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“I DON’T SMELL CHEMICALS, I SMELL MONEY:” THE EFFECTS OF FEDERAL POLICY AND THE CHEMICAL INDUSTRY ON HUMAN HEALTH AND THE ENVIRONMENT IN THE KANAWHA RIVER VALLEY

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A THESIS APPROVED FOR THE
DEPARTMENT OF HISTORY

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Abstract

Federal policy and the need for American produced chemicals saw a need for a domestic chemical industry to be erected in the Kanawha Valley of West Virginia during World War I. Following the war, federal policy continued supporting the chemical industry and throughout the Interwar Period and World War II Union Carbide, DuPont, and Monsanto constructed chemical plants in the valley. The chemical industry continued growing in the valley despite the rise of the environmental movement following World War II, and during the second half the twentieth century residents of the Kanawha Valley formed conflicting opinions regarding the benefits of the industry in the area. Accordingly, this thesis studies the means by which federal policy supported the chemical industry and, in turn, the industry negatively impacted human health and the environment.

Introduction: Forgotten Industry

The chemical industry in the Kanawha River Valley of West Virginia is an understudied example of industrialization in Kanawha County.[1] While the coal industry has prospered in the county since the nineteenth century, most coal operations are found in undeveloped areas away from towns and cities. Chemical plants, in contrast, reside along the Kanawha River in some of the most populated communities like South Charleston, Nitro, Institute, and the capital city of Charleston. The map below depicts the location of these and other cities in relation to rivers within my area of study (Image 1). When travelling alongside the Kanawha River between Charleston and Nitro, one cannot avoid the massive chemical plants currently operated by Covestro, founded 2015; Dow, founded 1897; and Altivia, founded 1986, to name a few.[2] Due to the proximity of these plants to dense human populations, the chemical industry has had an outsized impact on people and the non-human environment in the Kanawha River Valley since the 1910s. Federal policy played a key role in developing the chemical industry there during World War I by ordering the construction of an explosives plant and mustard gas plant. Policy transformed the valley from agriculture and small-scale industrial works for salt and metals to large-scale operations producing polyols and methylamines. Since the First World War, such policies have affected the lives of hundreds of thousands of West Virginians.

[1] Throughout this study, Kanawha River Valley is sometimes shortened to "river valley" or "valley." All are used interchangeably. Academic publications regarding industrialization in the Kanawha Valley are limited, but some include Rice, "Coal Mining in the Kanawha Valley to 1861: A View of Industrialization in the Old South;" E.T. Crawford Junior, "Salt: Pioneer Chemical Industry of the Kanawha Valley;" and Cantrell, "Localized innovation: A geography of the petro-chemical industry in the Kanawha Valley of West Virginia." Other publications that tell the history of the Kanawha Valley or the history of chemical plants within the area include: Wintz, *Annals of the Great Kanawha*; Wintz, *Nitro the World War I Boom Town: An Illustrated History of Nitro, West Virginia and the Land on which It Stands*; and Woomer, *The Institute Site: From George Washington to the World of Chemicals 1763-2000*. These final three works are used for this study.

[2] These companies are present in the valley as of October 1, 2023.

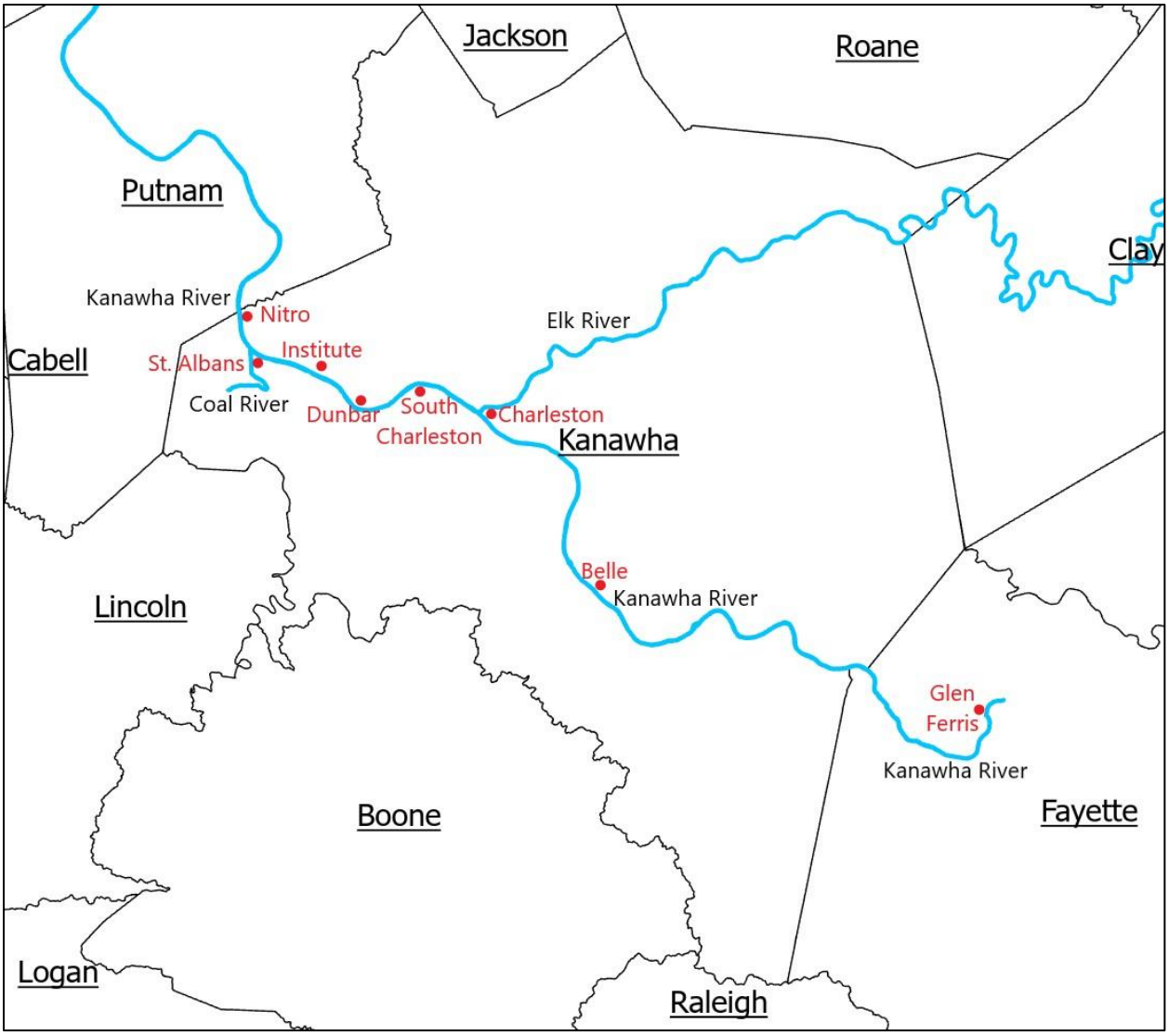


Image 1: This map depicts the Kanawha River and its two major tributaries, the Elk River and the Coal River, in blue with black text. The counties are underlined, and most of the key places discussed in this study are in red text with red points depicting their approximate location.

Source: Made by author using the software program ArcGIS Pro.

This thesis investigates wartime legislation promoting the production of chemicals and chemical by-products for the war effort, environmental laws, and public safety legislation to showcase the ways in which federal policy supports the chemical industry. Federal intervention bolstered employment for those living in the area, but production practices at the plants threatened workers' safety and contaminated the air and water those living and working in the

valley needed to survive. These matters continue today, so it is important to investigate how and through what means the chemical industry impacted human health and the environment in the Kanawha Valley from the early twentieth century to the early twenty-first century. Additionally, this study discusses how those working in the chemical industry and living in the valley responded to the impacts on human health and the non-human environment. Some desired more aggressive state and federal environmental legislation to remedy current pollution and prevent future pollution. Additionally, those individuals wanted the chemical companies in the area to take responsibility for the pollution they caused. Meanwhile, others feared more aggressive legislation pressuring companies to alter their practices would hinder the local economy because the companies would leave the area. Ultimately, both groups had little impact on federal policymaking because chemical firm representatives and lawmakers dictated policymaking without regard for the residents and workers directly impacted by the chemical industry.

My study argues that the chemical industry negatively impacted human health and the environment of the Kanawha River Valley due to the role federal policy played in supporting the industry. Federal policy began supporting the industry in the valley during World War I, and this support continued through the Interwar Period and World War II. The growth of the industry during this time resulted in environmental federal legislation to attempt addressing pollution following the Second World War, but the original laws were ineffective because they lacked federal oversight of pollution. Later, the pollution prevention goals set by amendments to those original laws were not achieved because shifts in federal policy made it increasingly difficult. Despite the efforts of the environmental movement, and the voices of residents in the valley

condemning the industry, the chemical industry continued harming human health and the environment through the remainder of the twentieth century.

The Landscape and Waterscape

The Kanawha River would not be as important to local history and the chemical industry if not for the many local creeks and two main tributaries that empty into it: the Elk and Coal Rivers. Both discharge into the river in Kanawha County where the industry mostly resides, and the Elk is more notable given its ties to the companies and corporations as well. As for its journey, the Elk traverses roughly 175 miles from Sutton Lake upstate to downtown Charleston. The Coal, on the other hand, totals only 19 miles from the census-designated place of Alum Creek southeast of Charleston, and discharges in the city of St. Albans. Although the former river is considerably longer than the Kanawha, the West Virginia Department of Environmental Protection does not note the Elk as the state's largest inland waterway because most of it is not navigable. Altogether, these three rivers drain 10,882 square miles with the Kanawha accounting for 8,750 of those square miles.[3]

The Kanawha River is approximately 97 miles long. It begins in the town of Gauley Bridge, in Fayette County, with the confluence of the Gauley and New Rivers.[4] Upon flowing in a northwesterly direction through Kanawha, Putnam, then Mason Counties, the Kanawha River empties into the Ohio River at the city of Point Pleasant.[5] Much of the river in nestled within

[3] According to the West Virginia Department of Environmental Protection, WVDEP, the Pocatalico River is not considered to be a river of West Virginia. While it is a tributary to the Kanawha River, this lack of classification prevents it from consideration as a major tributary. Learn more about West Virginia's rivers at: https://dep.wv.gov/WWE/getinvolved/sos/Pages/WVrivers.aspx.

[4] Indigenous peoples viewed the New River and Kanawha River as one river, and this is still argued today. For this study, they are viewed as two distinct bodies of water.

[5] "Kanawha River Watershed," *West Virginia Department of Environmental Protection,* accessed August 19, 2023, https://dep.wv.gov/WWE/getinvolved/sos/Documents/Poster/Kanawha.pdf.

steep hillsides, but the chemical industry resides in the places with ample flatland bordering the body of water. Residential areas are then situated within the hills. The elevation of the valley ranges from approximately 600 feet above sea level to approximately 1,200 feet in the residential areas.[6] As a result of this change in elevation, air pollution is trapped in the valley because weather patterns, especially adverse weather, keep the pollutants in the valley rather than moving over the mountains.[7]

Significance of Study

The story that follows may be read as a declensionist narrative. Historian Carolyn Merchant defined declensionist narratives as "a narrative structure, or plot, that portrays environmental history as a downward spiral,"[8] and beginning in the 1990s environmental historians lessened their use of such narratives instead opting to focus on tales that offer hope for the future.[9] However, historian Sverker Sörlin pointed out in a 2011 article that "the declensionist narrative has been reinterpreted as a constructive recovery narrative."[10] In other words, declensionist narratives now transcend the hopelessness many historians associate with them by focusing on the complex relationship between the human and non-human environments. Only by understanding this relationship, especially in the wake of increasingly agricultural and industrial societies through time and space, can environmental historians offer

[6] U.S. Geological Survey, *Charleston West Quadrangle*, Scale 1:24,000, 7.5 Minutes Series (Topographic), 2014 and U.S. Geological Survey, *Charleston East Quadrangle*, Scale 1:24,000, 7.5 Minutes Series (Topographic), 2014.
[7] U.S. Environmental Protection Agency, Office of Enforcement and Compliance Monitoring, *Overview of Environmental Pollution in the Kanawha Valley*, by James R, Vincent, (Denver, Colorado, 1984), I-1, https://nepis.epa.gov/Exe/ZyPDF.cgi/9101HEGP.PDF?Dockey=9101HEGP.PDF.
[8] Carolyn Merchant, *The Columbia Guide to American Environmental History*, (New York: Columbia University Press, 2002), 206.
[9] Sverker Sörlin, "The Contemporaneity of Environmental History: Negotiating Scholarship, Useful History, and the New Human Condition," *Journal of Contemporary History* 46, no. 3 (July 2011): 619-620.
[10] Ibid., 621.

hope for the future while discussing the complexities of the past that affect the present. While my study focuses on the historical and ongoing harm the chemical industry wrought on the Kanawha River Valley and the failures of federal policy to contain or rectify these harms, within those discussions I also explore the complex relationships residents had with the industry.

To achieve this, my study dialogues with and contributes to multiple areas of scholarship: industrial history, business history, environmental history, political history, labor history, environmental justice, and sociology. Most of the scholarly intervention of this study focuses on environmental history due to its purpose of understanding the complex relationship between the human and non-human environments of the Kanawha River Valley. Accordingly, an array of literature with interventions into environmental history dating back to the 1960s is used to analyze this story's argument. Many of the works to be discussed ask similar questions and present overlapping arguments, but each tells a story that responds to one or more of the following topics: responses to industry, legacies of industry, and policies that relate to industry. This study researches each of those topics in relation to the chemical industry of the Kanawha River Valley, so the texts to be discussed contextualize my story through their research questions, arguments, and themes.

How individuals respond to industry, especially those whose communities are tied to industry, is important to discuss because the voices of people can shape policy if they choose. Some texts that address this topic are author and activist Claudia Clark's *Radium Girls*, historian Chad Montrie's *To Save The Land and People*, environmental justice author Steve Lerner's *Sacrifice Zones*, sociologist Shannon Elizabeth Bell's *Our Roots Run Deep as Ironweed* and *Fighting King Coal*, and historian Jessica van Horssen's *A Town Called Asbestos*. Published first, in

1997, *Radium Girls* researched the story of dialpainters, women that painted wristwatches with radium-based paint, in their push for recognition of the dangers of their work, compensation for the victims of radium poisoning, and prevention of continued poisoning.[11] The efforts of these workers serve as the basis of her argument: that dialpainters were active participants of industrial health reform. Accordingly, the author notes her work is an occupational health history,[12] but that it "is less a story of medical success than a story of political process."[13] It is about how these women, and labor reformers like the National Consumers League, used their knowledge and understanding of dialpainting practices to demand federal regulations that protected dialpainters.

This trend of scholarship, addressing how individuals respond to industry, continued with Montrie's 2003 work *To Save the Land and People*. Like Clark in *Radium Girls*, Montrie discussed the role of people in rallying against industrial employers and pushing for policy change to protect themselves. However, unlike dialpainters seeking protection in the workplace, Appalachians broadly, not just laborers of the coal industry, sought to abolish an industrial practice altogether during the 1960s and 1970s. Overall, Montrie argued that, while tactics differed from middle-class participants, "common people" took part in the environmental movement.[14] When it came to surface mining, individuals of the working class formed coalitions at the local level to protect their farms, homes, and families. Despite their efforts not leading to a federal ban on the mining practice, nor a state ban in West Virginia, Montrie's study called

[11] Claudia Clark, *Radium Girls: Women and Industrial Health Reform, 1910-1935,* (Chapel Hill: University of North Carolina Press, 1997): 2-3.
[12] Ibid., 5.
[13] Ibid., 2.
[14] Chad Montrie, *To Save the Land and People: A History of Opposition to Surface Coal Mining in Appalachia*, (Chapel Hill: University of North Carolina Press, 2003): 3-4.

attention to the ideology that unified coal communities across state boundaries: "Lockean doctrine of natural rights that deemed rebellion a right and duty when other natural rights, such as the right to property, were being threatened."[15] In other words, Montrie advanced the discussion of individuals responding to industry by explaining that Appalachians fought against surface mining industrial practices for more than recognition of the harm it caused. Appalachians had a right to fight for their private property in response to industry encroaching on it.

Steve Lerner's third work, *Sacrifice Zones*, offers national context to the discussion of responses to industry. Additionally, it offers national context to the issue of federal policy supporting the chemical industry considering the harm the industry reaps on poor communities and communities of color. Based on twelve case studies throughout the United States: Alaska, California, New York, Florida, Texas, Ohio, and Nevada, Lerner argued that the term "sacrifice zones" should be applied more broadly: that chemical pollution exists rampantly across the United States due to, for example, charcoal factories, oil refineries, and plastics plants. This Orwellian term, for its use by the U.S. Department of Energy regarding uranium mining and weapons of mass destruction during the Cold War, is applicable to all communities threatened by industrial and chemical pollution. [16] To support his argument, Lerner repeatedly criticized the EPA and other government agencies, at state and federal levels, for their inactions at effectively addressing environmental injustices. Additionally, Lerner showed that zoning designations

[15] Ibid, 5.
[16] Steve Lerner, *Sacrifice Zones: The Front Lines of Toxic Chemical Exposure in the United States*, (Cambridge: MIT Press, 2010), 2 and Keith Schneider, "Dying Nuclear Plants Giver Birth to New Problems," *New York Times*, October 31, 1988, https://timesmachine.nytimes.com/timesmachine/1988/10/31/003188.html?pageNumber=1.

regularly allowed neighborhoods to be sacrificed. Cities deemed some land "residential/industrial" as a mixed-use classification to entice multiple types of development.[17]

Ultimately, the communities featured in *Sacrifice Zones* did not know their communities were sacrificed until the damages of industrial pollution had already impacted their health, their local environment, and, in some cases, their property values. In response, because the communities did not idly allow the destruction to continue, the communities of Pensacola, Florida; Marietta, Ohio; Ocala, Florida; and Port Arthur, Texas, to name a few, formed grassroots coalitions in an effort to pressure industry or government to take action against industrial pollution. Entering the communities sacrificed by industry, Lerner expanded our understanding regarding how individuals respond to the effects of industry by entering the sacrificed communities and asking residents to explain their stories and methods for combatting the industry, or industries, that polluted their communities. Shannon Bell's research echoes the efforts of Lerner but expands on it to also explain why people may elect to not mobilize against industry.

