wondrous likeness to the divine Hebrew... In speaking of himself and works, he would utter a tremendously long sentence of mysterious nonsense, invariably terminating with the phrase “highfalutin di-de-de-diddle-dum,” a conclusion which would make us convulse with laughter.”<sup>96</sup>**

--Would you see this reporter as sympathetic to the insane? Why or why not? What is the purpose of this piece? What effect does the writer aim to achieve?

**c. Primary, 1850: The Treatment of Lunatics**

**“One of the most gratifying results of the present day is found in the moral treatment of lunatics. The report of the missionary at Blockley Almshouse discloses some intensely interesting facts. The proportion of those who have been partially or entirely cured has been 33%, a far greater ratio than has been reported at any previous period. He reads the whole of the Episcopal service and finds a respectfully attentive audience... Here is the fact: lunatics like to assemble, hear attentively, and join reverently in prayer and praise.”<sup>97</sup>**

--Most hours of the day, ‘lunatics’ would be forced into hard labor. It may be that they were happy to hear a long sermon because it freed them from work. Look up the logical fallacy called “false cause.” Can you explain why this author might be committing this fallacy?

**d. Reforming the poor, primary source from 1855**

**1855: The daily cost of an inmate at the Blockley Almshouse is 22 cents per day. Of the five or six thousand paupers more than half were of competent ability to earn their own living. No reasonable doubt could be entertained concerning the bulk of this floating multitude, that if a suitable place were provided for their compulsory employment, a large majority of them could earn their own support. (We need to) set to work this great army of vagrants, drunkards and paupers and eradicate their vicious habits, and transform them into industrious, sober, stay-at-home citizens.”<sup>98</sup>**

--What are the attitudes towards the poor you see in this article? Justify your claim with evidence from the text.

--Are these attitudes different or similar to how we view poverty today?

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<sup>96</sup> “Vagaries of Insanity.” *Saturday Evening Post*, Philadelphia, Sept. 21, 1861.

<sup>97</sup> “The Treatment of Lunatics.” *Episcopal Recorder*, Philadelphia, April 6, 1850.

<sup>98</sup> “Employment for the Poor.” *Pennsylvania Journal of Prison Discipline and Philanthropy*. April, 1855.

e. On gender: a primary from 1882

**“Last Tuesday there expired at the Blockley Almshouse, John Talboy Binns, a man sixty nine years of age. Believing himself to be a woman and affecting women’s ways, he was dubbed in the institution ‘Sally’ Binns. Clad in feminine attire whenever a ball or concert was given for the patients, he affected an effeminate voice and acted in every respect like one of the female sex. He had a great taste for drawing, painting and embroidery and all the feminine arts dear to the hearts of the gentler sex. He produced rare specimens of lace and fancy work, and was especially skillful in working slippers. Everybody who visited the House called on “Sally” and purchased specimens of his handiwork, considering it a rare curiosity as coming from the hand of a man.”<sup>99</sup>**

--Sally was seen as insane by her society. How would we see her today?

--Look at the way Sally is described. Do you think the description is disrespectful? Explain.

f. Saving money by turning ‘paupers’ into nurses: primary from 1870

**“These (pauper nurses) are persons whose companions are the most abandoned, whose haunts are the most degraded, and whose lives are about equally spent between the Almshouse and the prison. They are detained against their will, they work reluctantly, they are insensible to praise, and have no fear of punishment. They perform no labor which they can avoid and do nothing right that is easier to do wrong. When required to lay hands on a patient, they do it in a most provoking manner.”**

--how do the ‘nurses’ described in this passage treat their patients? Explain, using evidence from the excerpt.

--Look at this website from the World Health Organization on elder abuse: <https://www.who.int/news-room/fact-sheets/detail/elder-abuse>

Does this website suggest that our treatment of the aged is better, worse or the same as it was in the 19<sup>th</sup> century?

Standards

Pennsylvania Department of Education, Academic Standards for History, June 1, 2009

8.1.7.B. Identify and use primary and secondary sources to analyze multiple points of view for historical events.

8.2.7.A. Identify the social, political, cultural, and economic contributions of specific individuals and groups from Pennsylvania.

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<sup>99</sup> “A Queer Character Gone.” Washington Post, Sept. 23, 1882.

8.2.7.B. Identify the role of local communities as related to significant historical documents, artifacts, and places critical to Pennsylvania history.

8.2.7.C. Explain how continuity and change have impacted Pennsylvania history as related to local communities. • Belief systems and religions • Commerce and industry • Technology • Politics and government • Physical and human geography • Social organizations

8.3.7.D. Examine conflict and cooperation among groups and organizations in U.S. history. • Ethnicity and race • Working conditions • Immigration • Military conflict • Economic stability

#### Educating For American Democracy Standards

What forms does civic participation take? Who has access to different forms of participation, and how has that access changed over time? HDQ1.3B

How has the definition of who is an American changed over time? HSGQ3.3C

Did the American Civil War and Reconstruction function as a second American revolution? HSGQ5.3C

How has immigration law affected the development of the United States? HSGQ5.3E