Abundance, Dependence, and Trauma at Philadelphia's Point Breeze Petroleum Refinery: A Mirror on the History of Pennsylvania's Oil Industry

Catastrophic fire struck the Atlantic Refining Company petroleum refinery at Point Breeze on June 11, 1879. Lightning sparked this first conflagration at the plant, and it was devastating. The blaze destroyed twenty-five thousand cases of petroleum stored at Atlantic's Schuylkill River docks, as well as five foreign ships. Six other ships were towed away before they ignited. Fire destroyed virtually every structure at the works, including the office and the superintendent's house, the cooperage, the tin shop (which made cans for shipping oil), and refining equipment. Fueled by oil that saturated the ground, the fire continued to burn long into the night. Two days later, lingering flames from one of the burning ships at the wharf spread under increasing winds to more of the oil company's waterfront property. In total, about a half mile of Philadelphia's waterfront was destroyed. Amazingly, firemen, sailors, workmen, and nearby residents escaped injury, but an estimated two thousand men were thrown out of employment, most sailors lost all their belongings, and some houses were destroyed.[1] Rather than marking an exception, however, this fire highlights Pennsylvania's often traumatic relationship with the commodity that it introduced to the world in 1859.

Crude oil gains value only with refinement and transshipment. Although far from oil wells, locales such as Point Breeze, where petroleum and its products are transported and processed, mark important cogs in the creation of the commodity petroleum and are revealing sites of historical inquiry. As a commodity, of course, petroleum becomes valuable when it has been moved and processed into the products that are now integral

[1] "Acres Blaze," *Philadelphia Inquirer*, June 12, 1879, 8; "Half a Mile of Ruins," *Philadelphia Inquirer*, June 14, 1879, 2; "Struck Oil: A Great Fire at Point Breeze," *Philadelphia North American*, June 12, 1879, 1.

Fig. 1. Aerial view to the northwest of the Point Breeze refinery in Philadelphia, 1926. Atlantic Refining's south yard is at the center of the photo, and the Passyunk Avenue Bridge crosses the Schuylkill River. The Philadelphia Gas Works is along the north side of Passyunk Avenue on the east side of the river, and Atlantic Refining's north yard is beyond the gas works on the bend of the river. The arrow at the lower center of the photo points to a black dot, which is the location of the 1962 sewer explosion that killed four construction workers. Photo no. 70.200.02453, Dallin Aerial Survey Company Collection, Hagley Museum and Library, Wilmington, DE, used by permission of the Hagely Museum and Library.

to human society. Most petroleum processing occurs at refineries, such as the Point Breeze facility, which separate crude into several constituent components called fractions. Refineries remove impurities and chemically reconfigure some fractions into diverse marketable products. But the business of refining oil is full of danger.

Today's refineries process millions of gallons of flammable, hazardous materials daily, and they pose significant risks to workers, neighborhood residents, and the environment. Events such as the 1879 fire, as well as oil

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leaks, explosions, accidents, and environmental damage at Point Breeze demonstrate the hazardous nature of refining. Point Breeze supplied the market with significant volumes of petroleum products, but the transportation, storage, and processing of oil there has had dire consequences for people and the environment throughout the facility's existence. The history of the Atlantic Refining Company at Point Breeze demonstrates that the oil industry embarked on a long trajectory of technological and organizational change to make the most economical use of crude oil, given changing market conditions. Point Breeze's history also shows that, despite efforts by industry and government to improve the safety and environmental impacts of oil refining, transporting and processing crude oil and its products continue to be sources of trauma for both people and environments (Fig. 1).

That crude oil both brings great benefit and is by nature a volatile commodity is now a basic reality of humans' relationship with the substance. On one hand, it is often celebrated, more than other fossil fuels (i.e., coal and natural gas), for liberating Americans from limitations on consumption imposed by their bodies and environmental conditions. Oil holds its distinct place in Americans' hearts because it has been the fuel that made relatively long-distance and high-speed personal mobility seem so effortless, thanks to the automobile and its gasoline-fueled internal-combustion engine. But as environmental historian Bob Johnson writes, oil has a darker side that Americans often don't want to contemplate. It has given rise to some of the largest corporations, which wield inordinate control over political and economic life in the United States and throughout much of the world. Its extraction, transport, processing, and use can sometimes lead to catastrophic accidents that result in maimed bodies and the loss of lives. And oil has dire consequences for the environment when it leaks or spills and when the byproducts of its combustion are discharged into the atmosphere. Johnson calls Americans' two-sided relationship with oil—profound dependence combined with safety and environmental disasters—*traumatic*, and like other traumas, oil's disasters have had long-term consequences for both individuals and society.[2] The history of refining at Point Breeze exemplifies this Janus-faced interplay of dependence and environmental consequences and places Philadelphia on the front line of this traumatic relationship.

[2] Bob Johnson, *Carbon Nation: Fossil Fuels and the Making of American Culture* (Lawrence, KS, 2014), xxv–xxvii, 134–62.

From its beginning, America's petroleum industry has featured serious losses of oil to the environment.[3] Production from oil fields, first in Pennsylvania, then in Ohio, West Virginia, and New York, and eventually elsewhere in the nation and throughout the world, led to local discharges on land, into waterways, and, often thanks to fires, into the atmosphere. Cross-country pipelines leaked. Loading and unloading ships with crude oil and petroleum products polluted the nation's harbors. Refineries near population centers posed threats of fire and explosion to their neighbors. Each of these forms of environmental degradation led to calls for regulation of the oil industry, but the industry was able to keep legislatures at bay until well into the twentieth century by arguing that, rather than fettering the industry with the costly apparatus of regulation, the engineering ideals of efficiency offered the solution to the problem. Engineers were professionally driven, so the argument went, to find ways to eliminate waste. It was in the economic interest of the oil companies to enable engineers to do just that. Because the elimination of waste would yield the additional benefit of reducing pollution, industry advocates urged legislatures to be patient.[4]

The Point Breeze refinery exemplifies self-regulation by the industry during its first decades. Its engineers and managers focused on improving the efficiency of the refinery's operations and thereby its profitability. Oil output at Point Breeze and by the industry overall grew tremendously, but at the same time, companies continued to discharge pollutants. Serious pollution continued because the engineering ideal of efficiency only went so far in abating losses of hydrocarbons to the environment. If a technological innovation that could reduce waste (and, therefore, reduce loss to the environment) did not also yield a financial return to a company (either in recovered marketable material or in savings due to fewer lawsuits) that was greater than the cost of implementing the innovation, then the innovation simply would not be adopted. Particularly in the refinery industry, growth without stringent regulation often worsened pollution problems.

Beginning in the 1920s and especially after World War II, legislatures finally realized that the efficiency ideal would not abate the problem and

[3] For environmental hazards in Pennsylvania's early oil extraction and transport, see Brian Black, *Petrolia: The Landscape of America's First Oil Boom* (Baltimore, 2000), 26, 84–91.

[4] This and the next paragraph are a brief synopsis of an excellent book on the subject: Hugh S. Gorman, *Redefining Efficiency: Pollution Concerns, Regulatory Mechanisms, and Technological Change in the US Petroleum Industry* (Akron, OH, 2001).

that governments had to regulate the oil industry. Regulation placed new importance on measuring and monitoring losses of material, especially contaminants, to the environment. Since the introduction of regulatory regimes, engineering expertise has been employed in part to help the oil industry remain profitable by finding ever more efficient ways to comply with environmental regulations.[5] At Point Breeze, management finally acceded to new government regulations in the 1920s and 1930s and began measuring and monitoring leaks and other losses. The refinery has nevertheless continued to be a source of loss to the environment up to the present century, in part because a refinery like the one at Point Breeze processes such large volumes of material on a continuous basis. Some of the loss has been through evaporation and flaring, and much has been a result of leaks into the ground. Leaks were and continue to be hard to detect, but a conservative estimate suggests that with a capacity to treat 160,000 barrels of petroleum daily in 1972, for example, Point Breeze, an old refinery, could have been losing 1,600 barrels of oil or product to the environment each day without raising alarm. Some 800 barrels per day, or 290,000 barrels (12 million gallons) yearly, could well have leaked to the subsurface without managers being aware that a slowly developing catastrophe was underway. As described below, slow-moving catastrophes did occur at Point Breeze.[6]

Prior to investigating such long-term implications, this essay first discusses the business and technological developments at Point Breeze in the context of a nascent industry, ownership and managerial developments, and the struggle for engineering efficiency in a regime of self-regulation. Developments at Point Breeze align with the rapid increase in demand for oil products, underscoring one side—the side of increasing dependence on the resource and its products—of the traumatic relationship Johnson describes. Next, the article explores the costs of this dependence for the safety of workers, residents, and the Philadelphia environment.