Addressing the topic of responses to industry continued with Bell's *Our Roots Run Deep as Ironweed* and *Fighting King Coal*, but these works did not discuss policymaking efforts like Clark and Montrie. Instead, since Bell is a sociologist, she investigated why and why not Appalachians participated in environmental justice movements in relation to the coal industry. Her first work *Our Roots Run Deep as Ironweed* interviewed twelve women, mostly from southern West Virginia, who participated in environmental justice efforts from the 1980s through the 2000s. Through those interviews, Bell argued that women in Appalachia are more

[17] Lerner, *Sacrifice Zones*, 6.

engaged with environmental justice movements in comparison to men due to a protector identity. She explains,

> This protector identity both encompasses and extends the motherhood identity such that many women perceive the moral authority for their activism emanating not only from a calling to protect their children and grandchildren from irresponsible mining practices, but also from an obligation to protect their communities, their heritage, their family homeplace, and the physical landscape that surrounds them.[18]

Nonetheless, while conducting research Bell discovered that most Central Appalachians do not participate in environmental justice movements against coalfields despite the destruction caused by the coal industry. So, in 2016 she published *Fighting King Coal* to discuss this finding. Bell presented multiple arguments to explain the overall lack of participation in combatting environmental injustice: "the social-capital deficit in Appalachian coal-mining communities,"[19] the efforts of the coal industry to convince Appalachians that supporting the industry is central to their identity, and that the destruction wrought by the industry is not visible to most Appalachians inhibiting a consciousness transformation.[20]

Published the same year as *Fighting King Coal*, 2016, Jessica van Horssen's *A Town Called Asbestos* combines the focuses of Bell's two books for her own. It suggests that the residents of Asbestos simultaneously chose to support industry and community health. In the author's own words,-Van Horssen claims, "The history of Asbestos reveals local residents engaged in a constant struggle for balance between the community and the mine, while maintaining a

[18] Shannon Elizabeth Bell, *Our Roots Run Deep as Ironweed: Appalachian Women and the Fight for Environmental Justice*, (Chicago: University of Illinois Press, 2013): 9.
[19] Shannon Elizabeth Bell, *Fighting King Coal: The Challenges to Micromobilization in Central Appalachia*, (Cambridge: MIT Press, 2016): 11.
[20] Ibid., 12.

commitment to both."[21] *A Town Called Asbestos* builds upon the works of Clark, Montrie, Lerner, and Bell because throughout her chapters and conclusion van Horssen utilizes an analytical structure found in a growing number of environmental publications by researching the interconnectedness of bodies of land, human bodies, and the body politic. While other scholars did not use this approach directly, each described the relationship the people within their communities of study shared with the land and government structures. In van Horssen's case, with bodies of land noted as the mineral, mine, and land the community occupied; human bodies defined as the laborers and residents of Asbestos; and the body politic described as the three class divides within Asbestos and gauging how they interacted with the mine in different ways, van Horssen's study effectively humanizes the human health issues found in Asbestos.[22]

This topic of scholarship, responses to industry, progressed over time to include the stories of individuals or groups supporting industry alongside the stories of those that worked against industry. In *Fighting King Coal*, Bell alluded to the work of sociologists Douglas McAdam and Hilary Boudet *Putting Social Movements in Their Place* when she wrote,

> As McAdam and Boudet (2012) maintain, there is a tendency among scholars of social movements to 'select on the dependent variable,' beginning with an instance of successful mobilization and then retrospectively studying the factors that have led to collective action and to recruitment into the movement.[23]

Scholars, across fields, formerly wrote stories of successful social movements, and in turn excluded the voices of those that participated in unsuccessful movements or did not participate. As environmental history became increasingly interdisciplinary, and intradisciplinary by

[21] Jessica van Horssen, *A Town Called Asbestos: Environmental Contamination, Health, and Resilience in a Resource Community*, (Toronto: University of British Columbia Press, 2016): 8.
[22] Ibid., 8-11.
[23] Bell, *Fighting King Coal*, 2. Doug McAdam is a sociologist by training, and Hilary Boudet received an interdisciplinary PhD in environment and resources with a sociology minor.

engaging with other subfields of history, the stories they told included a greater variety of voices and conclusions. Authors across scholarly fields and historical subfields taught us that individuals across class boundaries engaged in social movements. Clark and Montrie showcased that working class laborers and their families rallied to protect their health and homes since the early twentieth century, but later scholarship by Bell and van Horssen complicated that conclusion to discuss when individuals decided to forego their health and environment to protect the industry that supported the local economy. Lerner researched communities across the United States to showcase that industrial pollution sacrifices communities everywhere, and effectively articulated that even into the twenty-first century federal policy, state policy, and environmental agencies fail to protect poor communities and communities of color. *Radium Girls* utilized the notion of social utility, the idea that the benefits of industrialization outweighed the negative effects on human health caused by many industrial practices, to explain the challenge dialpainters faced when fighting for political recognition of their declining health.[24] Montrie, Lerner, Bell, and van Horssen, while not using the term in their own works, also engaged with this idea because the people they studied had their own ideas regarding industrialization and its benefits.

Policymaking is a topic of scholarship Clark and Montrie also evaluate, alongside other scholars. Clark discusses the political process taken to politically recognize the harms of dialpainting and Montrie describes the efforts taken to institute a potential federal ban on strip mining. Other scholarly authors research the topic, and for this study I reflect on Clark, Montrie, economist V. Kerry Smith's edited volume *Environmental Policy Under Reagan's Executive Order*,

[24] Clark, *Radium Girls*, 4.

and historian Kathryn Steen's *The American Synthetic Organic Chemicals Industry*. The first published work of these four was Smith's edited volume. Published in 1984, the essays of this text focus on the effects, real and potential, of President Ronald Reagan's (R) Executive Order 12291 issued on February 17, 1981. The order called for the implementation of a benefit-cost analysis when assessing the need for federal regulations.[25] This was a significant shift from previous policies that sought to "control the regulatory burden imposed on the economy" by requiring the use of such an analysis.[26] In response to the changes brought about by this order, professionals engaged in public administration, economics, and environmental science wrote about the impacts of Executive Order 12991 on environmental regulation.[27] To properly evaluate those impacts, scholar of environmental policy Richard N.L. Andrews researched what prompted the establishment of the order. He utilized a historical analysis to argue "that the executive order represents a new and significant twist in three interwoven threads of historical development, all of which were well underway before the Reagan presidency…"[28] Those threads focus on the development, integration, and use of the benefit-cost analysis in evaluating public projects to achieve Reagan's domestic policy goal of limiting the regulatory powers of the federal government.[29]

Andrews' essay is primarily an economic and political history. He pointed out that bipartisan support for environmental regulation stemmed from a broad consensus that

[25] U.S. President, Executive Order, "Federal regulation, Presidential oversight," *Federal Register* 46, (December 31, 1981): 2.
[26] V. Kerry Smith, "Environmental Policy Making Under Executive Order 12291: An Introduction," in *Environmental Policy Under Reagan's Executive Order,* ed. V. Kerry Smith, (Chapel Hill: University of North Carolina Press, 1984), 4.
[27] Ibid., 5.
[28] Richard N.L. Andrews, "Economics and Environmental Decisions, Past and Present," in *Environmental Policy Under Reagan's Executive Order,* ed. V. Kerry Smith, (Chapel Hill: University of North Carolina Press, 1984), 43.
[29] Ibid., 43-44.

businesses did not comply with environmental regulations made at the state level. It appeared federal enforcement was the means by which to achieve compliance. Such regulation faced scrutiny from businesses and economists who feared that reducing pollution at a rapid level would hinder the economy and argued for the implementation of market incentives.[30] This text, with its environmental focus, follows the trend of the first generation of environmental history scholarship by addressing the effects of federal policy on the environment.[31]

While Smith and the volume discussed the effects of policy, Clark and Montrie described the processes various groups practiced in an effort to create policy, another aspect of policymaking. Again, the National Consumers League worked with dialpainters in a story describing a political process. Efforts began in the courts to recognize the failing health of workers, and, eventually, some legislative measures came to fruition following those cases. For example, in New Jersey, recognition of radium poisoning as an industrial disease featured as part of a worker's compensation bill.[32] In Montrie's study, grassroots militancy in opposition to surface mining was a method used to prevent the industrial practice. For example, in August 1968 four eastern Kentucky men detonated charges attached to multiple pieces of mining equipment to prevent operations.[33] Later, throughout the 1970s, as opposition to surface mining became a national issue, grassroots movements became part of national environmental movements with some supporters like the Sierra Club. The goal maintained by all was a federal ban on the industrial practice, but as a national movement traditional policymaking tactics of

[30] Ibid., 57-58.
[31] Richard White, "American Environmental History: The Development of a New Historical Field," *Pacific Historical Review* 54, no. 3 (August 1985): 298-301.
[32] Clark, *Radium Girls*, 147-149.
[33] Montrie, *To Save the Land and People*, 1.

making compromises and concessions prevented abolitionists of surface mining from achieving their goal.[34]

Studying policymaking continued with Steen's *The American Synthetic Organic Chemicals Industry.* Published in 2014, this work tracks the growth of the American chemical industry from the First World War through the 1920s and describes the ways in which chemical firms and their representatives lobbied Congress to protect the new American industry.[35] She argues that "chemicals became deeply entwined with the American political economy during World War I and the following decade" by asserting US policymaking played a direct role in the new domestic industry achieving international prominence by 1930.[36] Steen utilized Congressional acts and offered some business history through glimpses into how five specific companies benefited from such policymaking to showcase that synthetic organic chemicals production reflected patriotism and allowed for considerable lobbying efforts by the hands of manufacturers. [37] Prior to World War I the United States imported most of its chemicals from Germany, so to protect American chemical production during peacetime chemical lobbyists continued using patriotic rhetoric to sway policymaking in their favor.[38] While this scholarship reflects earlier interventions into environmental history by researching policymaking and its effects, it also reflects later scholarship by including how policy was made.

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[34] Ibid., 204.
[35] Legislation that bolstered synthetic organic chemicals benefitted all parts of the chemical industry, so while Steen's work focuses on synthetic organic chemicals her findings apply to the industry broadly.
[36] Kathryn Steen, *The American Synthetic Organic Chemicals Industry: War and Politics*, *1919*-1930*,* (Chapel Hill: University of North Carolina Press, 2014), 3.
[37] Glimpses into the activities of National Aniline & Chemical Company/Allied Dye & Chemical Corporation, E.I du Pont de Nemours & Company, Dow Chemical Company, Union Carbide & Chemical Company, and Bakelite Corporation from 1919-1930: Steen, *The American Synthetic Organic Chemicals Industry*, 250-285.
[38] Some of the signs of patriotism related to the growth of synthetic organic chemicals production: Steen, *The American Synthetic Organic Chemicals Industry*, 9, 76, 113, 171, 274, and 287 and pre-war chemical reliance on German imports: Steen, *The American Synthetic Organic Chemicals Industry*, 23.

Overall, scholarship regarding policymaking includes stories with a top-down approach as seen in Smith's edited volume and parts of Steen's publication by beginning with policy and later gauging its impacts, but also includes bottom-up approaches utilized by Clark and Montrie to discuss how the residents and workers of those affected by industrial pollution attempted to shape policy. Investigating this subject of study showed scholars that a variety of people across class and labor boundaries engaged with the policymaking process. Throughout the twentieth century, industry representatives worked to establish policy that benefited production and profits causing employees and residents impacted by industry to in turn seek policy that protected them from industry. Smith, Andrews, Clark, Montrie, and Steen all exposed how policy was created, or not, and by what means policy impacted environmental regulations, chemical production, or people.

The final topic of scholarship I utilize to support my argument that federal policymaking bolstered the chemical industry and in turn negatively impacted human health and the environment in the Kanawha Valley is industrial legacies. This topic dates to author and activist Rachel Carson's 1962 publication *Silent Spring* when she utilized findings from environmental science to articulate the lasting harmful effects of pesticides used throughout the United States. Other scholars articulated this topic like historian Nancy Langston in 2010 with *Toxic Bodies* and historian Bartow Elmore in 2021 with *Seed Money*, so this subject has been important to study for approximately sixty years. A commonality between these three works is that each discusses chemical production and use, which benefits my study because with multiple publications on the legacy of the chemical industry there is grounds to argue that the reliance on chemical production for modern quality of life gives reason for federal policy to continue supporting the

industry. Reflecting on the idea of social utility, federal policy bolsters the chemical industry today as it did more than 100 years ago because the negative legacy of chemical production does not hinder modern reliance of chemical products.

Originally published in 1962, *Silent Spring* shed light on synthetic chemicals, with a special emphasis on the pesticide DDT, and sparked national conversations regarding such products. Carson argued that synthetic chemicals negatively impacted human health due to their widespread use that moved up the food-chain from plants to prey, like birds and fish, to humans. The book faced mixed reception with chemical companies condemning Carson's findings that their products negatively impacted the food-chain. Meanwhile, housewives and non-scientists found her conclusions compelling and frightening.[39] Part of the work's indictment of the use of synthetic chemicals was Carson's assertion "that we have allowed these chemicals to be used with little or no advance investigation of their effect on soil, water, wildlife, and man himself."[40] In other words, she claimed that individuals had the right to be properly informed of the side effects of commonly used pesticides to determine if the use of them was worth the costs. Again, reflecting on social utility, people had a right to determine for themselves if the sacrifices made for reliance on DDT and other synthetic chemicals were worth them living in the environment for more than a decade and impacting wildlife, waterways, and human health.[41] Just as *Silent Spring* sparked the environmental movement, it similarly served as a building block for the field of environmental history. Alfred Crosby, in an article reviewing the history of the

[39] Eliza Grizwold, "How 'Silent Spring' Ignited the Environmental Movement," *The New York Times Magazine*, September 21, 2021, https://www.nytimes.com/2012/09/23/magazine/how-silent-spring-ignited-the-environmental-movement.html.
[40] First Mariner Books edition: Rachel Carson, *Silent Spring*, (New York: First Mariner Books, 2002), 13.
[41] Ibid., 15-16.

field, asserted that Carson created an audience for the field by transforming environmentalism "from an elitist to a popular movement."[42] Due to the legacy of synthetic chemicals described in *Silent Spring* and the legacy of its publication, it is important to engage with the findings of this work because it shaped how other scholars interacted with the subject of industrial legacies.

Accordingly, Nancy Langston engaged with the efforts of Rachel Carson by not only detailing the impact *Silent Spring* had on public understanding of the relationship between science and nature, but by tracing the impact of synthetic chemicals, namely endocrine disrupting chemicals, on the environment, human health, and wildlife.[43] In her work, Langston addressed how farmers gave DES to livestock, primarily cattle, and in turn people ate that cattle.[44] Similarly, she examined the ways in which cattle excrement affected wildlife because the chemicals within cattle waste eventually entered bodies of water that other animals lived in and drank. Eventually, the offspring of wildlife exposed to endocrine-disruptors succumbed to hindered sexual characteristics that limited opportunities for them to procreate.[45] Alarmingly, Langston also described the complicity of federal agencies that promoted the use of endocrine disrupting chemicals for preventing miscarriages and managing menopause despite the known harms associated with them dating back to the 1940s.[46] Langston developed the topic of industrial legacy by historicizing the impacts of synthetic chemicals on human health and the environment.

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[42] Alfred Crosby, "The Past and Present of Environmental History," *The American Historical Review* 100, no. 4 (October 1995): 1186.
[43] Nancy Langston, *Toxic Bodies: Hormone Disruptors and the Legacy of DES*, (New Haven: Yale University Press, 2010), 2-5, 85-90.
[44] Ibid., 75-77.
[45] Ibid., 2-5, 119-121.
[46] Ibid., viii, 48-49.

Bartow Elmore, on the other hand, wrote a business history to describe the legacy of Monsanto. Elmore argued in *Seed Money* that Monsanto's notable efforts to enhance quality of life via pesticides and genetically engineered seeds, as two examples, are overshadowed by the company's toxic legacy.[47] Elmore notes that "Monsanto has consistently ended up on the lists of the most hated firms in America" and utilizes the stories of individuals negatively affected by the "ecological and human health costs" of the company's practices to offer complexity to that notation.[48] This work of business history traces Monsanto's legacy from its inception in 1901, through Bayer's purchase of the company in June 2018, to 2020. Whereas Carson and Langston traced the legacy of chemicals and federal compliance of toxic exposure, Elmore traced the legacy of one company to detail the multitude of ways chemical companies negatively impacted human health and the environment. Beyond the use of synthetic organic chemicals indoors and outdoors for medical and pesticidal purposes, chemical companies left negative legacies on production floors by sacrificing the health and safety of employees. Alarmingly, Monsanto recognized the impact of its legacy when the company changed its name from Monsanto Chemical Company to Monsanto Company in 1964 partly in response to *Silent Spring.* Its publication made "chemical" a word with a negative connotation.[49]

For this topic of study, industrial legacy, its development since the 1960s exposed the issue of federal and industrial compliance in allowing negative legacies to continue regardless of the impacts on human health and the environment. Carson conducted her own environmental

[47] Bartow Elmore, *Seed Money: Monsanto's Past and Our Food Future*, (New York: W.W. Norton & Company, 2021), 14-15.
[48] Both quotes: Ibid., 15.
[49] Ibid., 106.

studies to gauge the legacy of synthetic chemicals, but, as Langston addressed, some knowledge regarding the harmful effects of synthetic chemicals dated back to the 1940s. Then, Elmore described the ways in which Monsanto sought to avoid its legacy. Altogether, these three works amplify the issue of modern reliance on chemical production. Due to the multitude of ways people used and continue to use chemical products inside and outside of their homes federal policy, federal agencies, and chemical companies curtail environmental knowledge and regulation to continue harming workers, residents, wildlife, and the environment.

Altogether, these various works contribute to our understandings of responses to industry, policymaking, and legacies of industry across the United States, along with the town of Asbestos, Canada, and I build upon them for this study. Each text is indicative of the ways in which industry is oftentimes favored over human health and the environment. However, there is little scholarly research of these matters in relation to the chemical industry in West Virginia. Elmore offered some insight into this subject when he described some of the impacts Monsanto had on the city of Nitro, and Lerner did the same when he described the ways in which residents of Marietta and Addyston, Ohio responded to nearby chemical companies. Meanwhile, other environmental studies, like those of Montrie and Bell, tend to focus on the coal industry in West Virginia. As described earlier, across scholarly fields researchers used to focus on the stories of successful social movements and trace their history. As scholars worked to correct this practice and discuss instances of unsuccessful movements or why some decide not to engage with social movements, they expanded geographic, temporal, and industrial scopes. However, the chemical industry in the Kanawha Valley is still largely absent from those stories, as noted in the first paragraph of this thesis. Similarly, as indicated in a 2021 forum in

the journal *Environmental History*, Appalachian environmental history is a burgeoning subfield of environmental history.[50] Accordingly, this study seeks to fill an existing gap of American environmental history that has not included stories from one of the oldest geographic regions of the United States.

Chapter Summaries

Chapter 1 begins in the nineteenth century with a brief discussion on the salt industry since salt is used in many chemical processes. The chapter then investigates alterations of the Kanawha River by the US Army Corps of Engineers and the establishment of a ferroalloy plant at Kanawha Falls, the headwaters of the Kanawha River. These events happened during the nineteenth century, and they all serve as reasons why the federal government elected to construct a chemical industry in the Kanawha River Valley during World War I. From that point, research is conducted into how the industry came to be founded on the banks of the Kanawha River during the First World War due to the impacts of federal policy to promote a domestic chemical industry instead of continuing to rely on German imports. Policy continued to bolster the industry during the Interwar Period, so private industry continued industrializing the valley. Due to the exponential growth of the industry during this time, federal intervention of the industry saw chemical plants in the valley supplying many wartime needs. Tracking the growth of the industry and the ways in which federal policy played a part in that growth, I advance my argument by addressing how the chemical industry impacted human health and the environment. If not for these early policies and the precedent they set to continue protecting

[50] Drew Swanson, Steven Stoll, Kathryn Newfront, Joyce Barry, and Timothy Silver, "Forum: Appalachia's Environmental History," *Environmental History* 26, no. 1 (January 2021): 7.

the industry, then the pollution and harm to health discussed in chapter 2 may not have happened.

Chapter 2 begins by addressing the earliest federal laws to address air and water pollution in the United States: the Federal Water Pollution Control Act of 1948 and the Air Pollution Control Act of 1955. These acts were ultimately ineffective because they did not establish air and water quality standards. Due to their ineffectiveness, many residents of the Kanawha River Valley discussed their aggravation regarding the rampant air and water pollution that negatively impacted their lives during the 1960s. Meanwhile, during the same decade and into the 1980s, some residents believed the industry benefited the economy of the valley to a degree that stronger pollution measures would hinder economic growth. The establishment of the Environmental Protection Agency and the 1970 amendments to the Clean Air Act and 1972 amendments of the Federal Water Pollution Control Act, sought to address these concerns. However, these later acts of environmental policy were also ineffective as seen by environmental reports in the 1980s that continued to address the rampant pollution occurring in the valley. Additionally, cancer studies published in the 1980s and 1990s noted an occupational relation between employment in the industry and increased rates of lymphosarcoma and reticulosarcoma. Following the trend of chapter 1 that focuses on federal policy, by discussing the effectiveness of environmental policy and the responses of those affected by the industry alongside environmental reports and cancer studies I advance my argument that the chemical industry negatively impacted human health and the environment.

Pollution marginally improved in the valley through the second half of the twentieth century, but practices of the industry remained unnecessarily harmful to residents of the

Kanawha Valley and beyond. Accordingly, the epilogue considers chemical leaks, explosions, and fires caused by the chemical industry in the twenty-first century. These incidents, despite the passage of multiple environmental laws and the Emergency Planning and Community Right-to-Know Act in the previous century, exemplify the limits of federal policy to effectively monitor these sites for the pollution they cause and their harms to human health. Overall, this recent history showcases the importance of this study and its argument. The chemical industry negatively impacts human health and the environment of the Kanawha River Valley to this day.

Chapter 1: The Boom of the World Wars

The chemical industry along the Kanawha River arrived in the region during World War I for a variety of reasons. Many environmental factors allowed for the establishment of the industry, including the abundance of salt deposits. Many chemical processes rely on the use of chlorine, one of the elements that make salt, so these deposits attracted early chemical industrialists to the valley. The atmosphere and multiple bodies of water similarly drew the interest of industry representatives to the area because oxygen, nitrogen, and hydrogen are other elements commonly used in chemical processes. Additionally, the region had stable weather patterns and barometric pressure which allowed for constant, year-round production. Finally, the abundance of coal in southern West Virginia provided carbon to produce a variety of chemicals and chemical byproducts. Coal further provided the industry with a steady energy source to power their operations. The presence of these environmental factors in one place attracted chemical industrialists because each benefited industry.

Many non-natural factors also drew chemical industrialists to the Kanawha Valley. One nonnatural factor that facilitated the development of the chemical industry included the proximity of the area to densely populated cities in the mid-west and Atlantic coast.[51] Also, the engineering feats the US Army Corps of Engineers (USACE), established 1779, accomplished in the late nineteenth century made the Kanawha River safe to navigate. Additionally, one ferroalloy plant existed at the headwaters of the Kanawha River during the Spanish-American

[51] Phil M. Conley, "The Chemical Industry in West Virginia," in *West Virginia Blue Book: 1935*, ed. Charles Lively, (Charleston: Jarrett Printing Company, 1935), 712.

War, successfully utilizing the hydroelectric power provided by the rapids at Kanawha Falls.[52] Beyond the USACE, the US Navy had interest in the area because the ferroalloy plant produced ferrochromium for warships.[53]

Owing to these environmental and non-environmental factors, when the United States ceased its reliance on imported German-made chemicals during World War I, federal policy fast-tracked the Kanawha River Valley as a place to break ground on a domestic, large-scale, chemical industry. It is important to research how the valley functioned prior to WWI as it helps one to understand what the region offered for the development of a chemical industry. This chapter begins in the late 18th century and ends with the conclusion of the Second World War. Little information is available to discuss the industry's effects on the environment and human health prior to the late 1940s, so this chapter examines the role of federal policy in fostering a domestic chemical industry in the Kanawha River Valley during wartime. I extend Kathryn Steen's conclusion that the patriotism associated with the chemical industry caused federal policy to bolster the industry during World War I, arguing that this policy continued through World War II under additional legislation. It is important to discuss through what means the chemical industry came to the Kanawha River Valley to properly understand how the industry negatively impact human health and the environment in the latter half of the twentieth century.

Salt Industry, Transforming the River, and the Falls at Glen Ferris

[52] Leland R. Johnson, *Men, Mountains, and Rivers: An Illustrated History of the Huntington District, U.S. Army Corps of Engineers, 1754-1974*, (Washington D.C.: US Government Printing Office, 1977), 81-91.
[53] Robert D. Stief, *A History of Union Carbide Corporation: From the 1890s to the* 1990s, (Danbury: Carbide Retiree Corps, Inc., 1998), 13.

In the early 1800s, Charleston, West Virginia became a hub for the salt industry. The origins of the industry date back to the indigenous Shawnees that labored as salt-workers in the region prior to European claims on the land.[54] Following European and American expansion west of the Appalachian Mountains, settlers erected and operated salt furnaces from the end of the eighteenth century to the outbreak of the American Civil War. Most operations resided along the Kanawha River from Charleston to Marmet, a town just south of the future capital.[55] Elisha Brooks constructed the first salt furnace in 1797 at the mouth of Campbells Creek and the Kanawha River, and by 1815 fifty-two furnaces operated in the area. The salt industry offered stable work and enticed many people from more developed areas east of the mountains to permanently settle in the valley. Many of the new inhabitants included professional tradesmen whose work directly benefited salt production. Trades ranged from coopers and carpenters that made barrels for storing salt, to drillers and boatmen who extracted and transported salt brine and its treated byproducts. Additionally, salt operators in the valley eventually supplied significant portions of the United States with salt because the Kanawha River serves as a major tributary to the Ohio River thereby connecting the area to many American cities. Although the height of production occurred in 1846, the industry continued to thrive until 1861 when the Civil War drew workers to battle. Also, a major flood in the valley happened in 1861 which further disrupted operations.[56]

[54] William D. Wintz, *Annals of the Great Kanawha,* (Charleston: Pictorial Histories Publishing Company, 1993), 3.
[55] Scanned map titled "Location of Salt Furnaces in the Kanawha Valley," Box 3, Folder Industry, William Wintz Collection, West Virginia State Archives (WVSA), Charleston, West Virginia.
[56] Wintz, *Annals of the Great Kanawha*, 47-51.

However, transporting salt along the Kanawha River was dangerous during the nineteenth century, at least prior to the US Army Corps of Engineers (USACE) transforming the river towards the century's end. Prior to the developments of the USACE, the Kanawha had many shoals and rapids that caused boat wrecks due to their turbulent water and areas of sediment buildup.[57] Constructing a series of locks and dams, water elevators that allow for large boats to safely navigate shallow or steep parts of a river, eliminated these dangers.[58] Local projects preceded federal construction, but a lack of federal funds resulted in limited improvements to the waterway. When the USACE received authority over the Kanawha River projects in August 1874, initial surveys called for twelve lock and dam structures along with a canalization project to connect the Kanawha of southern West Virginia to the James River of eastern Virginia. The James flows through the city of Richmond to its destination of the Chesapeake Bay, so this project would have connected West Virginia to the eastern seaboard. The canalization project planned by the USACE required overcoming Kanawha Falls to allow travel upstream through the New and Greenbrier Rivers before constructing a tunnel through the Appalachian Mountains to connect with the James River Valley. Combined, engineers meant for these feats to function as part of a Central Water Line connecting the Mississippi and Missouri Rivers to the eastern United States and Chesapeake Bay.[59]

Congress approved surveys for the canalization project in 1875, and by the end of the year construction began on locks 4 and 5 upriver of Charleston. Multiple floods in the latter half

[57] Johnson, *Men, Mountains, and Rivers*, 81-82.
[58] "Locks 101," *US Army Corps of Engineers: Huntington District Website*, accessed August 20, 2023, https://www.lrh.usace.army.mil/Missions/pcxin-outreach/locks101/.
[59] Johnson, *Men, Mountains, and Rivers*, 82.

of the 1870s challenged construction by bankrupting the project multiple times. Due to the lack of funds needed to effectively manage the project, the locks faced problems immediately following their opening in 1880. After fixing these existing locks, the USACE reevaluated the Central Water Line project in its entirety. Ultimately, the engineers eliminated the construction of locks 1 and 12, leaving only eight to be constructed.[60] Upon the project's completion in 1898, the financial benefits were immediate with more than twenty-three times the increase in the number of coal mines in the region and at least six times the number of exported tons of coal. As one work documented:

> When construction began in 1875, the three coal mines in the Kanawha valley shipped 161,932 tons; by 1898 over seventy mines employing 9,000 men were in operation, shipping over a million tons by river at the lowest freight rates in the United States.[61]

More coal operations resulted in marked increases in population, income, and business in the valley, but when the projects of the Kanawha River moved from the USACE office in Baltimore to Cincinnati at the turn of the century the role of the Kanawha River as part of the Central Water Line ceased.[62] Regardless, the completion of this water project demonstrated that the Kanawha River benefitted business.

Coinciding with the near completion of this river project, just before the Spanish-American War of 1898, Willson Aluminum Company, founded in the early 1890s, constructed a hydroelectric smelting plant at the headwaters of the Kanawha River in 1897. [63] I argue this plant drew the attention of future chemical firms because it highlighted some of the

[60] Ibid., 85-86.
[61] Ibid., 90.
[62] Ibid., 91.
[63] The Spanish-American War was the intervention of the United States in wars of independence Spanish colonies waged against Spain. Stief, *A History of Union Carbide Corporation*, 6.

environmental factors of the Kanawha Valley that benefited industrialization; namely the constant flow of the river's waters at Kanawha Falls in Glen Ferris, now known as the Falls of Glen Ferris. The plant exclusively produced ferroalloys, and this focus allowed the plant to provide abundant ferrochrome to the US Navy for armor plating on naval ships.[64] The importance of ferroalloys is their role in creating higher quality steel. The iron base of steel is combined with another metal of greater value, in this case chromium, to reduce the amount of oxygen contained within the final product.[65]

These brief overviews of the salt industry, waterway projects, and the Falls of Glen Ferris offer information regarding early federal intervention and investment in the area for the sake of industry. Despite its eventual decline, the early salt industry laid vital groundwork for the coming chemical industry since many of the chemical processes to come used chlorine found within salt as a key ingredient. Also, as the first industry in the region, it drew attention to the importance of the Kanawha River for transporting goods and materials. Then, that industry's success fueled federal interest in the region through the allocation of federal funds to the USACE for waterway projects. Eliminating the treacherous shoals, rapids, and sediment build-up of the Kanawha River better, and more safely, connected the region to the Gulf of Mexico via the Ohio and Mississippi Rivers. Finally, the efforts of the USACE to transform the river readied the valley for private industrialization that federal policy, through the US Navy, utilized; as seen with the Falls at Glen Ferris.

Imports to Domestic Production

[64] Ibid., 12-13.
[65] Abraham Berglund, "The Ferroalloy Industries and Tariff Legislation," *Political Science Quarterly* 36, no. 2 (June 1921): 246-247.

Following federal and private industry activities around the turn of the century, little federal intervention and industrial development occurred to promote a chemical industry in the Kanawha Valley until World War I. Prior to the war, the United States relied on Germany for chemical imports, mostly dyes and pharmaceuticals, because unified Germany and its government embraced the chemical industry following industrialization unlike the United States. Kathryn Steen explains German dominance of the industry from the 1870s-1914 was due to "German government policies on patents, cartels and educational support; global market and sales strategies; and, most of all, pioneering research laboratories and a full embrace of science in industrial innovation."[66] That final point echoed the remarks of German-born chemist Bernard Herstein. In 1912, following fifteen years of work in US chemical firms and three years in US government, Herstein critiqued the US patent system for how it limited competition by patenting the chemical product rather than the chemical process. Under this system, only the original inventor and the company they worked for could produce said product unless explicit permission was given to a competitor. Meanwhile, in other countries, like Germany, the patent system only patented the process. For example, any company in Germany could produce indigo dye if production processes differed.[67] Nonetheless, the dominance of German chemicals and chemical byproducts production ceased with the outbreak of WWI.

Since it was well known among chemical industrialists like Bernstein that the US lacked expertise in the chemical industry compared to their German counterparts, developing this

[66] Steen, *The American Synthetic Organic Chemicals Industry,* 23.
[67] On patent system: Bernard Herstein, "Patents and Chemical Industry in the United States," *The Journal of Industrial and Engineering Chemistry* 4*,* no. 5, (May 1912): 328-333; On background of Bernard Herstein: "Bernard Herstein, Chemical Expert," *New York Times*, June 9, 1939, https://timesmachine.nytimes.com/timesmachine/1939/06/09/93926648.html?pageNumber=27.

industrial prowess became a matter of patriotism. Americans believed that developing a domestic industry would provide jobs and foster another aspect of American identity, and chemical companies achieved this goal due to the limited trade between the US and Germany. Great Britain, with the world's largest navy at the time, prevented German chemical imports to the United States. This was especially true for dye imports after March 1915. Accordingly, importers that once relied on German dyes turned to American suppliers to fulfill orders or utilized their own expertise to manufacture products themselves.[68]

Federal Operations During and Immediately After World War I

Patriotism and limited German imports promoted the establishment of a domestic chemical industry and resulted in the opening of three small-scale operations in the Kanawha Valley as soon as 1915. Rollins Chemical Company opened in South Charleston and produced chlorine and barium products.[69] Two additional plants also began operations in South Charleston the same year, but sources contradict each other regarding their relationship. The photo description from an online archive asserts E.C. Klipstein and Sons Chemical Company formed Warner-Klipstein Chemical Company, suggesting the latter was a subsidiary of the former.[70] However, the West Virginia state encyclopedia suggests a different relationship: it discusses the differing histories and products produced for all three plants, suggesting they operated as three separate companies. The article notes that E.C. Klipstein and Sons produced sulfur dyes, tear gas, and anthraquinone while Warner-Klipstein produced chlorine, caustic

[68] Steen, *The American Synthetic Organic Chemicals Industry,* 44-46.
[69] Stief, *A History of Union Carbide Corporation*, 39.
[70] Photo titled "Lab Inside Warner Klipstein Chemical Co. Factory, South Charleston, W. Va.," Date Unknown, Identifier 047658, Collection No. A&M 2523, West Virginia & Regional History Center, Morgantown, WV, https://wvhistoryonview.org/catalog/047658.

soda, carbon disulfide, and carbon tetrachloride.[71] Regardless of how these companies began in 1915, their operations demonstrate that the valley could meet the needs of the chemical industry.[72]

Federal intervention to foster the chemical industry in the Kanawha Valley during WWI occurred because of two pieces of legislation. The Hagley Museum in Wilmington, Delaware cites the Urgent Deficiency Appropriations Act of October 6, 1917 for bolstering the industry, whereas Kathryn Steen in her work *The American Synthetic Organic Chemicals Industry* credits the Trading with the Enemy Act of 1917.[73] To speak on the former, during a special session of Congress from April 2 to October 6 of 1917, the legislative branch passed seven deficiency appropriations acts totaling nearly $19 billion.[74] Deficiency appropriations acts during this conflict authorized additional funds to federal agencies to fulfill wartime needs.[75] The final act, issued October 6, focused on funding the Army, Navy, and their branches. The act ordered these branches "to carry on the work of the council of national defense and the shipping board, to

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[71] Charles J. Denham, "Chemical Industry," *e-WV: The West Virginia Encyclopedia,* last modified March 2, 2023, https://www.wvencyclopedia.org/articles/1124.

[72] Sources contradict one another regarding when Belle Alkali Company began: 1915 or 1919/1920. Sources that claim 1915: Denham, "Chemical Industry," and J. Moore, "Appalachian Storage Hub (ASH) Project: The Role of Petroleum Geology and Salt Production on Manufacturing and Development in the Appalachian Bason," https://www.wvgs.wvnet.edu/ash/securepages/Presentations/Moore_ASH_History_Slideshow.pdf. However, since most sources claim Belle Alkali Company began after World War I, sources cited later along with an EPA webpage noted momentarily, I elect to use that set of dates. EPA webpage: "Settlement: EPA Issues AOC to Implement Final Remedy at Occidental Chemical Company Facility in West Virginia," *U.S. Environmental Protection Agency,* last modified June 1, 2023, https://www.epa.gov/enforcement/settlement-epa-issues-aoc-implement-final-remedy-occidental-chemical-company-facility.

[73] Steen, *The American Synthetic Organic Chemicals Industry*, 5 and Description for "Photographs of U.S Government Explosives Plant 'C' in Nitro, West Virginia," 1918, Item ID 08148247, Call number 2002.248, Location AVD Stacks, Hagley Museum and Library, Wilmington, Delaware (hereafter cited as Description, Hagley Museum and Library).

[74] *Statement of Appropriations and Contract Authorizations for the Fiscal Year 1918, and Deficiency Appropriations for the Fiscal Year 1917, Made During the Second Session of the Sixty-fourth Congress and the First Session of the Sixty-fifth Congress*, 65th Cong., 1st sess., *Congressional Record* 55, pt. 8: 7779.

[75] U.S Government Accountability Office, *Principles of Federal Appropriations Law,* GOA-16-464SP, (Washington D.C.: 2016), 4, https://www.gao.gov/assets/2019-11/675709.pdf.

provide civilian military training, to construct fortifications and to guarantee the custody of alien enemies."[76] These measures allowed the US Armed Forces to distribute approximately $2.4 billion to private companies via supply contracts or by purchasing their existing sites outright.[77] In the Kanawha Valley, the US military purchased an unfinished mustard gas plant located in the town of Belle, about 12 miles upriver from Charleston.[78] Additionally, the act authorized a contract with E.I du Pont de Nemours and Company (DuPont), founded 1802, to manufacture explosives: it was illegal to manufacture nor possess explosives during the war without a license.[79]

Meanwhile, the Trading with the Enemy Act (TWEA) affected all chemical firms, foreign and domestic. Steen pinpointed this piece of policymaking due to how it hindered German chemical firms in the United States. Congress published the legislation on October 6, 1917, the same day as the Urgent Deficiency Appropriation Act.[80] The TWEA allowed for the creation of the Office of Alien Property and its executive position, the Alien Property Custodian, to oversee German-owned property within the United States.[81] President Woodrow Wilson established the office and its custodian through Executive Order 2729-A on October 12, 1917.[82] Coupled

[76] Charles Kettleborough, "Congressional Legislation," *The American Political Science Review* 12, no. 4, (November 1918): 667-668.
[77] *Statement of Appropriations and Contract Authorizations for the Fiscal Year 1918,* 7779.
[78] U.S. Environmental Protection Agency, National Health and Environmental Effects and Department of Environmental Engineering Sciences at the University of North Carolina, *Environmental Accounting Using Emergy: Evaluation of the State of West Virginia*, by D.E. Campbell, S.L. Brandt-Williams, and M.E.A. Meisch, (Narragansett, Rhode Island), 32, https://archive.epa.gov/emap/aed/research/web/pdf/envaccttechrept.pdf and Copy of newspaper article with no publication information briefly describing the Town of Belle's history of the chemical industry, Box 3, Folder Industry, William-Wintz Collection, WVSA, Charleston, West Virginia.
[79] Kettleborough, "Congressional Legislation," 671-672 and Description, Hagley Museum and Library.
[80] Another act of the same name passed Congress on June 15, 1917.
[81] Steen, *The American Synthetic Organic Chemicals Industry*, 139, 150.
[82] "Records of the Office of Alien Property," Guide to Federl Records, *National Archives*, accessed October 29, 2023, https://www.archives.gov/research/guide-fed-

with authority from the War Trade Board and Federal Trade Commission, the Office of Alien Property prevented German chemical operations within the US from benefitting the war effort of Germany and its allies. While Congress designed this legislation to hinder the German war-effort and in turn boost the American chemical industry and America's wartime effort, it also negatively impacted American firms with ties to the German industry.[83] However, this did not affect the Alien Property Custodian, A. Mitchell Palmer. He and his friend, Francis P. Garvan, who led the APC's Bureau of Investigation,[84] "took on the German chemical industry as a patriotic mission, attacking the most German of industries."[85] In summary, federal policy designed the TWEA with authoritative power to protect and promote American chemical firms whereas the Urgent Deficiency Appropriations Act of October 6, 1917 (UDAA) supported the industry with monetary aid.

In response to the UDAA, DuPont surveyed multiple places to construct explosives plants, and the company's findings cited the ample farmland on the banks of the Kanawha River 16 miles west of Charleston as one good location. The company additionally cited Nashville, Tennessee and Louisville, Kentucky, but the Louisville location was not built. The site in West Virginia, in the city that came to be Nitro, DuPont sought to construct Explosives Plant "C."[86] However, Secretary of War Newton D. Baker (D) never finalized a contract with DuPont. Robert S. Brookings of the War Industries Board brought to Baker's attention that DuPont was set to receive profits upward of 15 percent, which amplified scrutiny of the company for existing anti-

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records/groups/131.html#:~:text=History%3A%20Office%20of%20Alien%20Property,the%20Enemy%20Act%20(40%20Stat.

[83] Steen, *The American Synthetic Organic Chemicals Industry*, 150, 168-169.

[84] Ibid., 156 & 159.

[85] Ibid., 171.

[86] Description, Hagley Museum and Library.

trust allegations.[87] This black mark would have held up wartime production when the United States needed to supply themselves and their allies with gunpowder, explosives, and other wartime products as soon as possible.[88] Instead, the Secretary contracted Thompson-Starrett Company, unverified founding, based out of New York to construct the plant beginning in January 1918. Construction proceeded quickly, and federal entities contracted the Hercules Powder Company of Delaware to run operations in May 1918.[89] Ultimately, despite remarkable efficiency, Thompson-Starrett Company did not complete construction of Explosives Plant "C" by Armistice. It is not clear how much the plant produced for the war effort, but it is speculated that "By the time the war ended on November 11, 1918, the sprawling manufacturing complex, … was capable of producing 350 tons of smokeless gunpowder per day."[90] Partial operation may have only been active for about one week.[91]

Following Armistice, Explosives Plant "C", as a government site, ceased operations swiftly and within two months "the plant was declared surplus and turned over to the Ordnance Department for disposal."[92] Meanwhile, the unfinished mustard gas plant in Belle did not face a similar fate because H.C. Ogden of Wheeling, West Virginia purchased the site. In 1919 the newspaper magnate appointed his son-in-law D.W. Stubblefield to complete the last third of

[87] See case details of the 1911 antitrust suit by the United States against E.I. DuPont de Nemours and Co. at: https://casetext.com/case/us-v-e-i-du-pont-de-nemours.
[88] William Wintz, *Nitro the World War I Boom Town: An Illustrated History of Nitro and the Land on which It Stands*, (Jalamap Publication: South Charleston, 1985), 40-41.
[89] Description, Hagley Museum and Library. This was the second iteration of Hercules Powder Company, but this time the company formed in response to the 1911 anti-trust lawsuit against DuPont. Ultimately, while not DuPont in name the company held close ties with DuPont.
[90] "History of Nitro," *City of Nitro,* last modified 2019, https://cityofnitro.org/about-nitro-west-virginia/history-of-nitro/ and Joseph Phillips, *Images of America: Along the Kanawha* River, (Mount Pleasant: Arcadia Publishing, 2013), 84-85.
[91] "Monsanto Current Events," June 29, 1929, Box 4, Folder Monsanto, William Wintz Collection, WVSA, Charleston, West Virginia.
[92] Description, Hagley Museum and Library.

construction and operate the plant. Stubblefield accomplished the task, and Belle Alkali Company began operations in the early 1920s. This private company focused on using the abundant nearby salt deposits and the brine found in them to produce liquid chlorine, caustic soda, and ammonia.[93] Ultimately, the patriotism and policymaking that functioned as the foundation for a domestic chemical industry remained following WWI but transformed to meet domestic rather than wartime needs. Accordingly, the federally operated sites in the Kanawha Valley transitioned to private ownership.