[5] This shift in the understanding of efficiency is the basis for Gorman's title, *Redefining Efficiency*.

[6] Hugh Gorman estimates that nearly 20 percent of the petroleum extracted from the ground at the turn of the twentieth century was lost to the environment by the oil industry before it made it to market. One hundred years later, that loss had dropped to less than 1 percent, due to a combination of government regulation and improved efficiency by the industry; see Gorman, *Redefining Efficiency*, 3–5. A loss of less than 1 percent might seem insignificant, but it can still be a huge amount, because of the vast volume of hydrocarbons a refinery such as Point Breeze processes daily. A 1972 article in *Oil & Gas Journal* about tools for conserving resources makes the point. The article describes mass-balance calculations, which compare the mass of material charged to the refinery with the mass yielded by the refinery processes. The article reported that, in that era, mass balances for new oil refineries could be

Beginnings of Oil Dependency and Abundance at Point Breeze

The Point Breeze area of Philadelphia lies along the east bank of the Schuylkill River a couple of miles above its confluence with the Delaware River (Fig. 2). Point Breeze forms a portion of a larger area of the city called South Philadelphia, which is that part of the city between the two rivers and south of the original southern boundary of Philadelphia at Cedar, now South Street. The area south of South Street was comprised of small colonial settlements and farms. Today's Oregon Avenue runs east from the Point Breeze area. Much of the area south of Oregon Avenue, historically called the Neck, was marsh and wet meadow. Most of the east bank of the Schuylkill River in South Philadelphia was tidal mudflat, the exception being a section south of Point Breeze called the Passyunk Bank, which sat about twenty feet above the river. The high ground along Passyunk Bank became an attractive location for early shipping and industrial facilities.[7]

The oil industry was not America's first fossil fuel industry. Nor was it the first fossil fuel industry in the Point Breeze section of Philadelphia; that distinction belonged to the Philadelphia Gas Works (PGW), which manufactured gas from coal. The City of Philadelphia chartered a private gas company to manufacture and distribute gas in 1835, and the next year the company built a plant on the north side of Market Street near the Schuylkill River to do so. Discord between the city council and the company's stockholders led the city to take possession of the gas works in 1841. Demand for gas grew, and the city constructed a second gas manufacturing plant on the east side of the Schuylkill River at Point Breeze. Like the original gas works, the site at Point Breeze was chosen to facilitate deliveries of coal by ship or barge. The Point Breeze works went into operation in December 1854. PGW still occupies its Point Breeze site, but it ceased manufacturing gas there in 1964.[8]

as close as 99.5 percent, the remaining 0.5 percent being lost through leaks, flaring, evaporation, and other means. Mass balances for older refineries would only be as close as 99 percent, meaning that 1 percent of the material charged to the refinery could be lost, without the managers knowing how it was being lost. O. A. Kozeny and E. J. Stanton, "Energy and Material Conservation in Refineries," *Oil & Gas Journal*, Nov. 6, 1972, 82. On the Point Breeze refinery's capacity in 1972, see "U.S. Refineries: Where, Capacities, Types of Processing," *Oil & Gas Journal*, Mar. 27, 1972, 152.

[7] Mary Maples Dunn and Richard S. Dunn, "The Founding, 1681–1701," in *Philadelphia: A 300-Year History*, ed. Russell F. Weigley (New York, 1982), 3–10; Martin P. Snyder, *City of Independence: Views of Philadelphia before 1800* (New York, 1975), figs. 26, 45–50, 59–60, and 66, and color plate 4.

[8] Oscar E. Norman, *The Romance of the Gas Industry* (Chicago, 1922), 42–44; "Our Gas Works Started in 1836," *Philadelphia Evening Bulletin*, Feb. 5, 1964; "Phila. Gas Works Created by Council 125 Years Ago," *Philadelphia Evening Bulletin*, Mar. 27, 1960, 3; W. Van Dusen, "Early History of the Point Breeze Plant of the Philadelphia Gas Works," *U.G.I. Circle*, Aug. 1922, 8.

Fig. 2. Detail from US Geological Survey topographical map of Philadelphia. Note the Point Breeze area and the underdeveloped lands of "the Neck." The Atlantic Refining Company's south yard is the development just west of the label, "Point Breeze." The Atlantic Refining Company's north yard is the development on the north curve of the river, just northwest of the south yard. US Geological Survey, "Pennsylvania—New Jersey, Philadelphia Sheet" (Washington, DC, 1898).

The business that would grow to become the Point Breeze petroleum refinery set up operations south of the gas works in 1866. As soon as oil wells in western Pennsylvania went into production beginning in 1859, entrepreneurs tried to find the most competitive system for refining, transporting, and marketing petroleum and its products. A group of Pittsburgh entrepreneurs, Charles Lockhart, William Frew, and William G. Warden, formed the Atlantic Petroleum Storage Company in 1866 to capitalize on Philadelphia's market and shipping facilities, hoping thereby to take control of some of western Pennsylvania's petroleum output. Lockhart, the new company's president, was a Pittsburgh businessman who, since the mid-1850s, had been selling petroleum from a saltwater well to Sam Kier, an early distiller of petroleum. Lockhart and Frew bought wells in the oil region and then quickly built a refinery at Pittsburgh. Shortly after Warden joined Lockhart and Frew, he moved to Philadelphia to begin marketing their crude oil and petroleum products. In 1866, the group formalized their business with the incorporation of Atlantic Petroleum Storage. The new company's storage and shipping facility was located on the east side of the Schuylkill River along Passyunk Bank, which offered a convenient wharfing location for transatlantic ships, as Liverpool had developed into a major market for new oil products. Atlantic Petroleum Storage Company featured two departments: Empire Stores, for storing and shipping crude oil, and Atlantic Stores, for storing and shipping products refined in Pittsburgh.[9] Still another entrepreneur, Philadelphian B. J. Crew, established a one-still refinery on land just south of the Empire Stores, which he called the Atlantic Petroleum Refinery.[10]

[9] "100 Years of Progress," centennial issue of *ARCO: The Magazine of the Atlantic Richfield Company*, Nov.–Dec. 1966, 5–10, and reprint of promotional brochure and map, 1866, for the Atlantic Petroleum Storage Company (copy held by the Hagley Museum and Library, Wilmington, DE); Ron Chernow, *Titan: The Life of John D. Rockefeller* (New York, 1998), 163.

[10] "100 Years of Progress," reprint of promotional brochure and map; "B. J. Crew's Atlantic Petroleum Refinery," *Hexamer General Surveys*, vol. 2 (Philadelphia, 1866), plate 105, Map Collection, Free Library of Philadelphia. B. J. Crew was a chemist who started a small petroleum refinery in Philadelphia with his brother, J. Lewis Crew, in 1862. Since 1849, they had been in business together manufacturing chemicals. B. J. left his brother a few years after 1862 to pursue his own business, first refining oil near Atlantic Petroleum Storage's warehouses and then manufacturing pharmaceuticals in Philadelphia. Meanwhile, Lewis Crew partnered with Lewis Levick to continue refining oil; see *Medical and Surgical Reporter* 18 (May 2, 1868): 397; *Pharmacist and Chemical Record*, Oct. 1869, 114; *The Biographical Encylopaedia of Pennsylvania of the Nineteenth Century* (Philadelphia, 1874), 615; and "London View of Crew-Levick Deal," *Petroleum Gazette*, Sept. 1916, 10. The nature of B. J. Crew's exact relationship with Atlantic Petroleum Storage is not known.

By the end of the 1860s, the owners of Atlantic Petroleum Storage Company had found that, with limited refining capacity in Philadelphia and with most of its finished product coming from Pittsburgh and the oil region, it could not compete with enterprises that had refineries along the Atlantic Coast, because it was more costly to ship packaged finished products than to ship crude oil in bulk. Lockhart, Frew, Warden, and some other associates reorganized their business as the Atlantic Refining Company, with Lockhart as president and Warden as general superintendent. Crew's little refining operation disappeared, and the reorganized company located its own refinery just north of the storage warehouses and south of the Philadelphia Gas Works' Point Breeze facility. The new refinery had greater capacity, with four stills and extensive facilities for processing distillates and packaging finished products.[11] This arrangement allowed Atlantic Refining to move crude oil in bulk to Philadelphia and then to ship packaged products to nearby and foreign markets.