Development of the 1920s

Just as Ogden purchased the chemical site in Belle, large corporations and companies settled in the area during the 1920s acquiring the smaller or incomplete operations from wartime. Union Carbide arrived first in the early-1920s, followed by DuPont in the mid-1920s, and Monsanto in the late-1920s. It quickly became evident that World War I brought change to the region that would not fade during this decade, nor for many to come. For the remainder of the century, and into the twenty-first century, many chemical manufacturers moved in and out of the Kanawha Valley. However, until the epilogue, this study focuses on the actions of three major firms: Monsanto, founded 1901; Union Carbide, founded 1898; and DuPont, founded 1802.[94] Since these three American companies arrived in the Kanawha Valley in the 1920s and operated in the area through the remainder of the twentieth century, federal policy-making of

[93] Digitized book broken into four parts by the Town of Belle. Cited as a web source, but part and page numbers are included prior to hyperlink: "Town of Belle History," *Town of Belle*, Part 2, 15-16, https://www.townofbellewv.com/history, (hereafter cited as "Town of Belle History" followed by part and page numbers) and "Teacher Reference Material on Chemicals," *West Virginia Department of Education,* 1954, page 91, Box 3, Folder Industrial History, William Wintz Collection, WVSA, Charleston, West Virginia (hereafter cited as "Teacher Reference Material" with corresponding page number).

[94] These are the shorthand names for each company. The years listed as the founding for each come from the earliest use of each name.

the chemical industry greatly benefited them and in turn affected the livelihood of residents more than other chemical firms.

Union Carbide Company, Electro Metallurgical Company, National Carbon Company, Linde Air Products Company, and Prest-O-Lite Company merged in November 1917 to form Union Carbide and Carbon Corporation (UCCC) due to the five companies' shared interests and concerns in steel and alloys production during the war. This allowed all parties of the new corporation to pursue the chemical industry as a new avenue for financial success. To accomplish this goal, UCCC sought to stake a claim in the newly popular American industry by studying the use of ethylene in liquids like diethyl sulfate and ethylene chlorohydrin. Primary studies began in Buffalo, NY at Linde's primary plant, but a destructive fire there in May 1920 caused a Linde manager, James A. Rafferty, to search for a new location. His search focused on Clendenin, WV, a small and rural town north of Charleston on the Elk River, because of the successful Clendenin Gas Company (CGC), unknown founding.[95]

This company, CGC, accessed the numerous natural gas deposits found nearby and processed the material into "wild" gasoline, for profit, and methane, for public utility. "Wild" gasoline, while unable to be used as fuel due to the high number of volatile gases within it, hence the name, was well known in the gasoline trade at the time.[96] The gases that needed to be removed were ethane, propane, and butane, and the CGC removed some of these gases by letting them evaporate in open storage tanks. The wasteful evaporation of ethane and propane, gases needed to produce ethylene and propylene, caught the attention of UCCC. So, UCCC

[95] Stief, *A History of Union Carbide Corporation*, 23, 25, 28.
[96] G.A Burrell and F.M. Seibert, "Gas Analyses by Fractional Distillation at Low Temperatures," *Journal of the American Chemical Society*, 36, no. 7, (July 1914): 1541.

formed its subsidiary Carbide and Carbon Chemicals Corporation (CCCC) in 1920 and purchased CGC thereby finding the world's first petrochemical plant.[97]

However, UCCC did not intend to make CGC a large-scale operation. Unlike towns found downstream from Charleston on the Kanawha, Clendenin lacked ample flat land to expand the plant. Construction from 1920 through summer 1921 did allow the company to capture ethylene which CGC formerly wasted, but lack of space prevented the site from becoming a commercial operation. So, to enter the commercial arena and hopefully supply government defense contracts, UCCC signed a 5-year lease for the "defunct" plant of Rollins Chemical in November 1923 and preparations to make it operational again began in early 1924. Considering Rollins produced chlorine during the war, UCCC began preparations under the assumption that the company could produce its own chlorine to produce ethylene chlorohydrin. However, considering Warner-Klipstein Company still produced chlorine in South Charleston it seemed wiser to purchase from them and invest in constructing other chemical operations at the former Rollins site. Ultimately, operations began at UCCC's South Charleston plant in November 1925 and turned a profit within one year. Such profits allowed UCCC to purchase Blaine Island, an 80-acre island in the middle of the Kanawha River, and additional land on the southern banks of the Kanawha in 1927.[98]

While UCCC began operations in South Charleston in 1925, DuPont began construction of its Belle Works plant the same year. After the former Secretary of War, Newton Baker, canceled the contract for work on the Explosives Plant "C" in Nitro, the company looked

[97] Stief, *A History of Union Carbide Corporation*, 28-29.
[98] Ibid., 35-41.

elsewhere in the valley to begin operations and attention focused on the town of Belle. DuPont aimed to produce nitrates, which are necessary for fertilizers, explosives, and plastics, among other products. Nitrogen is a key element of nitrates, and despite the abundance of nitrogen in the atmosphere it is difficult to capture and transform the element as needed. In turn, DuPont utilized the Claude Process which synthesized ammonia, a colorless gas of nitrogen and hydrogen, to produce nitrates.[99] DuPont chose a site in Belle because of nearby coal to burn for heat, established transportation routes by land and water, and proximity to the capital city which offered a large workforce. Belle Works was the first plant in the United States to commercially synthesize ammonia by this process.[100]

Finally, Monsanto arrived in 1929 when the company purchased Rubber Services Laboratories Company (RSL), founded in 1922, of Akron, Ohio as well as its subsidiary Elko Chemical Company, which operated a site in Nitro. As the subsidiary of RSL, Elko focused on creating specialized chemicals for rubber companies. Monsanto purchased RSL to participate in the burgeoning rubber market, and the 1.5-million-dollar assets of RSL made it an attractive choice to achieve Monsanto's goal.[101] Additionally, Monsanto saw that the proximity of the Kanawha Valley to cities like Cincinnati, New York, and Norfolk allowed for cheaper transportation costs. The industrial district of the valley also provided "a capital investment in factories of over sixty millions of dollars with an annual factory payroll of eleven millions of

[99] For information on the Claude Process and processes like it see: F. A. Ernst, F. C. Reed, and W. L. Edwards, "A Direct Synthetic Ammonia Plant;" Fritz Haber, "The synthesis of ammonia from its elements;" and Kevin H.R. Rouwenhorst, Aloijsius G.J. Van der Ham, Leon Lefferts, "Beyond Haber-Bosch: The renaissance of the Claude process."
[100] "Teacher Reference Material," 89 and "Town of Belle History," part 2, 17.
[101] "Rubber Service Plant – Nitro," *The Putnam Democrat,* November 8, 1929, Box 4, Folder Monsanto, William Wintz Collection, WVSA, Charleston, West Virginia.

dollars." [102] In other words, Monsanto knew there was an available and ready workforce along with support from the state capital in Charleston.

Federal policy played a key role in protecting the bourgeoning American chemical industry during the 1920s, and industry advocates worked to direct policy in the favor of American firms. While Armistice saw an end to combat, America remained in a state of war with Germany until 1921.[103] These immediate post-combat years greatly effected economic relations between the two countries and can be viewed as a period of economic war.[104] The protection of the chemical industry was a vital topic during this time, and by capitalizing on continued anti-German sentiment federal policymaking assured that Germany's chemical industry would not return to its state of prominence. One way in which federal policy benefited the American chemical industry into the 1920s was that wartime policy that did not end until 1921. From 1918 to 1921, the Office of Alien Property maintained control over German firms in the United States and the patents they used. During this time, the Alien Property Custodian, first A. Mitchell Palmer then Francis P. Garvan, sold German patents to American entities, American chemical companies and the American non-profit Chemical Foundation, Inc., assuring limited production of products.[105] Additionally, even after peace, representatives of chemical firms lobbied Congress to continue issuing tariffs on German chemical imports on the basis of national security, as seen with the Fordney-McCumber Tariff Act of 1922.[106] Through the end of

[102] "Monsanto Current Events," June 29, 1929.
[103] The US Senate rejected the Treaty of Versailles because senators did not wish for the United States to participate in the League of Nations. Accordingly, Germany and the United States signed their own peace treaty in August 1921, the US-German Peace Treaty. The Know-Porter Resolution of July 1921 preceded the treaty and passed by both houses of Congress, officially ending the state of war between the US and Germany.
[104] I borrow this term from Kathryn Steen as her sixth chapter is titled: Economic War, 1919-1922.
[105] Steen, *American Synthetic Organic Chemicals Industry*, 173-175.
[106] Ibid., 190 and 202.

the decade, isolationist coupled with nationalist and patriotic tendencies fostered the growth and development of an American chemical industry.

The 1930s and World War II

The chemical industry, despite the Great Depression, continued growing in the Kanawha Valley throughout the 1930s. Policymaking of the 1920s directly bolstered the industry, especially through tariffs, and the industry sought renewed high tariffs designed in the Smoot-Hawley Tariff Act of 1930. As one industry representative noted in a 1929 Congressional hearing:

> Chemical products are ever changing. New Products takes the place of old ones and the element of risk is greater in the chemical than in any other industry. We urge such a tariff on chemical products as will warrant the extension of existing plants, encourage sustained research, permit of payment of the American standard of wages, and at the same time justify the expectation of reasonable profit on the capital investment. The tariff rates must be such as to meet the conditions, thereby insuring the permanency of this industry.[107]

Representatives of chemical firms desired protection for the American industry to continue making significant revenue. These representatives knew policymaking via tariffs would secure their profit margins. Following Steen's argument that policymaking aided industry, it is evident that this remained the case despite the plight millions of Americans faced during the outset of the Great Depression in 1930.

Union Carbide, following its land purchases and expansions in the 1920s, continued growing substantially in South Charleston throughout the 1930s. First, the corporation constructed an ethanol plant in 1929 that began operations in 1930, and it was the "first

[107] U.S. Congress, House of Representatives, Committee on Ways and Means, *Tariff Readjustment – 1929*, 70th Cong., 2nd sess., 1929, 4.

successful commercial synthetic ethanol facility in the world."[108] Next, amines, important products for corporate revenue, were first produced commercially in 1935. These were non-acidic, organic compounds typically used in detergents and shampoos. Then, the corporation's first commercial VINYLITE unit began operations in 1936. It produced vinyl resins. Finally, Carbide replaced the original plant built on Blaine Island in the late 1920s with a larger facility in 1937 for a Fine Chemicals Unit. This new unit allowed the corporation to research creating new products and research new, more efficient chemical processes.[109] Additional advancements in industry for Carbide and Carbon Chemicals Corporation (CCCC) came as a result of WWII. Prior to American intervention in the war, the US government asked CCCC to investigate the possibility of producing butadiene and styrene. By August 1941, the federal government called for CCCC "to design and build a plant for the Defense Plant Corporation at Institute, West Virginia."[110] The company operated the Institute site following its construction, and by February 1943 the first shipment of butadiene to be transformed into synthetic rubber left the site.[111] Carbide later purchased the plant in 1947.[112]

In response to the war, young people desired to be part of the chemical industry and some had ambitions to work at Union Carbide specifically. In the 1943 yearbook of South Charleston High School, two seniors noted their explicit interest in working at Carbide. Ailian Toney said her ambition was "to be an office worker at Carbide" and Maggie Bowen echoed that

[108] Stief, *A History of Union Carbide Corporation*, 43.
[109] Ibid., 46-49.
[110] Warren J. Woomer, *The Institute Site: From George Washington to the World of Chemicals 1763-2000*, (Aventis Crop Science, 2000), 9
[111] Ibid., 9.
[112] Stief, *A History of Union Carbide Corporation,* 76.

sentiment when she said she desired to work in a Carbide lab.[113] Since the high school, at that time, was located only two blocks away from the chemical powerhouse students had an opportunity to view the plant and consider their future frequently.[114]

Meanwhile, DuPont's Belle Works plant was the first commercial producer of urea by combining carbon monoxide and ammonia. This substance, at the time, was commonly used in fertilizers and synthetic resins in the United States.[115] Similarly, when DuPont scientist Wallace Carothers discovered nylon in 1935 the company needed a plant to produce millions of pounds of the new fabric per year. By early November 1938, the company decided to construct a nylon plant at its Belle Works site because a unit capable of producing 12 million pounds of nylon per year could be achieved there rather than at another site. Belle Works was the only location in the Western Hemisphere to manufacture it until 1947. Ultimately, at the conclusion of the 1930s the plant in Belle manufactured more than eighty products and represented the company's largest investment of any site.[116] As for the Second World War, the United States Navy utilized Belle Works to produce a type of plastic discovered in England. While it was "during World War II practically a military secret" used for radar equipment in fighter planes, it became commercially known as "Alathon" after the war.[117]

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[113] My grandmother owns this yearbook: South Charleston High School, *Memoirs 1943*, (South Charleston, West Virginia: 1943), 23, 31.
[114] The building which housed South Charleston High School until the 1970s is now home to South Charleston Middle School.
[115] "Teacher Reference Material," 90 and David A. Hounshell and John Kenly Smith Jr., *Science and Corporate Strategy: DuPont R&D, 1902-1980*, (Cambridge: Cambridge University Press, 1988), 188.
[116] "Teacher Reference Material," 89-91; "Town of Belle History," part 2, 16; Hounshell and Smith, *Science and Corporate Strategy*, 188-189 and 268; and "Wallace Carothers and the Development of Nylon – Landmark," *American Chemical Society*, accessed September 16, 2023, https://www.acs.org/education/whatischemistry/landmarks/carotherspolymers.html.
[117] Hounshell and Smith, *Science and Corporate Strategy*, 90 and Commercial titled "Dupont commercial highlighting an Alathon flexible tumbler," 1953, Item ID FILM_1995300_FC254_05, Location FC 254, Hagley

Monsanto's purchases in Nitro allowed for substantial growth during the Interwar Period, as well. By acquiring Rubber Services Laboratories, existing infrastructure for manufacturing rubber allowed the company to easily focus rubber production there during the 1930s and 1940s.[118] As for wartime, the federal government did not contract Monsanto's Nitro plant. A specific arm of the government, the Rubber Reserve Company, which contracted Carbide for butadiene in Institute, instead held a contract with Monsanto's Texas City, Texas site to produce styrene. This material, like butadiene, was essential for synthetic rubber to be used for tires and soling combat boots. [119]

Coinciding with American intervention in WWII and the ways in which chemical firms in the Kanawha Valley responded to the war effort, the US Public Health Service conducted a pollution survey on the Ohio River and its tributaries. The survey's second volume focused on the Ohio's major tributaries and their corresponding basins, with the Kanawha River and its basin noted as one tributary to examine.[120] The study focused on pollution measures needed to curb the amount of domestic and industrial wastes entering each tributary. Upon examining the Kanawha River Basin, over 90 percent of pollution entered the waterway in Charleston and its satellite area with industrial waste cited as the leading cause of the issue.[121] However, despite this conclusion, the report also asserted, "Because of the technical and often secret nature of

Museum and Library, Wilmington, Delaware, https://digital.hagley.org/FILM_1995300_FC254_05 (hereafter cited as Commercial, Hagley Museum and Library).

[118] Elmore, *Seed Money*, 81-82.

[119] Ibid., 65.

[120] The Kanawha River Basin extends into western Virginia and western North Carolina due to the New River. The New River then meets with the Gauley River in Gauley Bridge, Fayette County, West Virginia.

[121] Federal Security Agency, U.S. Public Health Service, *Ohio River Pollution Survey: Final Report to the Ohio River Committee, Volume II,* (Cincinnati, Ohio, 1942), iv-vi, 389-390, https://babel.hathitrust.org/cgi/pt?id=uiuc.3870929v2&seq=1&q1=kanawha.

the industrial processes involved, industrial pollution corrective measures are squarely up to the industries themselves."[122] At the time of this survey, federal policy was not concerned with water pollution.

Despite these clear indications as to the detrimental effects of pollution, federal policymaking continued to support the chemical industry during the Second World War as it did during the Great Depression. Kathryn Steen repeatedly addressed the topic of how patriotism bolstered industry during World War I. I build upon her argument by examining how similar phenomenon bolstered the industry during World War II. First, just as the Urgent Deficiency Appropriations Act of October 1917 pushed for contracting private companies to supply the war effort, the second War Powers Act of 1942 pushed for similar relations.[123] Additionally, the Trading With the Enemy Act (TWEA) was still in use and operated much the same as it did during WWI. Amendments in 1940 and 1941 increased the power of the President to manage foreign-owned property.[124]

Other Wartime Industries

The chemical industry was not the only industry to experience rapid growth due to the First World War. Dialpainting began in 1917 in response to soldiers needing easy-to-read wristwatches while in trenches. The newly invented time-telling device served a military purpose because the radium-based paint made the watch face glow-in-the-dark making it easier

[122] Ibid., 390.

[123] Aidan Lawson and June Rhee, "Usage of the Defense Production Act Throughout History and to Combat COVID-19," *Yale School of Management*, June 3, 2020, https://som.yale.edu/blog/usage-of-the-defense-production-act-throughout-history-and-to-combat-covid-19#:~:text=The%20second%20War%20Powers%20Act,government%20contracts%20for%20national%20defense.

[124] *Trading With The Enemy Act*, *U.S. Code* (1958), §§ 1-40.

to read. Consumers fascinated with dialpainted wristwatches during the war fostered a domestic commercial market following the conflict, and sales of luminescent wristwatches soared.[125] Meanwhile, the asbestos mine in the town Asbestos, Quebec, Canada also rose to prominence during WWI. The asbestos mineral is fireproof and individuals knew of this novel quality dating back to the nineteenth century, but the first boom for asbestos mining did not occur until WWI. Soldiers, just as they needed easy-to-read wristwatches, needed fire retardant uniforms for protection.[126] Following the war, "asbestos was fuelled largely by society's desire for modern conveniences: fire retardant housing materials, fireproof clothing, long-lasting cement structures, and safe and durable automobile parts."[127] The American chemical industry, the Quebec asbestos mining industry, and the dialpainting industry all became prominent industries during World War I, and the similarities between the three industries showcase the issue of industrial companies placing profits over workers safety and the environment.