Similar to other early refiners, the Atlantic company needed to meet the technological challenges of the industry. Petroleum had to be treated before it was ready for the consumer market. Crude oil is a liquid comprised of an assortment of hydrocarbon molecules, some with small numbers of carbon atoms and some with many. Hydrocarbon molecules with between one and four carbon atoms are gaseous at ambient temperatures and pressures. Molecules with more carbon atoms are liquid at ambient temperature and pressure, and the more carbon atoms they have, the higher their boiling point and the more viscous they are. In fact, hydrocarbon molecules with more than twenty-five or thirty carbon atoms are so viscous that they are barely liquid at all; they have to be heated so they can flow. The largest molecules are asphalt. All the varieties of hydrocarbon molecules are mixed together in crude oil, much the way alcohol and water are mixed together in a bottle of whiskey. Distillation, the first step in refining crude oil, uses the different boiling points of the hydrocarbons to evaporate them and then condense them at different temperatures, thereby separating them into useful fractions. For example, hydrocarbons with between five and twelve carbon atoms are said to be in the gasoline range. (Pentane, with five carbon atoms, boils at ninety-seven degrees Fahrenheit and is typically too volatile to be included in gasoline fuel.) Hydrocarbons with between

[11] "100 Years of Progress," 10–11, and reprint of promotional brochure and map; "Atlantic Refining Company," *Hexamer General Surveys*, vol. 7 (Philadelphia, 1872), plates 562–63, Map Collection, Free Library of Philadelphia.

eight and sixteen carbon atoms are said to be in the kerosene range. Larger hydrocarbon molecules comprise oils useful for lubricating, furnace fuel, and asphalt, among other uses. In the early years of the oil industry, the most important marketable fraction was kerosene, used as illuminating oil. Refining amounted to little more than distillation of the crude oil and then treatment of the distillates, first with sulfuric acid and then with caustic soda and then with several water washes after each treatment.[12]

The oil industry had a very fluid and volatile structure at its outset, as numerous entrepreneurs like Warden and Lockhart had rushed to capitalize on new opportunities to generate wealth. Some speculators had gone directly to the oil regions of western Pennsylvania to drill wells, hoping to strike the liquid, black gold. Boomers pumped more oil into the nascent market than it demanded in the first few years, but then demand surged to meet supply, as more potential customers learned the benefits of kerosene as an illuminant and of heavy oils as lubricants. Other entrepreneurs had rushed into the downstream segments of the industry: transportation, refining, and marketing. No one knew yet the most effective means to transport a bulk liquid commodity across long distances. And no one was sure how the vertical structure of the industry should be organized or where best to locate refineries. Should they be located in the oil regions, or in Pittsburgh, or near customers?[13]

Point Breeze and the Standard Oil Trust

The Point Breeze facility that Lockhart and Warden were developing grew in capacity because they had chosen to cooperate with the monopolistic ambitions of John D. Rockefeller. The initial years of the oil industry attracted a competing collection of producers, refiners, shippers, and investors; this free-for-all encouraged too much pumping and too much refining. As a result, consumers were enjoying prices so low that refiners could not make a profit.[14] Seeing the excessive refining capacity in the country, Rockefeller set about consolidating that segment of the industry in 1870, beginning in Cleveland,

[12] Harold F. Williamson and Arnold R. Daum, *The American Petroleum Industry: The Age of Illumination, 1859–1899* (Evanston, IL, 1959), 215–27; William L. Leffler, *Petroleum Refining in Nontechnical Language* (Tulsa, OK, 2000), 9–13, 50–55.

[13] Daniel Yergin, *The Prize: The Epic Quest for Oil, Money, and Power* (New York, 2008), 10–18, 21–22; Brian Black, "Oil Creek as Industrial Apparatus: Re-Creating the Industrial Process through the Landscape of Pennsylvania's Oil Boom," *Environmental History* 3 (1998): 214–23.

[14] Yergin, *The Prize*, 10–18, 21–22.

where he established the Standard Oil Company of Ohio. At the start, Rockefeller's refining company had about 4 percent of the refining capacity in the United States. By 1871, Rockefeller owned nearly all the refineries in Cleveland, giving him control of about a quarter of the nation's refining capacity. He next set his sights on refineries in Pittsburgh and Philadelphia, each also home to about a quarter of US refining capacity. Rockefeller's strategy was to bring the largest refiners in each city into Standard Oil, and that meant bringing in Lockhart and Warden. In 1874, they accepted Rockefeller's invitation to sell their Pittsburgh and Philadelphia operations to Rockefeller's Standard Oil Company in exchange for Standard Oil stock and the opportunity to be part of Standard's management structure. Lockhart and Warden then turned their attention, with Rockefeller, to the smaller refiners in Pittsburgh and Philadelphia, either acquiring them or forcing them out of business through cutthroat pricing. Rockefeller used a similar method to take control of the refining industry in New York. By 1879, Rockefeller and his Standard Oil Trust controlled over 90 percent of the nation's refining capacity.[15]

The Atlantic Refining Company (still a distinct corporate entity within the Standard Oil Trust) acquired the Philadelphia Refining Company's refinery on the north side of the Philadelphia Gas Works in 1878. Atlantic integrated the two facilities into a single refinery, despite their being separated by the gas works. The Philadelphia refinery came to be known as Atlantic's Philadelphia yard and eventually as Atlantic's north yard (with the Atlantic refinery known as the Atlantic yard and then the south yard). The north yard came to specialize in treating heavy oils, such as asphalt, paraffin, and lubricating oils, and the south yard treated light fuels, such as gasoline and kerosene (Fig. 3). Atlantic also acquired some smaller refineries in the Philadelphia area and took them out of operation. In 1892, Standard Oil placed all of its interests in Pennsylvania and Delaware in Atlantic's hands. That included the Philadelphia properties as well as a refinery in Pittsburgh and a refinery at Franklin in western Pennsylvania's oil region.[16]

[15] "100 Years of Progress," 10–11; Elizabeth Granitz and Benjamin Klein, "Monopolization by 'Raising Rivals' Costs': The Standard Oil Case," *Journal of Law and Economics* 39 (1996): 1–2, 8–9; Chernow, *Titan*, 162–63; Yergin, *The Prize*, 23–24. Note that Granitz and Klein claim that Pittsburgh and Philadelphia each had about a quarter of the nation's oil refining capacity when Rockefeller began to make his play for their refineries, but Williamson and Daum, *Age of Illumination*, table 12:1, p. 291, show Pittsburgh with about a fifth of the nation's capacity and Philadelphia with only about 4 percent.

[16] "100 Years of Progress," 10–11, 15; Indenture between the Philadelphia Refining Company and the Atlantic Refining Company dated Oct. 30, 1878, Deed Book DHL 206, pp. 79–84, Philadelphia City Archives; G. M. Hopkins, *Atlas of the City of Philadelphia, 1st, 26th, 30th Wards*, (Philadelphia,

Fig. 3. Atlantic Refining Company's south yard, ca. 1920. This view to the east shows Atlantic Refining's shipping wharf along the Schuylkill River in the lower portion of the photo, the crude distillation stills (each still with its own stack) along the right edge of the photo, the light-fuels treatment area in the left portion of the photo, and petroleum storage tanks in the background. Photo no. P.8990.1861, Aero Services Collection, Library Company of Philadelphia. By permission of the Library Company of Philadelphia.

Although Atlantic was a distinct corporate entity in the Standard Oil enterprise, it operated as a refinery department of the Standard Oil organization. Other elements of the Rockefeller enterprise supplied the Point Breeze refinery with crude oil and marketed the refinery's product, and Standard Oil managers in New York directed overall operations. Thus Standard Oil was able to transfer two of its top refinery managers from Lima, Ohio, to Philadelphia in 1903. J. W. Van Dyke was made manager

1885), plate 12; "Ladenburg, Thalmann & Co's Oil Shipping Yard," *Hexamer General Surveys*, vol. 20 (Philadelphia, 1885), plates 1884–85; George W. and Walter S. Bromley, *Atlas of the City of Philadelphia*, vol. 7, *22nd Ward* (Philadelphia, 1889), plate S; Herman LeRoy Collins, *Philadelphia: A Story of Progress* (Philadelphia, 1941), 94–95; Chernow, *Titan*, 162–63.

of the Point Breeze refinery and W. M. Irish his assistant. In terms of capacity, the Point Breeze refinery was second only to the plant at Bayonne, New Jersey, among Standard Oil's refineries (third largest was the refinery at Whiting, Indiana, near Chicago).

Led by Van Dyke and Irish, Atlantic became a pioneer of improved refining technologies, including distillation methods. For example, Atlantic's Max Livingston was the first American to develop a practical method for continuous distillation, in which a series of connected stills brought the charge of oil to successively higher temperatures, each still evaporating a different fraction of hydrocarbons. In a different approach, Irish and Van Dyke developed a tower still in 1904 and received a patent for it in 1913, and Atlantic built some of them at Point Breeze. A tower still brought the charge to a temperature high enough to evaporate most of the hydrocarbons. Vapors then passed through successive condensers, which distilled different fractions of hydrocarbons. These technological improvements aimed to make operations more efficient and therefore more profitable; if they reduced losses of hydrocarbons to the environment, that improvement would have been incidental. Within a few years, Standard Oil had converted many of its other refineries to use tower stills.[17]

The Point Breeze refinery continued as an integral part of the Standard Oil empire until 1911, when the US Supreme Court ruled that the giant trust was in violation of the Sherman Antitrust Act of 1890 and had to be dissolved. The trust refined more than 75 percent of the crude oil in the United States; it transported more than 80 percent of oil produced in Pennsylvania, Ohio, and Indiana; it sold more than 80 percent of the kerosene in the country; and more than 80 percent of US kerosene exports were Standard Oil's. US railroads bought more than 90 percent of their lubricating oils from Standard Oil. In July 1911, the trust announced its dissolution plan, which specified that each of its major subsidiary operating companies, including Atlantic, would become an independent corporation, conducting its business independently of the others. Although

[17] Charles F. Wilner, *J. W. Van Dyke: The Story of a Man and an Industry, Correlated with a Short History of the Atlantic Refining Company, 1870–1936* (Philadelphia, 1936), 4–8; J. W. Van Dyke and W. M. Irish, Process of and Apparatus for Distilling Petroleum, US Patent 1,073,548 (filed Oct. 4, 1909, and issued Sept. 16, 1913), US Patent 1,095,438 (filed Apr. 18, 1911, and issued May 5, 1914), and US Patent 1,143,466 (filed May 16, 1914, and issued June 15, 1915); "Largest Refinery Center in World Got Its Start in Third Era," *Oil & Gas Journal*, Aug. 21, 1934, 104–6, 146; "Grew in Oil Atmosphere," *Oil & Gas Journal*, Aug. 20, 1936, 141; "100 Years of Progress," 56–57; Paul H. Giddens, *Standard Oil Company (Indiana): Oil Pioneer of the Middle West* (New York, 1955), 61; Harold F. Williamson et al., *The American Petroleum Industry: The Age of Energy, 1899–1959* (Evanston, IL, 1963), 124–28.

Atlantic and the other companies, such as Standard of New Jersey (now the Exxon of ExxonMobil), Standard of New York (now the Mobil of ExxonMobil), Standard of Indiana (now Amoco, which has merged into BP), and Standard of California (now Chevron), did not compete in each other's territories in the early decades after the dissolution, the breakup of Standard Oil nevertheless introduced a degree of competition into the US oil industry that had been lacking since the end of the 1870s.[18]

At the time of the trust's dissolution, Van Dyke was president of the Atlantic Refining Company, and Irish was his vice president. Restructuring presented Atlantic's leaders with several immediate problems. Although the company owned three refineries in Pennsylvania—the one at Point Breeze as well as refineries in Pittsburgh and Franklin—the company did not have its own source of crude oil. In the short term, Atlantic had to bid against competitors to acquire petroleum on the open market, but Van Dyke quickly assembled an organization to find and acquire oil-producing properties in Kentucky, Texas, Louisiana, and Arkansas. Atlantic's other major problem concerned marketing. Atlantic sent 60 percent of its output, including 80 percent of the Point Breeze refinery's production, to overseas markets, and yet Atlantic had no export organization. That, too, had been handled by Standard Oil. In the short term, Atlantic sold its product to Standard companies that had foreign sales organizations, but Atlantic quickly developed its own marketing offices in Paris, Copenhagen, and elsewhere, and it entered a partnership with Anglo-American Oil Company to conduct sales in England.[19]

Refining Technologies and the Transition to the Automobile Era

The dissolution of the Standard Oil Trust occurred as markets for petroleum products were rapidly shifting and stimulating profound changes in the ways oil companies, including Atlantic, refined petroleum. Throughout the nineteenth century, kerosene had been the industry's most important product, with lubricating oils comprising most of the rest of the market. During the oil industry's first several decades, gasoline, which might comprise about 18 percent of the hydrocarbons available in a typical crude oil, had largely been a waste product of the distillation process. The

[18] Yergin, *The Prize*, 91–94. Since the dissolution, several of the Standard Oil subsidiaries that became independent in 1911 have merged. For example, Exxon and Mobile are now part of ExxonMobil, and Amoco and Atlantic (which would later become Atlantic Richfield) are now part of BP.

[19] "100 Years of Progress," 17–18, 55–57.

advent of the age of electricity, however, began to have a severe impact on kerosene sales, as people came to prefer the incandescent light bulb to the kerosene lamp. Although kerosene sales continued to grow into the twentieth century, sales of gasoline grew even faster, beginning in the 1890s, with the development of the automobile, powered by the internal-combustion engine and fueled by gasoline. Gasoline sales accelerated in the early twentieth century, as Henry Ford introduced the Model T and the assembly line, making low-priced cars attractive to masses of Americans. Revenue from gasoline sales surpassed those from kerosene in 1914, and the volume of gasoline sold surpassed that of kerosene in 1919. This stimulated technological improvement in the oil industry to make more efficient use of the hydrocarbon molecules available in crude oil.[20]

Because the gasoline fraction typically comprised only about 18 percent of crude oil, refiners worried that production of crude oil could not keep pace with accelerating demand for gasoline. A technical solution lay in a process that made it possible to break apart the larger molecules of a fraction of crude oil, called gas oil, into the smaller molecules of the gasoline range. Gas oil, with molecules having between fourteen and twenty-three carbon atoms, is the fraction between kerosene and the heavier lubricating and fuel oils, and there was little market for it. Prior to the 1910s, refiners had been using very high temperatures and ambient pressures, in a process called destructive distillation or "cracking," to break gas-oil molecules into kerosene molecules, thus increasing the supply of the kerosene fraction when illuminating oil was the industry's principle product. In the early twentieth century, researchers began looking for practical means to use high temperature and high pressure to break gas-oil molecules into molecules in the gasoline range, thus increasing the proportion of crude oil that could be marketed as gasoline. The most significant commercial breakthrough occurred at Standard of Indiana's Whiting refinery, where William Burton developed and patented a process for thermal cracking that quickly became the industry standard. By 1920, several former subsidiaries of the Standard Oil Trust and some previously independent refining companies had obtained licenses from Standard of Indiana to use the Burton process. This was a period of rapid technological change, however, and several other innovators were also developing thermal-cracking methods and equipment.[21]

[20] Williamson and Daum, *Age of Illumination*, 485, 615; Williamson et al., *Age of Energy*, 111–12; Yergin, *The Prize*, 94–96.

[21] Williamson and Daum, *Age of Illumination*, 218–21; Williamson et al., *Age of Energy*, 132–50; Yergin, *The Prize*, 94–96.