While dialpainting grew in demand following WWI due to a commercial desire for glow-in-the-dark wristwatches, by the mid-1920s practitioners of the profession began drawing attention to the harmful side effects of their work. Prior to the discovery of radium poisoning, other industrial products had been flagged for dangerous side effects: white phosphorous and benzene during the nineteenth century and mercury during the early twentieth century prior to WWI, to name a few. Industrial hazards were well-publicized during this time, so Clark articulated that some dialpainters, like Katherine Schaub, deduced that their illnesses were

[125] Clark, *Radium Girls*, 1.
[126] Van Horssen, *A Town Called Asbestos*, 4.
[127] Ibid., 4-6.

related to their work.[128] In comparison to asbestos mining and the chemical industry described later, dialpainters did not have to wait as long for recognition of their industrial illnesses. Thanks to the publicity given to the cause of New Jersey dialpainters by the National Consumers League, some workers received out-of-court settlements. While these settlements did not aid all workers during the 1920s, and recognition of radium poisoning under a New Jersey worker's compensation bill capped the statute of limitations under too short a frame to file a complaint, legal recognition of radium poisoning began in earnest shortly after WWI despite the popularity of luminescent watches.[129]

Meanwhile, in the town of Asbestos residents did not confront the consequences of industrial practice. From 1918 to 1949 the Asbestos mine grew exponentially, by geographic and financial means, and the "few local objections to this growth went unheeded as the people of Asbestos found themselves confronted time and time again by the need to sacrifice the community to the mine."[130] By the end of WWI the Canadian mine supplied 80 percent of the world's supply of asbestos, and during World War II Asbestos continued to dominate the market because, despite the lack of European markets, mineworkers struggled to keep up with the wartime demands of the United States.[131] During these times, WWI through WWII, the mine in Asbestos was an opencast operation. In other words, it was a giant pit. To meet demands, the

[128] Clark, *Radium Girls*, 12, 18-23. Additionally, while discussing industrial hazards, Claudia Clark briefly described the "chemicalization of industry" and asserted that products used in the American chemical industry exposed many workers to "dangerous new compounds," (22). Since Clark did not state if these toxic discoveries were known during the earlier twentieth century or understood later, I chose to not include these assertions as part of my study.
[129] Ibid., 147-149. Claudia Clark did not specify the statute of limitations in New Jersey. Meanwhile, Connecticut, as described on page 139, had existing worker's compensation laws that covered workplace ailments for up to five-years, later shortened to three.
[130] Van Horssen, *A Town Called Asbestos*, 34.
[131] Ibid., 35, 44-45.

mine geographically expanded by the owners acquiring more and more land, and by 1948 the mine totaled approximately two-thirds of one mile long by one-half of one mile wide. All the land acquired over the years became part of the opencast operation, so the company, Jeffrey Mine, began underground mining during WWII.[132] Meanwhile, researchers discovered the link between inhaling asbestos fibers and lung diseases like asbestosis but information was not shared with workers and the community of Asbestos. Jeffrey Mine company officials did not want company profits to suffer, so they did not publicize the findings that declared asbestos unsafe. In the event a report could not be denied, officials claimed there were clear differences between asbestos elsewhere in the world compared to Canadian asbestos. The chrysolite asbestos found in Quebec, they claimed, was safe.[133]

In striking similarity to my area of study, the first half of the twentieth century saw the chemical industry of the Kanawha Valley grow and develop rapidly while supplying many of the world's "chemical firsts."[134] Like asbestos mining and dialpainting, working in the chemical industry skyrocketed during World War I. The wartime affiliations and notable uses of radium based paint, asbestos, and chemicals rose in popularity following the war. While dialpainting and the use of radium based paint decreased in popularity during the Interwar Period, despite its surge in popularity immediately post-WWI, asbestos mining and chemical manufacturing continued growing rapidly. Clark noted, in one instance of who should be held liable for the deaths of dialpainters, "Officials of the U.S. Radium Corporation, in pursuit of profit, were willing

[132] Ibid., 46-48.
[133] Ibid., 55-56.
[134] "Chemical firsts" is my own term to describe how groundbreaking chemical operations in the Kanawha Valley were in relation to the global industry. Discussed earlier in the chapter, the Kanawha Valley housed the world's first petrochemical plant and Dupont's Belle Works was the first commercial producer of urea.

to risk not only their own health but that of workers and consumers."[135] In a similar fashion, van Horssen cited, "JM [Jeffrey Mine] would not sacrifice its profits for the sake of its workers."[136] This trend of placing business over human health, and the environment in the case of Asbestos, is traced in reference to the Kanawha Valley in the following chapter. Furthermore, the sacrifices workers and residents made, like in Asbestos, is described in order to encompass the complexity of business over health.

Conclusion

During the nineteenth century, the salt industry, engineering projects, and ferroalloy production highlighted the use of the Kanawha River Valley for industrial practices. They demonstrated the use of the river for transporting goods and harnessing hydroelectric power. Accordingly, when World War I began and the United States no longer relied on chemical imports from Germany, federal policy called for fostering a domestic chemical industry. Through the Urgent Deficiency Appropriations Act of October 1917, Congress tasked the US military with fostering the growth of a domestic chemical industry. To accomplish this task, the Armed Forces turned to existing chemical companies, and the initial surveys done by DuPont selected the Kanawha River Valley of West Virginia as one place capable of accomplishing the task. Although DuPont did not construct and operate a chemical plant in the valley during the war due to earlier anti-trust allegations, plans to construct an explosives plant in the town that came to be known as Nitro continued. Although the end of WWI prevented the plant from operating at max capacity, its near-complete construction invited private industry to the region.

[135] Clark, *Radium Girls*, 167.
[136] Van Horssen, *A Town Called Asbestos*, 55.

Throughout the 1920s, Union Carbide, DuPont, and Monsanto arrived in the Kanawha Valley in the towns and cities of South Charleston, Belle, and Nitro, respectively. During the Interwar Period, these companies diversified their product lines and expanded their geographic footprint in the valley through cutting-edge facilities. High tariffs issued by the Fordney-McCumber Tariff Act of 1922 and Smoot-Hawley Tariff Act of 1930 assured the growth of the new American industry. Chemical firm representatives argued that the industry was vital for national security, and this notion pushed Congress to act in favor of business.

Then, during WWII federal policy again fostered the growth of the chemical industry along the Kanawha River. The second War Powers Act of 1942 urged businesses to sign government contracts, and amendments to the Trading With the Enemy Act allowed the president to manage foreign-owned property. To meet the needs of this legislation, Union Carbide, DuPont, and Monsanto signed contracts with the federal government to produce wartime necessities. In the Kanawha Valley, Union Carbide produced butadiene that was used to make synthetic rubber. Dupont, on the other hand, produced plastic. However, the contract with Monsanto did not apply to their plant in Nitro.

Overall, this chapter addressed through what means the chemical industry came to the Kanawha Valley. Federal policy promoted the creation of a domestic chemical industry to produce explosives and other wartime necessities during WWI, and renewed policy during WWII expanded the industry further. The sense of patriotism surrounding the industry continued throughout the Interwar Period, thanks to tariffs, and the Second World War further bolstering the American industry. By discussing through what means the industry came to be in the valley, there is a better understanding of the various responses residents had with the

industry during the second half of the twentieth century. Additionally, it allows readers to better comprehend why policy post-World War II did not protect the environment and human health.

Chapter 2: The Effects of Policy and Industry

The world wars of the twentieth century required massive production of various materials to meet demand. Federal intervention through chemical production began during WWI, but construction in Belle and Nitro stopped prior to completion due to the conclusion of the war. Private companies quickly arrived and purchased the unfinished plants with the goal of completing construction. The private sector of chemical production quickly established itself in the valley during the Interwar Period and was essential for World War II (WWII) when another international conflict came to pass.

Following the Second World War, Congress began addressing water and air pollution, but these early legislative efforts were ineffective due to their lack of pollution standards and regulations. As a result, the chemical industry in the Kanawha Valley continued expanding and polluting. As the industry became an increasingly important part of the identity of residents, individuals living and working in the valley became progressively more outspoken about the chemical industry. Some residents commented on the negative impacts the industry had on the environment and their health, while others focused on the benefits of the economic revenue chemical production brought to the area. Regardless, chemical firms in the valley continued polluting at alarming rates and threatened the safety of people living and working in the area through the end of the century.

This chapter studies how the chemical industry negatively impacted the Kanawha River Valley throughout the second half of the twentieth century and the responses of residents to those impacts. Some continued to support the industry believing the local economy would suffer without chemical production, and others condemned the chemical industry for causing

rampant pollution. Ultimately, the outcries of residents did not result in effective legislation to correct the issues caused by the chemical industry. Utilizing cancer studies, environmental reports, newspaper articles, and federal legislation, I argue that the chemical industry negatively impacted human health and the environment due to federal policy continuing to support the industry despite the pleas of citizens for protection against those impacts.

Population and Unions

By 1950 West Virginia reached its highest population at 2,005,552 persons, and union organizations in the state were widespread. The state's population decreased on average following that decade primarily due to mechanization of the coal industry and economic development elsewhere in the United States, but the chemical industry also played a role. Following WWII, chemical production responded to overwhelming domestic demands and throughout the remainder of the twentieth century many chemical companies left the Kanawha Valley. The open spaces and abundance of oil for production processes were found in Texas rather than West Virginia. Nonetheless, union representation continued growing through the 1960s. Those employed in chemical occupations belonged to the United Mine Workers, International Association of Machinists, or the Oil, Chemical, and Atomic Workers.[137] Despite the decrease in population and shrinking of the chemical industry throughout West Virginia, the Kanawha Valley still grappled with the effects of the industry at an overwhelming level into the twenty-first century.

[137] George W. Hammond, "Population," *e-WV: The West Virginia Encyclopedia,* last modified August 9, 2023, https://www.wvencyclopedia.org/articles/1900; Ronald L. Lewis, "Labor History," *e-WV: The West Virginia Encyclopedia,* last modified April 19, 2021, https://www.wvencyclopedia.org/articles/1271; and Denham, "Chemical Industry."

Early Environmental Legislation

During the immediate post-WWII years, Congress began addressing pollution. First, the Federal Water Pollution Control Act (FWPCA) of 1948 served as the first act passed by Congress to address water pollution, but the act lacked "federally required goals, objectives, limits, or even guidelines."[138] It kept water pollution a local problem for municipal and state governments to combat. According to this legislation, federal intervention only came in the form of monetary aid for research and direct oversight of interstate bodies of water upon the polluting state's request. As an example, reflecting on the Ohio River Pollution Survey discussed in the previous chapter, since a significant amount of pollution in the Ohio River came from the industrial wastes dumped into the Kanawha River around Charleston, the state of West Virginia had to request federal aid instead of Ohio. On a national level, little remediation came as a result of this ineffective law, and amendments followed as pollution continued at exorbitant levels. The first set of amendments came in 1956 with the second set in 1961. Other major amendments to the act came in 1965, 1966, and 1970.[139]

As for legislation regarding air quality, Congress passed the Air Pollution Control Act (APCA) in 1955. Like the original FWPCA, this act asserted that state and local governments remained responsible for air pollution remediation. It merely offered federal aid through technical assistance and funds to abate future pollution. Some of the funds accounted for research regarding abatement measures, efforts to reduce emissions, and this enticed private

[138] U.S. Library of Congress, Congressional Research Service, *Clean Water Act: A Summary of the Law*, by Claudia Copeland, RL30030 (2016), 2.
[139] Ibid, 1-2.

companies because the upfront costs of research fell to the federal government.[140] Congress amended the APCA in 1963 to place more responsibility on the federal government because air pollution crossed local jurisdictions and state boundaries. Unlike the FWPCA, which required the state in which the pollution originated to address the issue (as opposed to another state affected by the pollution), air quality appeared to be too widespread an issue for individual states to address.[141] Additional amendments in 1966 allowed for the authorization of grants to agencies combatting air pollution and consolidated appropriation ceilings allowing the federal government to allocate more funds from June 1967 to June 1969.[142]

It was clear that the Federal Water Pollution Control Act of 1948 and the Air Pollution Control Act of 1955, in their original forms, were weak. In the FWPCA, responsibility of addressing and abating water pollution was left to the individual states with no federal guidance, merely financial assistance. As for the APCA, it offered federal funds and technical services for research, but failed to establish air quality standards. Neither act addressed pollution through immediate and direct federal intervention via enforced regulations. It was not until both laws received massive overhauls in the form of the Clean Air Act of 1970 and Clean Water Act of 1972 that the newly created Environmental Protection Agency enforced pollution abatement and prevention measures set forth by the legislation. However, even then, the goals of those amendments did not receive enough industrial compliance. Investigated later, many chemical plants along the Kanawha River continued to release significant amounts of toxic

[140] *An Act to Provide Research and Technical Assistance Relating to Air Pollution Control*, Public Law 84-159, *U.S. Statutes at Large* 69 (1955): 322-323.
[141] *An Act to Improve, Strengthen, and Accelerate Programs for the Prevention and Abatement of Air Pollution,* Public Law 88-206, *U.S. Statutes at Large* 77 (1963): 392-401. With these amendments the Air Pollution Control Act was renamed to Clean Air Act.
[142] *Clean Air Act Amendments of 1966*, Public Law 89-675, *U.S. Statutes at Large* (1966): 954-955.

substances into the air and water. Additionally, operations within the plants negatively impacted the health of workers.

The Clean Air and Clean Water Acts changed pollution standards from state to federal matters and altered the way in which federal policy operated, with more oversight of industrial practices that was not seen in earlier laws. Due to these significant differences, I argue few scholars research environmental legislation prior to these acts, and the establishment of the EPA, because earlier legislation was ineffective and differed greatly from current statutes. The findings of McAdam and Boudet, summarized by Shannon Bell, assert studies of social movements commonly begin with "an instance of successful mobilization."[143] In this case, the perceived success of the Clean Air Act and Clean Water Act cause some scholars to render earlier legislative measures pertaining to the environment as insignificant to study. Meanwhile, I find the FWPCA and APCA worthy of study because their ineffectiveness amplifies the voices of those bothered by industrial practices prior to the 1970s.

For example, rampant industrial pollution during the 1950s in or near densely populated cities like Houston and Los Angeles shed let on the need for effective environmental legislation outside of the Kanawha Valley. Both cities, Houston and Los Angeles, were refining capitals with automobile dependent populations. Accordingly, both cities suffered from poor air quality. Historian Hugh Gorman's essay in the edited volume *Energy Metropolis* briefly discussed the ways in which Houston's Air and Water Pollution Control Director Walter A. Quebedeaux observed air pollution control measures in Los Angeles in the mid-1950s. Quebedeaux watched how Los Angeles city officials reacted to industrial air pollution in hopes of mimicking their

[143] Bell, *Fighting King Coal*, 2.

efforts in Houston. However, some Houstonians contended, with the support of arguably misleading air monitoring samples, that their air was far better than that of Los Angeles thereby rejecting the idea that smog was a significant public concern. Meanwhile, other Houstonians signed a petition demanding the city act against air pollution. Los Angeles relied on federal funds, made available by the APCA, to research and address their smog, but the divide among Houstonians inhibited Quebedeaux from addressing the issue in a similar fashion. Also, the mayor of Houston during the early 1960s claimed that while industrial pollution was a growing issue worthy of concern there was no need for aggressive action. Instead, he promoted continued cooperation between city and industry as the method for success.[144] The mayor's approach promoted industry and business over protecting the environment and human health. Since Houstonians at this time favored maintaining their pro-business climate over environmental regulations, this stance is unsurprising.[145]

As for my area of study, Kanawha Valley residents around this time, the 1950s-1960s, seemed to experience environmental awareness in ways that echoed Houston and Los Angeles. Discussed in greater detail later, those that lived in the valley during the 1960s seemed to overwhelmingly support environmental regulations, like Los Angeles officials, while some did not. Those that did not support regulations did so under the same assumption as those in Houston, heightened regulations threatened business.

Prominent Production and Industry Growth from World War II through the 1960s

[144] Hugh S. Gorman, "The Houston Ship Channel and the Changing Landscape of Industrial Pollution," in *Energy Metropolis: An Environmental History of Houston and the Gulf Coast*, ed. Martin V. Melosi and Joseph A. Pratt, (Pittsburgh: University of Pittsburgh Press, 2007), 63-65.
[145] Ibid., 53.

During the Second World War, the US Army researched herbicides to combat the dense jungles commonly found on the Pacific Islands. Studies concentrated on a chlorinated herbicide called 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), but the Armed Forces did not use it during the war. Nonetheless, despite an absence of knowledge regarding the compound's effects on plants and humans, the US Department of Agriculture determined 2,4,5-T could serve as a domestic weedkiller. Monsanto invested in this chemical in 1945 and began producing it at corporate headquarters in St. Louis following the dissemination of wartime research. The Nitro plant began producing the product in 1948, but excitement surrounding production of this compound was short-lived.[146]

On March 8, 1949, a safety valve ruptured causing a chemical leak and additional explosion that ultimately affected over 100 men working at and around the production site. Symptoms varied from nausea and headaches to severe symptoms of chloracne, a skin condition resulting in large pustules encompassing the body. Treatment required removing, or peeling-off, multiple layers of skin. Some doctors that studied the men with the worst cases went so far as to assert some symptoms were the result of long-term exposure and not solely due to the explosion. Years later, employees stated this news was not shared with them. While most men tried to treat their symptoms and avoid the production site of 2,4,5-T, Monsanto managers, following the incident, gave some employees the ultimatum to return to the unit or face termination. Considering Monsanto paid twice as much as minimum wage, $2.18 per hour, the unit was fully staffed again by the mid-1950s.[147]

[146] Elmore, *Seed Money*, 79-97.
[147] Ibid., 79-97.

While profits from 2,4,5-T production did not yield the immediate, successful results Monsanto desired due to the explosion, the company continued to produce it. The most prominent period of manufacturing occurred from 1962 to 1969. During a significant portion of the Vietnam Era, the major American conflict of the time, the US Military deployed Agent Orange on a massive scale. A key ingredient of Agent Orange was 2,4,5-T.[148] Speculation regarding the long-term effects of the compound remained among employees, despite symptoms occurring at plants producing it elsewhere in the United States. Additionally, the conclusions of research conducted by a German scientist in 1957 confirming that dioxin was the contaminant within 2,4,5-T was not shared with employees.[149] The events workers faced at Monsanto in the Kanawha Valley echo the situation of the dialpainters described by Clark in *Radium Girls* due to the idea of social utility. Since federal policy historically supported the chemical industry, it appeared that sacrificing the health of workers in Nitro for the sake of military efforts in Vietnam was beneficial.

As for Carbide and Carbon Chemicals Corporation (CCCC) during this time, it also began producing a greater variety of products along with expanding its geographic footprint in the valley. First, CCCC purchased the Institute site in 1947 and by the mid-1950s both plants had about 10,000 people on the payroll.[150] It also acquired the US Navy's polyethylene unit in South Charleston shortly after the war, and thanks to upgrading the unit in 1949, the CCCC produced

[148] On the time Agent Orange was used: Institute of Medicine: Committee to Review the Health Effects of Vietnam Veterans of Exposure of Herbicides, *Veterans and Agent Orange: Health Effects of Herbicides Used in Vietnam*, (Washington, D.C.: National Academies Press, 1994), 74. Noting when the Nitro Plant stopped producing 2,4,5-T: "Bibb v. Monsanto: Stuart Calwell's Eight Year Battle to Clean Up the Town of Nitro, West Virginia," *Calwell, Luce, Ditrapano*, accessed August 19, 2023, https://www.cldlaw.com/news/eight-year-battle-to-clean-up-the-town-of-nitro-wv/.
[149] Elmore, *Seed Money*, 95-96.
[150] "Teacher Reference Material," 83 and Stief, *A History of Union Carbide Corporation*, 76.

30 million pounds per year there. The corporation also began producing alcohols using olefins, a new process in the chemical industry, with a unit in South Charleston in 1955. The other location was in Texas City, Texas. Concurrently, the Institute site began producing an insecticide called Crag Sevin in the 1950s, and it was Carbide's breakthrough into the agricultural side of the chemical industry. To further the production of this insecticide, CCCC constructed a permanent unit for its production in 1960. From its first operation, the unit had the ability to manufacture 50 million pounds per year of Crag Sevin. Prior to this construction, in 1959 the corporation established its Technical Center in South Charleston and Carbide designed the center solely for research, development, and engineering. By 1960 Carbide owned and operated three sites in the valley.[151]

These serve as a few examples of the corporate growth of Carbide in the Kanawha Valley, but that growth came with an environmental cost. One example is the landfill Union Carbide operated along the banks of Davis Creek in South Charleston in 1950s. This landfill, used through the 1980s, saw the waste of one Carbide plant, presumably the one in South Charleston, along with two coal-burning power plants. Some of the wastes included arsenic, lead, mercury, and chrome. Industrial wastes made up most of the wastes at Filmont Landfill, and the site caught fire at least once in 1966 (Image 2).[152]

Dupont's success during the interwar and wartime periods in the town of Belle continued postwar, and research regarding a new type of plastic was at the forefront of

[151] Stief, *A History of Union Carbide Corporation,* 80, 82, 87.
[152] Series of news articles on the same webpage: Curtis Tate, "Attorney Who's Sued Carbide 4 Times Pushes for Civil Penalties," *West Virginia Public Broadcasting*, October 22, 2021; Chris Tate, "Union Carbide Faces New Lawsuit Over Water Pollution," *West Virginia Public Broadcasting*, September 10, 2021; Eric Douglass, "Decision Still Pending on Carbide Landfill Temporary Restraining Order," *West Virginia Public Broadcasting*, March 17, 2021, https://wvpublic.org/tag/union-carbide/page/3/?amp=1.



Image 2: Industrial waste on fire at the Filmont Landfill in June 1966.