The first cracking stills Atlantic Refining installed may have been for the Burton process. When the American Chemical Society (ACS) met in Philadelphia in September 1919, its members toured several industrial facilities in the city, including Atlantic's Point Breeze refinery. A description of the tour in the October 15 issue of *Chemical and Metallurgical Engineering* features two photographs of stills at the Atlantic refinery, one labeled as "high pressure horizontal Burton process stills" and one as "high pressure vertical Burton stills."[22] The horizontal stills may well have been Burton cracking stills, but the vertical stills were those developed and patented by Atlantic's Joseph W. Lewis, who followed Irish's and Van Dykes's example of technological innovation at the Point Breeze refinery.[23]

Lewis had long been superintendent of the Point Breeze refinery, and for several years his process was Atlantic's sole method for cracking heavier oils to make gasoline-range distillate at Point Breeze as well as at Atlantic's other refineries. Unlike Standard of Indiana, however, which licensed the Burton process to competitors, Atlantic kept the Lewis process proprietary and did not attempt to license it.[24] Atlantic boasted of its unique vertical pressure stills for cracking heavier oils into gasoline. The caption for a drawing of the cracking units in the company's *Story of Gasoline* describes the vertical stills as "original and exclusive Atlantic equipment that assists The Atlantic Refining Company in keeping up with the increasing demand for good, uniform gasoline" (Fig. 4).[25] This indeed was the purpose of cracking: to convert a higher percentage of crude oil into motor fuel. Atlantic's promotional booklet on gasoline includes a drawing of a second set of vertical stills under construction. Aerial photos from the mid-1920s show both sets of Lewis stills in the north yard, helping Atlantic supply Americans' increasing thirst for motor fuel.[26]

As with so much other equipment, however, the vertical pressure stills exhibited the Janus-faced nature of oil refining. Not only did the Lewis

[22] Williamson et al., *Age of Energy*, 148; "Industrial Excursions," *Chemical and Metallurgical Engineering*, Oct. 15, 1919, 488–89.

[23] J. W. Lewis, Method of and Apparatus for Treatment of Petroleum, US Patent 1,364,443 (filed Apr. 19, 1917, and issued Jan. 4, 1921).

[24] Eugene H. Leslie, *Motor Fuels: Their Production and Technology* (New York, 1923), 381; C. O. Willson, "Install Process of Special Design," *Oil & Gas Journal*, May 21, 1925, 24.

[25] Atlantic Refining Company, *The Story of Gasoline* (Philadelphia, 1920), drawing inside front cover, Hagley Museum and Library, Wilmington, DE.

[26] Aero Service Corporation, photographer, "Atlantic Refining Company plant, 3314 Passyunk Avenue, Point Breeze, Philadelphia," photo P.8990.1138 (ca. 1920) and P.8990.6112 (1926), Aero Service Negative Collection, Print Department, Library Company of Philadelphia.

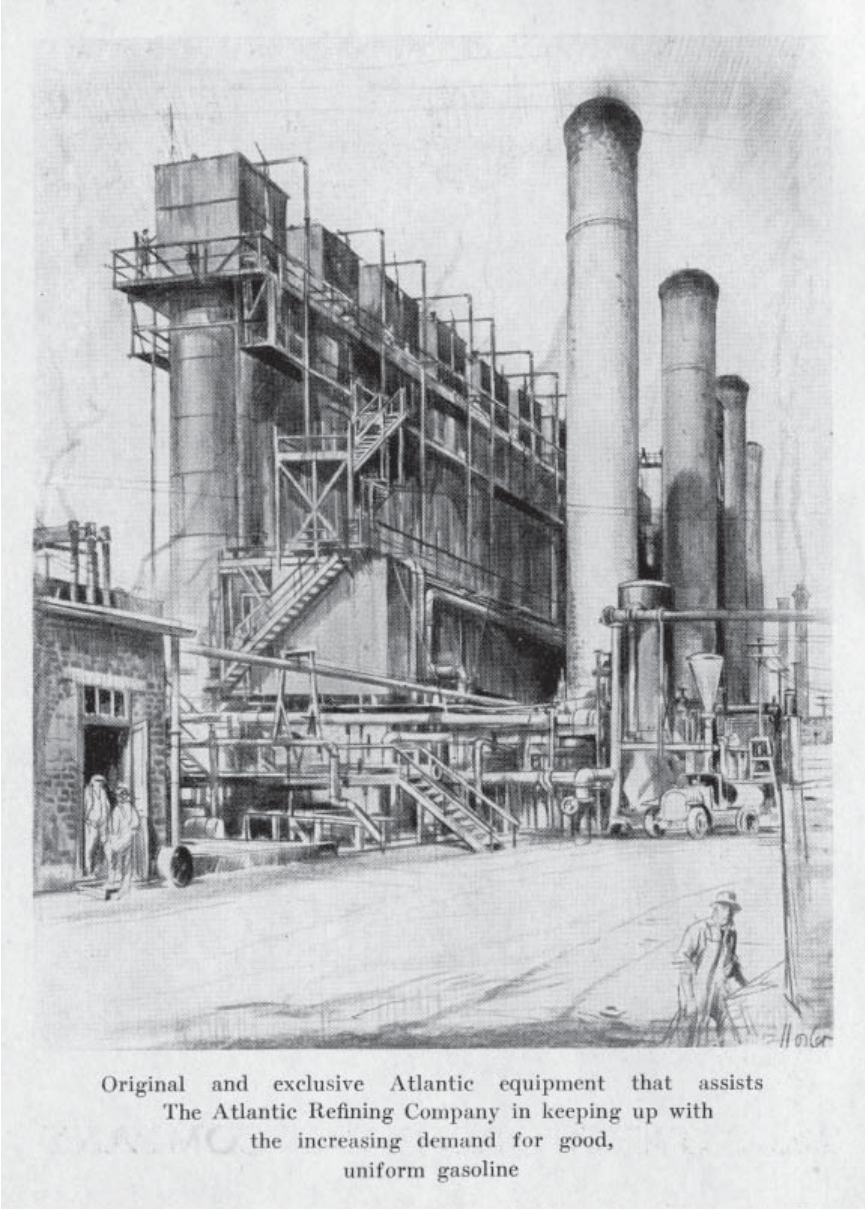

Fig. 4. Drawing of Atlantic Refining Company's Lewis stills, used in the north yard for thermal cracking of gas oil to produce a distillate rich in hydrocarbons in the gasoline range. Atlantic Refining Company, *The Story of Gasoline* (Philadelphia, 1920), Hagley Museum and Library.

stills help Americans acquire the mobility they desired; the vertical pressure stills were fraught with danger. In September 1921, a pipe in the initial set of vertical stills ruptured and the naphtha it was carrying exploded, killing twelve workers.[27] The 1921 explosion at the Lewis stills is just one of a number of catastrophic events at the Point Breeze refinery throughout its history that have led to loss of life and/or significant losses of oil and oil products to the environment.

Environmental Catastrophes at Point Breeze

Numerous catastrophic events have occurred at the Point Breeze refinery, the most widely publicized of which have been fires and explosions. Such disasters were widely reported by the news media when they were accompanied by loss of life. Several of the fires and explosions killed workers and also released large volumes of oil into the environment. Other catastrophes have been less spectacular, but they, too, resulted in large releases.

An early casualty of the development of facilities for processing fossil fuels at Point Breeze was the area's ground water. The earliest known reference to oil contaminating the water table is in the 1884 annual report of the Philadelphia Water Department (PWD). The Philadelphia Gas Works laid a ten-inch water line along Passyunk Avenue, from Broad Street to Schuylkill Avenue along the river, in order to deliver good water to the Point Breeze area, including the gas works. PGW turned the pipe over to the PWD upon completion of the project. The reason PGW made the expenditure was that soil in the Point Breeze vicinity was said to be saturated with "oil and other objectionable matters," making water pumped from shallow wells unfit to use.[28] The gas works had been in operation for thirty years by then, the refinery for almost twenty. The report did not speculate on the source of the oil contamination, but given the propensity of both manufactured gas and oil refining plants to leak hydrocarbons to the environment, the report of contamination is not surprising.[29]

[27] "Explosion of Naphtha Spells Death for Ten," *Philadelphia Record*, Sept. 15, 1921; "Former Blast Victim Explains This Tragedy," *Philadelphia Inquirer*, Sept. 15, 1921; "Blames None for Fatal Oil Blast," *Philadelphia Inquirer*, Sept. 16, 1921.

[28] *Annual Report of the Chief Engineer of the Philadelphia Water Department for the Year 1884* (Philadelphia, 1885), 2.

[29] Joel Tarr, "Toxic Legacy: The Environmental Impact of the Manufactured Gas Industry in the United States," *Technology and Culture* 55 (2014): 107–47.