Source: Archival photo featured in a news article: Eric Douglass, "Decision Still Pending on Carbide Landfill Temporary Restraining Order," *West Virginia Public Broadcasting*, March 17, 2021, https://wvpublic.org/decision-still-pending-on-carbide-landfill-temporary-restraining-order/.

company interest. Aside from the immediate commercial success of Alathon for frozen food storage, tumblers, and other kitchen products following the war, researchers at DuPont began work on Delrin, a formaldehyde polymer based plastic, in late 1952.[153] Research regarding how to assure Delrin's ability to withstand extreme temperatures along with finding a commercial use for the product were initially difficult. Nonetheless, when scientists confirmed the stability of the product, DuPont engineers designed a semiworks operation at Belle. The site at Belle Works provided the formaldehyde polymer that was used for product development at a commercial plant and market evaluation.[154]

As the industry grew in the valley post WWII, it came to be a part of local identity as seen by high school seniors at the time. Coupled with the sentiments of two seniors in 1943, more South Charleston High School seniors in 1952 sought to work at Union Carbide. The school was still located only two blocks from the original South Charleston plant, and three students: Ellen Campbell, Charles McGee, and Bob Pence all noted their desire to work at Carbide. Bob Pence went so far as to want to go to work that summer, soon after graduating.[155] By this time, it was increasingly apparent that individuals living in the valley associated heavily with the chemical industry. Just as the Monsanto workers stayed in the 2,4,5-T unit following the explosion for the high income they made, young people wanted to go work in the industry.

These sentiments echo the community of Asbestos. Just as the human bodies were inextricably linked with the asbestos mine through ailments and incomes, human bodies in the

[153] Commercial, Hagley Museum and Library and Hounshell and Smith, *Science and Corporate Strategy*, 486.
[154] Ibid., 487-490.
[155] My grandmother owns this yearbook, and in the absence of page numbers I note the section name: South Charleston High School, *Memoirs 1952*, (South Charleston, West Virginia: 1952), Ambitions.

Kanawha Valley felt connected to the chemical industry in a similar fashion. For example, Bertrand McNeill of Asbestos, following the five month strike held by mineworkers in 1949, said he "aspired to nothing more than a life of stable employment at the Jeffrey Mine" thanks to the wages his work provided.[156] Due to these attachments to the bodies of land in Asbestos, the following section describes ways in which Kanawha Valley residents related to their land.

This section offered examples and stories regarding how Monsanto, Carbide, and DuPont maintained their prominence in the valley following World War II. During that time, their operations significantly polluted the valley, and, as discussed in the next section, individuals living in the valley offered many remarks reflecting on the negative impacts of the industry. Their comments appeared in local newspapers during the 1960s and proclaimed the ambient air quality was poor and the water from residential taps was unpalatable.

Citizen Pleas to Address Pollution in the 1960s

Prior to the respective passages of the Clean Air and Clean Water Acts, when earlier legislation through the FWPCA and APCA proved ineffective, residents of the Kanawha Valley publicly addressed their frustrations regarding poor air and water qualities. The *Charleston Daily Mail* and *Charleston Gazette*, local newspapers, gave a voice to these frustrations through the circulation of many articles on the subjects throughout the 1960s. In mid-July of 1963 there appeared to be increased discussion on the matter with the printing of a three-part series discussing the unpalatable water of Spring Hill, Dunbar, and Nitro along the Kanawha River.[157] Charlie Connor, staff writer at the *Charleston Daily Mail*, began the series with interviews from

[156] Van Horssen, *A Town Called Asbestos*, 165.
[157] Spring Hill is the name reserved for a western portion of South Charleston that circles Spring Hill Mountain.

residents expressing their frustrations. Albert McCutcheon of South Charleston remarked, "We're getting ready to send a man to the moon but we can't get a decent drink of water," when reflecting on a recent report made by the Kanawha-Charleston Health Department stating the local spring he would retrieve water from each day was unsafe. Another inhabitant of South Charleston, Mrs. Charles Spradling, commented, "I moved away from North Charleston to get away from the air pollution, but now I'm in an area where I can't drink the water. I don't know which is worse."[158] She only used tap water or water from the nearby spring to wash laundry.[159]

At this time, the water filtration site for 13,000 homes, namely in Spring Hill, Dunbar, and Nitro, was in Nitro and operated by West Virginia Water Company (WVWC). In 1962 the process to install a double aeration system began costing $750,000. Constructed in approximately one year's time, the aeration technique pumped water under extreme pressure twice to remove odor causing gases. Then, activated carbon, highly porous charcoal with an increased surface area that absorbs more compounds than traditional carbon-heavy substances, soaked up organic compounds upon placement in the water. Finally, the filtered water flowed to a settling basin for chlorination prior to distribution.[160]

Despite this elaborate process of water purification, many occupants of those homes did not believe the system properly filtered water from the Kanawha River and continued to take extreme measures to gather palatable drinking water elsewhere. Some travelled to Tyler

[158] North Charleston is not a city like South Charleston, founded in 1917, but an area of the city of Charleston. The name North Charleston is similar to others like the West Side or East End, other areas of Charleston.
[159] Charlie Connor "Foul-Tasting Water Stays Despite Filtering Efforts," *Charleston Daily Mail*, July 16, 1963, Box 689, Folder Water Pollution, Randolph Collection, WVSA, Charleston, West Virginia.
[160] Charlie Connor, "Chemicals Polluting River; No Relief Seen Before 1965," *Charleston Daily Mail*, July 17, 1963, Box 689, Folder – Water Pollution, Randolph Collection, WVSA, Charleston, West Virginia and "Activated Carbon," *Chemviron: A Kuraray Company*, 2022, https://www.chemviron.eu/products/activated-carbon/.

Mountain Water Company in an unincorporated area northwest of Charleston and paid fifteen cents per gallon for water from the clean mountain spring. [161] Others went to the homes of friends or family residing in Charleston or St. Albans whose water came from the "relatively unpolluted Elk and Coal Rivers."[162] These extreme measures caused Lawrence Barker, former mayor of Dunbar, to call for the permanent establishment of a new water source. The water company responded and claimed that locating a new source and distributing water from it would cause rates, at a minimum, to double. On a similar note, the current mayors of Dunbar and South Charleston, W. Dale Long and W.W. Kramer, were hopeful that the taste of the water would improve soon. A new source was unnecessary as Kramer believed there was good "cooperation between cities, industries and the water company."[163] Nonetheless, to ease the tensions of his constituents, he claimed he would still investigate the quality of springs in Spring Hill as an alternative water supply. Ultimately, his search did not comfort the minds of those in the vicinity because Dr. W.C. Hueper at the National Cancer Institute in Bethesda, Maryland recently remarked that residue from the river could be cancerous.[164]

By the time this series appeared in the local newspaper, the Kanawha River Industrial Action Committee (KRIAC) was already working on pollution prevention measures. Established in 1957 to address the concerns of residents, members consisted of volunteer scientists from the thirteen chemical plants along the river working closely with individuals from the Division of Water Resources within the State Department of Natural Resources (DNR). The scientists of

[161] Tyler Mountain Water Company was, and continues to be, a well-renowned local water-bottling company since it opened in the 1930s. Note that the Elk River is in Charleston and the Coal River is in St. Albans.
[162] Connor, "Foul-Tasting Water."
[163] Ibid.
[164] Ibid. The article does not cite where Hueper offered his comment.

KRIAC reported that they recognized the foul taste and odor coming from the river. Bern Wright, Chief of the Division of Water Resources, noted that WVWC was working to the best of its ability to provide palatable water by 1965 and praised the construction of the double aeration system. Since the water company received an "A" grading for abatement and the chemical companies received an "E," Wright asserted the remaining duty for water purity loomed over the chemical industry.[165]

The claim by Wright was well-supported beyond the cost of the double aeration system. By 1963 all cities along the Kanawha had individually spent millions of dollars to meet state-mandated orders to fight river pollution via domestic sewage, because federal standards did not exist. For example, the city of Charleston had spent $14 million on its sewage system. However, the various chemical companies and corporations had not invested nearly as much as one city despite being the source of odorous and unpalatable water. Union Carbide, with sites in South Charleston and Institute, invested only $8 million for waste treatment plants in both locations. Approximately $5 million went to the joint city-company sludge treatment project in South Charleston with the remaining $3 million going to the company operated sewage plant in Institute. At DuPont's site in Belle, assistant manager George Cato remarked that the company had been "working on the pollution problem for 15 years 'but we've still a ways to go.'"[166] Then he assured pollution treatment was a priority for DuPont because: "'It's part of doing business these days… We have to do it and we're happy to do it."[167] The method used to curb river

[165] Connor, "Chemicals Polluting River."
[166] Charlie Connor, "Pollution Efforts Costing Millions," *Charleston Daily Mail*, July 18, 1963, Box 689, Folder Water Pollution, Randolph Collection, WVSA, Charleston, West Virginia.
[167] Ibid.

pollution at that time was pumping the sludge to a nearby mountaintop impoundment where bacteria broke it down.[168] These steps may seem commendable, but evidently the amount of pollution released by Union Carbide, DuPont, and fellow chemical companies far exceeded the amount removed from the river hence their "E" grade. Neither the 15 years of work on DuPont's part nor KRIAC had done enough to assist municipalities in reducing effluence.

However, other organizations formed to combat pollution in this body of water. Since the Kanawha River is a major tributary to the Ohio River, in 1962 the Ohio River Valley Water Sanitation Committee (ORSANCO) became acutely concerned with the Kanawha. Operating as a joint federal and state commission to protect the Ohio River Basin since 1948; the group's main concerns were to assure the river would no longer be a source of interstate water pollution, to make it safe for water-based recreational activities, and to make it a "satisfactory" supply of water for residents and industry. To evaluate and gauge clean-up efforts, members from the eight states affiliated with ORSANCO, West Virginia state representatives of the DNR, legislative leaders, other agencies from various levels of government, media, chemical industry representatives, and guests held an inspective boat tour in September 1964. They traversed the river between Nitro and Belle and were pleased with the measures taken concerning pollution abatement. By the time of their tour, approximately fourteen months since the three-day pollution feature in the Daily Mail, the chemical companies had invested $18 million and local municipalities had invested $30 million. While not diminishing these efforts and investments, Bern Wright continued to affirm that more action was necessary. For instance, there was a goal

[168] Ibid.

for a 70% reduction of wastes in the river by 1966.[169] Union Carbide, Monsanto, DuPont, and the other, approximately twelve, companies all needed to invest more time and money in preventative and remediation efforts.[170]

Such a significant reduction of chemical pollution in a two year time frame was a lofty goal. Especially with residents downriver from Nitro, in Putnam and Mason Counties, also calling for a new water source.[171] While the state received approximately $3.8 million under the Public Works Acceleration Act of September 1962, none of the $1 million for sewage treatment facilities went to cities in the Kanawha Valley.[172] The Public Works Acceleration Act allocated funds to areas "burdened by substantial unemployment and underemployment" in hopes of making the area "more conducive to industrial development and better places in which to live and work," and the valley either did not meet this criteria or did not face these issues as detrimentally as other places.[173] Nonetheless, as detailed earlier, cites along the Kanawha River updated sewage treatment facilities on their own accord. The effect of these efforts was unsuccessful in the eyes of some because in 1965 Congressional Representative John M. Slack Jr. proposed a new water source for the valley. It called for a pipeline from Summersville Lake to the Charleston area, but the project faced opposition due to its cost.[174] The Coal River in St.

[169] "Kanawha River Boat Inspection Tour," *West Virginia Department of Natural Resources* and *Ohio River Valley Water Sanitation Commission,* September 9, 1964, WVSA, Charleston, West Virginia.
[170] For approximate number of chemical plants at the time: Connor, "Chemicals Polluting River."
[171] Thomas F. Stafford, "Adequate Water: Ignored But Growing City Crisis.," *The Charleston Gazette*, May 25, 1965, Box 693, Folder Water – 1965 Misc., Randolph Collection, WVSA, Charleston, West Virginia.
[172] "Accelerated Public Works Program Brings Millions of Dollars into West Va.," *The Clarksburg Exponent*, February 27, 1963, Box 689, Folder Public Works-Accelerated Program, Randolph Collection, WVSA, Charleston, West Virginia.
[173] *Public Works Acceleration Act,* Public Law 87-658, *U.S. Statutes at Large* 76 (1962): 541-544.
[174] Richard Grimes, "All-County Pipeline for Water Advised in Report By Slack," *Charleston Daily Mail*, April 1, 1965, Box 693, Folder Water 1965 – Misc., Randolph Collection, WVSA, Charleston, West Virginia.

Albans, the cleanest tributary to the Kanawha in the greater Charleston area, since the Elk became increasingly polluted each year, was another contender for a new water source.[175]

In the same year, 1965, representatives of five chemical plants along the river met with US Senator Jennings-Randolph (D-WV) to voice their opposition to proposed federal standards regarding water pollution. The individuals preferred state standards. The federal standards, or the Senate version of the bill, included enforcement procedures that the House version did not.[176] This author argues the companies preferred the House version because, as exhibited by public frustrations regarding water quality, the state did not hold chemical plants as responsible for pollution as needed. Municipalities invested more to improve water quality than the companies despite Bern Wright, Chief of the Division of Water Resources, claiming the plants needed to do more.

As for continued discussion regarding air pollution, significant attention came to the issue when in January of 1966 members of the Charleston Women's Club invited other women from clubs throughout the valley to join them in a meeting with West Virginia Senator Paul Kaufman.[177] The state representative ultimately urged all women in attendance to organize and call for state mandated regulations regarding air quality. Kaufman thought enforced state standards would improve the valley's ambient air since the plants could be fined $100 per day per violation if they did not meet the standards. However, Senator Kaufman also expressed concern about relying on state standards to enforce pollution standards when he noted that

[175] Stafford, "Adequate Water."
[176] "Pollution Control Delayed by Dispute," *The Charleston Gazette*, July 31, 1965, Box 693, Folder Water Pollution 1965, Randolph Collection, WVSA, Charleston, West Virginia.
[177] Unverified political affiliation.

other states, like New York, passed "weak laws" that lacked uniform criteria for all polluters to follow.[178]

The efforts of women in the Kanawha Valley rallying for clean air echoed the efforts made by Appalachian women located in coalfields during the 1960s in their organizations against surface mining. Historian Jessica Wilkerson noted in her work *To Live Here, You Have to Fight*, that the Save the Land and People movement highlight by Chad Montrie began by the efforts of a woman. Ollie Combs sat in front of a bulldozer at a strip mining site and refused to move, and her time spent in jail inspired others to act against surface mining.[179] Coupled with the works of Shannon Bell, the role of Appalachian women in environmental movements dates back, at least, to the 1960s.

The concerns shared by Senator Kaufman and women of the Kanawha Valley were later verified by a report published in 1970 that studied air pollution in the valley from August 1964 through December 1966. Conducted jointly by the US Public Health Service and the West Virginia Air Pollution Control Commission (WVAPCC), the study evaluated eight criteria with an inventory of emitted pollutants as one key area. The report declared, as residents already knew, that industrial pollutants hindered air quality in the valley. Additionally, the study tracked fifteen industrial sources of pollution with eleven of the sources being steam-generation plants that operated in the chemical industry: Monsanto, DuPont, and all three Carbide locations were listed as sources. Across the eleven chemical sites, the efficiency of capturing particulates

[178] Jean M. Rhodes, "Women Attack Air Pollution," *The Charleston Gazette*," January 11, 1966, Box 696, Folder Pollution – 1966 Air and Water, Randolph Collection, WVSA, Charleston, West Virginia.
[179] Jessica Wilkerson, *To Live Here, You Have to Fight: How Women Led Appalachian Movements for Social Justice*, (Chicago: University of Illinois Press, 2019): 31-32.

before they entered the atmosphere was reported via questionnaire to be at an average of 71 percent. While that number may be commendable, individual plants reported 0 percent efficiency up to 96 percent efficiency. Accordingly, in its background research the study noted early ordinances that prohibited open burning of waste and limited smoke density that inhibited visibility. It also cited the passage of the West Virginia Air Pollution Control Act of 1961, which was ineffective legislation as alluded to by Kaufman and members of various Women's Clubs.[180]

Legislation at the federal level was unsuccessful at sufficiently curbing pollution, because, as designed, responsibility was placed upon individual states to mitigate pollution. In turn, states and communities had to balance the issue of assuring economic well-being with pure air and water as one Kanawha Valley resident pointed out.[181] The Kanawha Valley during this time is similar to the communities Lerner investigated in his work *Sacrifice Zones*. He found that low-income areas across the United States that abut military bases, oil refineries, and chemical plants, to offer a few examples, suffer from poor air, water, and/or soil quality. For example, the city of Marietta, Ohio found along the Ohio River across from Wood County, West Virginia suffered from the odors of the nearby ferroalloy plant operated by Eramet Marietta, Inc. The odors there indicated a larger issue of obnoxious manganese pollution into the river valley's air. Residents there, knowing the company was the culprit, hesitated to take the issue to state officials out of fear of retaliation from the chemical plant or the closure of it. The latter, as believed by one individual, would negatively affect the town's economy and would cause many

[180] U.S. Department of Health, Education and Welfare, Public Health Service and West Virginia Air Pollution Control Commission, *Kanawha Valley Air Pollution Study*, (Raleigh, North Carolina, 1970), iii, 1-2, 3-1 – 3-4, https://nepis.epa.gov/Exe/ZyPDF.cgi/9100EKKT.PDF?Dockey=9100EKKT.PDF.
[181] "Without Those Odors We Could Be A Lot Purer and Poorer In About Equal Measure," *Charleston Daily Mail*, July 19, 1963, Box 689, Folder Water Pollution, Randolph Collection, WVSA, Charleston, West Virginia.

to lose their jobs. This conundrum from the late 1990s and 2000s strikes stark resemblance to the issues of pollution in the Kanawha River Valley during the 1960s. Both communities suffered from the practices at nearby chemical plants and the failures of the federal government to protect the environment and human health.[182] Just as government and business sacrificed Marietta under Lerner's expanded use of the term "sacrifice zone," federal policy and chemical companies sacrificed the Kanawha River Valley.

Establishing the Environmental Protection Agency and Passage of the Clean Air & Water Acts

Despite their stated interest in significantly reducing pollution, chemical companies along the Kanawha River did not significantly reduce pollution by 1970. In October of that year, State Attorney General of West Virginia Chauncey Browning Jr. (D) conducted hearings on the Blue Ridge Dam project in Galax, Virginia. The Attorney General was concerned that the dam would alter the flow of the New River in West Virginia, which would in turn affect the Kanawha River. In relation to the chemical industry, adjusting the flow of these rivers could negatively affect the ability of the Kanawha River to dilute the pollutants found in it. On the first day of the hearing, Monsanto's Director of Pollution Control at Nitro, Max Galloway, stated the company released 44 tons of solid waste, 2.5 tons of organic waste, and 13 million gallons of contaminated water into the river each day.[183]

In relation to the environmental movement and policymaking of the 1960s and 1970s, environmentalists desired tougher legislation on a number of issues. For example, Appalachians at this time, from northern Alabama to western Pennsylvania, sought to abolish surface mining

[182] Lerner, *Sacrifice Zones*, 137-154.
[183] Richard Grimes, "Monsanto Dumps Tons Waste Daily," *Charleston Daily Mail*, October 21, 1970, Box 724, Folder Pollution, Randolph Collection, WVSA, Charleston, West Virginia.

practices. As Montrie observed, abolitionists typically utilized one of two rhetorical practices to call for legislation against the mining practice. Some utilized a conservationist argument claiming natural resources should be used rationally, and that this method protected the wildlife commonly harmed by surface mining operations. Others, instead, used Judeo-Christian messaging that claimed surface mining destroyed the beauty of earth. Accordingly, since humans are stewards of the land, it was up to the people to act against industry.[184] The concerns extended beyond the physical environment, however, and abolitionists also sought to protect their homes from landslides and cracked foundation caused by blasting at mine sites.[185] State legislation throughout the 1960s did not abolish strip mining, and the issue become regional then national in an effort to receive a ban at the federal level. Ultimately, becoming a national cause undermined the issue, despite good intentions, because "national groups played traditional beltway politics, engaging in compromise long before any sort of decline in the movement required it, and lawmakers responded."[186] Part of Montrie's story occurred following the establishment of the Environmental Protection Agency (EPA), so he noted that environmentalists from the Sierra Club to West Virginia Congressional Representative Ken Hechler tried to garner EPA oversight of strip mining practices for the hopeful phase-out of the practice.[187] While the efforts of surface mining abolitionists differed from the efforts of Kanawha Valley residents, especially since those in my area of study did not mobilize into grassroots

[184] Montrie, *To Save the Land and People*, 201-202.
[185] Ibid., 3.
[186] Ibid., 204.
[187] Ibid., 150, 162.

activism, their desire for effective federal intervention to address environmental issues was similar.

Prior to the passage of amendments that established the Clean Air Act and Clean Water Acts as they are known today, President Richard Nixon (R) established the EPA. In July of 1970 he remarked on the flaws of the acts meant to be combatting pollution:

> Our national government today is not structured to make a coordinated attack on the pollutants which debase the air we breathe, the water we drink, and the land that grows our food. Indeed, the present governmental structure for dealing with environmental pollution often defies effective and concerted action.[188]

To combat these flaws, Nixon wanted to create one government organization to oversee research on pollutants, monitor pollutants, establish standards of the maximum amount a pollutant should be found in the environment, and enforce policies to reduce the number of pollutants. Congress agreed with the establishment of such an agency, and in December 1970 the EPA was established.[189]

Later that month, Congress passed amendments to the Clean Air Act that greatly differed from existing policy. On December 31, 1970, President Nixon signed the Clean Air Act into law. Pursuant to the establishment of the EPA, the amendments called for national standards regarding ambient air quality, research and regulation of pollutants, and strengthened the authority of federal enforcement of quality standards. However, states maintained the

[188] Richard Nixon, "Special Message from the President to the Congress About Reorganization Plans to Establish the Environmental Protection Agency and the National Oceanic and Atmospheric Administration," Reorganization Plan No. 3 of 1970, *U.S. Environmental Protection Agency*, September 6, 2016, https://www.epa.gov/archive/epa/aboutepa/reorganization-plan-no-3-1970.html.
[189] Nixon, "Special Message" and "The Origins of the EPA," EPA History, *U.S. Environmental Protection Agency*, June 5, 2023, https://www.epa.gov/history/origins-epa.

ability to submit their own implementation plans to the EPA regarding how they would reach national standards.[190]

The Federal Water Pollution Control Amendments of 1972, later referred to as the Clean Water Act, served much the same purpose as the Clean Air Act by establishing national standards regarding pollution. Ambitiously, these 1972 amendments established a "national goal that the discharge of pollutants into the navigable waters be eliminated by 1985" and a "national policy that the discharge of toxic pollutants in toxic amounts be prohibited."[191] However, many of the policies to attain these goals placed responsibility on states and municipalities to treat, decontaminate, wastewater. As seen in the previous section, municipal compliance in treating wastewater and updating sewage systems was swift whereas industrial compliance was not as apparent.

Persistent Polluting and Environmental Justice Through the 1990s

Despite the federal actions of establishing the EPA and signing the Clean Air and Clean Water Acts into law, detrimental operating practices resulting in pollution and harming human health persisted in the Kanawha River Valley. Just as in the 1960s, citizens in the Kanawha Valley continued recognizing that the chemical industry harmed their health and the environment. For example, a gas leak at Carbide's Institute plant in August 1985 resulted in 135 people seeking treatment at local hospitals. Ultimately, the Occupational Safety and Health Administration (OSHA) fined the company $1.3 million for 221 safety violations; OSHA's largest fine cited up to

[190] U.S. Library of Congress, Congressional Research Service, *Clean Air Act: A Summary of the Act and Its Major Requirements,* by Richard K. Lattanzio, RL30853 (2022): 1-3 and *Clean Air Amendments of 1970*, Public Law 91-604, *U.S. Statues at Large* 84 (1970): 1676-1713.
[191] *Federal Water Pollution Control Act Amendments of* 1972, Public Law 92-500, *U.S. Statutes at Large* 86 (1972): 816-903.

that point in its history.[192] While federal policy made significant strides in addressing pollution, the effectiveness of those policies in the Kanawha River Valley was not successful.

In 1984, one EPA report noted that: "Although much progress in enhancement of the environment has been achieved, several environmental problems have not been fully resolved."[193] This report found that the most important point sources of chemical substance pollutants came from industrial manufacturing plants and hazardous waste disposal sites. Ultimately, the report cited all three Union Carbide sites, located in South Charleston and Institute, and Monsanto's Nitro plant as major sources of pollution. All locations were among the top-20 major sources of toxic substances and wastewater dischargers in the nation.[194] Considering the EPA published this report more than a decade after the major amendments of the Clean Air and Water Acts, it shows the inadequacies of government regulation in effectively enforcing air and water quality standards.

One reason for these inadequacies is the shift in federal policy caused by President Reagan's Executive Order 12291. As studied by Smith and Andrews, the enforced use of a benefit-cost analysis to determine environmental regulation resulted in an inability to pursue adequate environmental remedies. By assuring the economy would not suffer by heightened regulations, it became more difficult to regulate air and water pollution because pollution measures had to be cost effective on a quantitative basis. These essays benefit my argument by

[192] Ben A. Franklin, "In the Shadow of the Valley," *Sierra* 71, no. 3 (May/June 1986): 38-44 and Dan Carmichael, "Union Carbide was slapped with a $1.3 Million Fine…," *United Press International*, April 1, 1986, https://www.upi.com/Archives/1986/04/01/Union-Carbide-was-slapped-with-a-13-million-fine/1789512715600/.
[193] U.S. Environmental Protection Agency, Office of Enforcement and Compliance Monitoring, *Overview of Environmental Pollution in the Kanawha Valley*, I-2.
[194] Ibid., V-1, V-16 – V-19.

showcasing that federal policy, and economists to a degree, supported industrial business despite the negative impacts the industry had on human health and the environment.[195]

This lack of enforcement is important because a 1987 study utilizing data from the 1984 study summarized above predicted additional cases of cancer related to chemical carcinogens in the air and water. In its air analysis section, the report conservatively estimated 126 additional cancer cases over the next seventy years. The study only evaluated the effects of twenty known chemical carcinogens because "many hundreds of chemicals routinely released within the Kanawha Valley are not regulated by these [current environmental] laws, partly because information is lacking concerning their toxicity, persistence, or fate."[196] In other words, the report only evaluated those twenty, when more than 450 chemicals were released into the air, because current state and federal laws addressed the twenty chemicals for which there was well-established scientific understanding. Additionally, some neighborhoods near chemical plants in Institute received a conservative calculation of an increased lifetime cancer risk of 1 in 100. Although this report utilized both point sources, like industrial facilities, and non-point sources, like automobiles, it noted that the effects of non-point sources were negligible. Fourteen of the twenty pollutants in the air analysis came from point sources.[197]

This section analyzed a few federal environmental reports over the final two decades of the century to showcase inadequate industrial compliance of air and water quality standards. Despite the passage of amendments to the Clean Air and Clean Water Acts establishing federal

[195] Andrews, "Economics and Environmental Decisions," 57-58.
[196] U.S. Environmental Protection Agency, Region III – Environmental Services Division and Office of Policy Analysis, *Kanawha Valley Toxics Screening Study: Final Report,* (Philadelphia, Pennsylvania, 1987), ii, https://nepis.epa.gov/Exe/ZyPDF.cgi/2000WALS.PDF?Dockey=2000WALS.PDF.
[197] Ibid., iv and vii.

enforcement of reducing pollution and the establishment of the Environmental Protection Agency, federal policy failed to adequately address pollution. The federal government knew it had a responsibility to protect its citizens, as seen in the ambitious goals of the 1972 amendments of the Clean Water Act, but failed to fully enforce those regulations. If they had, industry would have done more to curb and clean up pollution from the start. This inaction, ultimately, negatively impacted the quality of life for those living in the Kanawha Valley.

Cancer Studies

In 1979, Union Carbide Corporation (UCC) and the National Institute for Occupational Safety and Health (NIOSH) conducted a study on "the mortality experience of employees exposed to ethylene oxide and others who worked in a coal hydrogenation process."[198] This study by UCC and NIOSH was in response to another 1979 study that claimed Carbide workers might have been at a higher risk of cancers.[199] This finding caused concern for UCC, so the company performed their own study alongside NIOSH with a much greater sample size, 42,000 compared to 819, to assess the validity of the claim. Rinsky et al. built upon this 1979 research with their 1988 publication and tracked the mortality patterns of 29,139 males that worked at least one day at any of UCC's locations in the valley: South Charleston Plant, Technical Center, or Institute Plant. The range for employment was January 1, 1940, through December 31, 1979. Overall, the appearance of cancer as a cause of death for this group was similar to white males nationally, but this study looked at all types of employment. The study evaluated custodial

[198] Rinsky et al, "Study of Mortality Among Chemical Workers in the Kanawha Valley of West Virginia," *American Journal of Industrial Medicine* 13, no. 4 (1988): 430.
[199] Study that Rinsky et al. builds on as cited by Rinsky et al.: Marsh GM (1979): A preliminary exploratory study of proportional mortality among employees and ex-employees of the Union Carbide Corporation's plant at South Charleston, West Virginia. Submitted to the Union Carbide Corporation on August 22, 1979.

workers that likely had limited exposure to hazardous material alongside researchers and laborers that likely had direct contact. For example, there were additional excess causes of death by lymphosarcoma and reticulosarcoma. Similarly, liver cancer deaths were found in excess for employees that worked at least 25 years for UCC, and their deaths mostly occurred from 1970-1978. These findings suggested that exposure to a substance which the corporation began manufacturing around World War II, butadiene, may be this cause of death. Notably, the Institute Plant produced butadiene during the war for synthetic rubber, and researchers on this suggested exposure to this substance be studied on its own.[200]

The 1,3-butadiene study that followed evaluated 364 men of the original 29,139 who had direct exposure to 1,3 butadiene across all three UCC sites but limited exposure to benzene and ethylene oxide. Those were two additional compounds produced in large quantities by UCC. The methods for this study differed from the original, and one important difference was the study extended mortality observation to January 1, 1990. Overall, the paper found that those employed in butadiene units had higher mortality rates related to lymphosarcoma and reticulosarcoma. This conclusion echoed the findings of the previous study. Most notably, Kanawha County suffered from a 15 percent higher average of lymphosarcoma and reticulosarcoma deaths when compared to the nation's population. Since most workers lived in the county close to their places of employment, the only mitigating factor for this higher cause of death rate was butadiene exposure. Ultimately, this study suggested that the compound

[200] Rinsky et al., "Study of Mortality Among Chemical Workers," 429-438.

produced and researched across UCC sites, including its contracted work by the US government during World War II, was carcinogenic. [201]

In addition to these studies conducted by the same authors, another group of researchers published an ecological study of mortality rates for selected cancers which utilized data from 1950 to 1984 for all residents in Kanawha County, not just workers. The methods for this study primarily compared Kanawha County women, Kanawha County men, Cabell County men, and Cabell County women. There was a need to compare sexes and Kanawha County to another in the state that had similar socio-economic and demographic factors to offer control variables, and Cabell County's background in the steel industry offered a good comparison. The pre-selected cancers for this study were biliary passages and liver, bladder, nervous system, leukemia, aleukemia, lymphosarcoma, and reticulosarcoma. Just as the earlier study of chemical workers and the later study on 1,3 butadiene, this research found elevated mortality rates for lymphosarcoma and reticulosarcoma. Considering these were exclusive to the men of Kanawha County rather than an even distribution for men and women, it was asserted that an occupational component existed accounting for these excesses.[202]

These studies of the late twentieth century discuss the legacy of the chemical industry on human health in the Kanawha Valley. By discussing them in this study, I build upon the work of Rachel Carson and Nancy Langston. Carson's *Silent Spring* warned readers that pesticides had a long-impact on the environment that affected human health, and Langston's research found a

[201] Ward et al, "Mortality Study of Workers in 1,3-Butadiene, Production Unites Identified from a Chemical Workers Cohort," *Environmental Health Perspectives* 103, no. 6 (June 1995): 598-603.
[202] Day et al, "A Comparative Ecological Study of Selected Cancers in Kanawha County, West Virginia," *American Journal of Industrial Medicine* 21, no. 2 (1992): 235-251.

similar conclusion when she discussed the legacy of endocrine-disrupting chemicals. These cancer studies had a similar conclusion when they linked occupational exposure within the chemical industry to increased rates of lymphosarcoma and reticulosarcoma.

Citizens Favoring Industry

Earlier sections discussed the pleas of citizens to address pollution during the 1960s, but there were some during the latter half of the 20th century that were wary of pollution regulations. These issues expand on the discussions presented in Shannon Elizabeth Bell's works *Our Roots Run Deep as Ironweed* and *Fighting King Coal* along with Jessica van Horssen's *A Town Called Asbestos*. While many residents argued for the chemical industry to take responsibility for their polluting practices, others feared that the lack of the industry would cause the valley to face financial ruin. Personal financial ruin was also a cause for concern, as seen by the Monsanto workers in 1949. This echoed the sentiments shared by those living in Asbestos when they wanted the mine to remain open despite their health. Additionally, this discussion builds upon Bell's two works that address why Appalachian women do or do not become involved in environmental justice movements regarding the coal industry. Coal mining, especially surface mining, threatens the safety of those living around the mines, including children, but some women see the industry as too beneficial to the local community. Regardless of the industry, it is apparent that resource-based communities receive support and condemnation from the individuals living and working at their industrial sites.

One resident of the valley voiced his favor for the industry when the title of his op ed read: "Without Those Odors We Could Be A Lot Purer And Poorer In About Equal Measure."[203]

[203] "Without Those Odors," July 19, 1963.

Published in the *Charleston Daily Mail* after the three-day series on pollution in July 1963, this writer began their piece by asserting the only way to solve the local issue regarding unpalatable water was for the chemical industry to leave town. However, the writer continued that this is unfeasible considering many of those complaining about the water work in the industry that causes the issue. Ultimately, the author believed cooperation between the chemical industry, the water company, and the state of West Virginia could remedy the issue based on "acceptable economic terms."[204] This resident was concerned with maintaining jobs and not driving industry out of the valley while others were more concerned about the effects of the industry on their health and the environment.

Another resident echoed the belief that the foul odors of the chemical industry equated to a thriving economy more than twenty years later. Following a chemical leak at Union Carbide's Institute plant in 1985, reporter Ben A. Franklin investigated the legacy of the chemical industry in the Kanawha Valley. He astutely assessed that, "Chemical manufacturing shapes much of the daily life for residents of the Kanawha River Valley, much as the concrete canyons of Manhattan do for New Yorkers."[205] As the industry expanded its geographic footprint in the area throughout the twentieth century, whether someone worked in the chemical industry or not, they could not move around the valley without seeing a chemical plant. Accordingly, the industry appeared to dictate the livelihood of all in the valley. As one resident put it, "I don't smell chemicals, I smell money."[206] While these residents did not use the term, it is apparent

[204] Ibid.
[205] Franklin, "In the Shadow of the Valley," 39.
[206] Ibid., 40.

that they succumbed to the idea of social utility because they were content with not combatting the practices of the chemical industry.

While these are only two examples of individuals supporting the industry, additional studies offer attention to this matter. Bell's *Fighting King Coal* is one of those studies. When researching why Appalachian women participate in environmental justice movements in comparison to Appalachian men, Bell determined it was partly due to identity correspondence. In other words, the personal identity of women aligned with such movements more than the personal identities of men. The hegemonic masculine identity of men in Central Appalachia associated masculinity with work related to the coal industry. While this identity is threatened by the closing of mines and the shrinking of the coal industry in its entirety, this identity still echoes throughout the region. Accordingly, even if men of Central Appalachia do not have ties to the coal industry, they opt to not participate in environmental justice movements against the industry because their masculinity, by simply being an Appalachian man, would be threatened if they did.[207] I present this information because due to the current absence of sociological studies on the chemical industry in Appalachia, and scholarly studies in general, the association of Appalachian men and industry may extend beyond coal.

Conclusion

Prior to the passage of the Clean Air and Water Acts, pollution, including industrial pollution, was an issue to be handled at the state level. The Federal Water Pollution Control Act (FWPCA) and Air Pollution Control Act asserted this principle. However, in the case of the FWPCA, requiring states to address pollution on their own resulted in little progress because the

[207] Bell, *Fighting King Coal*, 75, 78-79.

state in which the pollution began would be held solely liable. Thus, polluting and operational practices that negatively affected human health and the environment continued through the 1960s. Shifts in federal policy through the establishment of the Environmental Protection Agency and passages of the Clean Air and Clean Water Acts sought to address pollution, but by Executive Order 12291 requiring the use of a benefit-cost analysis when any government party tried to alter federal regulation, the ground-breaking legislation ceased to be as helpful as designed. Additionally, the chemical industry kept sacrificing the environment by curtailing pollution enforcement.

Within this story of federal policy, residents of the Kanawha Valley spoke about their opinions of the chemical industry. Throughout the 1960s many residents complained about the poor air quality and unpalatable water within the valley and called for the chemical companies to correct their polluting practices. Others called for more stringent legislation that instituted air and water quality standards that the industry had to abide. However, others enjoyed the presence of the industry and wanted it to stay in the region because they believed it was beneficial to the local economy. Due to national attention surrounding the issue of pollution, the EPA, Clean Air Act, and Clean Water Act sought to resolve pollution issues nationally, because as the environmental movement grew throughout the 1960s the voices of those against industry outweighed their opponents that desired to protect industry. However, policymaking of the 1980s, namely Reagan's Executive Order 12291, inhibited the effectiveness of environmental regulations. Ultimately, on average the voices of those supporting or condemning the chemical industry held little sway on policymaking. Instead, policymaking

regarding industrial pollution and how to manage it was a discussion reserved for industry representatives and policymakers.

The opinions of the condemning group received scientific and medical support for their stance when environmental reports and cancer studies cited the industry for negatively impacting the two matters. Researchers discovered a clear link between occupational work in the industry and increased rates of lymphosarcoma and reticulosarcoma. As for the environmental reports, they noted that chemical companies continued to pollute more than federal standards allowed and needed to take more action to address the issue.

By discussing federal policy, environmental reports, cancer studies, and the opinions of residents, it is clear that the chemical industry negatively impacted human health and the environment in the Kanawha Valley due to federal policy. Shifts in federal policy, with little regard for the voices of those impacted by industry, prevented the implementation of environmental regulations necessary to handle and prevent pollution. While policymakers briefly listened to public outcries and established the EPA, Clean Air Act, and Clean Water Act, industry representatives and sympathizers thwarted the goals of environmental regulations by instituting new policies that greatly limited federal regulation. In the end, policies during the latter half of the twentieth century followed the trend of limited federal regulations to protect business.

Epilogue: Disasters of the 21st Century

Government policy continued to fall short and fail residents of the Kanawha River Valley in the early twenty-first century. Deadly chemical accidents showed proof of this when it came to light in reports from the U.S. Chemical Safety and Hazard Investigation Board (CSB), established in 1990 but not operational until 1998, that safety protocols and inspections were ignored throughout the valley.[208] The most public manifestation of this neglect was that of "Aqua-pocalypse" in early 2014.[209] A chemical spill on the Elk River upstream of West Virginia American Water affected 300,000 West Virginians across nine counties.[210] Ultimately, these incidents reflect the negligence of the federal government in failing to establish chemical inspection boards within any federal entity. Considering these incidents repeatedly cite faulty equipment and lack of knowledge regarding operations, the federal government must be held responsible for its inaction in assuring public safety.