The huge fire of June 1879 was neither the only nor the last such incident. On August 14, 1921, about a month before the explosion at the Lewis stills in the north yard killed twelve workers, catastrophic fire struck Atlantic's south yard. The fire started in the early morning hours when a steam still exploded, and it spread quickly to three storage tanks holding between 5,000 and 20,000 barrels of refined product. The fire engulfed agitators and about two dozen storage tanks holding a variety of refined and unrefined materials in the treating area of the yard. Within a short time a number of other installations of the refinery had been destroyed, including five steam stills, each containing between 1,500 and 4,000 barrels of oil; four lead-lined agitators, each containing about 1,000 barrels of oil; a concrete oil-water separator containing a large but unestimated volume of oil; five storage tanks, each containing between 5,000 and 20,000 barrels of oil; and four large pump houses equipped for pumping oil to and from ships. The fire threatened but did not reach the administration building on the Schuylkill River bank. Corporate officers organized numerous secretaries and clerks to move the company's books out of the building. Three steamships docked at the refinery were quickly moved away when the fire erupted. All of the damage was confined to what Atlantic called the light oils (naphtha, kerosene, benzine) section of the plant; there was no damage to the north yard. City officials complained that the fire had grown to catastrophic proportions because of Atlantic's policy of having employees try to extinguish refinery fires without calling the fire department. The fire killed six and injured many others.[30]

Dramatic fires and explosions at the Point Breeze refinery continued to take lives and release large volumes of hydrocarbons into the environment throughout the twentieth century.[31] Many other losses, including leaks and spills, went unnoticed for years. Although small at any given time, leaks

[30] "Many Firemen Hurt in Early Morning Point Breeze Blaze," *Philadelphia Inquirer*, Aug. 14, 1921; "4 Dead, 10 Injured by Blazing Oil at Point Breeze Fire," *Philadelphia Inquirer*, Aug. 15, 1921; "Cortelyou Demands Reports on Blaze," *Philadelphia Inquirer*, Aug. 16, 1921; "New Fire Starts at Point Breeze," *Philadelphia Inquirer*, Aug. 17, 1921; "$1,000,000 Blaze at Point Breeze Kills Four Men," *Philadelphia Record*, Aug. 15, 1921; "New Outbreak of Fire in Point Breeze Plant," *Philadelphia Record*, Aug. 18, 1921; "Six Die in Big Oil Fire; Million Dollars Loss," *Oil & Gas Journal*, Aug. 19, 1921, 78.

[31] Other fatal fires at the Atlantic refinery included an explosion and fire in April 1944 that killed three workers; see "Three Killed in Five-Alarm Refinery Fire," *Philadelphia Inquirer*, Apr. 13, 1944. Across a dozen years, from 1962 to 1976, there were four major fires at the Point Breeze refinery, including a fire that killed seven workers in May 1970 and a fire and explosion that injured Philadelphia's Mayor Rizzo in October 1975; see "Region Plagued by Refinery Fires," *Philadelphia Evening Bulletin*, Jan. 24, 1977.

can amount to large volumes if undetected or left unresolved. Such was the case in the early twentieth century, as oil refineries and other sectors of the industry failed to reduce losses to the environment they promised would accompany improvements in efficiency.

That began to change in 1924, when Congress passed the Oil Pollution Act, aimed at protecting the nation's harbors. The American Petroleum Institute formed a committee to study means—including measuring and monitoring—by which refineries could keep oil and oil products out of bodies of surface water. Atlantic's W. B. Hart served on the committee. A few years later, a journalist described what Hart said Atlantic was doing to protect the Schuylkill River from oil pollution. A principal tool at Atlantic and other refineries was the oil-water separator, which was little more than a settling basin that allowed oil and water to separate by gravity. The Point Breeze refinery used separators to treat waste water from processing as well as surface runoff collected in sewers on the property. The latter would otherwise be a significant source of discharge to the river because the ground surface of the refinery was often soaked with oil, and rainwater would carry some of that oil away. Crews skimmed oil from the surface of a separator and allowed water to drain from the bottom of the basin to the river. By the 1930s, Hart reported, keeping oil and refined material from leaking to the ground had also become an important undertaking for the Point Breeze refinery, which employed thirty-seven "leak detectives" who monitored the refinery's five thousand miles of pipe. When they found underground leaks, they reportedly dug out any oil-soaked earth and burned it. This was said to prevent seepage into the river. Hart claimed that separators at the Atlantic refinery recovered between six thousand and eight thousand barrels (between 252,000 and 336,000 gallons) of oil per month. Drip pans and other devices throughout the refinery collected another forty thousand to forty-five thousand barrels (1,680,000 to 1,890,000 gallons) per month. Recovered material was either burned at the refinery as fuel or cycled back into the process.[32]

The refinery remained a leaky operation, despite the regulatory regime. Considerable volumes of oil leaked into the ground, and some of that oil found its way into the city's sewers, with disastrous consequences in 1962. The city's sewer system had several sewer mains in the Point Breeze area

[32] Gorman, *Redefining Efficiency*, 102–17; W. B. Hart, "Disposal of Refinery Waste Waters," *Industrial and Engineering Chemistry*, Sept. 1934, 965–65; Stephen Spencer, [no title], *Philadelphia Evening Bulletin*, Aug. 10, 1936.

running from east to west. They were part of the combined sewer system in south Philadelphia, built in the late 1800s and early 1900s to convey both storm water and sanitary sewage to the Delaware and Schuylkill Rivers. In the late 1940s, the City of Philadelphia began constructing interceptor sewers to convey sewage to treatment plants, rather than allowing it to run raw into the Delaware River system. One of those interceptors, the Lower Schuylkill East Side Interceptor, was to convey storm water and sewage from Penrose Avenue on the south to a pumping station near University Avenue on the north. From there, sewage would be pumped under the Schuylkill River to the city's treatment plant in southwest Philadelphia. The Philadelphia Water Department awarded a contract to Driscoll Construction in March 1962 to complete the last section of the Lower Schuylkill East Side Interceptor, running along Twenty-Sixth Street (the east side of the refinery) from Penrose Avenue north to Shunk Street.[33]

The interceptor sewer had to pass under the existing sewers. The portion of the interceptor to be built in 1962 would be some forty feet below the surface, which put it at or below the water table. The construction scheme called for driving a series of twelve vertical shafts along Twenty-Sixth Street and then tunneling between the shafts, rather than excavating an open trench along the entire length of the sewer construction. Because the interceptor was to be installed below the water line, water had to be pumped from the construction site. At the commencement of construction, workers found that hydrocarbons, in addition to water, were seeping into the bottoms of the shafts. Those liquids also had to be pumped from the shafts. Initially the mix of water and hydrocarbons was allowed to drain directly to the river, but after a short time Atlantic Refining began allowing Driscoll Construction to pump the mix of liquids to oil-water separators at the Point Breeze refinery. At the underground work site, the contractor had to enhance ventilation in an effort to keep hydrocarbon vapors below safe levels. This safety measure was not accomplished satisfactorily, however, and on August 22, 1962, a series of explosions in the tunnels and shafts killed four workers—James C. Hennigan, Robert Wilson, John Riddick, and William Gregory—and injured several others working in shaft number five, just south of Hartranft Avenue (Fig. 1). Analysis by the refinery of hydrocarbon samples taken from the sewer excavation shortly after the

[33] "$2,421,442 Is Low Bid on Sewer Unit," *Philadelphia Evening Bulletin*, Oct. 19, 1947; "Sewer Project in Final Stage," *Philadelphia Evening Bulletin*, Mar. 14, 1962.

explosion showed that the material was mostly in the gasoline range.[34] Gasoline is the fraction that makes petroleum the highly sought resource it is, but gasoline that leaks to the environment can lead to traumatic events, such as the 1962 sewer explosion.