Starting off with a Bang

Upon reviewing the incidents discussed later, it is evident that chemical companies do not properly protect workers nor residents of the valley. The first event to exemplify this point is the explosion at Bayer CropScience in Institute on August 28, 2008. A container of methomyl, a toxic and combustible material used to make the pesticide Larvin, exploded killing two employees and exposing eight to toxic exposure: two contracted employees and six volunteer

[208] "History," *U.S. Chemical Safety and Hazard Investigation Board*, accessed September 1, 2023, https://www.csb.gov/about-the-csb/history/.
[209] Unsure when the term was first used, but a song made by an individual affected by the spill popularized the term: TJKing, "Aquapocalypse in West Virginia," *Soundcloud*, January 2014, https://soundcloud.com/tjking-1/aquapocalypse-in-west-virginia.
[210] U.S. Chemical Safety and Hazard Investigation Board, *Chemical Spill Contaminates Public Water Supply in Charleston, West Virginia*, (May 2017), 1, https://www.csb.gov/assets/1/20/final_freedom_industries_investigation_report_(5-11-2017).pdf.

firefighters. The final CSB report explained that the event was a "runaway chemical reaction [which] occurred inside a 4,500 gallon pressure vessel … causing the vessel to explode violently…" and listed multiple factors that caused the event.[211] Some of the most egregious factors causing the accident were the lack of professional expertise needed to operate the vessel, the sub-par equipment for the vessel, and the deviation from documented start-up procedures considering the unit was temporarily off for upgrades. Along with the fatalities and exposures at the plant, the release of this substance to the atmosphere led to a precautionary shelter-in-place to be issued for 40,000 residents. Officials of Bayer CropScience vowed the toxicity burned off during the fire, but the air safety monitors nearby the unit were inoperable at the time so this statement was not confirmed.[212]

Then, approximately seventeen months following the Bayer explosion, DuPont's Belle plant leaked methyl chloride, oleum, and phosgene from January 22 to 23, 2010. Oleum is a liquid whereas the other two are gases. Each leaked separately in various units, but with all three occurring within two days of one another the CSB investigated the incident. The board noted in their report, "DuPont is regarded as an industry leader in the advancement of health and safety practices..." insinuating their investigation was pertinent because the leaks were a surprise. However, DuPont had a noted history of poor environmental practices in the town of Washington near Parkersburg, north of Charleston, and by the time of this leak the company had to pay over $10 million in a settlement to the EPA.[213] Aside from the perceived

[211] U.S. Chemical Safety and Hazard Investigation Board, *Pesticide Chemical Runaway Reaction Pressure Vessel Explosion,* (January 2011), 1, https://www.csb.gov/bayer-cropscience-pesticide-waste-tank-explosion/.
[212] Ibid., 1-3.
[213] "Dupont to Pay $10-Million Penalty in Settlement with EPA," *Engineering News-Record*, December 15, 2005, https://www.enr.com/articles/31671-dupont-to-pay-10-million-penalty-in-settlement-with-epa.

astonishment of the CSB, the release of phosgene caused one employee to die due to toxic exposure also warranting an examination of the leaks. Ultimately, like with Bayer, this accident owed to shared commonalities of poor maintenance and poor alarm systems. Poor alarm systems then resulted in ineffective emergency responses. Due to the improper release of information to emergency services, they did not issue a shelter in place despite the noticeable plume of oleum and thousands of pounds of methyl chloride that reportedly released into the atmosphere.[214]

Recently, following the water crisis that will be discussed next, an explosion occurred at the Optima Belle LLC location in Belle on December 8, 2020, around 10:00 pm. Local authorities issued a shelter-in-place for those living within a two-mile radius of the plant for more than four hours, as a precaution. The explosion caused debris to fly nearly one-half of a mile away from the site, and the incident resulted in two injuries and one fatality. The cause of the explosion resulted from the "unexpected decomposition reaction" of chlorinated isocyanurate.[215] Decomposition resulted in a release of gases that exceeded the internal pressure of the drying unit the compound was in which caused the explosion. The resulting fire occurred when debris from the explosion struck a methanol pipe. The CSB ultimately found Optima and Clearon Corporation, Clearon contracted Optima to operate the site, dually responsible for the incident. Ineffective safety and management systems, inadequate knowledge regarding how to work with

[214] U.S. Chemical Safety and Hazard Investigation Board, *E.I. DuPont de Nemours & Co., Inc.,* (September 2011), 9-14, https://www.govinfo.gov/content/pkg/GOVPUB-Y3_C42_2-PURL-gpo49947/pdf/GOVPUB-Y3_C42_2-PURL-gpo49947.pdf.
[215] U.S. Chemical Safety and Hazard Investigation Board, *Fatal Chemical Decomposition Reaction and Explosion at Optima Belle LLC*, (July 2023), 7, https://www.csb.gov/optima-belle-explosion-and-fire/.

the compound, and "failure to follow existing industry guidance for toll manufacturing" were a few of the key causes of the explosion and subsequent fire, according to the CSB report.[216]

"Aquapocalypse"

The first signs of the 2014 spill that would become known as "Aquapocalypse" occurred the morning of January 9 when the West Virginia Department of Environmental Protection (DEP) received odor complaints from nearby residents of the Freedom Industries storage tanks along the Elk River. Callers reported an obnoxious licorice smell, and by the evening many households across multiple counties receiving water from WVAW reported the same odor. Around 11:00 am DEP investigators located, assessed, and reported the leak to the West Virginia Department of Health and Human Resources (DHHR). By noon the DHHR reported the matter to WVAW since the water intake system was only one-and-a-half miles downstream from the site of the spill. When WVAW found the water system may have been contaminated, the company contacted the Office of the Governor and the DHHR Bureau of Public Health (BPH) regarding the incident. By 6:00 pm Governor Tomblin issued a "Do Not Use" order and restaurants, salons, and other places of work and business closed their doors. Tomblin also issued a state of emergency later that night and requested a similar declaration be approved and issued by President Obama. The request was issued, and with it the Federal Emergency Management Agency (FEMA) provided assistance and support in the days to come. They worked in conjunction with the West Virginia National Guard in creating an emergency water distribution plan that brought tankers of water from other states to be distributed to citizens

[216] Ibid., 9.

along with trucks filled with bottled water as local supplies were sold out. FEMA and the West Virginia National Guard established locations across the nine counties.[217]

From an initial finding, 10,000 gallons of MCHM and 7% by volume of propylene glycol phenyl ether (PPH) leaked from the same storage tank. When the spill occurred, few studies on the health effects of MCHM had been performed. Its uses were well-established, an alcohol used as a cleaning agent for coal so it burns more cleanly to reduce air pollution, but researchers had only performed exposure tests on animals such as rats and guinea pigs at the time. Extrapolating data from animal tests, and such tests continued following the spill, offered calculations of safe exposure limits of the chemicals that could be relayed to the public. Scientists recommended exposure not exceed one part per million, or else adverse health effects could arise.[218] Nonetheless, residents succumbed to health effects at low exposure levels and West Virginia Poison Center received phone calls on the day of the spill, with residents "reporting rashes, nausea, vomiting, diarrhea, and other symptoms."[219] The April report mentioned exposure to liquid MCHM also resulted in eye irritation and exposure to gaseous MCHM "can also irritate the eyes, nose, throat, and lungs."[220] Most emergency department (ED)

[217] Peter Markham, Jimmy Gianato, and Major General James Hoyer, "After Action Review: Emergency Response to January 9, 2014, Freedom Industries Chemical Leak," submitted to Governor Earl Ray Tomblin, January 9, 2015, 2-4, https://emd.wv.gov/West%20Virginia%20Public%20Water%20Supply%20Study%20Commission/Documents/After%20Action%20Review.PDF.

[218] "Information about MCHM," *Centers for Disease Control and Prevention*, February 5, 2014, https://emergency.cdc.gov/chemical/mchm/westvirginia2014/mchm.asp, and West Virginia Bureau for Public Health and Agency for Toxic Substances Disease Registry, *Elk River Chemical Spill Health Effects: Findings of Emergency Department Record Review*, (April 2014), 1, https://dhhr.wv.gov/news/chemical-spill/documents/elkrivermedicalrecordsummary.pdf.

[219] West Virginia Department of Health and Human Resources Bureau of Public Health and Agency for Toxic Substances Disease Registry, *Elk River Chemical Spill Health Effects*, 1.

[220] Ibid., 1.

visits occurred during the first week following the spill, but over the first two weeks 13 individuals were hospitalized due to their exposure.[221]

One demographic greatly concerned about the water quality and exposure to these chemicals was pregnant individuals. The BPH and CDC conducted small and quick evaluations to report what a safe level of exposure would be for all people, but "out of an abundance of caution," not a scientific study, they advised pregnant persons only consume bottled water. As for other types of exposure, an additional remark from the CDC "re-affirmed previous advice that it does not anticipate any adverse health effects from levels less than 1ppm."[222] A frequently asked questions document prepared by the BPH and CDC emphasized that short term exposure at less than 1ppm was of little concern and would not cause harm to the fetus. However, four of the first five answers offered in the document admitted to there being no information available in various wording thereby minimizing the credibility of the answers.[223] One Charleston resident recalled that she "felt this growing urgency of needing to get out of town and not be anywhere around it."[224] Rebecca Roth, the resident, was expecting her second child with a two-year old at home when the spill occurred. She and her husband left town with their child, and after returning to follow the flushing instructions, measures taken to remove the chemical from household pipes, they still felt unsafe.[225]

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[221] Ibid., 3.
[222] West Virginia Department of Health and Human Resources Bureau of Public Health and Centers for Disease Control and Prevention, *Water Advisory for Pregnant Women,* (January 2014), https://www.wvdhhr.org/advisory1152014.pdf.
[223] This source is the second part of the previous source, but when found online they are two separate document so I made separate citations: West Virginia Department of Health and Human Resources Bureau of Public Health and Centers for Disease Control and Prevention, *Frequently Asked Questions: Consumption of Water by Pregnant Women*, (January 2014), 1, https://www.wvdhhr.org/wvbphCDCfaq.pdf.
[224] Laura Harbert Allen, et al, *I'm Afraid of that Water: A Collaborative Ethnography of a West Virginia Water Crisis*, (Morgantown: West Virginia University Press, 2020), 3.
[225] Ibid., 2-4.

Governor Tomblin's "Do Not Use" order began to be lifted to by zones as early as January 13th and was completed 5 days later. By January 25 MCHM was undetectable by concentration tests. Nonetheless, residents remained skeptical as the licorice odor remained despite levels below 1 ppm. With the persistence of the obnoxious odor and the contradictory information given to pregnant individuals, suspicion remained among affected residents despite the lifted warning.[226]

The CSB report of this incident cited corrosion resulting in two small holes in the bottom of the storage tank holding MCHM as the cause of the leak. Additionally, the report cited Freedom Industries for poorly communicating the spill and what was leaked to local emergency responders, West Virginia American Water, and the necessary state and federal agencies. Similarly, the CSB noted that during its investigation into the incident no documents related to inspections of the storage tank were found. The report detailed more indictments of Freedom, but one comment, which echoed comments from other CSB reports reviewed above, noted the absence of leak prevention and detection systems.[227]

How did these Incidents Happen?

Over the first twenty-one years of this century multiple life-threatening incidents occurred at chemical plants throughout the valley. Most chemical accidents resulted in fatalities whereas another did not. Either way, the industry continued to suffer misfortunes like the plants of the previous century. The accidents of this century occurred at various sites with various

[226] West Virginia Department of Health and Human Resources Bureau for Public Health, *Analysis of Birthweight after the January 9, 2014, Chemical Spill in Charleston, West Virginia*, by Sarah Sanders, (Charleston, West Virginia, 2016), 1, https://www.wvdhhr.org/mcfh/files/birthweightanalysis.pdf.
[227] US Chemical Safety and Hazard Investigation Board, *Chemical Spill Contaminates,* 1-4.

factors causing them, and each indicate that chemical companies and federal policy are responsible for allowing gross negligence to occur at these plants. As noted in the CSB report for the 2008 Bayer CropScience explosion, the federal government does not inspect industry facilities nor enforce safety programs. Through the Emergency Planning and Community Right-to-Know Act (EPCRA), industrial facilities must share their emergency plans with local emergency services. This practice allows local services to establish their own emergency responses accordingly, but they do not have the authority to make recommendations to the operator of the facility. Additionally, unless state or municipal law authorizes a government body to inspect industrial facilities, such sites are left uninspected.[228] In the case of "Aqua-pocalypse," it is evident what neglecting to inspect facilities can cause.

Congress amended the EPCRA since its passage in 1986, but the amendments did not address the inherent flaw of the act that does not enforce third-party inspections and proper safety protocol.[229] This omission from federal legislation is a primary way by which federal policy allows the people of the Kanawha River Valley to succumb to the negative effects of the chemical industry on the environment and human health.

Continued Shifts in Policymaking

Reagan's Executive Order 12291 affected all federal regulations, including environmental regulation, because it only allowed quantitative measures for consideration when conducting a cost-benefit analysis. President Clinton amended Reagan's order with his own in 1993: Executive

[228] US Chemical Safety and Hazard Investigation Board, *Pesticide Chemical Runaway*, 3-4.
[229] "EPCRA Guidance Documents and Fact Sheets," *US Environmental Protection Agency*, accessed September 4, 2023, https://www.epa.gov/epcra/epcra-guidance-documents-and-fact-sheets.

Order 12866. This order called for the inclusion of qualitative measures when conducting a benefit-cost analysis because while such measures are "difficult to quantify" they are "essential to consider."[230] President Obama expanded the ability to institute beneficial environmental regulations as well. With Executive Order 13563, functioning as an expansion of 12866, Obama reiterated the importance of utilizing quantitative and qualitative measures when determining federal regulations. Additionally, he called for federal agencies to "consider (and discuss qualitatively) values that are difficult or impossible to quantify, including equity, human dignity, fairness, and distributive impacts."[231] These orders benefited environmental regulations, in spite of the benefit-cost analysis, because they expanded the ability of policymakers to institute change that the American people desired.

The use of qualitative measures is important, because most people interact with their environment on a qualitative basis. As seen in chapter two, during the 1960s many residents spoke out against water pollution on a qualitative basis, deeming the water unpalatable. Accordingly, when chemical representatives told residents of the Kanawha Valley that the water was palatable the people refused to accept the water was safe. Additionally, qualitative perceptions, understandings, and syntheses of environmental pollution are important when creating environmental policy because without such measures policymakers reduce the potential for support of their decisions. Without the use of qualitative environmental methodologies policymakers lack a "deeper contextual understanding around implementation

[230] U.S. President, Executive Order, "Regulatory Planning and Review," *Federal Register* 58, (October 4, 1993): 1. https://www.archives.gov/files/federal-register/executive-orders/pdf/12866.pdf

[231] "Executive Order 13563 of January 18, 2011, Improving Regulation and Regulatory Review," *Code of Federal Regulations,* Title 3 (2011): 216, https://www.govinfo.gov/content/pkg/CFR-2012-title3-vol1/pdf/CFR-2012-title3-vol1-eo13563.pdf.

and effectiveness of environmental management interventions, and disregard the diversity of perspectives and voices (e.g., indigenous peoples, farmers, park managers) fundamental for tackling wicked environmental issues."[232] Since individuals approach the environment differently, policymakers like Clinton and Obama issued policies that took a greater amount of criteria into consideration to issue effective policy.

These advancements in environmental policymaking came under attack during the Trump presidency. With Executive Order 13771, President Trump proclaimed that when proposing a new federal regulation during the 2017 fiscal year two existing regulations must be cited for elimination. Accordingly, the new regulation could not exceed the cost of the previous two regulations combined.[233] This order threatened regulations that protect workers safety and the environment because, as noted by Public Citizen Inc., the order called for an agency to "evaluate whether the cost of the new rule … is worth the benefit of the new rule."[234] Public Citizen was so concerned by this order that the non-profit attempted to sue President Trump claiming the Executive Order was unlawful.[235]

Conclusion

The chemical industry arrived in the Kanawha Valley during World War I in part due to the salt industry, engineering projects, and ferroalloy production that occurred in the valley

[232] Macura et al., "Systemic Reviews of Qualitative Evidence for Environmental Policy and Management: An Overview of Different Methodological Options," *Environmental Evidence* 8, no. 24 (June 2019): 8.
[233] "Presidential Executive Order on Reducing Regulation and Controlling Regulatory Costs," *Executive Orders*, January 30, 2017, https://trumpwhitehouse.archives.gov/presidential-actions/presidential-executive-order-reducing-regulation-controlling-regulatory-costs/.
[234] Public Citizen, Inc., et al., v. Donald J. Trump, President of the United States, et al., Civil Action No. 17-253, (U.S. District Court for the District of Columbia 2018), 2-3, https://www.dcd.uscourts.gov/sites/dcd/files/show_temp.pdf.
[235] Ibid., 1.

during the nineteenth century. Grouped with the area's proximity to major cities in the eastern United States and ample transportation routes, alongside other environmental qualities that benefited the industry like regular weather patterns, coal deposits, and an abundance of natural elements, federal policy bolstered the creation of a large scale, chemical industry in the Kanawha River Valley for industrial practices. Through the Urgent Deficiency Appropriations Act of October 1917, the US military contacted DuPont to conduct surveys determining where an explosives plant should be built. Despite DuPont not constructing nor operating a chemical plant in the valley during the war due to earlier anti-trust allegations, the Armed Forces continued their plan to construct the plant. Although the plant did not function at max capacity, its near-complete construction invited private industry to the region.

Following World War I, during the 1920s, Union Carbide, DuPont, and Monsanto arrived in the Kanawha Valley in the towns and cities of South Charleston, Belle, and Nitro, respectively. During the Interwar Period, these companies continued growing thanks to the Fordney-McCumber Tariff Act of 1922 and Smoot-Hawley Tariff Act of 1930. Then, renewed federal policy with the second War Powers Act of 1942 and amendments to the Trading With the Enemy Act bolstered the industry, again, during World War II. Dupont and Carbide received government contracts during the war to produce wartime necessities like synthetic rubber and plastics.

Following the Second World War, federal policy began addressing pollution. However, until the passage of the Clean Air and Clean Water Acts, coupled with the establishment of the Environmental Protection Agency, these original legislative efforts were ineffective. The Federal Water Pollution Control Act of 1948 and the Air Pollution Control Act of 1955 did not issue

federal pollution standards and instead kept pollution a state problem. In turn, throughout the 1960s, many residents of the Kanawha Valley condemned chemical companies for the pollution they caused. The discharges of the chemical plants commonly clouded the valley in a thick smoke and made the water unpalatable.

Federal policy shifted through the establishment of the Environmental Protection Agency and passages of the Clean Air and Clean Water Acts because policy now aligned with the demands of the people. The agency and acts sought to address pollution through federal regulation of air and water pollution in a timely manner. However, Executive Order 12291 was another shift in federal policy. In some ways, it reverted to older policy by requiring the use of a benefit-cost analysis for regulations. This allowed business to prosper because businesses would not have to abide by environmental regulations that negatively impacted the industry. The benefits of regulation, as it was understood, would not outweigh the cost placed on chemical companies.

While some residents spoke against the industry, others spoke in favor of it. Those that did not mind the odors found in the valley claimed the smells were a clear sign of economic prosperity. If not for the chemical industry, residents of the valley would be poor. However, when compared to environmental reports and cancer studies perhaps the industry negatively impacted the valley more than positively impacted. In the end, their divisions regarding the chemical industry did not affect lasting change in the valley. While federal environmental policy of the 1970s was in response to the heightened environmental movement and the millions of Americans across the country that desired reduced industrial pollution, by the mid-1980s the

benefit-cost analysis required for all federal regulations inhibited the potential effectiveness of earlier policy.

In accordance with Reagan's implementation of the benefit-cost analysis, each administration enters office with their own policy agenda in relation to that analysis. Clinton and Obama included and expanded the ability to utilize qualitative measures when determining benefits and costs. However, Trump's one-in-two-out measure threatened the progress made by the orders of Clinton and Trump because it inhibited the possibility of instituting additional policy. Trump focused on the costs associated with federal regulations, much like Reagan, and focusing on costs associated with environmental regulations prevents the ability to address all concerns associated with pollution: quantitative and qualitative.

Federal policy has played a distinct role in supporting the chemical industry since World War I, and the legacy of the industry since that conflict caused the environment and human health to suffer. Despite the improvements to air and water quality through the latter half of the twentieth century, the chemical industry continued to make the Kanawha River Valley a sacrifice zone due to federal policy ineffectiveness. While Union Carbide, Dupont, and Monsanto no longer occupy the riverbanks like they did in the previous century, primarily due to company mergers that have changed names and oversight throughout the twenty-first century, the chemical companies that currently operate on the banks of the Kanawha River continue to threaten the health and safety of residents.[236]

[236] Bayer acquired Monsanto in 2018, Dow acquired Union Carbide in 2001, and DuPont is its own company again, as of 2019, after the conglomeration of DowDuPont in 2017 dissolved.

The chemical industry shaped the identity of Kanawha Valley residents and workers throughout the twentieth century and continues to have an outsized impact on people there today. This is why I recommend the use of grassroots activism to promote policy change and offer hope for the future of the Kanawha River Valley. While not all grassroots movements are successful at challenging nor changing policy, as seen through Montrie's *To Save the Land and People* and some examples in Steve Lerner's *Sacrifice Zones*, the ability to rally individuals under a common goal to protect human health and the environment can be profound. That profoundness, at times, can even hold industry responsible while not threatening its position in the local community, as seen in Marietta, Ohio under Lerner's case study. The ability to organize lies in understanding why individuals choose to be involved in grassroots movements related to environmental justice, so it is important to listen to the concerns of all residents regardless of if the concerns focus on the presence of the chemical companies. The Clean Air Act, Clean Water Act, and Emergency Planning and Community Right-to-Know Act all need to be amended to better protect human health and the non-human environment, and grassroots movements can be the first step to instituting lasting change.

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