Widows of three of the four dead workers (Hennigan, Wilson, and Riddick) filed suit against Atlantic Refining and the City of Philadelphia. The trial took place in federal court before Judge A. Leon Higginbotham in November 1966. Various employees and officials of the Philadelphia Water Department testified about the design of the sewer and the precautions they had implemented during construction to keep workers safe in an underground environment harboring explosive vapors. Inspectors described working conditions at the construction site. James and Michael Driscoll, the brothers who owned Driscoll Construction, described conditions they and their workers encountered in the excavation along Twenty-Sixth Street. Chemists at the water department and the police department laboratory testified concerning samples that had been collected from the site at the time of the explosion. Officials from Atlantic Refining Company testified about conditions at the refinery and about the way the refinery handled liquids (including both water and hydrocarbons) that Driscoll construction pumped from the construction site and conveyed to the refinery. Finally, the three widows testified about the hardships they faced with their husbands dead. Before the end of the trial, however, Atlantic settled with each of the plaintiffs for $100,000 (with Atlantic's excess liability insurer paying half the settlement amount). The attorneys for the plaintiffs therefore asked that the court find only against the City of Philadelphia. In light of the settlement, plaintiffs' attorneys reasoned that even if Atlantic had been negligent in allowing hydrocarbons to leak into the soil (and they were not arguing that Atlantic had been negligent), the immediate cause of the explosion that killed the workers was the city's negligent design of the tunnel for construction of the sewer and its failure to provide a safe workplace. The jury found the city negligent under both theories.[35]

[34] "Blasts, Fire Kill 4 in Deep S. Phila. Pit," *Philadelphia Daily News*, Aug. 22, 1962; "Rescuers Battle Smoke, Fumes in Search for 4," *Philadelphia Evening Bulletin*, Aug. 22, 1962; "Air Forced into Tunnel in Probe of S. Phila. Blast," *Philadelphia Evening Bulletin*, Aug. 23, 1962; "4 Workers Killed as Explosions Rip Sewer Tunnel," *Philadelphia Inquirer*, Aug. 23, 1962; "Blame Explosion on Seeping Oil Refinery Fumes," *Philadelphia Tribune*, Aug. 25, 1962.

[35] "Sandhogs' Kin to File $-Million Suits," *Philadelphia Tribune*, Aug. 28, 1962; Gwendolyn Sharpe, testimony in the United States District Court for the Eastern District of Pennsylvania, Hennigan v. Atlantic Refining Company et al. (Civil Action No. 32433, hereinafter cited as Hennigan v. Atlantic), Nov. 3 and 4, 1966, pp. 359–61, 403–5, file 7, box 3484, file 9, box 3484, entry 42-E-56, Record Group

The verdict notwithstanding, testimony presented at the *Hennigan* trial offers insight into Atlantic's long knowledge that it had been leaking hydrocarbons into the subsurface and about the character and composition of hydrocarbons that caused the sewer explosion. For example, William Wakeley, the refinery's plant protection superintendent, testified about the refinery's tank farm that was adjacent to the site of the explosion. Although he tried to be vague about it, Wakeley testified that the refinery had about 1,300 tanks on the property and that some of the tanks along the eastern edge of the property were as large as 160,000 barrels (6,720,000 gallons). While admitting that some leaks from these tanks might go into the ground, he tried to focus attention on leaks that would vaporize or be captured by the refinery's surface sewer system. Nevertheless, when pressed, Wakeley admitted that at least some of the petroleum products that Driscoll had been pumping from its excavation were Atlantic's materials, and he estimated that petroleum had been sitting on the water table in that area for about one hundred years.[36] At the time of the trial in 1966, a refinery had been in operation at Point Breeze for exactly one hundred years.

Atlantic officials testified that, through evaluation of samples taken from test wells installed by the refinery, they were well aware that hydrocarbons were present on the water table along the refinery's eastern property boundary. Charles Stose, former manager of the refinery, also testified that Atlantic recovered hydrocarbons from those wells. He said that Atlantic had two purposes for pumping material from the recovery wells. One was to try to prevent the migration of hydrocarbons beyond Atlantic's property boundary. Another was, by monitoring the volume recovered, to be alerted to any increases, which might indicate some new leak or other problem that would need to be corrected. Stose testified that he was aware that an

21, Records of the United States District Court for the Eastern District of Pennsylvania, National Archives at Philadelphia (hereafter cited as RG-21). The following testimony is also in Hennigan v. Atlantic, RG-21: Samuel K. Wilson, Nov. 4, 1966, pp. 452–74, file 9, box 3484; Stewart James Nichols, Nov. 4, 1966, pp. 436–42, file 9, box 3484; James Dennis Holden, Nov. 4, 1966, pp. 446–50, file 9, box 3484; Richard Thompson, Nov. 4, 1966, pp. 497–99, file 9, box 3484; Edward J. Burke, Nov. 7, 1966, p. 766, file 10, box 3485; J. Howard Myers, Nov. 16, 1966, pp. 1526–31, file 14, box 3485; William J. Hume, Nov. 16, 1966, pp. 1671–84, file 15, box 3486; Charles S. Wolff, Nov. 18, 1966, pp. 1924–25, file 15, box 3486; see also James E. Beasley, closing argument in Hennigan v. Atlantic, Nov. 29, 1966, pp. 2277–78, file 19, box 3486, RG-21; Opinion of the United States Court of Appeals for the Third Circuit in the Appeal of the City of Philadelphia of the verdict in Hennigan v. Atlantic, file 2, box 3483, RG-21.

[36] Wakeley, testimony in Hennigan v. Atlantic, Nov. 14, 1966, pp. 1237–39, 1313, 1316, file 13, box 3485, RG-21.

excavation down to the water table along the alignment of the Twenty-Sixth Street sewer would encounter hydrocarbons and yield vapors that could be explosive. He stated his belief that the ground could not be decontaminated of liquid hydrocarbons, although he believed that vapors in the excavation could have been controlled.[37]

Construction of the Twenty-Sixth Street sewer resumed in late 1964, with the Philadelphia Water Department having awarded Driscoll Construction a contract to complete the work. The first task in preparing the site for construction was to test the shafts for liquid hydrocarbons and gases in the explosive range. On December 17, a measurement showed the "depth of hydrocarbon (oil, etc.)" to be "about 30 [inches] above [about] 5 [inches] of H_2O."[38] After continuous pumping for several weeks, however, the liquid at the face of the tunnel was still twelve to eighteen inches deep, so in early February 1965 the contractor installed five deep wells on the Atlantic side of the tunnel alignment. Within a few days, the contractor was pumping as much as two hundred gallons per minute from the five deep wells plus three sump pumps in shafts, discharging the liquids into Atlantic's waste oil and water system. Shortly after the middle of the month, pumping had lowered the apparent level of the hydrocarbons to below the tunnel floor. Extending the tunnel commenced, although work had to be suspended occasionally because of infiltration of liquids (water and hydrocarbons) into the work or unsafe concentration of gases in the underground atmosphere. On at least one occasion, the diaries reported that a worker became sick from breathing fumes in the work area.[39]

After the Twenty-Sixth Street sewer was completed, PWD began in late 1966 to notice infiltration of hydrocarbons into the sewer line near shafts six, seven, and eight (adjacent to and just east of the refinery's number two tank farm). The atmosphere in the line was tested, showing concentrations near the explosive level, and samples of liquids were taken for analysis. As PWD officials met at the site with contractors to discuss grouting of the line to prevent infiltration of hydrocarbons into the sewers, at least one Atlantic representative joined the discussion, in part because

[37] Charles Stose, testimony in Hennigan v. Atlantic, Nov. 16, 1966, pp. 1568–78, file 15, box 3486, RG-21.

[38] Twenty-Sixth Street Sewer Construction Diary for Dec. 17, 1964, drawer SD-250-SW to SD-320-SW, Delaware & Race Pumping Station, Philadelphia Water Department, Philadelphia (hereafter cited as PWD).

[39] Twenty-Sixth Street Sewer Construction Diary for Dec. 26, 1964, Feb. 9 and 10, Feb. 17 and 18, Apr. 12, 21, and 22, May 25, and Aug. 20, 1965.

Atlantic was granting permission for the grouting operation to access the sewer line from Atlantic property.[40]

One more problem associated with leaks of petroleum from the refinery into the surrounding environment merits mention. In 1987, the Defense Supply Center Philadelphia (DSCP, a military supply depot owned and administered by the US Department of Defense) discovered a large plume of liquid petroleum beneath its property east of the refinery's south yard while responding to a leak in a fuel line associated with the filling station DSCP operated at the depot. DSCP reported the leak to the Pennsylvania Department of Environmental Protection (PADEP). At first DSCP suspected that the plume of petroleum might have come from its own leak, but subsequent analysis led officials to conclude that the plume had originated from another source: the refinery. Nevertheless, under terms of the Pennsylvania Storage Tank and Spill Prevention Act, PADEP issued an order to DSCP in 1999 to remediate the plume, because of the proximity of the plume to DSCP's underground storage tanks for the filling station. Believing that the refinery, not DSCP, was liable for the plume, the United States filed suit against the refinery's current and previous owners in 2005. A federal judge ruled, however, that the United States could not bring the suit because the statute of limitations had run out on the government's right to do so. Although the United States appealed the judge's ruling, the parties settled the litigation before it was finally resolved.[41] Remediation of the plume continues.

Recent Changes at the Point Breeze Refinery Reflecting Changes in the US Refinery Industry and the Continuing Threat of Trauma

Atlantic's Point Breeze refinery continued to grow through the first two-thirds of the twentieth century. Entering the last third of the century, Atlantic Refining underwent a significant change in 1966 when it merged with the Richfield Oil Company, which had a refinery in California and established markets on the Pacific Coast. The two companies believed that their markets on the two coasts and their refinery locations were complimentary and that the size of the new Atlantic Richfield Company (ARCO) would be better able to compete in expanding and diversifying

[40] Twenty-Sixth Street Sewer Construction Diary for Dec. 10, 12, and 19, 1966.

[41] U.S. v. Sunoco, Inc., 644 F. Supp. 2d 566 (E.D. Pa. 2009). See https://casetext.com/case/us-v-sunoco-6.

markets. In 1973, ARCO reconfigured its Philadelphia refining operation, spending more than $60 million to convert the Point Breeze refinery from a full-product-line facility to one that concentrated on fuels and continued to produce lubricating oils and asphalt. Such products as wax, however, were eliminated. As part of the reconfiguration, ARCO removed processing operations from the north yard and consolidated all refining in the south yard.[42]

In 1985, ARCO sold its eastern refining and marketing operations, including the Point Breeze refinery, to John Deuss, a Dutch oil trader, who formed Atlantic Refining and Marketing Corporation. Three years later, Deuss sold the property, including the refinery, more than five hundred former ARCO service stations on the East Coast, and the Atlantic Pipeline Company (a network of more than a thousand miles of product pipelines in Pennsylvania and New York) to Sun Company (Sunoco). Sunoco already had a large refinery just downstream of Philadelphia, built along the Delaware River at Marcus Hook in 1902. In 1988, Sunoco decided to sell its exploration and production assets and focus its business in the areas of refining and marketing petroleum products. Its first new purchase that year was the Point Breeze refinery, which had the capacity to treat heavier, sulfur-laden crude oil (Sun's Marcus Hook refinery could only handle light, sweet crude). In 1994, Sunoco purchased the Girard Point refinery from Chevron (which had bought the facility from Gulf), consolidating it with the Point Breeze facility. Sunoco called the combined Point Breeze and Girard Point facility the Philadelphia refinery.[43]

A recent leak involving the Philadelphia refinery occurred in 2000, when an underground pipeline, running five miles from Sunoco's Hog Island marine terminal on the Delaware River to the Philadelphia refinery, developed a leak beneath the John Heinz National Wildlife Refuge near the Philadelphia International Airport. Sunoco received imported crude oil by ship at the marine terminal and conveyed it via the twenty-four-inch pipeline to the refinery. The February 2000 leak discharged an estimated

[42] Atlantic Refining Company, *Annual Report 1965* (Philadelphia, 1966), inside front cover, 38; Atlantic Richfield Company, *1966 Annual Report* (Philadelphia, 1967), 6; "Why Oil Companies Merge," *Oil & Gas Journal*, Apr. 18, 1966, 56–57; Ted Wett, "ARCO's Philadelphia Refinery System Restructured," *Oil & Gas Journal*, Apr. 9, 1973, 80–82.

[43] Idris Michael Diaz, "Sun Will Buy Atlantic Corp. for $513 Million," *Philadelphia Inquirer*, July 6, 1988; Daniel F. Cuff, "Oil Trader a Big Winner in Atlantic Sale to Sun," *New York Times*, July 7, 1988; Sunoco, "Our History, Our Community" (Philadelphia, ca. 2000, Sunoco brochure in possession of the author).

192,000 gallons of crude oil into a pond in the midst of the refuge. Sunoco paid for the remediation under an order from the US Environmental Protection Agency.[44]

In the last few years, the refinery has undergone further changes reflecting corporate restructuring of the refining industry. In September 2011, Sunoco announced that it was leaving the refining business and that it would either sell or close its Point Breeze and Marcus Hook refineries. The following May, Energy Transfer Partners, a Texas pipeline company, acquired Sunoco, stating that it would continue Sunoco's retailing and pipeline business and try to find a buyer for the refineries. In July 2012, the Carlyle Group, a private equity firm, entered an agreement with Sunoco to operate the refinery by means of a joint venture called Philadelphia Energy Solutions. Because the Philadelphia refinery is now the largest on the East Coast, officials from the White House and the City of Philadelphia worked to bring the Carlyle Group and Sunoco together in the undertaking. In announcing the deal, a Carlyle spokesperson said that the new venture would include a high-speed railroad unloading facility at the refinery so that it could treat increased volumes of low-sulfur crude oil from North Dakota's booming Bakken Shale formation. The refinery now receives 160,000 barrels per day (about half of its capacity) from the Bakken formation, most of it by rail. For decades, the refinery had relied primarily on crude oil imported by ship, which in recent years had become more expensive than domestic crude.[45]

Receiving Bakken crude by rail from North Dakota links the Point Breeze refinery to another dangerous feature of the oil industry: the possibility of railroad accidents involving tank cars filled with explosive materials—a potential that was realized in June 2013 when a train carrying

[44] Sandy Bauers, "Wildlife Refuge Cleanup Crew Were Working Nonstop after a Pipeline Ruptured," *Philadelphia Inquirer*, Feb. 8, 2000; "Restoring Habitat at John Heinz National Wildlife Refuge at Tinicum," US Fish and Wildlife Service newsletter, Aug. 2009, http://www.fws.gov/northeast/pafo/pdf/john_heniz_final.pdf; Environmental Protection Agency, "John Heinz National Wildlife Refuge: Current Site Information," last updated Mar. 2008, http://www.epa.gov/reg3hscd/super/PA/johnheinz/pad.htm.

[45] Andrew Maykuth, "Sunoco to Sell or Close Its Refineries in Philadelphia, Marcus Hook," *Philadelphia Inquirer*, Sept. 7, 2011; Maykuth, "Texas Pipeline Firm to Buy Sunoco Inc. for $5.3 B," *Philadelphia Inquirer*, May 2, 2012; Maykuth, "Deal Will Keep Sunoco's Philadelphia Refinery Operating," *Philadelphia Inquirer*, July 2, 2012; "Partnership Formed to Keep Philadelphia Refinery Open," *New York Times*, July 2, 2012; Ryan Dezember and Jerry A. Dicolo, "Carlyle Bets Big on U.S. Energy," *Wall Street Journal*, July 2, 2012; Luke Geiver, "Philadelphia Refiner's Bakken Rail Project Saves Company," *Bakken Magazine*, Oct. 2013; Ryan Dezember, "Carlyle to Sell Shares in Philadelphia Refining Equipment," *Wall Street Journal*, Sept. 22, 2014.

Bakken crude derailed and exploded in the Quebec town of Lac-Mégantic, killing forty-seven people. In December 2013, a train carrying Bakken crude through North Dakota exploded a mile west of Casselton, leading to an evacuation of the town. Although the accident had no casualties, the accident highlighted the possibility that such an event could again lead to loss of human life.[46]

In reporting the deal to keep the Point Breeze refinery in operation, an Associated Press article in the *New York Times* called the combined Philadelphia refinery "the oldest and largest refinery on the East Coast."[47] Oil refining began at Point Breeze in 1866, during the first few years of Pennsylvania's oil boom, and the refinery was an important cog in the monopolistic enterprise that John D. Rockefeller formed to rationalize the industry in its early decades. The technologies developed and employed at the Point Breeze refinery have helped it adjust to a variety of sources of crude oil supply and to changing market conditions for petroleum products, and the facility continues to provide Americans the fuels they demand to maintain lifestyles of ready personal mobility. That perhaps, is the side of the refinery's history that is easiest to contemplate. But refineries are messy operations, and the Point Breeze refinery has been no exception. It has created its share of human and environmental disasters, beginning in 1879 and continuing into the twenty-first century. This is the traumatic side of the refinery's history, and a history of trauma is likely to continue.

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[46] David George-Cosh, "After Lethal Crash, Quebec's Fears Return of Oil Trains," *Wall Street Journal*, July 4, 2014; David Schaffer, "As Oil Train Burns, 2,300 Residents of Casselton, N.D., Told to Flee," *Minneapolis Star Tribune*, Dec. 31, 2013.

[47] "Partnership Formed to Keep Philadelphia Refinery Open," *New York Times*, July 2, 2012.